Facial Modeling and Animation Done Right

STOP STARING

Second Edition

JASON OSIPA

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SECOND EDITION

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About the Author

Jason Osipa has been a working professional in 3D content for over 10 years, touching television, games, direct-to-video, and film in both Canada and the United States. Carrying titles from author to modeler to animator to TD to director, he has seen and experienced the world of 3D content creation and instruction from all sides. Jason is currently spending his time directing in San Francisco at LucasArts working alongside sister company ILM on new ways to converge the visual targets, techniques, and tools of games and film.

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Introduction

Animation has got to be the greatest job in the world. When you get started, you just want to do everything, all at once, but can't decide on one thing to start with. You animate a walk, you animate a run, maybe even a skip or jump, and it's all gratifying in a way people outside of animation may never be lucky enough to understand. After a while, though, when the novelty aspects of animation start to wear off, you turn deeper into the characters and find yourself wanting to learn not only how to move, but how to *act*. When you get to that place, you need the tools and ideas to fuel your explorations, and here they are.

Animation is clearly a full-body medium, and pantomime can take years to master. The face, and subtleties in acting such as the timing of a blink or where to point the eyes, can take even longer and be more difficult than conquering pantomime. Complex character, acting, and emotion are almost exclusively focused in the face and specifically in the eyes. When you look at another person, you look at their eyes; when you look at an animated character, you look at their eyes, too. That's almost always where the focus of your attention is whether you mean for it to be or not. We may remember the shots of the character singing and dancing or juggling while walking as amazing moments, but the characters we fall in love with on the screen, we fall in love with in close-ups.

Stop Staring is different than what you may be used to in a computer animation book. This is not a glorified manual for software; this is about making decisions, really learning how to evaluate contextual emotional situations and choosing the best acting approach. You're not simply told to do A, B, and C; you're told *why* you're doing them, *when* you should do them, and *how* to make it all possible.

Why This Book

There is nothing else like *Stop Staring* available to real animators with hard questions and big visions for great characters. Most references have more to do with drawing and musculature and understanding the realities of what is going on in a face than with the application of those ideas. While that information is invaluable, it is not nearly tangible and direct enough for people under a deadline who need to produce results fast. Elsewhere, you can learn about all of the visual cues that make up an expression, but then you have to take that and dissect a set of key shapes you want to build and joints you have to rig. You'll

likely run into conflicting shapes, resulting in ugly faces, even though each of those shapes alone is fantastic.

Stop Staring breaks down, step-by-step, how to get any expressions you want or need for 99 percent of production-level work quickly and easily—and with minimum shape conflict and fantastic control. You'll learn much of what you *could* learn elsewhere while also picking up more pertinent valuable information you *couldn't* learn elsewhere. Studying a brush doesn't make you a painter, using one does, and that is what this book is all about—the doing and the learning all at once.

Who Should Read This Book

You should. If you've picked it up and you're reading this right now, then you have curiosity about facial modeling, animation, or setup, whether you have a short personal project in mind, plan to open your own studio, or already work for a big studio and just want to know more about any part of the process from construction all the way to good acting. If you're a student trying to break into the industry, this book will show you how to add that extra something special—how to be the one that stands out in a pile of demo reels—by having characters that your audience can really connect with.

If you have curiosity in regard to anything facial, you're holding the answer to all of your questions on how to get this stuff done efficiently, easily, and with style.

Maya and Other 3D Apps

There are obviously some technical specifics in getting a head set up and ready for character-rich animation, so to speak to the broadest audience possible, the instruction centers primarily around Autodesk's Maya. The concepts, however, are completely program-agnostic, and I have created similar setups in several different 3D programs.

How *Stop Staring* Is Organized

While *Stop Staring* will get you from a blank screen to a talking character, it is also organized to be a reference-style book. Anything you might want to know about the underlying concepts of the how and the why of facial animation is in Part I. Everything to do with the mouth—all animation, modeling, and shape-building—is in Part II. Part III takes you through everything related to the brows and eyes. Part IV brings all of the pieces together, both literally and conceptually.

Part I, "Getting to Know the Face," teaches you the basic approach used throughout the book. Each chapter in this part is expanded into detailed explanation in a later part of the book: Chapter 1 in Part II, Chapter 2 in Part III, and Chapter 3 in Part IV.

Chapter 1, "Learning the Basics of Lip Sync," introduces speech cycles and visimes.

Chapter 2, "What the Eyes and Brows Tell Us," defines and outlines the effect of the top of the face on your character.

Chapter 3, "Facial Landmarking," brings in broader effects such as tilts, wrinkles, and even the back of the head!

Part II, "Animating and Modeling the Mouth," refines the visime list and sync technique, then shows how to build key shapes and set them up with an interface.

Chapter 4, "Visimes and Lip Sync Technique," delves deeply into how to model for effective sync and shows that building good sync is less work than you thought but harder than it seems.

Chapter 5, "Constructing a Mouth and Nose," attacks the detailed modeling you'll need for a full range of speech shapes.

Chapter 6, "Mouth Keys," shows you a real-world system for building key sets— one that invests time in the right shapes early so you can later focus on artistry undistracted.

Part III, "Animating and Modeling the Eyes and Brows," guides you through creating a tool to put the book's concepts in practice beyond the mouth. From there you'll learn how to create focus and thought through the eyes.

Chapter 7, "Building Emotion: The Basics of the Eyes," shows you which eye movements do and don't have an emotional impact—and how years of watching cartoons have programmed us to expect certain impossible brow moves!

Chapter 8, "Constructing Eyes and Brows," guides you through building the eyeballs first, then the lids/sockets, and connecting all of that to a layout for the forehead and eventually shows you how to make a simple skull to attach everything else to.

Chapter 9, "Eye and Brow Keys," applies the key-set system from Chapter 6 to the top of the face, bringing in bump maps for texture and realism.

Part IV, "Bringing It Together," takes all the pieces you've built in Parts II and II and brings them together into one head and then shows you how to weight them and rig them for use.

Chapter 10, "Connecting the Features," teaches you to take each piece of the head—eyes, brows, and mouth, plus new features such as the side of the face and the ears—pull all of it into a scene together, and attach them to each other cleanly.

Chapter 11, "Skeletal Setup, Weighting, and Rigging," focuses on rigging your head, including creating the necessary skeleton and weighting each of your shapes for the most flexibility in production. In this chapter, you'll learn to use a system to control any eye object in any orientation, and how to zipper the lips.

Chapter 12, "Interfaces for Your Faces," demonstrates the benefit of arranging and automating your setup to make all your tools accessible and easy to use. There are ways to share interfaces as well as get very intricate shape relationships with very little work.

Chapter 13, "Squash and Stretch and Squoosh," takes all the concepts taught up to this point and turns them a little sideways. This chapter introduces a few key ideas and integrates them into everything you will know by this point, and as a result, you'll see your characters really start to bend!

Chapter 14, "A Shot in Production," presents five different scenes through the complete facial animation process, taking you inside the mind of a master animator to see how and why every pose and move was made.

The Companion CD

The CD you'll find in a sleeve at the back of this book is an integral part of the learning for *Stop Staring*. It gives you example scenes, models, sound files, animations, and MEL scripts, so you not only get tools that you can use to build up models and control any head you want, you get to see and work through the thinking process in bringing characters to life. There are several scenes in which you can see for yourself the layered approach to getting a character to jump out of the screen and connect emotionally to the viewer.

Installing the Shelf and Tools Is Easy!

To install the Stop Staring shelf and scripts, simply copy files from the CD onto your computer. You need to find two locations on your computer, your shelves directory and your

scripts directory. Typically, these locations are in your My Documents folder under the version subfolder in your Maya folder. Most of you will be looking in `/My Documents/maya/8.5/prefs/shelves/`, which is where you want to copy the `ss2_shelf.mel` file from the CD resources. Copy all the rest of the scripts into in `/My Documents/maya/8.5/scripts/`. To be absolutely sure, in the Script Editor or the command line, enter this tiny MEL script: `internalVar -ush` will tell you where to put the shelf, and `internalVar -usd` will tell you where to put the scripts. It'll give you a little readout of the directories you should drop things in.

What's on the CD

The *Stop Staring* CD provides all of the tools you need to work through the techniques taught in this book—including the main head model used throughout the chapters, source images and audio, and even Maya interface controls that you can use as is or practice with to learn to build your own.

Chapter Files

You can access specific animation projects and source files from the CD interface by clicking the Chapter Files button. Use these chapter-by-chapter files as you walk through the step-by-step instructions on how to model parts of the face, rig them all to simplify your work, and then animate them quickly and naturally.

Resources

The Resources button takes you to the head model, interface setups, and other elements of the scenes and shapes taught in the book. Here you'll find a new Maya shelf and MEL scripts to speed up your work, plus all the textures used in the book.

Extras

Click the Extras button to access bonus movies that continue the demonstration of effective animation. And you get several extra sound files to practice animating your own work!

> Sybex strives to keep you supplied with the latest tools and information you need for your work. Please check www.sybex.com for additional content and updates that supplement this book and CD.

Getting to Know the Face

Before *we start animating, building, or rigging anything, let's be sure we're speaking the same language. In Chapter 1, I talk about talking, pointing out the things that are important in speech visually and showing how to ignore the things that aren't. Narrowing our focus to lip sync gives a good base from which to build the more complicated aspects of the work later. In Chapter 2, I define and outline, in the same focused way, the top half of the face. In Chapter 3, we zoom back to the entire face—the tilt of the head, wrinkles being a good thing, and even parts of the face you didn't know were important.*

Each chapter in this part is expanded into detailed explanation in a later part of the book: Chapter 1 in Part II, Chapter 2 in Part III, and Chapter 3 in Part IV.

Learning the Basics of Lip Sync

In modeling for facial animation, mix and match is the name of the game. Instead of building individual specialized shapes for every phoneme and expression, we'll build shapes that are broader in their application and use combinations of them to create all those other specialized shapes. On the animation front, it's all about interface and maximum control for minimum effort. You want to spend your time being creative and animating, not fighting with the complexities that can emerge from having a face with great range. It doesn't sound like there's much to these concepts for modeling and animating, and, yeah, they really are small and simple—but they're huge in their details, so let's get into them.

Before we can jump into re-creating the things we see and understand on faces, we first need to figure out what they are. Starting on the ground floor, we're going to break down the essentials of lip sync and learn the only absolutes. Next, we'll go into how basic speech can be broken into two simple and basic cycles of movement, which is what makes the sync portion of this book so simple. Finally, at the end of this chapter, we'll take those two things—what's essential and the two cycles—and actually build them into a technique for working.

- **The bare-bones essentials of lip sync**

- **The two speech cycles**

- **Starting with what's most important: visimes**

- **Building the simplest sync**

The Essentials of Lip Sync

People overcomplicate things. It's easy to assume that anything that looks good must also be complex. In the world of 3D animation, where programs are packed with mile after mile of options, tools, and dialog boxes, over-complication can be an especially easy trap to fall into. Not using every feature available to you is a good start in refining any technique in 3D, and not always using the recommended tools is when you're really advancing and thinking outside the box. Many programs have controls and systems geared for facial animation, but you can usually find better tools for the job in their arsenals.

If you've ever tried lip sync in CGI, it has probably been frustrating, complicated, difficult, and unrewarding. In the end, most people are just glad to see it get done and regret deciding to involve sync in their project. We're starting to see some amazing results come from facial motion capture techniques, but that is outside of the cost range for most of you out there reading this. Automated techniques are on the rise too, but so far, they aren't keeping up with a good artist or capture technique.

Don't despair. I will get you set up for the sync part of things quickly and painlessly so you can spend your time on performance (the fun stuff!). If your bag is automation, there's still a lot of information in here you can take so you can bump the quality up a couple of notches on that, too.

When teased apart properly, the lip sync portion of facial animation is the easiest to understand because it's the simplest. You see, people's mouths don't do *that* much during speech. Things like smiles and frowns and all sorts of neat gooey faces are cool, and we'll get to them later, but for now we're just talking sync. Plain old speech. Deadpan and emotionless and, well, *boring*, is where our base will be. Now, you're probably thinking, "Hey! My face can do all sorts of stuff! I don't want to do boring animation!" You're right, your face *can* do all sorts of things, and who really wants to do boring animation? For the basics, however, we're not going to complicate it yet—that'll come later. In a very short while, in Part II, we'll build a model of a mouth that can do almost anything your mouth can do, without needing hundreds or even thousands of blend shapes (believe it or not, that's how they do it in the movies!), but before we go and do that hands-on work, you'll need the stuff from this chapter in your head; let's make sure you know the concepts before we try to use any of them.

When dealing with the bare-bones essentials of lip sync and studying people, we've whittled it down to just two basic motions. The mouth goes Open/Close, and it goes Wide/Narrow; all of these are illustrated in Figure 1.1.

That's really, at its core, all that speech entails. If we were lip-syncing a character with a plain circle for a mouth (and we will in just a minute), the shapes in Figure 1.2 would be all the keys we would need to create the *illusion* of speech—and that's all we need to do. A CG character need not actually speak; that's some kind of Frankenstein experiment. All we need to do is create the *illusion*.

Figure 1.1

A human mouth in the four basic poses

Your reaction to this very short list of two motions might be, "What about poses like F where I bite my lip, or L where I roll up my tongue?" *Not* answering that kind of question is precisely the point of these early chapters. We ignore those unique and complicated shapes, strip the process down to what is absolutely necessary to be understood visually, and then build it back up from a solid base. If these two controls—Open/Closed and Wide/Narrow—are all you have to draw on, you get creative about how to utilize them. Things like F just get pared back to "sort-of closed." If you were to animate this way and stop the animation on the frame where the "sort of closed" is standing in for an F and say, "That's not an F!" you'd be right, but in motion, you hardly notice, and what we're talking about here is *motion*, not still frames. As a standard in this book, I'm going to try *not* to be concerned with the individual frames, so much as the motion and the impression it gives. If your first instinct is to add more and more and more shapes into the mix early on, your instinct is to *hide* what is wrong instead of *fixing* what is there. Bad instinct; let's fix it.

Animating lip sync is all smoke and mirrors. What is *really* happening isn't relevant; it's all about the impression. How about M? "I need to roll my lips in together to say M. I can't do that with a circle-mouth-thingama-jig." Sure you can, or at least you can give that same impression that the lips are rolled in—just close the mouth all the way; that's good enough. When you get the lip sync good enough and focus on the acting, people notice only the acting. The sync becomes visual noise!

Figure 1.2

A circular spline mouth in the same four basic poses

Analyzing the Right Things

Let me take you on a little real-world tutorial of what's important, and what's not, in action. There can be a tendency—and it's not necessarily a bad one—to slow things down to the frame-by-frame level and analyze in detail what happens so that we can re-create it as animators.

Here's an example: Look in the mirror (or don't) and slowly, deliberately, and clearly enunciate the word *pebble:* PEH-BULL. You're trying to see just what exactly happens visually, on your face and lips, during that word, so you can re-create it in animation. Think about or watch what your lips are doing—all the details: The little puff in your cheek after the B. The way the pursing of your lips for P is different than for B. How your tongue starts its way to the roof of your mouth early in the B sound and stays there until after the end of the word. All these details give you a pretty good idea of how to analyze and re-create the word *pebble* in animation, right? Wrong! That's exactly the wrong way to do it. That's how you would do it for a character who was speaking slowly and deliberately, and enunciating clearly. This is how a mirror can be dangerous if used incorrectly. It leads to overanalysis. None of these details are wrong—they're just not necessary, and I'll explain why in the next paragraph.

This time, at regular, comfortable, conversational speed, say, "How far do you think this pebble would go if I threw it?" How did the word *pebble* look? Check it out a few times, resisting the urge to do it slowly. As far as the word *pebble* is concerned, the overall visual impression is merely closed, a little open, closed, a little open. That's it. In a sentence spoken regularly, the word *pebble* will most likely look the same as *mama* or *papa*. Say the sentence again with that in mind. Try not to change what your mouth does, but instead notice that the Opens and the Closeds are the most significant things happening during the word. The mouth doesn't open wide enough (in this case) to see a tongue, so why would you animate it or need to spend time thinking about it? Because it's "correct?" That would be like animating a character's innards. You can't see them, but they're there, so animating them would be the "correct" thing to do, right? Wrong. It's a silly waste of the time you could otherwise spend on the acting.

The Opens and the Closeds are the most important of any of the things a mouth does. That's why puppets work. Does it look like a puppet is really *saying* anything? Of course not, but with the flapping of the jaw happening around the same time as the sounds the actor makes, your brain fills in the connection. You want to believe that the character is talking, and that's why the only truly important action in the word *pebble* is open, closed, open, closed.

This is how you analyze the right things: search for the overall impression, not the details. It's very easy to learn how to do this but very hard to master; luckily you're only in the first of 14 chapters, and all the rest of them are going to help you work on mastering this stuff.

Speech Cycles

This approach of identifying cycles and "visimes," which you'll learn more about in just a moment, is likely very different than what you know now. If you're looking for a phoneme-to-picture comparison chart, you're not going to get it here. In this approach, there is no *absolute* shape for each sound, and to point you in such a direction would do more harm

than good, despite what you might think you *want* to see. Each sound's shape is going to be unique, and you'll learn to identify it as its components. To start, let's talk about the two speech cycles.

In its simplest form, there are two distinct and separate cycles in speech: open and closed, as in jaw movement, and narrow and wide, as in lip movement.

> When I say "cycle," I'm merely referring to how the shape will go from one to the other and then back again. There are no other stops along the way. The mouth will go open, closed, open, closed; the lips will go wide, narrow, wide, narrow.

These two cycles don't necessarily occur at the same times, nor do they go all the way back and forth from one extreme to the other all the time. The open and closed motion generally lines up with the puppet motion of the jaw, or flow of air—with *almost any* sound being created—while the wide and narrow motions have more to do with the *kind* of sound being created. In the sentence "Why are we watching you?" we get this sequence for the Wide/Narrow:

Word	Wide/Narrow Sequence
why	Narrow, wide
are	No change/shape
we	Narrow, wide
watching	Narrow, slightly wide
you	Narrow

Simple, right? Now let's look at the jaw, or Open/Closed, cycle. "Closed" refers to a position not completely closed, but closer to closed than to open:

Word	Open/Closed Sequence
why	Closed, open, closed
are	Closed, open, closed
we	Closed, slightly open
watching	Closed, open, closed, slightly open, closed
you	Closed / no change

That's it for the essentials. We're going to get into more shapes and controls and special cases, but there it is. The backbone of this book's lip sync technique has to do with simple analysis of the Wide/Narrow and Open/Closed cycles; over time, we'll add more and more levels, each one simple on its own, to create complex, believable performances.

These cycles will be the foundation on which we build everything else. Taking the lead from the human mouth, I've based all of this book on the "simpler is better" mindset. Your mouth is lazy. Go on, admit it. It hits the major sounds and fudges over the rest, like saying hi to someone even though you forgot their name, hoping they don't notice. It makes good sense; it's efficient.

Figure 1.3
All varieties of G

I've had programs and books and teachers all show me sets of shape keys for sync I had to build that included things like G. Why would we build a shape for or pay special attention to the letter G? Whether it's hard G or soft G, you can say it with your mouth in any of the shapes shown in Figure 1.3.

Now, these are obviously all pretty different. But if you were to try to say a soft or hard G with your mouth held in each of these poses, you could do it without much trouble. Ninety-five percent of the time, when the letter G comes up in sync, we're going to ignore it—that is, it will get no keys in the animation. Further, we will most certainly not build a shape for G; how would we pick just one?

The G sound is actually created in the throat, not by the lips or the open/closed positions of the mouth. This whole example with G is to illustrate the criteria of visimes. What are visimes, you ask? Read on.

Starting with What's Most Important: Visimes

So, we've decided that we're going to go with a less-is-more approach. That's good. For this noninclusive approach, however, where we're trying to exclude all the extraneous mouth positions, something you'll need to know is what *must* be included. There are certain sounds that we make with our mouths that absolutely need to be represented visually, no matter what: visimes. These are the sounds that can only be made by the mouth with specific characteristics to the mouth shape, or range—such as narrow for OO, as in *food*, or closed, for M, as in *mom*. There are more visimes to address than the Open, Closed, Wide, and Narrow can properly do, but even these must-see shapes can be "cheated" to fit into the "circle mouth" setup you've seen and we're about to build.

Why Phonemes Aren't Best for CGI

The most common key sets and setups out there for public consumption are based on *phonemes,* which means "the sounds your mouth makes during speech." To base sync on phonemes seemingly makes perfect sense—it's the way it's been done for years with

classical animation—but for the newer world of CGI, it can be overly complicated. Phonemes worked fantastically on paper, where nothing comes for free; every frame had to be drawn, and a lot of popping from frame to frame was just part of the style. In CGI—in anything, really—the eye is drawn to what is out of place, and generally, most computer animations don't have wildly different keys on every frame, or even every second frame. Sure, some animators will end up with a key on every frame before they are done, but those keys are going to have some relationship to each other in motion. If just on the mouth there's a totally different key on every frame of your lip sync, you had better believe that's where all eyes will be, and that's probably not a good thing. Thinking too hard about phonemes can lead people down a path that will create this look.

In the search for a better system for CGI sync, something became very apparent: There are three different *kinds* of sounds you can make during speech, and not all of them are easy to see! Phonemes-based sync lumps all of these sounds together, and that is what precludes it from being the best solution for us. The important point I'm coming to here is that during speech, some sounds are just not easily distinguished visually. Some sounds are made primarily with your lips, some are made primarily by your tongue, and others are made in your throat and vocal cords. Of these three, the only ones you absolutely *have* to worry about every time in animation are the sounds made primarily by the lips.

> I said the only sounds you absolutely *have* to worry about every time in animation are the sounds made primarily by the lips. I say "primarily" because combinations of all these ways to make sound occur all the time. Also, you could argue that your throat makes *all* sounds, but that would be an intellectual standpoint, not an artistic one, like saying we should include the lungs in sync—and believe me, we're not going to be doing that!

Phonemes are sounds, but what matters in animation is what can be seen. Instead of phonemes, of which there are about 38 in English (depending on your reference), what we're going to base our system on is "visual phonemes," or *visimes*. Visimes are the significant shapes or visuals that are made by your lips. Phonemes are sounds; visimes are shapes. Visimes are all you *really* need to see to be convinced. You obviously cue these shapes based on the sounds you hear, but there aren't nearly as many to be seen as there are heard. The necessary visimes are listed in Table 1.1. Remember that these are shapes tied to sounds, not necessarily collections of letters exactly in the text.

Words are made up of these even if they aren't spelled this way; the word *you* comprises the two visimes EE and then OO, to make the EE-OO sound of the word. As we move forward, you'll learn that if there is no exact visime for the sound, we'll merely use the next closest thing. For instance, the sound OH, as in M-OH-N (moan), is not really shown on this chart, whereas OO is. They're not really the same, but they're close enough that you can funnel OH over to an OO-type shape.

VISIME	EXAMPLE SOUNDS	RULE
B,M,P / Closed	*mu*rder, *p*lantation, cheru*b*	Lips closed
EE / Wide	ch*ee*se, m*e*, charit*y*	Mouth wide
F,V	*f*ire, *f*ight, *V*irginia	Lower lip rolled in
OO / Narrow	d*u*de, *u*se, f*oo*l	Mouth narrow
IH	tr*i*p, sn*i*p	Sometimes taller or wider than surrounding shapes
R	ca*r*, *r*oad	Sometimes narrower than surrounding shapes
T,S	bea*t*, *t*raffic	Sometimes taller or wider than surrounding shapes

Table 1.1 includes just 7 shapes to hit, and only a few of those are their own unique shape to build! Analysis and breakdown of speech has just gone from 38 sounds to account for to 7. Some sounds can show up as the same shape, such as UH and AW, which need to be represented only by the jaw opening.

Open Mouth Sounds

So many sounds have no real shape to them, so they're out as visimes. Another group of sounds (Table 1.2) have no shape in the sense that the lips aren't doing anything in particular, but they have the common characteristic that the mouth must be open. I don't consider these visimes but instead refer to them as open or jaw sounds, even though by my own definition, they are visimes. It's a layered reason that takes layered thinking. Visimes as we identify and animate them are really aspects of lip positions, not whole mouth positions. Since the jaw, and therefore the mouth, is open in so many shapes, I've just kicked it out of the visime club because it would make things more difficult, the number of explicit combinations would explode, and you would be back out at phonemes again. Open mouth sounds should be considered separately from visimes.

SOUND	EXAMPLE SOUNDS
UH	f*u*n, s*o*me, th*u*nder
AH	bl*a*st, b*a*t, *Va*ncouver
OH	sn*ow*, f*oe*
AW	*o*xford, g*o*lly, l*aw*n

For example, an OH sound (which should be read as a very short OH, not like the word *oh*, which is broken down to OH-OO) is just a degree of Narrow and some Open—which is really the same as an OO sound but with different amounts. Instead of referring to sounds as their phonetic spellings, such as OH or AW, I like to break them down further to their components. For me, OH simply becomes a semi-Narrow shape and some Open.

By separating out what's really happening, not just in motion but within each frame, into some basic elements, you can animate faster and better and more precisely tailor your shape to the sound you hear. This isn't saying to break down the overall content of the sound OH and open it first and then make it narrow, as in OH-OO, which is how you'd read OH. It's saying to look at only that first part, the OH sound, and figure out what it's made of using the ingredients of Wide, Narrow, Open, and Closed. It's like a trumpet. There are three valves and there's a mouthpiece—that's it. Combinations of these few

things can produce varied sounds and beautiful complex melodies, but at its root, it's still just three valves and a mouthpiece.

When we identify visimes, we really are ignoring the open mouth portion of open mouth sounds. After we finish keying and identifying the visimes quickly, we go back to the start and add in the open mouth/jaw motions. By treating these separately, we can move through animations very quickly. If your only goal is visimes, you can burn through a long animation extremely quickly. At the end of that, it doesn't look like much but you are left with a simple version of the lip sync you can then build on simply by going back and identifying where the jaw must be open.

This approach is much faster than meticulously trying to get every sound right as you move through your animation at one steady pace. This way, you end up with a jumping-off point for finessing. The time you spend animating sync and expression will be more heavily weighted toward the *quality*—with the quantity out of the way, you'll have more time for it. This method applies to any system, not just mine, where you have control over the building-block components of shapes as opposed to separate and distinct whole-mouth shapes based on phonemes.

> Disclaimer: The choices of what is and is not important are based on my own experience. This is not torn from another book, university study, website, or anything else. The way I break down words isn't even a real phonetic representation; words are presented this way here because if you're like me, those phonetic alphabet symbols with joined letters and little lines and marks all over them in dictionaries don't mean much.

Visimes Aren't Tied to *Individual* Sounds

One visime shape can represent several sounds; you might not read the AW in *spa* and *draw* with the same letters, but you can represent them with the same visual components. This is going to give us fewer things to animate and keep track of as animators, leaving us more time to be performers.

Visimes are the only sounds that have absolute criteria visually. Each one has a rule that we'll cover in further detail in Part II. For example, you can't say B or M without your lips closed, you can't say OO without your mouth narrow, and so forth. For now, if you look at Table 1.1 again, you'll see these rules in the rightmost column.

Now, this isn't to say that for *every* F sound, you'll need the biggest, gnarliest, lower-lip-chewingest, gum-baringest, spit-flyingest F shape—just that you need to make sure something, anything "F-like," happens in your animation to represent it. That's what visimes are: the representation of the sounds through visuals that match only the necessary aspects. Visimes are not entire poses. F is not a shape, it is part of a shape. The whole shape may be smiling or frowning, wide or narrow, but the lower lip is up and the upper lip is up, giving us what we need for an F.

Representative Shapes

You may notice some disparity between the Wide/Narrow–Open/Closed distinctions and the visime set, which I summarize in Table 1.3. There is, and there isn't. As long as we represent the visime in some way, we're all right.

Table 1.3

The Visimes' Representation on an Open/Closed Narrow/Wide Mouth

VISIME	DESCRIPTION	SCHEMATIC
B,M,P / Closed	Closed	
EE / Wide	Somewhat open + wide	
F, V	Somewhat open	
OO / Narrow	Somewhat narrow + somewhat open	
IH	Somewhat wide + open	
R	Sometimes narrower than the shapes around it, if they're not already narrow	
T,S	Sometimes wider than the shapes around it, if they're not already wide	

The last two, R and T/S, take us into the next concept in a world full of exceptions to the rule: relative shapes. EEs don't need to be the widest shape ever; they just tend to be picked up visually if they are any wider than the shapes surrounding them. Same with OOs or OHs. They don't need to be the narrowest, just narrower than their neighbors. That's how the system works. Instead of giving ourselves 20 unique keys that contort the whole mouth into an unmistakable shape, we use fewer, simpler components that can combine in different ways with other shapes to create those big unmistakable shapes. Working this way leaves us more flexible to customize each and every shape to the vocal performance, with much less work than it would be to do it the other way.

Relative Shapes

As just mentioned, there are shapes that are relative. To make this distinction clearer, anything with an *er* on it is a relative shape. An OO sound is a narrow shape; it's absolute. An R is simply narrow*er*. Absolute shapes take precedence over relative shapes.

Here's an example of relative shapes. In the phrase "How are you?" the OO in *you* is not as narrow as the OO of *you* in "Do you chew?" In the latter, because all the sounds are OOs, there are variations in the intensity and the OO in *you* is the strongest.

> The process of deciding which shapes take precedence in strings of similar sounds is explained in Chapter 4, "Visimes and Lip Sync Technique."

If that's a little confusing, that's all right; understanding comes with practice. A lot of the system involves looking at a sentence and, instead of trying to define the shapes in absolutes, seeing them in relation to the previous shapes and the shapes that follow.

"Who are you and what are you doing?": Wide/Narrow

We know how to cheat visimes using Wide/Narrow/Open/Closed, as per Table 1.2, so we need practice identifying those visimes.

I'll use the phrase, "Who are you and what are you doing?" since it has all sorts of wide/narrow travel. Let's do Wides/Narrows first; we'll do the Open/Closed pass second. I've included images with both Open/Closed and Wide/Narrow to make it easier to follow, but focus on the width more than the height through this next passage. Much of the information and reasoning here jumps ahead to things not yet explained. This is a glimpse of the thought processes you'll learn in action.

Rest in the following chart refers to the *width* of the mouth as it is at rest, in the default position. In the visuals in this chapter, it's the width of the Closed shape. But though its width is that of the Closed shape, the shape is not necessarily closed. It's hard to give visuals for visimes, as they change every single time! For example, if a shape is narrow and then goes wider, it goes wider relative to the narrow—which basically returns it to the width of the mouth at rest.

Word	Wide/Narrow Sequence
Who	Rest, narrower
Are	Little wider (rest)
You	Narrower
And	Wider (rest)
What	Narrower, rest
Are	No change in width
You	Narrower
Doing	Narrower, wider

> When I talk about working in passes, I mean going through the sound, scene, or process from start to end, dealing with only one goal at a time, and then returning to the start to go through a *second* or third time with a different goal in mind. To properly grasp sync by visime, I strongly recommend that you work in the passes described.

who I started with rest, not because of some mysterious H visime that occurs, but because without rest, we wouldn't see that the narrow OO shape to follow was narrower than anything; it's a relative shape. By leaving the mouth at rest for a moment, I created something for the OO shape to be relative to.

are This will be wider. Being exclusively affected by the Open/Closed of the mouth in this case (the main sound being AW, which is an open mouth/jaw sound), this is made wider not because it needs any particular Wide/Narrow, but instead because it's sandwiched between two OOs. With something wider between them, both OOs will have more punch. If you're wondering why this has no need for a specific Wide/Narrow, take a look at the visime list: R is *relatively* narrower, not just narrow. R should be narrower
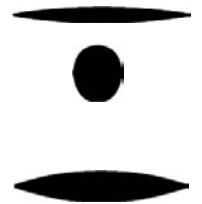
than its surrounding shapes, but since both of its surrounding shapes are already narrow, it gets *cancelled out*.

you Narrower; this has an OO sound, which needs to be represented, but that's it, nothing fancy. A true visime breakdown would be from EE to OO, EEYOO, but we went slightly wider in *are* to enforce the OO in this word, so that aspect of starting wider was already taken care of—we already had that effect. "Less is more" can be tricky sometimes!

and Again, this needs no specific Wide/Narrow shape, if we're referring to our visime list looking for a match, so we widen it to make the OO sounds around it look narrower. This concept of shaping the mouth opposite to shapes that precede or follow the sound is called, well, *opposites*, and is explained in Chapter 4. Opposites is an idea not unlike anticipation.

what This has two shapes (a concept we'll move on to next). With the *w* portion of the word, we need an OO shape—it's a visime. With the *ut* portion of the word, UH-T, we've hit a (sort of) special case. T is one of those relative visimes like R. We widen the mouth on this sound to show that another visime besides UH is present. Nothing specific, just wid*er* than UH.

are Like the previous *are*, this one's tricky; it's influenced by Open/Closed only. There's nothing characteristic that needs to be done with Wide/Narrow. We're going to use this sound like many of the preceding shapes, to emphasize its surrounding shapes. Since the next sound is an OO and we're already at a somewhat wide shape, we don't want to narrow it because that will take away from the impact or unattractively lead into the next sound. We don't want to widen it because that would indicate that we're trying to hit a visime, which we're not. So, we effectively "hold" the shape we already have. It may not seem like it, but this reasoning is a subcategory of opposites called *stepping*, also explained in Chapter 4. Briefly described, stepping is for when you've got multiple similar shapes in a row trying to out-extreme each other. You can pause on each one briefly to give each a moment of its own and then move on.

you As before, this sound is in the easy territory of a basic visime. OO visime = narrower key. The EE sound in the word *you* only really gets played up at the beginning of a sentence or after a long pause.

doing For the do portion, we need to consider the surroundings before we can choose what to do. At the end of the preceding word we went narrower. This sound, too, should lead us narrower, but by narrowing twice in a row, we risk not seeing the first shape as we breeze right by it to even narrower. Remember "stepping" from *are* two words ago? That's what we'll do again here. You may need to take some strength away from the OO in *you* to leave the OO in *do* something to be narrower in relation to. The *ing* portion is wider. This is partly because IH is a visime, and also because *ing* is most definitely not an OO sound. Sometimes we need to key *away* from surrounding sounds as much as we need to key into them.

"Who are you and what are you doing?": Open/Closed

Now let's look at the Open/Closed for "Who are you and what are you doing?"

Word	Open/Closed Sequence
Who	Open, semi-closed
Are	Open, semi-closed
You	Open, semi-closed
And	Open, semi-closed
What	Open, semi-closed
Are	Open, semi-closed
You	Open, semi-closed
Doing	Open, semi-closed

Interesting. Hmm. That all looks like the same motion over and over. And the reasoning is not present; the conclusions are just laid out for you! This is a bit of an oversimplification because of timing and strength of the motions, but in essence, the Open/Closed cycle is going to be a function of syllables. The jaw, or Open/Closed, should be treated like a sock puppet. If all we had as a tool to work with was Open/Closed, we should still be able to convince people that the words were coming out of the character's mouth (albeit somewhat sock-puppety!). This is the process you will learn to use.

The Simplest Lip Sync

You're ready for your first sync tutorial!

Let's put this simple stuff to the test. It's easy—trust me. We don't want to get bogged down in expressions and fancy heads and shapes just yet; there's a whole book ahead of us going into that stuff in detail, so for now we're going to do some copying of expressions and really basic point-pulling for the sake of the exercise. This may seem a little like jumping through hoops, but it gets us to a starting point really quickly.

> Every practical instruction needs a tool, but you might be using any of several good 3D animation programs. For my hands-on tutorials, I prefer to use Maya, but the principles will carry over to other software; you'll just have to do a little bit more digging, finding the specific buttons and tools. I've set up rigs in several packages and the logic does apply, and work, in all of them.

Creating a Sync Tool 1: Shapes

First we're going to breeze through creating our shapes. In the next steps, I'll have you create a simple circle and a set of Wide/Narrow and Open/Closed keys along with an interface. This little model in hand, we can start on some of the early practical work of the book. If you would rather not build it yourself (I recommend highly that you do), you can load the finished setup from the CD; in the Chapter 1 folder, look for `SplineMouth.mb`.

Units! For the duration of the book, I speak in terms of 24 frames per second (fps) and the Y axis as the world up.

1. Create a circle. A circle of eight points will look *most* like the visuals to follow, but any circle will do. In Maya, choose Create → NURBS Primitives → Circle ❒.

2. In the options window, make the "Normal Axis" Z (this makes the circle upright as opposed to flat).

3. Name the circle Mouth.

4. In component mode, modify the shape so that it looks almost like a flat line. (It's important not to just scale the object; make sure you're manipulating CVs.) The easiest way is with all the CVs selected to scale (close to) flat in Y.
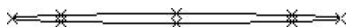
5. Duplicate Special the Mouth object twice. Make sure Copy—not Instance—is selected in your duplicate settings. Move the two duplicates away from Mouth and each other so they are all separate.

6. Select one of the duplicates and name it OpenClosed. In component mode, reshape it to look like the example here, which will represent the open mouth. Be sure you're moving the lower and outside points and not the three upper ones.

7. Select the other duplicate and name it WideNarrow. In component mode, reshape it to be wider, like the image here, which will represent the wide mouth. Be sure to include *all* the points in the widening, not just the end ones; otherwise this won't work properly.
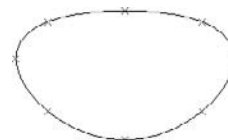
8. Now that we have our shapes, select the two duplicates and then Shift+select Mouth. In the Animation module, press Create Deformers → Blend Shape. This assigns Open-Closed and WideNarrow as shapes to be used by the object Mouth.

9. Select Mouth again, and in the Channel Box under Inputs, highlight blendShape1. Rename it MouthShapes.

If you want, you can now hide, *but don't delete,* OpenClosed and WideNarrow. We shouldn't need them later but just might.

Okay, that's it—we have the art side of things ready to go. These are the shapes we'll use in our first setup.

Creating a Sync Tool 2: Setup

Now for the expressions. If you don't know expressions or don't understand what you're doing as you go through the steps, don't worry. I'll be describing it later, specifically in Chapter 12, "Interfaces for Your Faces." All we'll be doing right now is linking the shapes we've built to one simple control mechanism so that we can have Mouth morph into each of these shapes *and* combinations of them in a very user-friendly way.

To reiterate, we will not be using the blend shape editor to control our faces. If you're looking for the part where I explain it, where to find it, how to set driven keys, or anything like that, you won't find it. We will be using home-made interfaces, using scene objects as the controls and expressions to link those to the shapes. I'll refer to these as our sliders. The main reason for doing so is that you can tie multiple shapes onto controls to make the wrangling of many sliders much easier. Chapter 12 is dedicated entirely to the ideas used to create the sliders and instruction on using some included MEL scripts to set up your own character's head with ease.

> If you are a MEL guru or expression wizard, this setup may seem sloppy or too simple; it's designed to be easy and accessible. If coding talents are at your disposal, feel free to re-create this in any manner you see fit, but do go through and first set up the described rig to get a feel for the functionality. I'll refer to using a rig like this throughout the book.

1. Create a locator and duplicate it. In the Hypergraph, Outliner, or however you prefer to do it, make locator2 the child of locator1.

2. Rotate locator2 to 45° in Z and scale it to 2,2,2. This is just to make it more selectable.

3. Rename locator2 MouthControl.

4. Open the Attribute Editor and select the MouthControl tab, then open Limit Information → Translate. (When you open the Attribute Editor, it defaults to Rotate; be sure you're doing this under Translate!)
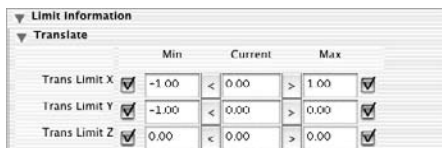
5. Check all the boxes and fill them in as shown in the screenshot above, limiting the motion to horizontal and vertical as viewed from the front. We're also limiting the range of movement within that view to keep our control under control!

6. Move locator1 out of the way of the mouth. MouthControl, being the child, should follow. MouthControl, as I'm sure you've guessed, will be how we manipulate the shapes on Mouth.

7. Select Mouth and then in the Channel Box under Inputs, highlight MouthShapes.

8. Go to Window → Animation Editors → Expression Editor.

> Another way to reach the Expression Editor is to right-click in the Channel Box over the name of an attribute and select Expressions.

9. In the Objects window on the left, highlight MouthShapes. You should see WideNarrow and OpenClosed appear in the Attributes window to the right (along with "envelope," which is generated automatically by Maya; we're going to ignore it). Highlight the WideNarrow attribute. In the Expression box near the bottom, type the following:

```
MouthShapes.WideNarrow = MouthControl.translateX
```

Maya is case sensitive, so be careful that you copy this exactly and that you've named all your objects correctly. When you have that typed, click the Create button at the bottom left. If it worked correctly, you should see the expression change to read:

```
MouthShapes.weight[#] = MouthControl.translateX
```

The number in the brackets may be [0] or [1]. It's Maya renaming the shape node to its behind-the-scenes Maya name. The number 0 or 1—even 2, 3, 4, or, in later heads, numbers up into the 20s—refers to the shape in the order it was selected for becoming a blend shape, starting at 0. When Maya changes that name after you click the Create button, you know the connection was made.

> You can also use the standard Ctrl+C, Ctrl+X, and Ctrl+V to copy, cut, and paste text into the expression window. If you select an object and an attribute in the top windows of the Expression Editor, Maya fills in a box just under that labeled Selected Obj & Attr, which creates the full string of `Object.Attribute` for you, so you can copy and paste it! It's a fast way to ensure that your spelling and capitalization are correct.

10. Highlight the OpenClosed attribute. In the Expression box near the bottom, type this:

```
MouthShapes.OpenClosed = -MouthControl.translateY
```

Be sure you include the little minus sign before MouthControl—that's very important. Again, if it worked, the expression should change subtly. The shape name should change to read *weight* and a number in brackets.

```
MouthShapes.weight[#] = -MouthControl.translateY
```

That's it. We're done messing around with yucky expressions. Now we have a *super basic mouth* to play with—but hey, it's a mouth. The 45-degree rotated locator we renamed MouthControl is now a slider for our mouth that works in two dimensions, X

and Y. Translating the locator controls the mouth. We connected MouthControl and Mouth so that left and right on MouthControl will make Mouth go through narrow and wide, while up and down will open and close it. Kind of neat, huh? Where else have you ever seen anyone say you could control all your basic sync with one slider? Nowhere! It's not unlike some painting programs in which you can select a range of colors because four extremes are laid out for you and you just click in the area that looks like the right mix.

This mouth is pretty simplistic. Right now there is really only one shape—Wide—and we're creating the Narrow by telling Maya to do the opposite. Pulling the slider left, you'll see the "fake" Narrow shape. That plus some Open/Slider Down should create a pretty good OO shape. If it's not quite how you want it, unhide the object WideNarrow and widen it, which will in turn affect Mouth's shape. Since in Narrow we're looking at the *opposite* of the WideNarrow (which is Wide), the wider you make Wide, the narrower Narrow can be. Backwards-tastic!

Using the Sync Tool

In the scene with your mouth, continue on as we use the slider, the shapes that slider controls, and what we've learned about syncing by visime to go for a test run. As I said before, sliding left and right will make the mouth widen and narrow, whereas pulling the control up and down will open and close it. Let's do a practice word without any sound, one of the easiest for this particular rig. The word: *why.*

> If you're finding that the frame numbers aren't lining up for you, give your preferences a look and make sure they're at 24 fps; film. In Maya, you can find the option for frame rate under Windows → Settings/Preferences → Preferences → Settings. Other programs will have this setting; you may have to poke around a bit to find it.

First analyze the word by sound and equate that with visimes. Sound out *why,* and you should end up with something like OO-UH-EE. OO and EE each need specific shapes, whereas UH is merely open. The way I like to do things is to first key the Narrow/Wide stuff and then go back and get the Open/Closed stuff. Since this sync is so incredibly short, we're going to put the height into the visimes as we go. After all, there are just two of them! The goal here is to get you rolling with the interface and to offer a taste of how this all works. By the end of the book, you'll have an array of sliders like this (and some others) hooked up to a myriad of shapes and a great character face to play, or even work, with.

In your scene, on frame 0, set a key with your control at 0,0 positionally; your mouth should be in its default state, closed, halfway between narrow and wide, much like in Figure 1.4. If yours doesn't match this perfectly, close enough is close enough. This is something we'll later refer to as *capping.*

Figure 1.4
A default mouth

Now on frame 10, move the slider down and to the left, until it looks like a good OO. X,Y values of –1, –0.2 should be about right, as in Figure 1.5. Set a key! You've just set the OO part of *why*, or of OO-UH-EE.

Figure 1.5
OO of OO-UH-EE

Now go to frame 30 and move the slider all the way to the right and up a little bit. That should put it at about 1, –0.2, as in Figure 1.6. Set a key! You've just set the EE part of *why*. All that's left to do is take care of the UH part.

Figure 1.6
EE of OO-UH-EE

Moving back to frame 20, simply pull the control down so that it opens the mouth in the middle of the word, as in Figure 1.7. Try –1 in Y. Set a key! You're done.

Figure 1.7
UH of OO-UH-EE
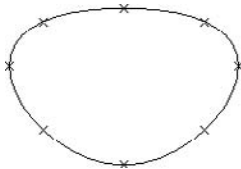
You've keyed the visimes in the word *why:* OO-UH-EE. Play it through a couple of times—not bad for a few seconds' work. Identifying visimes all on your own steam and working through the special cases will take a little time, but not too much more than that bit right there.

Now, I recommend going back and looking at the phrases we've already dissected, using your new toy (I bet you would whether or not I told you to—it's fun!). This little rig really is how we're going to get into some very complicated performances, and it illustrates quite well the less-is-more approach I'm preaching. There will soon be a little army of sliders and controls just like this one, each custom-made for a different type of motion and shape.

The setup we just did could directly be translated to work on some beautiful shapes and characters. It's just a matter of getting them built so we can use them. We're only playing with a circle for now, but that's so you can get some practice at your basic concepts of both shapes and controls before we get too crazy; with some patience, I think you'll amaze yourself with your work in a surprisingly short time. On the CD, there's some sound for you to play with. Files for each of the examples we've already walked through are in the Chapter 1 folder, named *sentenceName*.wav. (If you need help loading sounds into your software, please see Chapter 4.) If you follow the directions in the text and try lining your mouth object up with the sound, you should have some pretty good results fairly quickly. Then turn the page—there's plenty more where this came from!

What the Eyes and Brows Tell Us

With our feet wet in the puddle that is sync, it's time to shift our focus to another introduction. Basic lip sync will lend credibility and draw focus to a speaking character, but without any emotion coming through, that character isn't going to mean much to the audience. Most emotion comes across in the top half of the face, with the eyes, the brows, and the eyelids. Most commonly, the brows get the bulk of the attention from animators, when the time should really be spent on the eyes and eyelids. When you sit down and talk to someone, you look them in the eye. Your gaze may not stay there for uncomfortable lengths of time, but it surely bounces to and from eye contact; that's the go-to point. If you do this, so does the person you're talking to, and therefore, in reference to emotion, the place most commonly referred to by us humans is the eyes, not the brows.

This is the first of many situations in which I'll talk about the concept of *landmarking*. In a nutshell, the stuff in the area surrounding what you *think* you're looking at is what you actually perceive. In this instance, the eyelids tell you most of what you'd think the brows do. The brows do indeed help us to create emotion, but what exactly do they do?

- **The two major brow movements**

- **The upper and lower lids' effects on expression**

- **Perception vs. reality in eyelines**

The Two Major Brow Movements

Much like the mouth and its two cycles of Wide/Narrow and Open/Closed, the brows have the two basic motions: Up/Down and Squeeze. A lot of animators focus much of their attention solely on the first. Brows Up/Down clearly have a lot to add to facial animation and expression, but not in the ways you might think. The brows Squeeze is in fact the most telling thing the brows are capable of. A degree of Squeeze is involved in most any expression.

Brows Up and Down

A common approach to brows Up/Down has them embody the alertness, or even simply the sound volume, of a character. If a character is alert or yelling, the brows are high; if not, they're low. Both of these states are illustrated in Figure 2.1. Sometimes Down can be used for anger or determination. These uses of the brows aren't necessarily wrong, but they're very limited. You get into all sorts of trouble when a character yells and then, well, yells more. It's easy to blow your character's acting range on the first line of dialogue and then have nowhere to go on the second.

Getting into the acting portion of facial animation, it's important to realize that subtlety is king. If we use the brows merely as an Up/Down gauge of the character speech volume, it's not going to add anything to the performance but instead merely tag along with the sound. In Chapter 7, "Building Emotion: The Basics of the Eyes," I'll build on this, but the important point for now is that things going on emotionally happen before the things going on verbally. The emotional shifts in a character's visual performance should lead the vocal performance. If the character has a line that is sad and then it shifts to an angry one, the visual facial representation of that shift should happen before the line. We think things

Figure 2.1
Brows Down and Up

before we do them. To lend credibility to the things we animate, we should make the emotional context of a scene slightly lead the sound. We're talking frames here, not seconds or minutes. All this is why I tend not to use the brows Up/Down in a strictly alertness- or volume-based manner but instead as emotional keys. They work (mostly) in conjunction with the Squeeze and eyelids to create poses, not motions.

Brows Squeeze

The Squeeze is by far the more interesting of the two motions in the brows' toolbox. If, without looking in a mirror, you were to explain what a "mad" expression on the brows was, you'd likely think it's that they drop low, and arc, as in Figure 2.2.

That this is how we interpret "mad" on the brows is a feat of the conventions used in cartoons. This is indeed a shape people associate with anger, but it's not entirely accurate. If you now look in a mirror and make a mad face, you'll notice the brows only squeeze. That's it. Figure 2.3 shows some real-life angry brows.

Figure 2.2
Stylized mad brows

There's no crazy swooping shape; if you're seeing one on your face, it's because you're cheating, tilting your head, and manipulating the shape through perspective. I'll get to that in Chapter 3, "Facial Landmarking," but for now, hold your horses, straighten your head out, and let's keep going. Your brows may drop a little bit, but not enough for that downward movement to be perceived as the main motion. It's the scrunching of the skin between and just above the brows' hair that really makes someone look mad.

Now let's try "thinking." It's a little tougher to pick a pose for, but let's do it. Look in a mirror (or don't) and put on your thinking face. It's not dissimilar, is it? The brows squeeze—maybe not as much as "mad," maybe you've got one eyebrow a bit higher than the other—but mostly, it's the brows coming together. Now put on your sad face. Behold, it's similar again. The brows raise, and the brows squeeze.

The Brow Squeeze Is *Every* Expression

As you saw in the previous section, just about any ol' expression is going to do the same thing: squeeze the brows. Some level of squeeze on the brows is involved in almost any emotion. To get more specific, squeeze denotes "thought." Absence of squeeze is generally absence of any wheels turning. It's the combination of the brow squeeze, the brow raise, the tilt of the head, the eyes, and the eyelids, working together, that creates an expression. That sounds like it's complicated and so much harder than just having a mad shape and a sad shape and an excited shape to use, but in fact it's so much easier, and credible—and best of all, there are only a few concepts to it. Now, you already know that squeeze is a part of almost every expression, if used with the right combination of other things, so you're already started on learning.

Figure 2.3
Real mad brows

Moving right along…since I shied away from portraying alertness and volume in the brows Up and Down, and they weren't anywhere to be seen in the Squeeze section, would you like to know how to do that? It's easy.

The Upper Lids' Effect on Expression

To keep in line with how I've talked about sync and the eyebrows, I'll tell you what the major motions of the upper eyelids are, even though they're much simpler in movement than the rest we've covered so far: Wide/Closed. Period. There are all sorts of specific points along the way between wide open and closed shut and each has its own meaning, but from Wide to Closed is basically it.

Start with the notion that the upper lids hold a lot of information, but it's not absolute. Just like some of the visimes in Chapter 1, "Learning the Basics of Lip Sync," such as T and R, are merely relatively wider or narrower than what's around them, nothing absolute, so are the upper lids. Simply put: All the information in the upper lids is relative. The iris and pupil are what the lids are relative to. If there were no eyeballs in the sockets, the upper eyelids wouldn't tell us a whole lot. That's gross and probably seems weird, but it's a point to think about. The iris and pupil serve as a reference point to tell us *how* wide or closed the eyelid is; the eyelid alone means nothing. Think of it like one of those "hit the pad with the hammer" games at carnivals. The markings on the slide tell you how hard you hit. If we can see white in the eye above the iris and pupil, the lids are wide; if the lid is low enough to cut into the pupil's silhouette, they're narrow. If we can't see the eye, the lids are closed.

The Upper Lids Show Us Alertness

All this is tied to alertness. In other words, the more alert we are, the more light our eyes let in and the wider they get. The less alert we are, the less light our eyes let in and the more closed they are. Allowing and blocking light is all the eyelid does (besides blinking, of course, which is something completely unrelated to this). With no iris and pupil, we couldn't read that effect. For example, Figure 2.4 is a set of eyelids, with no iris and pupil drawn in.

Eyes, right? No big deal. Now look at an iris and pupil drawn into Figure 2.5.

Figure 2.4
Eyeless sockets

Figure 2.5
Regular eyes

Figure 2.6
Eyes up/sleepy

Figure 2.7
Eyes down/alert

Eyes, right? Again, no big deal. Now in Figure 2.6, the same iris and pupil have been slid higher in relation to the eyelid, which hasn't changed at all.

Wait. That's different. Why is it different? It looks sleepy. Why does it look sleepy? Because the iris and pupil are partially covered, it appears as though the lids are blocking some light into the pupil, something that happens when we're sleepy, or bored, or for any number of reasons. The point is that the eyeballs moving in an unchanging lid are changing the overall facial *expression*, not just moving about positionally. In Figure 2.7, you'll see the same eyes with the iris and pupils moved down instead of up.

Hold on. This guy's excited. He's all bug-eyed. That's weird. Once again, the eyelids and brows haven't intentionally changed expression; the iris and pupil have simply moved! That doesn't make sense, does it? Well, yes it does. This brings me back to what I touched on earlier with the brows. Using the brows to accentuate the alertness or vocal volume of a character is not as effective since the brows usually have more to do with the type of expression, not the intensity of it. As you see in Figure 2.8, the upper eyelids are almost exclusively the visual key we as humans use to perceive someone's alertness. The way we achieve that perception is by looking at the eyelids' position relative to the eyeballs, using the pupils and irises as the measuring stick.

This is just something we have to be ever aware of—which is really the point of these first three chapters: not to teach you everything there is to know, but instead to have a base to draw upon when you make certain decisions when building your models and key shapes. (We'll go over most of this again in more detail in Chapter 7.) The eyelid's level is *always* relative to the iris and pupil, no matter where they may be looking. That's what I meant when I said the upper eyelid's information is relative. As the eyes turn here and there, the expression/level of alertness is going to change almost randomly. It just won't do if every time the eyes look up you'll have "sleepy guy" and when they look down you'll have "fraidy cat guy—look out!" We have several ways to tackle this problem automatically, through rigging simple or complex head setups that you'll read about in Chapter 11, "Skeletal Setup, Weighting, and Rigging," and in Chapter 12, "Interfaces for Your Faces," but the most important thing right now is that you're aware of it. Before we get to automation later in the book, though, there is an elbow-grease way to deal with this little detail, and it's what I'll describe next.
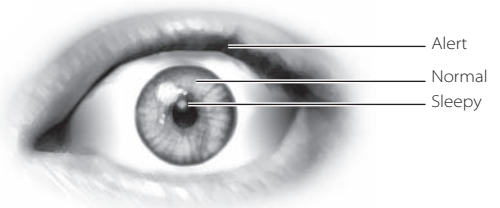
Figure 2.8
Pupil-and-iris-o-meter

Alert
Normal
Sleepy

Figure 2.9

Eyes up and down, expression maintained

The Upper Lids Usually Stay Relative to the Pupil and Iris

For a simple knowledge-based fix (as opposed to a rig, for just this moment) or method to avoid unexpected expression changes, the upper eyelids should hold their relationship to the eyes. In CG terms, the *upper* lids should behave as though the eyeballs are their parent objects (vertically). To maintain expression throughout eyeball movement, the upper eyelids should seemingly close some as the eyeballs look down and widen as the eyes look up, as in Figure 2.9. If there's still some convincing needed as to the validity of this, get a friend to look up and down in front of you and watch their upper eyelids. If their lids don't behave as I've described, get them to a hospital. Quickly.

The Lower Lids' Effect on Expression

Now that we know enough about the upper lids to last us for a while, it's lower lid time. The lower lids—or Squint, as we'll refer to them in this book—are actually the visual effect of an area of muscle called the *orbitularis oculi*. When I say "lower lids" in this book, I mean the whole area including the upper half of the cheeks, the outer edges of the brows, and even the skin between the eye and the ear! Figure 2.10 shows this area in darker gray.

The actual orbitularis oculi muscle extends up and over the upper eyelid. The area shown refers to the area we will affect in our key shapes.

That's not really how you'd identify the lower lids if someone asked you to point at them, I know. The affected area is very broad. Referring to the cheeks as an independent area that emotes is a leading cause of badly done facial animation, so with "lower-lids

Figure 2.10

Lower lids Squint

Squint," I picked a name that was better suited—not to mention that it makes a nice pair with the upper lids.

This main muscle surrounds the eye, and its motion is like a squeeze. Figure 2.11 shows the "track" all the different areas are on—the affected areas and the directions they move—as the lower lids flex.

So, in actuality, it's a squeeze and a twist, both. Everything pulls in toward the eyeball, and the outer areas have to get around some skull to do that, so they have to curve in toward the eye as they travel. This is the motion that causes "crow's feet" wrinkles on people. Even in babies, there's all this skin that's trying to move into the same spot, so it has to bunch up. The squeeze and twist of the lower lids is a major, major part of facial animation and one of our most basic and important controls.

The Value of a Good Squint

So we've got a name and a motion in lower lids Squint, but what does this shape do for us? In short, it's an emotional intensifier, and it can help create focus in a performance. It's not necessarily tied to volume or alertness, or even a specific emotion; it just intensifies all emotion.

Remember when I said that the squeeze in the brows all alone can mean "think"? Well, this lower lids Squint makes *that* think *more* think. I can't tell you a logical reasoning for this or give you a medical or anthropological reference—it's just the way it is. I'm talking to you as 100 percent artist, 0 percent intellectual on this point. A good visual example of the lower lids intensifying an emotion is a "mad" expression on the brows. There's Squeeze, there's a little bit of downward movement, the head is tilted forward, but there's still one thing missing. In the first image in Figure 2.12, we've got everything minus the lower lids Squint, and then in the second image, the Squint is included.

Do you *feel* the difference? It can be subtle to look at it and compare, but the squeezed lower lids add so much determination to the mad expression. I look at those two and think the first one is mad and the second one is full of hate. Sometimes when you're animating, that's the difference in performance you need to find, and knowing how to get it helps.
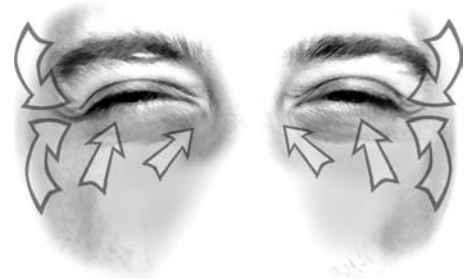

Figure 2.11
Squint motion

Figure 2.12
(left) Squeezeless anger and (right) anger with squeeze

Squint Is Not Emotion Specific

Now, obviously lower lids are available to us as a tool not only to show hatred and bad things; if the lower lids are used properly, happiness and even sorrow or frustration are intensified, and feel more real. Often in a smile, animators will feel they need a control for the cheeks. The effect they're looking for should come from the mouth smile key spreading over a large enough area of the face combined with the effect of the lower lids. If you look in a mirror and smile trying not to include your lower lids, it can look very contrived. To do the same thing and consciously flex your lower lids or squint, you'll see the opposite, a more genuine smile. I had a friend I would joke with long before I was in CGI and I would tell her it seemed that she had to trade her eyes for her teeth whenever she smiled.

Squeeze Across Different Styles

The lower lids are also very heavily used in styles that aren't just human, even though all styles are somewhat rooted in human cues. Characters that have what I call "clamshell eyes"—an eyelid that is made of a collapsed sphere and tracks the eye's surface—also use the lower eyelid similarly. Pick your favorite CGI movie and watch how a toy, a bug, or maybe even a monster with these clamshell eyes will actually *grow* a lower eyelid for certain expressions. The lower eyelid is such a fantastic tool for expressing so many things that I can't possibly cover them all until we use it in scene context. For now, just know that you'll need it, and you'll love it.

Eyelines: Perception vs. Reality

So if the brow squeeze tells us there are thoughts trucking through the head, and if the brows up/down tell us what kinds of thoughts those are, and if the upper eyelids are a window to alertness, and if the lower lids intensify and modify emotions…does the eyeball itself have anything to do with emotion? Not really, no.

In the context of a scene, a character looking down while saying something may tell us there's shame or fear or bashfulness, or any number of things, but that has more to do with the overall head pose, facial expression, and dialogue than the fact that the eyes are pointed downward. Someone could be looking down for any number of reasons.

We're all done dealing with expression in the top half of the face until Chapter 7; for the rest of this chapter, I want to talk about how the eyeballs primarily tackle the hefty task of telling us where the character is looking. How strange. The eyes tell us what's being looked at. Simple, right? Let's read between the lines: The eyes, *not the head,* tell us what's being looked at.

Headline vs. Eyelines

Something I see all the time in computer animation is eyelines—where the eyes are pointed—done improperly. A common tendency is to animate *head*lines—that is, to point the entire head at the character's focus. If my head is pointed at something, that's where I'm looking, right? Well, technically it's not wrong; it just doesn't communicate clearly with an audience. There's no *reference* for us to pull around the eyes and lids. The iris and pupil are dead center in the eyelid, relatively, so there's a lot of interpretation that has to be done by the viewer.

Here we go with references and relative stuff again: If the white to the left and right of the iris is equal, the eyes are pointed straight forward in relation to the head. To carry that to a real-world scenario, if two actors were standing next to each other on a stage, eye contact would mean they'd be facing each other nose to nose. Yes, technically, they're looking at each other, but it's a little unnatural.

Implied Eyelines

What will better show where the eyes are looking is an *implied* eyeline, not a "geometrically correct" one. That's right, all you folks who constrain eyeballs by pointing them at a locator or null—I'm saying, don't do it. It might look bad. Sure, in 3D space it may be "correct." It is correct *if the eyes are perfect spheres and exactly one half of that sphere is visible*, but that's not usually the case. Our job is primarily to communicate with our audience from a chosen framing—and if it doesn't *look* right, it isn't right.

> Real-time free-camera game animation may be the exception to the advice to implying eyelines but splitting the difference between the eyes and the head is still something you should try to do the second that you do have control over the camera, like in a game cut scene. Also, even in a game world, do keep an "eye" on your eyelines; don't believe that because there is an aim constraint, the eyes look like they are pointed at what they are supposed to be pointed at.

Figure 2.13 is a 3D model with the eyeballs constrained to a focus on an object in front of it and the head pointed directly at the object.

There he is, looking at it. Yep, looking right at it. No one can argue the *factuality* of him looking at it. But it's pretty darn boring, don't you think? Also, he could be looking right past it; from here, I have no idea of knowing for sure. Now, let's spice it up a little tiny bit. In Figure 2.14, let's do it my way. Now we can see more of his face, which almost always looks better, and we've also more heavily implied that he is looking at that star, because the eyeballs are sitting to the right of the eyelid opening, not balanced in the center. The reference we have is that eye; if there's more white on our left, he's looking to our right. It's a simple perception equation.
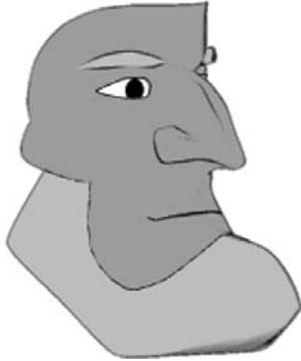
Figure 2.13
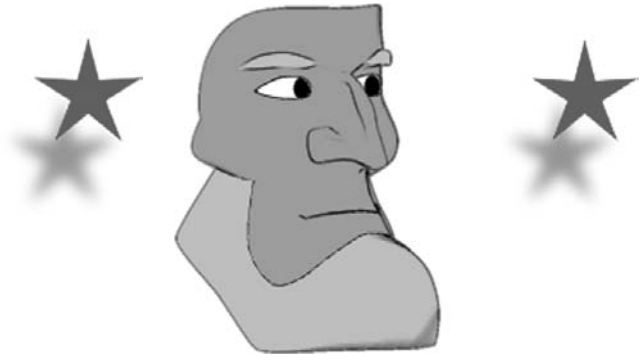**Correct eyeline sans flair**

Figure 2.14
A more interesting eyeline

The funny thing is that in my scene, a top-down wireframe with lines drawn in so you can see where the head and eyes are pointed, looks like Figure 2.15.
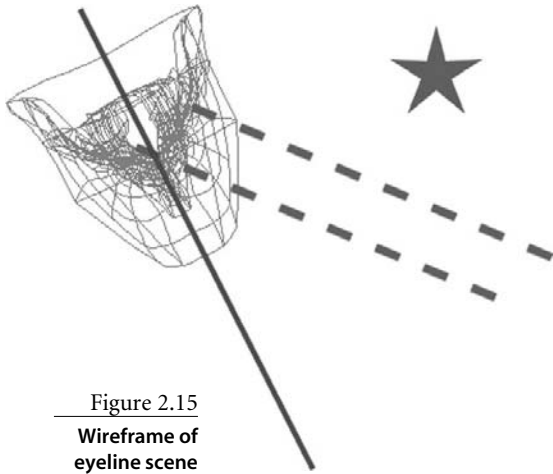

Figure 2.15
Wireframe of eyeline scene

Even with that knowledge, I still like the eyeline in Figure 2.14 better than the one in Figure 2.13. Seeing a character's face is going to go a long way toward helping their performance, and all that matters in an eyeline, like anything else, is the perception, not the fact. Figure 2.14 gives a better impression of looking to the right; our brain fills in the part about the focus being the star because it's also to the right. Approaching eyelines this way will convince an audience 10 out of 10 times, where an aim constraint may not. Once we get the basics of "Which way are the eyes pointed?" sorted out in our scene, the audience is distraction free and ready to read the lids, the brows, and anything else we want to act with.

Distraction Is the Enemy of Performance

This is to become a recurring theme. There are certain things we can do that will distract an audience from the story, making them stop to figure something out. Missing our sync by a couple of frames, moving the brows instead of lids when a character screams, or making the audience question where a character is looking—any of those things will break the illusion that our character lives, breathes, thinks, and exists just past their television screen.

Facial Landmarking

Facial animation and modeling does indeed involve knowing how to lip sync and how to use the eyes, brows, and lids for expression. *Good* facial animation and modeling, however, involves knowing a whole lot more than that. Good acting and modeling means knowing about the relationships between features on the face, what the changes in those relationships will do to the model and/or expression, and how to be in total control of all those variables with the simple tilt of the head or the addition of a crease.

- **Introduction to landmarking**
- **Landmarking mouth creases**
- **Landmarking brow creases**
- **Landmarking the tilt of the head**

Introduction to Landmarking

As I said briefly in Chapter 2, "What the Eyes and Brows Tell Us," landmarking, as I refer to it in this book, means noticing the area *surrounding* what we think we're looking at—that's where we get the real cues for the impressions we get. Landmarking is used in two ways: to analyze creases and to measure *distances* between features. By landmarking, we can study what effect those two things, creases and distances, have on perception of everything from eyelines and brow expressions to mouth expressions.

Landmarking is used to identify what overall perceived change has been created in a way that might not be obvious. That is a big mouthful and concept, to be sure, but it's one worth understanding. Landmarking means realizing that a tilt of the head may have more to do with why someone looks mad than the shape of the brows does or that a wrinkly brow may make someone look more excited than raising those brows even higher does. Think of it like this: When you enter your neighborhood on your way home, you know you're near home because you're surrounded by landmarks—things you recognize—that tell you so. If your neighborhood (minus your house) was demolished one day, you'd still intellectually know where you lived; your address wouldn't have changed, and all the directions, the turns, and the streets would be the same, but something about the trip home would *feel* a heck of a lot different, wouldn't it? Landmarking on the face is learning to spend most of your time looking at the neighborhood first and your house second.

Landmarking by Example

For a more visual representation, take a look at Figure 3.1, a plain old mouth. Modeling a smile from this mouth, most people would concentrate solely on the lips and try not to mangle the rest of the face too much. A basic battle plan would be to pull the corners of the mouth out to the sides and up, revealing more of the teeth. The resultant shape is wide and arced; it's everything we associate consciously with a smile. Doing it like that is not necessarily a wrong approach, but it would look like Figure 3.2.

I'll do some talking about shapes, key shapes, blend shapes, and so on. These are, well, different shapes that get assigned as target or key shapes to one master head. That head can then draw upon, or morph into, each one of those shapes. This can be done using Maya's built-in interface found under Window → Animation Editors → Blend Shape, or you can create your own interfaces to drive the values, as I do. To create blend shapes, select the target or key shapes and then the master (default) head. In the animation module, select Create Deformers → Blend Shape.

Figure 3.1
A default mouth

Figure 3.2
One unusual smile

Supervising other modelers building facial key shapes, and even doing it myself when I was newer at this, I saw this all the time as a first-pass for a smile shape. Figure 3.2 has all the pieces we consciously recognize as a smile, but it's not right—I think we can all agree on that. It doesn't *feel* like a real smile, and in a lot of ways, it doesn't feel extreme or broad enough. It looks as though it's a fake or tortured smile; it's a little creepy, actually.

A gut instinct for correcting this would be to make it bigger. Just make it bigger. To pull this mouth wider and taller and farther back would actually just make it look worse. When looking at the result of that, we'd have the same reaction and probably try widening it again. Before long, we'd be able to see into a giant mouth, we'd have all the back teeth and gums exposed, the mouth practically peeling the face off, and the smile still wouldn't look genuine or extreme.

Now in Figure 3.3 is the same *mouth* again, with one big difference.

The surrounding area of the face, just outside of the mouth, up to and including the cheeks, has changed rather drastically. There's a massive crease and shift of the surrounding skin mass now. All of a sudden, the smile looks genuine, and wide. Why is that? It's because of that crease. Creases (which I'll go into more specifically in the later sections of this chapter) communicate the simple fact, whether as an illusion in CGI or the fact of real life, that skin is being displaced. It's very apparent that the same mouth shape with and without creases yields a completely different look.

Figure 3.3
A genuine smile

Fixing a Shape by Fixing Its Surroundings

The inclusion of the crease is the result of using landmarking. Specifically here, we're looking to and using the effects on the surrounding area to emphasize the *perceived* primary area. The problem we're faced with as artists, in this example, is how to make a smile that doesn't look wide or genuine look wider and genuine. The solution is not to widen the mouth or add some genuine sauce, but instead to show that the shape is already wide by showing that it is affecting the rest of the face too. By adding the more natural look of skin with the creasing, we've made it look more genuine.

The Landmarking Process

Landmarking can be done for a complex of reasons and serve a variety of uses. The crease for the smile is something often overlooked, but now that you know to look for it in a smile, you'll never again forget it. If we were really doing a top-to-bottom landmarking of a smile, what we'd be doing is looking at a real-life smile and analyzing everything *except* the mouth itself—we'd look to its proportions and surrounding area. We'd make a list of those things, either physically or mentally, in referential or landmarking terms and make sure to include them in the shape we build for our character. If we were critiquing work, we'd have stuff to pull from our bag of suggestions.

Something of this nature might be as simple as looking at Figure 3.4 and making a list of five small observations:

1. The mouth is 1.3 times wider than default, 1.3 times *deeper* than default.
2. The lips move up 1 upper lip height.
3. The eyes squint.
4. The mouth pushes cheeks (effect visible almost all the way back to the jaw).
5. A crease appears, apex directly down and in line with outside edge of eyes.

Even that simple list will help us identify things we might not otherwise. We may also take the information and deconstruct it. For instance, the smile usually has an effect all the way up to the lower lids, or upper cheeks, but if we were to include that squint in a basic smile, we could run into problems with mixing our shapes together, so we'd build everything *but* that into the smile shape. A squint shape by itself mixed with a squint that's included in a smile could get ugly. By laying out all factors involved, you can identify certain reusable attributes in shapes, which becomes a very powerful tool in deciding key shapes to build in a set. That sort of information and planning, however, is best left for later. In the modeling section for shapes in Chapter 6 it all gets explained in greater depth.
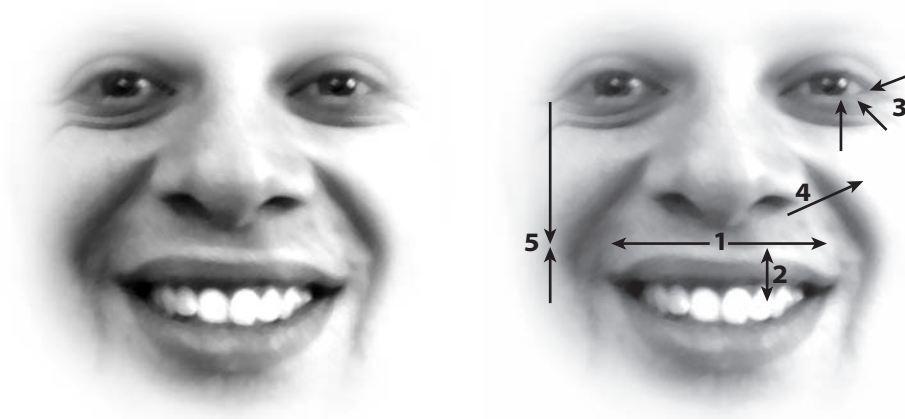
Figure 3.4

Looking for landmarks in a smile

Landmarks Are Obvious When They're Alone

Looking at the smile crease again, this time in Figure 3.5, you'll see an odd mix. The picture has the *mouth* returned to its default position, but with the crease from the smile. This is what we should be picturing mentally when we're landmarking something, truly ignoring the supposed main focal point—in this case, the mouth. Here the crease looks very dramatic, and almost silly in how pronounced it is, but when smiling occurs, it's real. This exact shape, with the mouth in default but with the smile creasing, is something you'll never see in life, nor as a shape we'll build, but it's here to illustrate just how pronounced that crease really is. It's intense. With the smile on the lips not present, we can focus better on the crease and how it looks in relation to the face. It's amazing, when you see it this way, that it's such a commonly overlooked part of a smile. It is, in fact, the *most important* part of a smile.

Figure 3.5

Smile crease on a non-smiling mouth

You may be wondering whether landmarking is exclusively concerned with the areas around the mouth; they are most definitely a big part of it, but not all. In the next section, I'd like to focus on the creases around the mouth and then move on to sections covering creases around the brow and the tilt of the head.

Landmarking Mouth Creases

The area around the mouth, as you just saw, creases during a smile. Translating this knowledge into a key shape for a 3D model that will look right, move well, and render without shading errors is a completely different and more complicated topic.

You now know that you'll need that surrounding mouth area to crease, and you know how that crease will need to look, at least in the case of a smile. Knowing this, you can start to think about mapping out the points of a model to be prepared for that movement—a sort of preemptive modeling strike. This is much like deconstructing the specifics of an individual shape and seeing if it can be made up of different smaller, reusable shapes. Thinking in these terms is very efficient. It's extremely advantageous to build a model to cooperate with what it will eventually have to do because with the wrong point layout, life can become very miserable, in a square-peg round-hole sort of way. For example, forcing a diagonal crease down a square grid can get ugly very quickly.

Landmarking to Plan a Point Layout

You should plan to look at all of the different shapes and creasing that the mouth will have to do (landmark them), comparing all of the different shapes and planning the point layout of the model in the way that best compromises for all the shapes. That sounds like a lot of brain- and legwork, so it's very lucky for us that the way we humans move our faces and the way we crease is extremely efficient. Every expression on the mouth needs pretty much the same point layout, so compromise isn't even a worry. The smile crease is the same crease we'll see in a sneer or scowl; there's just different emphasis in different places. The crease (and bumps) in a frown appear on the same area of skin as the smile, but the whole area moves down instead of up. All expressions share the same features; they just use them in different ways.

The Main Crease of the Mouth Area

The area of skin where creases occur on most people is on a curved track between a point about a centimeter (or a little less than half an inch for all you people still using that old imperial system) off of the side of the mouth and continues up to where the top/side of the nostril meets the face, as in Figure 3.6. I've mapped out a matching grid with the shaded line illustrating where the crease skin is. I went over the top of the nostril, to put emphasis on the skin behind it, since that's what we're looking at.

If you look extremely closely in a mirror, and if you're over 15 years old or so, you should be able to make out a faint line on your face along this darkened one I've pointed out, even when you're not expressing. That's the crease, or more accurately, what becomes the crease. That's the one that creases in your smile, scrunches up in a scowl, and frames the outside of a frown. It's also the very same line that will eventually frame the front of your jowls when you get older. The fact that it gets creased in every single emotion is part of the reason that happens!

The Same Crease Does Different Things

Here, I'd like to point out the different ways that one crease, the one that appears in smiles and frowns and sneers, behaves and moves in those positions.

Smile In a smile, this area pulls up and out, much like the simplistic *impression* we get from a smile, but you can see that we get that motion from the area immediately surrounding the mouth, not the lips. The mouth area *moves* into this shape like curtains drawn open on a stage or classic drapes in a window, as illustrated in Figure 3.7.

You'll notice, too, that into and out of the crease from top and bottom, the skin bends into the apex; it's not a straight line or curve. That tightest point is approximately where the muscles that create the smile are anchored most firmly, so they get pulled the farthest and crease the most. This is how a smile looks on my face, and this is the most *common* shape type for smile creases, but it's not the rule.

> Different people do crease differently, so if some of this doesn't *exactly* match your own face, or the face of the person you use as reference, don't be too distracted. It's a detail; for the most part, all of this still holds very close to correct. The amount of information I'm trying to communicate in this book dictates that I'm going to have to generalize here and there, so I'm going with the most common shapes and creases. In Chapter 5, "Constructing a Mouth and Nose," and in Chapter 6, where I talk more about modeling and key shapes, the important aspect of a shape such as a smile pull away from the specific shapes *I* build, leaving you to model the shapes *you* want to see.

Figure 3.6
Default crease layout
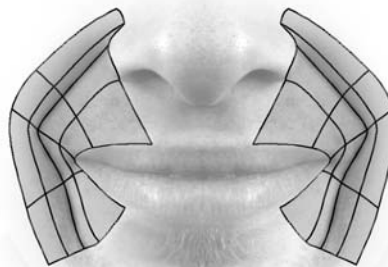
Figure 3.7
Smile crease layout
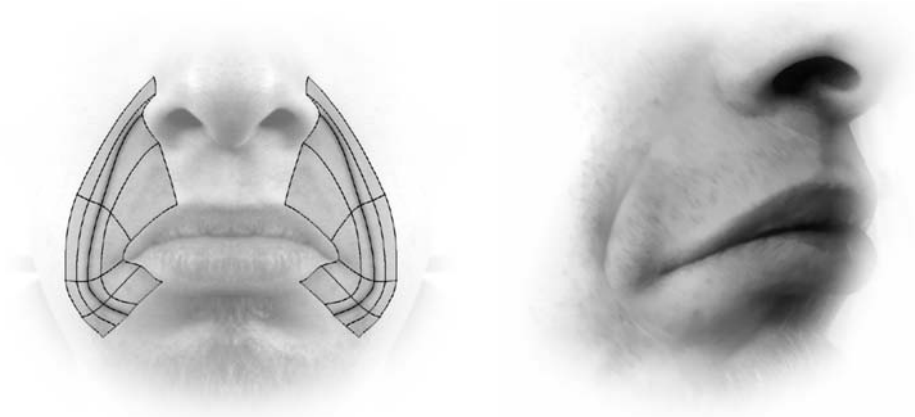
Frown In Figure 3.8, I've tracked the grid model over a picture of a frown. Of the three mouth shapes discussed here, the crease is the least apparent in the frown, so in the second image of Figure 3.8, the crease is shown from a second view. Once again, you'll notice that the row that was in the apex of the smile crease is at the base of the frown. You'll also notice that the line that is darkened, the center of creasing, travels to exactly where the crease occurs. That is always the case, and a good thing for us, too; that line goes to the crease, wherever it is, period. Knowing that makes our job building shapes less ambiguous.

Scowl/Sneer In Figure 3.9, we've got a scowl, or sneer. This one is interesting because it shares many things in common with both the smile and the frown. The look of the mouth—the lips themselves—is very much like that of the frown, only shifted vertically

upward. The crease, as always, is shared; it's as deep as in the smile, but the tapers are reversed. What I mean by that is that in the smile, the crease goes from the nostril side to the area surrounding the mouth and down from there toward the chin. In that shape, the focal point of the crease, the deepest part, is where the crease changes direction. In the scowl, the focal point of the crease is right next to the nose, and the crease then tapers down to where the smile crease changed direction.
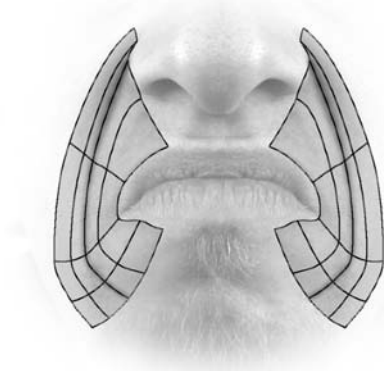
The area where the crease changes direction is easiest visualized as drapery. When drapes are pulled back, they have a very distinctive shape. The point at which the drapes are tied and the curve of the hanging drapes changes abruptly is what I'm referring to as the deepest part of the crease.

Where Is the Crease Most Intense?

The scowl crease as compared to a smile crease opens up another whole world of detail. To simply *have* a crease is a step in the right direction. The *right* crease with the *right* focal point is another, more challenging step to take. In Figure 3.10, I've shown the mouth crease for your viewing pleasure. I've got the depth/intensity of the crease shown by width and darkness. The darker and wider, the more intense the crease. As it thins, it tapers back to a smoother, flatter face. You can see that they are very similar but completely opposite.

The smile has its main focal point out to the side of the mouth, while the sneer is most intense behind the nostril. This difference is quite important.

Even the Big Boys Sometimes Get It Wrong

I've actually seen this mouth-crease detail missed in big-budget feature films. Human characters indeed have the detail of a crease when they smile, but the distribution of the crease is *even* all the way down from nose to mouth. The overall shape is correct, but the intensities of the creases are, as I said, even. To some animators who know that the creases have a lot to do with expression, it seems obvious why many expressions get a little confused. Whenever a human character smiles, it looks awkward or forced, or as if there is some undertone that isn't supposed to be there. There is always an element of sneer in the happiness. It hurts the facial performances in a subtle but, I think, important way.

Figure 3.10
Smile and scowl crease intensities

Creasing Applied to Each Shape

The creasing in the mouth is absolutely full of detail and idiosyncrasy, and I can't cover it all at once and expect you to remember it. Each mouth shape we model in the book will have its own important crease information right along with other aspects that get flushed out; I just wanted to make sure you were getting a feel for how important and different the information can be.

The brows, while "creasy" in a lot of the same ways, have some of their own unique fun.

Landmarking Brow Creases

The mouth's main crease is most visible on the smile, which is very close to (and in some setups *is*) the Wide shape. That's right, the same Wide of Wide/Narrow fame. The creases on the brows are very similar in that they occur on the Up/Down and in the Squeeze. Yes, these concepts are all related—you've just got to wait a little bit for all the loose ends we've frayed to tie themselves back together again.

Brows Up/Raise

The easiest, and therefore first, brow position to examine for creasing is brows Up, or Raise. Figure 3.11 is an image of brows raised. Let's repeat my favorite phrase: It's not necessarily wrong. The problem with Figure 3.11 is that the brows are raised, yes, but they don't give the impression "I'm raised as far as I go." Just as in the case with the mouth, raising them further won't solve that problem, whereas the simple addition of creases, as in Figure 3.12, shows the brows looking more taxed, more extreme. The creases tell me that they're being pushed pretty far out of their default position.

Figure 3.11
Raised brows, no creasing

Figure 3.12
Raised brows, with creasing

The brows—specifically the eyebrow *hair*—haven't moved between Figures 3.11 and 3.12. This may seem like a rehash of the mouth concepts, and in some ways it is, but they're very different in how their details work. When dealing with the mouth, the distraction and misplaced stuff had to do with the lips, whereas on the brows it's the eyebrow hair that tries to steal your attention. This is the part of the brows that gets overmanipulated generally. What's extra unfortunate about that is that the brows are situated over the border of the eye socket and the forehead. That's a bone. One problem in CG with moving brows up for extra emphasis is that typically the ridge, the front of the skull, gets melted away unless you are using advanced deformers. In the brows' default position, the area of mesh between the eyelids and the brow ridge is fairly well connected by the geometry, meaning that when the brows need to move up more than a little bit, the forehead gets shrunken and the eye sockets grow taller. That's not normal. As I said, that area of skin is sitting on bone, and bone can't do that. In real life, the skin on the brows travels over the surface of the skull, but re-creating that effect with simple blend shapes can be hard (we do it in Chapter 9, "Eye and Brow Keys"). This is another great reason to put the emphasis on the creasing rather than just making the brows go higher.

The Shape of Brow Creases

Brow creases on most people appear like waves. There are layers, not all perfectly lined up but generally moving together with peaks just outside and over the eyes. There are usually a pair of smaller creases that don't continue all the way across the brows but live just above the arc in the brows. To show how important those are, look at the images in Figures 3.13 and 3.14. One is simply raised brows and the other is a scared or concerned shape. The brow hair is obviously different, as the skin the hair is growing out of has moved, but look closely at those creases above the brow peaks.

In the scared image, the creases are not nearly as pronounced, and their emphasis is toward the center of the forehead. In the raised image, you're getting the information that the raise is happening pretty evenly, across the brow, or you could even look at it thinking that the bulk of the upward force is coming from above the brow peaks. These creases are telling you *more* about the expression than the hair on the brow ridge.

Brows Down/Squeeze

With the brows' Down shape, you've really got a misnomer. We talked briefly in Chapter 2 about how trying to drop your brows doesn't really drop them. They move downward a bit, but it's more of a side effect of squeezing them. Working forward with that, there are two major kinds of creasing that occur from squeezing the brows. There's the classic vertical crease(s), as in Figure 3.15, and there's the harder "turbulence" style creasing that's more like bunching than creasing; it's more of an anti-crease, as in Figure 3.16.

Figure 3.13

Wavelike brow creases (raised)

Figure 3.14

Scared brows

Figure 3.15
Squeezed brows, vertical creases

Figure 3.16
Squeezed brows, bunching creases

In simpler setups and characters, 10 out of 10 times I'll recommend you go with the first, the vertical lines; they communicate more clearly at a glance, and it's an easy shape to build, both in model point layout and in the key shape. If you really want to make a character realistic, the bunching, as in Figure 3.16, is going to go a lot further to impress and convince an audience of the character's emotions. As a shape to build, though, it's a bad one. Most people's brows are some unique combination of the two.

> I'm firmly convinced you could do forehead furrow IDs just as you can fingerprints and retinal scans!

The bunching brow shape is convincing because it's hard to put a finger on it. It's nothing as overt as the creases in a brow raise or the fold in a smile, but just like those others, having it will sell the pose better than brows so low they cut into the eyes' silhouette, which brings us ever so quickly to our next topic: cutting into the eyes' silhouette.

Landmarking the Tilt of the Head

If you look back to the two images in Figure 2.1, in the first section of Chapter 2, you should see that I cheated. Brows Up and Down, it was called. Reading the topic heading for this section and looking at those pictures, it should be pretty obvious exactly *how* I cheated, too. Do you have it? That's right: the tilt of the head, among other things, can influence how high or low the brows look. This all happens based on their perceived distance from the eyes. The closer to the eyes the brows appear, the lower they look. In this, the final section in the introduction to landmarking, I'm going to talk a lot about how a change in perspective can seemingly move features of the face. In Figure 3.17 you can see how easily this illusion was created.
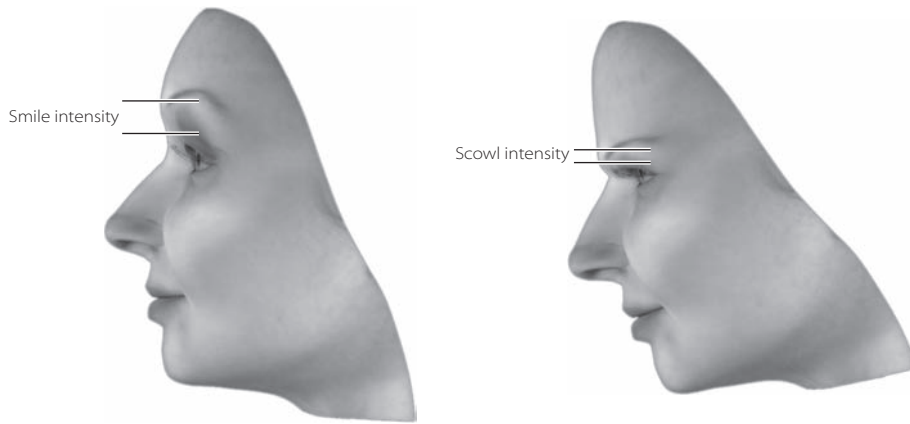
Figure 3.17

**Side view of
Figure 2.1**

Smile intensity

Scowl intensity

Perspective and the manipulation of perspective is something we all do with our heads for some strange reason. When you're mad, you probably express it, in one way, by tilting your head forward. This isn't because it's heavy or you're trying to point at people with your forehead, it's just a thing we do. In fact, if you have a mirror handy, simply look into it, maintain your eye contact with yourself and tilt your head forward. You look pretty angry, don't you? No expression changed in any way you'd expect, no facial muscles were flexed, but you look angry, so your expression did indeed change.

Here's another fun one: Smile. In a regular relaxed manner, smile. Now, again, maintain your self-loving gaze and tilt your head forward. Now you look quite insane or devious. Tilt that back and forth. Happy, crazy, happy, crazy, happy, crazy! Okay, stop. The point I'm making here is that, much like creases, another set of landmarks is distances. In this case, the most important distance relationship in expression is the distance between your eyes and brows. When you manipulate that distance through perspective, you manipulate the expression.

Every Expression Has a Tilt

Every expression has its "home tilt." There is going to be a way to hold the head that will emphasize a particular expression. That may seem like a fun thing to know and be able to work with, but once you start thinking about it, let me tell you, it becomes an obsession. Since there's usually *a* home tilt, there's usually an infinite number of *wrong* ways to tilt the head, and it's easy to get wrapped up in that.

In the case of creasing, there could most definitely be a stylistic choice not to include creases on a model and instead emphasize the shapes themselves in a different, more cartoony way, but this concept of the tilt of the head carries through all possible styles, from hyperrealistic all the way to toon shaded demon babies. If your character *is* a head—like, say, a green eyeball of a monster like Mike Waszowski, or a fish like Nemo, or even a *car*—effectively, the *entire body* tilts as though it were just the head. This idea really does works for any style.

The Significance of Tilts

The head tilt is also a technique I use very often, if not always, to embellish sync—it draws the eyes' attention from the mouth. I noticed the significance of the head tilt for the first time while rewinding a videocassette of a live TV show. In every close-up I was noticing that people really move their heads a lot during regular talking. Sped up, it looked like they were going to snap their necks. It was scary. Simply traveling from start to end of a sentence usually requires a nod or two. Heck, every time people are agreeing with each other, they don't make one stoic nod at the end of the sentence or during the word *yes*—people nod their heads before, during, and after the sentence they hear and respond to positively.

The Benefits of More Animation on the Head

What's nice about tilting the head through dialogue is that it livens up other animation on the body. In pose-to-pose animation, a technique carried over from classical animation, characters hit major key poses in their performance for a scene and basically hold them. There may be smaller motions, such as the "swimming" of hands as a character searches for a word or settles into or anticipates out of the poses, but it's basically pose, hold, pose, hold. Another advantage to animating the head through the dialogue is that people are looking to the head and eyes anyway, and if you keep that area alive, the facial poses can hold a little longer and therefore come across stronger, and for the time-conscious animator, it can save some of the effort. And as I pointed out, all this head movement also draws attention from the mouth, because when it's not sitting still in one spot, it's not as easy to hyperanalyze. That may seem like a cop-out, but it's not. I go back to the notion that animating the characters' lungs for the sake of realism is silly. If there's anything you can do to make your life easier while still turning out good work, you should do it. Tilting the head is one of those things you can do to help yourself.

Musical Head Tilts

The main way I like to key the head-tilting through animation is musically. To better explain: I tend to repeat the sound back to myself, mimicking the actor's vocal performance, but with my mouth closed—I basically hum the line to myself. Yes, it's something I try not to do in public, but it works. Generally, the highs and lows in the tonal quality will translate very naturally to the head-tilting. High note, tilt the head up; low tone, tilt the head down. When the actor gets sing-songy, by hitting several kinds of sounds, high and low, in a sentence, so does the character. It's surprisingly effective and easy. In the last chapter, where together we'll work through some animation, you'll see this in action.

The tilt of the head doesn't get its own section beyond this introduction, but it does get brought up extremely often in other chapters, tutorials, and topics, so you need to be aware of it as a concept. Congratulations! You are officially one leg up on people who skipped this chapter or don't have this book! Now go rub it in their faces.

Animating and Modeling the Mouth

NOW *that you've been introduced to the two speech cycles, visimes, the two major brow movements, the effects of the upper and lower lids, and of course creasing and head tilting—whew!—it's time to devote closer attention to one topic at a time. With all that background, the stuff in the rest of the book will make more sense to you.*

Pushing aside everything that's not crucial to lip sync, I focus in this part on the mouth, in both modeling and animating technique. After you move through some animation tutorials and finesse your sync, you'll be able to build a mouth capable of doing all the things you understand it needs to do. Once that is done, there's nothing left to do with the mouth but build all the key shapes, preparing you for Chapter 12, "Interfaces for Your Faces," where we'll hook that baby up to an interface!

Visimes and Lip Sync Technique

Here we go, the first cut into the meat of the book. The big thing for you to keep in mind, and I'll try to stress it, is that while moving through this and the next few chapters, I want you to learn what is important and unimportant in sync. Pay close attention to the things I include and *don't* include as we progress; things left unmentioned aren't priorities for now.

Beginners and pros alike will very likely have a first reaction of thinking that this approach is too simplistic. In many ways, my technique *is* very simplistic, but you'll quickly see that it's merely the first layer of many. The concepts are easy, but sometimes the sound can make the application difficult. The sync animations come in waves that all merge together to provide a solid performance. In Chapter 1, "Learning the Basics of Lip Sync," you were exposed to phonemes, visimes, and some very basic technique in Wide/ Narrow cycles. Here, we're going to take all of that a step further with some practical applications, instruction, and, of course, more descriptions and imagery.

- **Identifying and breaking down visimes**

- **The best order of building sync**

- **Practice, practice, practice**

Sync: Wide/Narrow Grows Up

First off, as we get more into the specifics of my techniques, I must say this: it's subjective. If interpreting text into visuals was a science, every piece of lip sync out there would be bang-on and nothing would have any more or less style; it would just be "correct." What's more, you wouldn't be reading this book, and I'd have fallen in love with some other subject or have a killer paper route. There are programs that are getting much better at using sound to generate sync, but even there, in the best setups available, there is still something missing or way too much included compared to what you get out of a well-trained artist. Most automatic systems make a great demo, but you would never use the output in any real production. I think it will happen one day, just not yet. What follows is the way I do it. It's a way that works, it's a way that makes sense, and, I think, it's a way that looks great considering how little effort you have to put in.

So the relationship of the main cycles in speech between Wide/Narrow and Open/Closed is still going to remain the same; it's just going to grow up a little bit from here on in. Wide/Narrow is by far the most important part of most visimes, but it's not the whole deal. If you refer to the visime table in Chapter 1 (Table 1.1), you'll notice there are other things, like "taller" and "lower lip rolled in," included in visimes, and at this point, we need to start considering them. So, as we move on, understand that everything I said and you understood about Wide/Narrow and Open/Closed in Chapter 1 is still the same. It's just that the Wide/Narrow cycle has evolved and merged into the greater whole of visimes.

Remember also as you read on that although they are both important and come together to create the look of speech, Wide/Narrow (now visimes), and Open/Closed do not get thought of at the same time in animation. By breaking them apart, we can focus on each of them more intensely. The whole look of speech is the result of these two cycles intertwining, and thinking of them together makes the process much slower and more complicated than considering them separately. As separate entities, they are easier to teach, easier to understand, and speedier to work with.

Visimes vs. Sounds

So I've talked about how visimes aren't whole shapes, they are just parts of shapes. We will use a similar approach throughout the book: We will build parts of shapes to facilitate constructing more flexible and precise whole shapes and set up interfaces that parallel the simpler thinking and analysis of visimes.

Since the visimes are components, not whole shapes, each can have multiple appearances, and that's why I shied away from showing picture-to-visime comparisons too heavily in Chapter 1—it's a little too ethereal for an introductory chapter. For all the talking I can do to describe shapes, the best thing is just to show you. Sometimes shapes have width attributes, sometimes they don't; sometimes they have Open/Closed values, sometimes they don't. When working with varying levels of rigs, all you can do is match the vital

components of each shape as it comes up in the sound as best as you can with what you have. If your face doesn't have lips-rolling-in shapes and you want to say B, just close the mouth. If you want to say F, just bare some upper teeth, or even just open the mouth. It's the best you can do with what you have, so don't dwell on it—keep moving on to the next shape in the animation. Rarely will an audience stop believing your character over something like a fudged F; it's not important to the plot. The best thing you can do is give a good impression of the sounds.

The Visimes

The shape sets you'll have after getting through a few more chapters will include the shapes pictured in Figure 4.1.

The Smile is basically your Wide, though it obviously pulls double duty as a smile. I'll often refer to Upper Lip Down and Lower Lip Up as the "lips-rolling-in" keys, because they do that more than they move up and down.

Figure 4.1

The nine shapes we'll use to create all of the visimes

Smile   Narrow   Frown

Upper Lip Up   Upper Lip Down   Lower Lip Up

Lower Lip Down   Tongue Up   Tongue Out

Using combinations of these shapes will create for us the visimes I've talked about.

B / M / P / Closed This shape has many, many, many forms, as you can see in Figure 4.2. It can be a Smile, as long as the lips are closed. It can also be a Narrow, or Frown, again, as long as the lips are closed. It all comes down to one simple rule: the lips must be closed. In most setups there are shapes we'll use to roll the lips in, so if it's needed, the shape can be even more than just the lips meeting; it can be the lips pulling in, which is very effective for the stronger sounds linked to this visime. This sound can be keyed in either the first or the second pass, but it can't be ignored, ever.

EE / Wide The terms EE and Wide are interchangeable. By definition, this shape is really only the width, but in practice it is almost always going to be accompanied by some baring of teeth and/or Open, as shown in Figure 4.3. A closed smile, that can be defined as a Closed shape, is also a Wide. The way that visimes are just pieces of shapes should be starting to fall into place for you now. Seeing that visimes are not all exclusive, they can be paired. A closed smile is both a Wide and a Closed visime.

F / V This has varying definitions based on your key set. Look at Figure 4.4 for some examples. At the lowest end, without a full set of keys for lips, it can be represented with semi-Closed. With the simple key set, as you'll read about in Chapters 5 ("Constructing a Mouth and Nose") and 12 ("Interfaces for Your Faces"), the upper lip can be pulled up to show some upper teeth and the jaw closed beyond Closed (using a value of less than 0 for that shape, something our slider controls will accommodate). For F in the full key sets, the upper lip pulls up to show the upper teeth and the lower lip rolls into the mouth for the upper teeth to press against. There is no width definition for this shape whatsoever. It can be Narrow or Wide.

Figure 4.2

The different forms of Closed
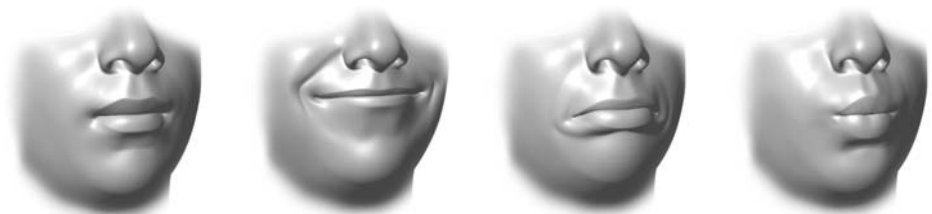
Figure 4.3

The different forms of Wide
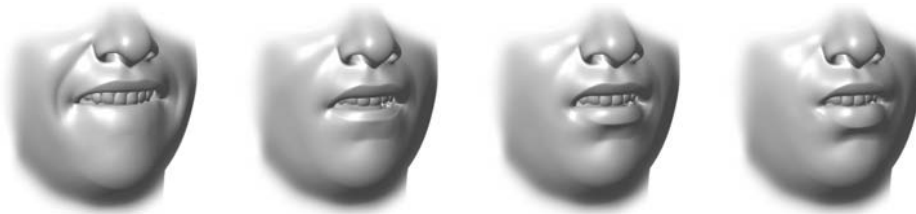
OO / Narrow OO and Narrow are interchangeable words as I use them. This shape is definitely tied to width; it is the Narrow half of the Wide/Narrow pair. Smiles and frowns don't mix very well with a Narrow, or pucker-type, shape in real life or in CGI, so this shape, although sometimes pictured with some expressions, is usually pretty much just the way it is. Stated differently, the Narrow (Figure 4.5) is the closest thing to an absolute shape as exists for visimes. Sounds like OH and AW are just an OO/Narrow shape with a little less potency and some Open/Closed mixed in. It's important to remember, though, that they are not their own shape; they are derivative of Narrow and Open and in animating should be thought of in just that way.

Figure 4.5

The Narrow shape

IH / T / S Relative shapes are fun. They make you think harder! IH and T/S are the same (after all, by definition, they are both "wider"), but they are different enough in their sounds that I thought it might be too confusing to put them together in any visime lists. Since the shapes are relative, their look floats depending on their surroundings. Next to a Narrow, they move wider, which may not even be as wide as the default shape, also referred to as "rest." So even though they have Wider as an attribute, they can really, on a global scale, be Narrow. Figure 4.6 is two pairs of images showing IH/T/S *next to* other shapes, to help clarify this.
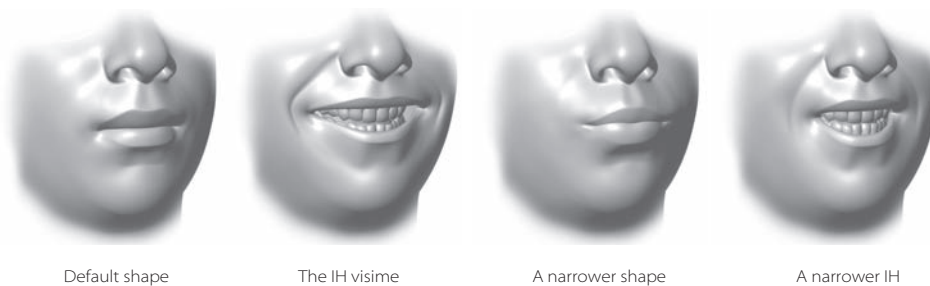
Figure 4.6

IH is relative, so here it is pictured next to the default shape and a Narrow shape for reference.

| Default shape | The IH visime | A narrower shape | A narrower IH |

Figure 4.7

R is also relative.

Default shape   The R visime   A wider shape   A wider R
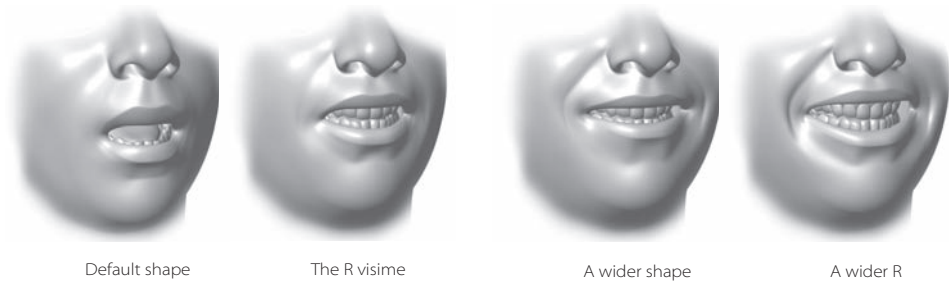
R   R, being another relative shape, is just the opposite of IH/T/S, this time narrower. In animation, you can almost pretend the character can't quite pronounce their Rs, and lean on Ws, like little kids sometimes do, leading you to OOs. When I was a kid, my sister used to "listen to the wadio." Sometimes, with an R sound, I'll also add in a little bit of height to the shape. This isn't always something that is necessary, or even desirable, but it's a good thought to have if the R sound in a scene isn't reading well. Another thing about R is that it involves the tongue being raised slightly. If you have a tongue, raise it; if not, ignore it—no one in the audience will even notice. An important note with R is that, really, it's wrong, and I know it's wrong. You can say R with your lips in any shape; it just usually benefits from the motions described. As with IH, I'll show the shapes in pairs (Figure 4.7) as being relative—there is no "correct" shape, only a shape correct in relation to another.

The Non-Visime Sounds

I'm not going to cover all sounds, because not all sounds are important. For anything not listed here, just slam it into the nearest-sounding thing that is identified. If there's more than one sound that it could be, just pick one; at worst, you may have to change it slightly as you tweak the scene. If a sound is that lost in the mix, it's probably insignificant to the visuals anyway. Remember, the visime list was condensed down to what it is by determining which sounds had necessary visual cues and letting all else drop by the wayside. These are some of those less cut-and-dried shapes. As you read these descriptions, try to create the sound yourself; you'll find yourself contorting your mouth into all sorts of shapes, proving for yourself these sounds' lack of importance as specific shapes.

The images in this section should *not* be used as direct reference when you lip-sync a scene. The reason that these are here is to help give you advice, and ideas, but they're not meant as a "This sound is this shape" reference, which is part of the reason they are not visimes. I don't like the idea of tying sounds to exact shapes; it's a potentially misleading instruction. Still, these are here for some help when you might be stuck. With each, I've provided "visime cheats," shapes whose criteria you might borrow to represent these non-visimes.

L / N (Visime Cheat: IH or R) L and N are primarily a function of the tongue, which, if you haven't noticed, I do not treat as important. The tongue can add a lot to a character, but it is time consuming and frequently over-animated, which explains my tendency to avoid using it too often. It's one of the things that, in my professional work establishing what characters will and will not have, I leave until the end, seeing if I can convince the powers-that-be that the tongue is not even necessary. For L and N, the mouth's shape can be here or there; the only qualification is that it is open at least slightly because both sounds require a flow of air (Figure 4.8 shows L). The cheat visime is really either direction, wider or narrower. It doesn't so much matter what happens as long as something happens to widen or narrow the mouth at least a little bit. As a result, there's not much in the way of important shapes to show, just the effect of the tongue.

Figure 4.8
The tongue up for L

D / SH / TH / NG / J (Soft G) / H (Visime Cheat: IH) SH, TH, and NG can be treated almost exactly the same as IH, T, and S. The tongue gets involved in TH by setting itself between the teeth (see its separate demonstration in Figure 4.9), but that isn't necessary for the impression of a TH. The overall impression is a Wider shape for all these cases. You'll notice that when you say it aloud, NG (or ING, as in *surfing*) is exactly the same *sound* as IH but with a little NG sound in the throat at the end, so it looks just like IH!

AW / OH / UH (Visime Cheat: Narrow + Open) These are basically combinations in varying amounts of Open and Narrow (each is depicted in Figure 4.10). Usually the way these sounds are animated is by keying the visimes around them and then opening the jaw for the syllable. The transition of width overlaid with the opening of the mouth usually creates the shape for you automatically.

EH / AH / UH (Visime Cheat: Wide + Open) These are the siblings to AW, OH, and UH; they are mouth-open shapes (Figure 4.11) but with a mix of Wide instead of a mix of Narrow involved. You'll notice that UH is found in both the Narrow + Open and Wide + Open groups; it can really go either way depending on the context.

SH, NG, T, J, H

TH
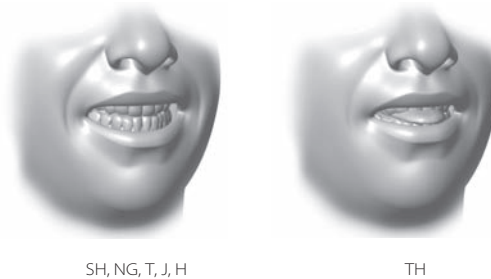
Figure 4.9
These sibilants have an overall impression of "wider."

AW

OH

UH
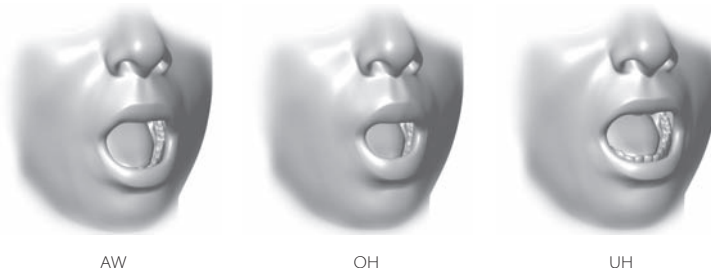
Figure 4.10
Some narrow, open vowels

Figure 4.11

Some wide, open vowels

EH   AH   UH
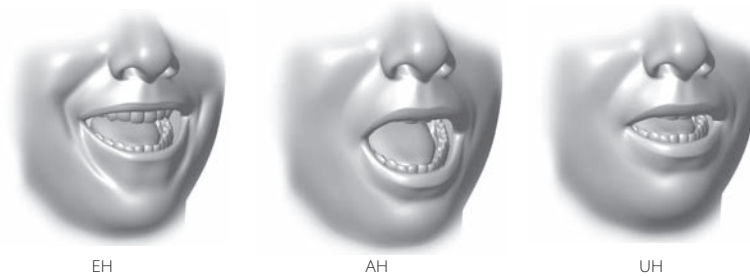
Hard G / K There is absolutely, under no circumstance or twist of fate, any situation that calls for these sounds to have a specific shape. There may be situations where a character really hits the sound, but the mouth will do nothing except possibly flex the position it's already in, or push it a little further, be that Narrower or Wider. There's really just throat involved in these sounds.

Breaking Sounds Down

What we've just gone through are the pieces used to make up speech—visimes—and ways to think of the sounds that aren't visimes. The next thing to learn about has to be how to take the sounds you hear and turn them into those pieces.

As much as there are rules and ideas to teach about visimes and sounds, there really aren't rules you can tie to *text*, because language is fluid, and no two people say the same word the same way, and often the same person doesn't say the same word the same way twice. All we've got are guidelines. Following are the ways I would take words and break down their sounds, as if they were spoken in a fairly "normal" way. With some example sounds that I have (which we'll use later on), I intentionally had the actors speak with accents or in heavy character style so that this process of breaking down the sounds, not the text, would be more clearly understood.

Spelling, Respelling, and S-P-EH-L-IH-NG

You could break down the word *spelling* into components as listed previously—as S-P-EH-L-IH-NG, P-EH-L-IH, S-P-EH-EE... and there really are a number of other ways to do it, too. When I say breaking the word down, I'm talking about saying it aloud and respelling, or at least re-thinking, it in a way that is represented with simpler components, some of which are visimes. Simpler is better. You want to look for the minimum that will be convincing and then work the animation up to a higher level of detail instead of including everything and weeding out unnecessary animation.

There's no advantage to respelling words sound for sound with EEs and IHs and OOs. If you remember back to Chapter 1, where we saw that the word *pebble* is visually interchangeable with *mama* or *papa*, that's what I'm talking about here. In the word *spelling*, if

the sound previous to the start of the word is anything *but* Closed, we can drop the S completely. S just needs to bare a little teeth or be a little Wide—almost anything covers that *when it's next to a Closed shape.*

If the S is the start of a sentence, or happens after a long silence, it needs some height and width. Next, the P in *spelling* is a visime, so we know we have to address it and how, with the mouth closed. For the end of the word, there are a number of ways to think of it, but in all iterations, it's an EE, IH, or NG, something that boils down to Wide, or Wider. Spelling can easily become S-P-EH-EE. In motion, in a sentence, that's all you'll need, at least as far as visimes go. EH isn't a visime, it's a function of the Open mouth/jaw, so you can see we're really only dealing with S, Wide/Tall; then P, Closed; and EE, Wide. In regard to the dropped L sound, it's still in my mind, it's just not important to my initial breakdown of the sounds. There is a layering approach to sync, as I teach it, and the tongue is done in later stages.

With practice, you'll see that this modified spelling will help you think less about the text and more about the sound in your specific performance, something that will loosen up your sync and provide you with less-rigid guidelines to work within. It's the way that I think it and do it, and it's why I'm no fan of phoneme-based sync. This is much easier and more attuned to the performance than to the text. S-P-EH-EE is a much easier sequence of shapes to tackle than spĕlĭŋ, I'd say. Following are some words and a middle stage of breakdown so you can better see how they got where they ended up.

Word	First Pass	Final Breakdown
Fountain	F-AH-OO-N-T-IH-N	F-AH-OO-IH
photograph	F-OH-T-OH-R-AH-F	F-OH-T-AH-F
Shepherd	SH-EH-P-R-D	SH-EH-P-R
stop staring	S-T-OH-P S-T-EH-R-NG	S-OH-P S-EH-R-IH

Funneling

Funneling is really two processes you'll use while working as I just described in the previous section. First, you can "funnel" non-visime sounds into visimes, such as Z to S and D to T, and second, you "funnel" when you reduce multiple visimes into one.

The reason I identify so few visimes, as I use the term in this book, is to make it so that you don't have to memorize every little specific combination of letters and sounds. You just learn, in your own work, to *funnel* the sounds you hear into their closest visime relative. By giving you only seven main visimes to look for, I'm trying to guide you into thinking about all sounds more simply and finding ways to mash other sounds into those seven.

If you write *literacy* as L-IH-T-EH-R-AH-S-EE, you're doing all right in converting regular text to pieces that look like mine, but not so great at using the process to its fullest potential. One thing to try is clumping sounds, funneling them, as I did in my previous examples. IH, T, and EH, the second through fourth sounds, are very similar, and the L is

of little importance visually, so quickly, in your own mind, think about whether you can cover them in one shape—something along the lines of Wider, or Wide—and represent it that way in your spelling. That would give you IH-R-AH-S-EE or EE-R-AH-S-EE. The next thing that jumps out is at the end of the word—the S is a Wider and the EE is a Wide. There's a good chance we could get away with IH-R-AH-EE. Look in the mirror and make up a sentence with the word *literacy* in it. At normal conversational speed, alternate the word *literacy* and the sounds "IH-R-AH-EE" as you repeat your sentence and see if IH-R-AH-EE holds up visually. On my end, in my mirror, it does just fine.

I recommend guessing how I'll break words down and then comparing your guess to what I've done. Look at the reasons and descriptions for what is different to see if there's something you maybe didn't think of. The more thought you put into the process at the beginning, the faster it becomes second nature.

The Best Order of Sync Operations

You know many of the steps, but now you'll learn the order to do them in, and why. I strongly recommend the order of hitting visimes first, then the Open/Closed, and then any advanced work, which I'll describe in the next section. The reason for that order is I like to get work done fast, or at least get very far very fast. Giving yourself a quick start, you'll have more time to spend on the finishing touches. In my experience, the last 10% usually takes 50% of the time, so I like to sprint when I start and give myself the most time for finesse as possible. Working in this order, and only having one goal at a time, you can defeat the tendency to get too deep into the process too early. The sync you have after working visimes, then Open/Closed, will by no means be finished, but it will be at the tuning stage fast, fast, fast.

I almost force myself to rush. Did I get the shape? Not quite the way I think I should have. Did I get it well enough? Yes. Move on. No love, no finesse, no babying of the material. It's all business to start with. All that art can come after you've laid down the basics. You have to trust yourself and know that you'll get to the details at a later time; for now, "no touchy!"

So the first part of the sync process is to work quickly through visimes and through Open/Closed. Oh, yeah, there's more to do, but let me show you how this much works before we push on.

Learn-While-Doing Sync: "Hey, buddy, I don't like your face"

The best way to learn is to do. So to demonstrate how you should sync—especially the order in which you should analyze sync—I'm going to show you how I do it. Before we use some real sound, let's explore what we'd do with a phrase, and what a nice one it is: "Hey buddy, I don't like your face." It's written to be followed along with any head or mouth, so you can proceed with just the Chapter 1 spline mouth or come back when you've got a more robust face to work with. I won't give frame numbers to work on, as

this is just text-based analysis—we're not as far as animation yet, but it's worth following in a scene for practice.

Following the recommended order, we will proceed with visimes and then with Open/Closed. Usually, this would be done over the entire scene, or at least in sentence-long chunks of a scene. For this example I'm going to treat each word like its own line. By shortening the return time on each word, you'll see more clearly why we can drop certain sounds in the visime stage, as we come back to pick them up with the Open/Closed.

In the written reductions of the words, I've cut out many "open mouth" sounds that I would usually leave in, to emphasize the different attention I give the two separate cycles. These sounds would usually stay in so that the text remains legible, but for the purposes of separating visimes from the product of Open/Closed, I've removed them. In later examples, they'll be left in. Also, I've gone through and shown a progression for the stages of my "S-P-EH-L-IH-NG," which will also not be the case in future examples; I'll usually just show the end result. Think of this as the place where I'm very explicit about all the stages and thought processes.

All that said, here's the process of breaking down "Hey buddy, I don't like your face" into visimes and Open/Closed:

hey (visimes) The order of the thought processes and the end result for visimes for this is H-EH-EE → IH-EH-EE → IH-EE. What better way to start than with a special case? H is not a visime, and in most situations, it is ignored. When it cannot be ignored—a decision made by trying, and seeing that it doesn't look good—we funnel it over to IH, Wider. To spell the word out in terms closer to visime-only would be IH-EH-EE. Since EH is mostly a function of the mouth Open, it's dropped and the visimes left are just IH-EE, almost like "hi." Since IH is relative, and EE is not, IH will be right around the default width, maybe slightly wider, and the EE will be Wide. The whole word just goes from somewhat Wide to Wider. This covers the Wide/Narrow portion of visimes, but there's also the added dimension of the lips' height. There are no lips-in sounds, like B, M, P, but there are IHs and EEs. Both can benefit from some added height, so I'll add in some height, at an even level throughout the word.

hey (Open/Closed) The sequence here is semi-Closed, Open, semi-Closed. Since there is a flow of air during the H sound, we need the mouth open slightly to begin with. The main sound comes through the middle of the word, so that's where the jaw is most Open, and then we almost close up for the end. Just as I've described, this is basically animating the Open to the syllables. Of note here is how breaking the EH out of the middle of the H-EH-EE may have seemed weird above in visimes, because it ignored the EH sound, which is important. By adding the jaw in, during where the EH occurs in the word, we've created the EH sound even though it was not explicitly considered in the visimes. EE + Open = EH. This is the way we can eliminate too much to think about during the visime pass; the pieces come together in later passes, such as the Open/Closed and finesse.

buddy (visimes) B-UH-D-EE → B-UH-T-EE → B-UH-EE → B-EE. The logic here goes through several stages. First, the D gets funneled over to a T (which itself is the same as IH), as it's the closest shape in a sound relationship. Then, since the T and EE are pretty much the same, with no really big need for distinction (an artistic judgment I made), the T goes away to leave the EE alone. From there I removed the UH, as it's more a function of the jaw. All we're left with is B and EE. The B is mainly a function of the jaw, but also, for the lips to meet, there is obviously a lip height issue, so the B stays in.

buddy (Open/Closed) Closed, Open, semi-Closed, semi-Open, semi-Closed. The starting Closed is actually the same finishing Closed from the previous word. This bounces through Open/Closed twice because there are two syllables. The motion is more subtle for the second half, I have concluded based on what looks good in my experience. In regular form, you might start with C, O, C, O, C and then reduce the second syllable in the finessing stage; I'm just getting a head start, knowing from experience what usually looks best.

I (visimes) This is AH-EE or UH-EE, which reduces to just EE. This brings us to something new. The last visime is Wide, and so is this one. This is a job for opposites. That's something we'd usually leave for the finessing stage, but I want to answer as many up-front questions in this example as possible. To keep the two sounds more clearly separate, I recommend having a slight movement narrower between the sounds to keep each differentiated, but that's the kind of detail I would work out later.

I (Open/Closed) Sequence: Closed, Open, Closed. As you're probably coming to expect, this is just an Open/Closed based on syllables and with the first Closed just piggybacking on the previous word's last Closed. This Open will help put back in the UH or AH we ignored in the visime stage. See how well the two steps work together?

don't (visimes) Funnel this as D-OH-OO-N-T → D-OH-OO-T → T-OH-OO-T → T-OO-OO-T → T-OO-T → OO-T. This is the first case where we're going to bridge across visimes in two words. As you can remove, or "funnel" visimes of the same type inside of a word, you can do the same across words. The divisions in the words and sounds is something that we create in our writing, but isn't really there in the sound. Since the D is moved over to a T and the T comes out of an EE (from I), we'll just drop it. Next, the OH isn't really a visime, but it is a lesser strength of OO, so we'll think of it that way. When you do that, you end up with two OOs next to each other and can drop one. The N isn't a necessary visual, so we'll just go straight to the T. All we're keying is a Narrow and then Wider.

don't (Open/Closed) This sequence is Closed, Open, Closed. Borrowing the first Closed from the end of I, this again is just representative of the syllable, and, with the Open happening as the mouth shape moves from Narrow to Wide, gives us our OH shape in the middle.

like (visimes) L-AH-EE-K → L-AH-EE → L-EE. L is a weird sound because it can't really be ignored, but it also has no specific look, besides the tongue, which we're not thinking about at this stage. Since L is sandwiched between two Wides—the T from the previous

word and the EE in this one—I'm going to knock it back to slightly narrower. The AH will get created through the opening of the mouth, so we ignore it, and the K is insignificant, so we're just left with L-EE.

like (Open/Closed) Closed, Open, Closed. At this point, there's not much more to say about it!

your (visimes) EE-OH-R → EE-R. The OH leading into the R is really leading to the same shape, so we'll drop it and let the Open/Closed pick it up. Basically, we have Wide, Narrower.

your (Open/Closed) Closed, Open, Closed. Syllable-tastic!

face (visimes) F-EH-EE-S → F-EE-S → F-EE. The F is a visime, so it's not going anywhere. The EH is composed of the motion from one visime to another plus the jaw, so we drop it here. The S is not really going to be any wider or less wide than the EE, so it can be ignored, too. We're left with F-EE.

face (Open/Closed) Closed, Open, Closed. Borrow the Closed from the last word, Open and Close over the duration of the word.

Finessing Sync

Once you've done the basic analysis of visimes and Open/Closed that I've already talked about, the following sections take you through completing lip sync as far as instruction can take you. The total process looks like this:

1. Identify visimes.
2. Identify Open/Closed.
3. Identify relative shapes between absolute ones.
4. Insert opposites and steps.

That last mile is always going to be up to you and practice!

Weighting the Rules

Everything is relative. The rules I've laid out as absolutes and relatives seem clearly defined, but even the absolutes like Wide and Narrow are relative. There really isn't a hard-and-fast guarantee of the intensity of a shape being perfect for a word. The shapes built for one character may read as wider than for another: 50% Wide on Tito may be equal to 75% Wide on Jermaine. That would mean that Jermaine would need to be animated at slider/control levels 25% more extreme than Tito.

That is one of many variables that enter into the mix; another is the location of a visime in a phrase or word. If you have five EEs in a row, you've got a bit of a problem, as the mouth will essentially sit in the same Wide shape while the jaw goes through its motions. In a situation like that, you may need to reduce the effects of some of the EEs so that you can "step" into and out of the more extreme EEs, even though they're all EEs.

Relatives between Absolutes

When a visime such as T, S, or R, which are all relative to their surroundings, comes up between two absolutes of the same function, there's a conflict of rules. A Wider between two Wides isn't necessarily Wider. For example, a Wider between two Narrows is easy—it's Wider. A Wider between two defaults (the width in the default pose) will be Wider, as in *Shasta*. The S and T would be wider than the As.

That same Wider between two Wides? Might not be wider. There will be situations where it will possibly even go slightly Narrower. A T/S between two EEs will either get smaller or stay the same. The word *cheesy* gives a good example: CH-EE-S-EE. The S is by definition wider, but between two EEs, it should be made narrower to make those EEs look wider. The S's relative rules can bend to make the stronger rules appear stronger.

Opposites

Once you start "weighting the rules," other new ideas become available. First, using or identifying *opposites* is when you make the decision to create a keyframe in the opposite direction to strengthen the look of those shapes around it. If you've got a long stretch of repeated Wides, opposites would be dropping in Narrower keys between them. Sometimes this happens in place of a visime; sometimes it will happen between them and you'll need to add keys.

Take the words *sheet metal*: SH-EE-T-M-EH-T-UH-L → EE-M-EH-T-UH. The M, part of B/M/P/Closed, has no real necessity in width. It can be a Smile, a Frown, or a Narrow—it just needs to be Closed. Since, in this case, it falls between an EE and an EH, which are both Wide, I'm going to choose to strengthen these Wides by narrowing the mouth during the M. This doesn't need to be a pucker, or even close to an OO, just narrower than the shapes surrounding it. That provides both surrounding shapes more identity as Wides. It's similar to the more global animation concept of anticipation, where you move left before you move right to communicate better with your audience what's happening.

Stepping

Stepping is a cousin of opposites. The same situations and criteria evoke both opposites and stepping; it's a judgment call which technique to use. In opposites, if you see several Wides in a row, you might start dropping in Narrower keys between them. With stepping, instead of having three Wides at 100% each and three Narrower shapes between them, you'd make the first Wide a weaker wide, the second EE/Wide more than that, and, finally, you'd make the third the most intense. All you're doing is weakening the first time a shape hits so that the next time it can have somewhere to go.

The word *believe* is a good example of stepping being very useful: B-EE-L-EE-V → B-EE-EE-V. If I were to knock out one of the two EEs here, the word would probably be too

"floaty" through the middle, usually the case when the same visime repeats over multiple syllables. Instead of making both EEs the same, I'd make the first maybe 40% and the second around 75%. The significance of that is that if I was just syncing the word *bee* all by itself, I would likely use more EE than 40%, but for *believe*, by cutting EE back for the first of two syllables I allowed the second to have an identity as an EE as well—I left myself more EE range to move toward.

> Use opposites and stepping only when necessary. This method of identifying and correcting repetition just isn't necessary all of the time. If certain words or phrases look good repeating away, there's no need to add more complexity; it's when they look broken or ugly that you can turn to this!

Sync Subtleties

This section outlines some remaining tidbits and doo-dads for sync that don't really fit nicely into any other sections. They are their own islands unto themselves, but useful information just the same.

Cap the Ends

At one time, this was a step I would explicitly include in the process, but I'll state it once here and be done with it. The first thing I do when I start any sync is to set keys on each and every control slider on the first and last frames of the scene. In very long scenes, I'll often key all sliders at the start and end of each phrase, just to make sure the face "cleans itself up" after each section. I recommend that step one in your sync be "capping" the ends of the scene and of phrases. It makes no real difference to the final product, but it makes maintenance of all your sliders less intense as you work.

Earlier Is Better

Light travels faster than sound. I don't really know if it's that, or if it's the way that human speech works and we need to get our mouth into position before we can make certain sounds, but visuals happening before sounds is better. If you sync, as you should, exactly to the sound on a frame-by-frame basis, your visuals will look late when played back with the sound. The amount to push your visuals ahead, or your sound back, can vary from one to five frames, but it's always going to look better, once you're done, to have the visuals happening very slightly ahead of the sound. On a decision-making level, if you have a shape you're trying to hit and the sound is occurring between two frames, favor the earlier one—that, too, usually looks better.

Percussive Sounds

Certain visimes, mostly the percussive ones like B, M, and P, need to be shaped and released earlier than the sound. In some cases, they even need to be held for a few frames so that it's very obvious that there was a hold and a release. The reason is that the sound is actually made in the release of the shape, not the creation of the shape. If a B, M, or P doesn't look quite right, just shuffle it up a couple of frames earlier and/or hold it for a few frames.

Oh Yeah, Almost Forgot the Tongue!

The mouth has a set of visimes, the tongue has its own. To include the tongue in the main visimes would push the level of complication out again, and that's not something I want to do. The tongue should be one of the last things you do in regard to sync. Its own set of visimes is more phonetic and looks like what's laid out here. Of very important note: Do not animate the tongue like a tail! Most animators, given the chance to do some overlapping animation, will jump all over it. If you do that with the tongue, it looks awful. Just…just don't be a statistic.

L, N, D, T, S, C, EE These will all involve the tongue moving up in the mouth.

TH This type of sound, and sometimes S and T sounds, will push the tongue forward in the mouth, sometimes even poking out between the teeth.

Wasn't that easy?

LOADING SOUND IN MAYA

Loading sound in Maya is a two-step process after you've loaded a scene with a head that's ready for lip-sync. In your scene, go to File → Import. Browse to the audio file you want to use, and then hit the Import button; your sound is now in your scene environment but not yet set up to play.

To hear the sound play back, right-click over the Timeline, and from the Sound submenu select the name of the sound file you just loaded.

If your playback settings are set to real time (Window → Settings/Preferences → Preferences → Timeline), play back the scene as you usually would and you'll hear the sound. To get a good approximation of the length of the sound, you should set the end time of your scene to accommodate the sound. Just look at the waveform; where it visually ends, the sound's done!

Sync Example 1: "What am I sayin' in here?"

On the companion CD, open the file `WhatAmISayingInHere.aif`. (If you've already modeled your head as detailed in following chapters, you are welcome to animate as we go; otherwise you can just read through and come back to do this later.) The sound clip says,

"What am I saying in here?" What we're going to do is simply listen for visimes, pick a frame for each, and move forward.

A couple of process tidbits about these examples. First, I'm working at 24 frames per second. Second, the little mouth graphics with each word are *not* what your mouth should look precisely like; they're icons, schematic representations of what the sounds would look like after completion. And third, the number of images for each word does not reflect anything except the number of images I felt I needed in order to show you the *motion*. If I were to cut out all but just the visimes, you might not get a sense of the animation, but sometimes the visimes are all that is necessary.

Identifying Visimes

On the Timeline and waveform (Figure 4.12), I've shown visimes using a line with a triangular head. This will represent any visime, be it Wide, Narrow, Tall, or otherwise. (A marker for each would get a little bit kooky.) This symbol will be reused throughout the book for showing where the visimes occur in the sound.
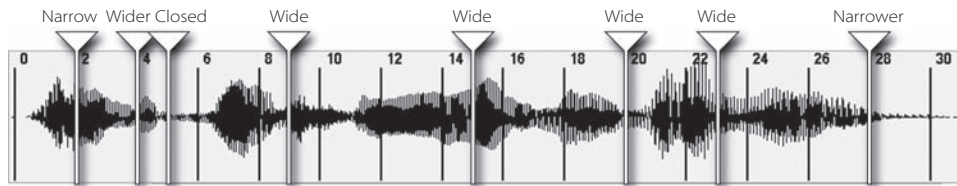
Figure 4.12
Sound waveform, with visime keys marked, for "What am I doin' in here?"

Following is my interpretation of the sounds.

If you are following along using a mouth or head setup, key no jaw motions yet. Key only Wide/Narrow and lip height shapes (lips).

what: OO-UH-T The first word, *what,* I would break down as OO-UH-T. Since UH gets nixed as a visime (it's a jaw movement), that leaves us with only two visimes to key for the word: OO and T—Narrow and Wider, respectively. Easy enough; let's go find them in the sound. After scrubbing through a few times, I've got them on frames 2 and 4.

Frame 1   Frame 2   Frame 3   Frame 4   Frame 5

"Scrubbing" refers to dragging the time slider of a program back and forth to hear the sound and watch the visuals forward or backward, fast or slow, depending on how fast you move the time slider. It is another way to play back audio or video with a flexible frame rate, without hitting the Play button. It is common practice, and highly recommended, to scrub frequently while lip-syncing.

am: AH-M AH, being mostly an Open sound, gets no attention yet, so all we have is lips closed, for M on frame 5. Be sure that any height given to the lips is removed, or even rolled in, and we'll come back to key the jaw in the Open/Closed pass. There is no specific width for any of the sounds in *am*.

Frame 4   Frame 5

I: UH-EE EE is a visime (Wide) and UH is not. A Wide key on frame 9 should do it.

Frame 6   Frame 7   Frame 8   Frame 9   Frame 10

saying: S-EH-IH-N N doesn't enter into the equation, but it's there for an easier read. If we just leave visimes, all we have is S, Wider, on frame 10, and something to cover both EH and IH, Wide, on frame 15.

Frame 10   Frame 11   Frame 12   Frame 13   Frame 14   Frame 15

in: IH-N IH is Wider and Taller, but since it's next to a proper Wide, in *saying,* it shouldn't go wider because that would diminish the previous Wide. In these situations, one option—and what we will do here—is to simply hold the shape. This is like stepping on a very small scale. On frame 20, use the same Wide value as on frame 15.

Frame 15   Frame 17   Frame 19   Frame 21
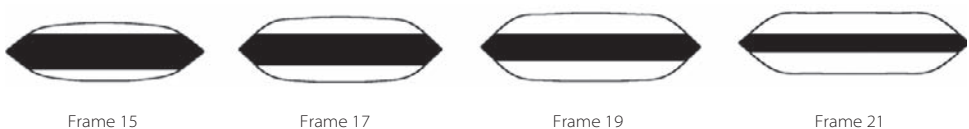
here: H-EE-R H isn't a visime, but it helps us read the word. We get an EE, Wider, on frame 23, and an R, Narrower, on frame 28.

| Frame 21 | Frame 23 | Frame 25 | Frame 27 | Frame 29 |
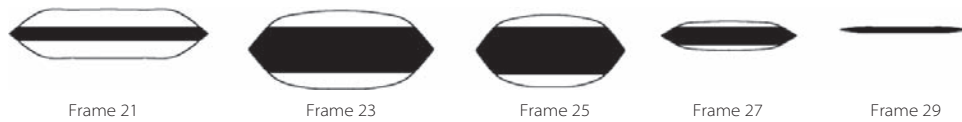
And there you have it—visimes, the first layer of sync in this method. If you *are* following along, you may think you've done something wrong, as this doesn't look right at all; to play it back looks quite mumbly. Yes, you are doing it right. It just takes the addition of the jaw before it looks like much. Now we're going to layer in the motion of the jaw.

Identifying Open/Closed

On the Timeline in Maya and waveform (Figure 4.13), I've denoted Closed keys with a flat-headed line and Open with a circular-headed line. Later, you will see ovular heads on some lines, which means semi-Open. These, like the triangular visime symbols, will be reused throughout the book. The Open/Closed keys get more detailed representation than the visimes because there are not as many positions to describe, and they're not as obtrusive.

Open/Closed are much easier to identify and animate than visimes, and it will help to make this mumbly mess take shape as a speaking mouth. Here, listen for the syllables. Simply listen for sounds that can only be made with the mouth open. In other words, just set Opens and Closeds based on syllables. In many cases, we need not set the Closed key at the start of the word if the previous word ends with a Closed, which most do. Not doubling up keys like that makes it easier to clean all this up in the end.

If you are following along using a mouth or head built and set up using this book, only set jaw keys in this section.

what: OO-UH-T Closed (frame 2), Open (frame 3), Closed (frame 4). Line up the Closeds with the OO and the T, and plant the Open in the middle. Remember, it's just syllables we're looking for, and each one gets an Open/Closed cycle.
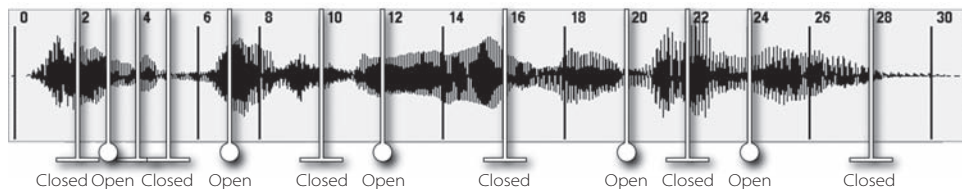
Figure 4.13
Waveform with Open/Closed keys

am: AH-M Open on the A, Closed on the M (frame 5) is the obvious choice, but since the A doesn't actually have a frame of its own, it shares a frame with the T. For now, I'll leave it Closed, as from the T, and come back to clean it up when I finesse the work.

I: UH-EE Following along by syllable, this one's Open on UH (frame 7) and Closed on EE (frame 10). There's nothing but basic work here.

saying: S-EH-IH-N Officially, the word *saying* has two syllables, but in this delivery (the only one that matters) the actor has said "sayin" rather quickly, in one long syllable, almost as if he had said "sain"—so it's a one-syllable word, and that's how I've broken it down. Open on frame 12, Closed on frame 16.

in: IH-N Open on the IH (frame 20), Closed on the N (frame 22); easy stuff.

here: H-EE-R Open through the EE (frame 24), Closed on the R (frame 28).

Now we're getting closer. You may have noticed that in not all cases did I put the syllable opening for a sound on the same frame as the visime for that sound. It reflects the nature of the two cycles—they are not necessarily going to be having all details occurring at the same time, and it's just another of the many reasons we attack visimes separately from Open/Closed.

Finessing

This is where we turn mostly to our function curves (otherwise known as FCurves). I like to use FCurves to see what can be done to our sync to make it better. To open the Graph Editor and see your curves, select the sliders/controls whose curves you want to see and select Window → Animation Editors → Graph Editor.

If you look at the Timeline in Figure 4.14, you can see I've added several "Narrower" marks with a V-shaped head. These marks will show shapes that are not explicitly their own visime but are visime-like additions for any number of reasons; mostly, those marks will reflect opposites and stepping.

At this stage, the work becomes less directional. You can move through in frame order, but I find that by looking at the whole, and attacking the most offensive pieces, I can quickly narrow down what I need to make the sync look good.

Figure 4.14

Waveform with sub-visimes marked
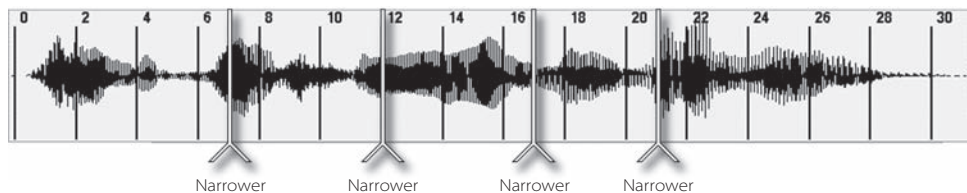
Inserting Opposites or Stepping

Looking at the animation and the Graph Editor, you may notice that after frame 2, we move wider and stay at EE/Wide all the way until the end of the sound, where we finally move narrower with the R in *here*. In animation, this means the mouth is Wide, and flapping its jaw during all of that time—not so good. As I explained with opposites, it can be as important to key *out* of shapes as it is to key into shapes themselves.

In this instance, we have five EEs, or Wides, in a row. To remedy this, we can just drop in opposites. In between the EEs, drop in Narrower keys, not full OOs—but you get the idea.

The frames I'll say need Narrower keys are 7, 12, 17, and 21. This I decided by picking the middle frame between the offending visimes, and if the decision involves favoring one frame or another —if the *middle* is actually between frames—picking the earlier one.

The Tongue

Since the tongue is incredibly simplistic, we can look at the phrase as a whole and just target the sounds that should be addressed. "What am I sayin' in here?" should have the tongue up on the T in *what*, the S and N in *sayin'*, and the N in *in*. Easy as pie. If you want to get really fancy, you can push it a little bit forward for the T and the S, but do it slightly early, so that the audience can see it. If you wait for the sound, the teeth are blocking the view!

What Bothers Me

Watching the scene as it is now, a few things still bother me, and that's where I'll focus my attention. It's always good practice to decide everything you like and don't like before just steaming ahead with fixes. It keeps you more on track. Here's a short list of my concerns right now:

- The first word, *what,* seems to start late.
- I don't like the "long" or "held" Closed between the T in *what* and the M in *am*.
- The two Ns on *sayin* and *in* don't need to close all the way, as they do.

With the first issue, the *what* seeming to start late, the solution is very simple once we look at our jaw (Open/Closed) curve, which is pictured in Figure 4.15.
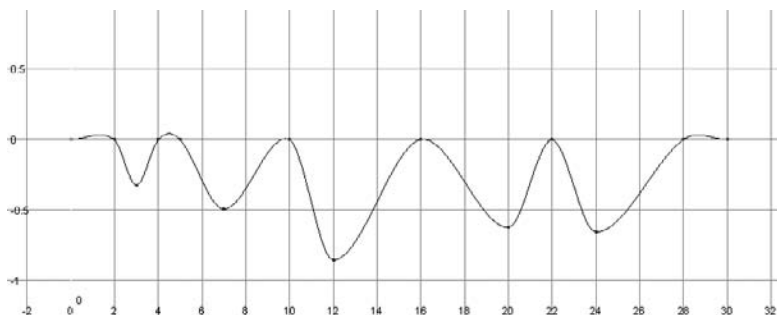
Figure 4.15

The Open/Closed FCurve before correcting

The jaw is held closed up until the OO in *what*. The simplest way to get a word to seem to start earlier is to open the mouth or move into the visime shape earlier. Since the Open is quite obviously held back until frame 3, I'd try first opening that earlier. What I would do here is delete the Closed key on frame 2. Your curve should look something similar to Figure 4.16. The word now seems to come out at the right time.

The next thing I didn't like was at the end of the same word. The T, held Closed next to the M, didn't look good to me. The Open/Closed seems to be the culprit again. In Figure 4.16, you should see that the Open is held for two frames. This is for the end of the syllable in *what* and the M in *am*. If you have to choose between dropping a jaw motion (Open/Closed) and a visime, favor the visime—lose the Open/Closed. Delete the Closed key for the T and look at your animation again. The curve should appear as it does in Figure 4.17.

The final big complaint I had with this was the closing up completely on the Ns in *sayin* and *in*. To look at the jaw curve and modify it is easy. Figure 4.18 shows the fix.

Figure 4.16

I deleted the Closed key at frame 2 to make the effect of the Open creep in sooner.
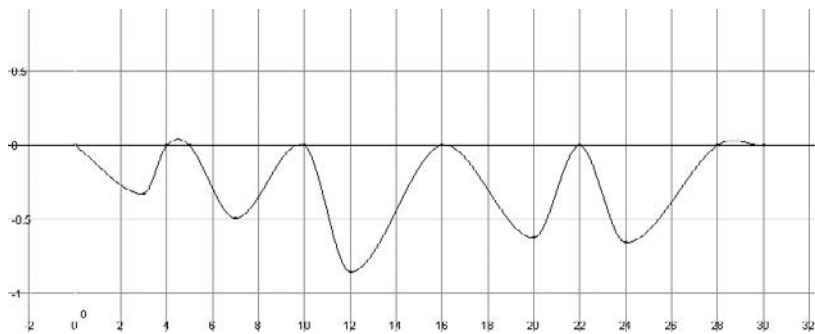
Figure 4.17

Another deleted key, at frame 4
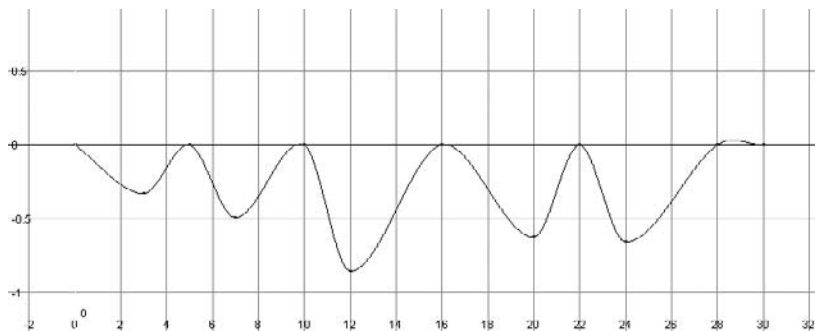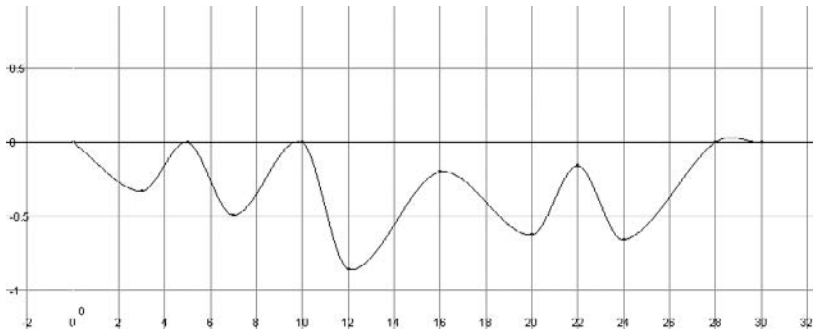
Moving the key on frame 16 down in the Graph Editor

This wraps up the distance I can take you with instruction as far as the basics of sync go. The rest is up to you and your own artist's eye. In Chapter 14, "A Shot in Production," I'll go through and do more of this detailed work, and discuss what I'm doing and why, but after the point we've reached here, it really is just your own flair that takes it to finished. Well, that and practice. There shouldn't be too much further to go before you're doing sync that's very impressive. Emotion comes into this, and getting all sorts of neat asymmetry and character into the work, but that gets covered in Part 4 of the book, where we bring all the pieces together in a scene. For now, let's keep practicing this sync thing.

Sync Example 2: "Was it boys?"

On the CD, find the sound file `WasItBoys.aif`, and I'll take you through another round of sync. Remember, we'll go through and get all the visimes, come back once for the Open/ Closed, and then wrap it all up with some final touches when we finesse it.

Identifying Visimes

The entire phrase reads "Was it boys?" (Figure 4.19 presents this sentence as a keyed waveform.) Let's get right to it!
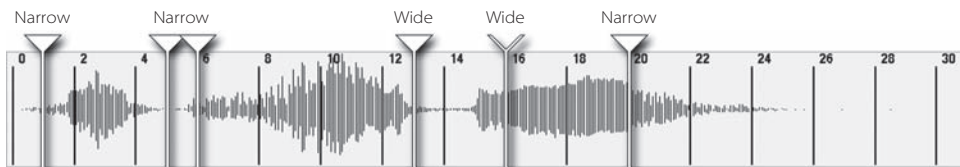
Figure 4.19

Waveform with visimes for "Was it boys?"

was: OO-UH-Z OO is a visime, so on frame 1, put a Narrow key. UH can be forgotten, as it will get attention in the next pass. Z gets "funneled" over to S, Wider, on frame 5.

| Frame 1 | Frame 2 | Frame 3 | Frame 4 | Frame 5 | Frame 6 |

it: IH-T The only visime here is the T (frame 8), which is Wider.

| Frame 5 | Frame 6 | Frame 7 | Frame 8 | Frame 9 |
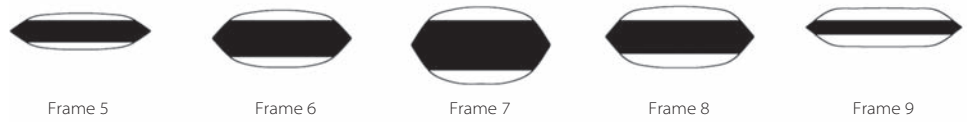
boys: B-OH-EE-Z B being a percussive sound means we'll have it happen early and hold for a frame, too. Since the B *sound* hits on frame 15, we're going to set the lips portion of the Closed (the lip height) on 13 and hold it for 14. That's two keys. OH is just a combination of Open and OO/Narrow, so it appears as Narrow, or like a weak OO would, on frame 17. EE is a visime and gets a key on 25. Z, which is basically S, is Wider, and that falls around frame 28.

| Frame 14 | Frame 16 | Frame 18 | Frame 20 | Frame 22 | Frame 24 | Frame 27 |

Okay, check your watch. That should have only taken a minute or two. Neat, huh?

Identifying Open/Closed

Let's quickly move forward with the Open/Closed, plotted in Figure 4.20.

was: OO-UH-Z Closed on the OO (frame 1), Open on the UH (frame 4), Closed again on the Z (frame 5).

it: IH-T Open for the IH (frame 7), Closed for the T (frame 9). Don't bother with a Closed at the head of this syllable, as it's usually best to piggyback on the previous word's last Closed if you can.
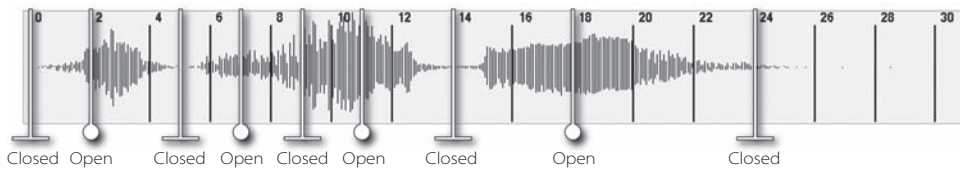
Waveform with Open/Closed for "Was it boys?"

boys: B-OH-EE-Z The B needs to be Closed (frame 14), to work in tandem with our visime pass, and the Z needs to be Closed (frame 27), as it caps the end of our word, but that's a big long space between those. We'll just drop in an Open key right in the middle (frame 20) and leave the tweaking for our next step. Gotta move!

Finessing

Before proceeding, watch your animation several times over. Look at the big picture, not the details. Find the things that bother you. If you've picked out some things you don't like, that's good; it gives you focus as you proceed. As I illustrated with *pebble* in Chapter 1, avoid frame-by-frame analysis: you'll end up fixing everything, and over-animating so that the mouth is popping into extremes too quickly. Let's continue through our process. I'll fix the things that bother me, and hopefully that will tackle most of your concerns, too.

Inserting Opposites or Stepping

Looking for ugly repeats, we'd have two in this phrase. With the two Wides on frames 5 and 8, we should drop in a Narrower key on frame 6, and between the two Wides on frames 25 and 28, we can add another Narrower key on 26 (Figure 4.21). In this case, the amount that you will want to key opposite, or Narrower, looks best when you do it very slightly—or just hold the previous key, otherwise known as stepping. That's what I meant when I said that the exact same situations can lead you to use opposites or stepping; it's always going to be an artistic decision as to which one to use.

The Tongue

In "Was it boys," the two S sounds are going to get some lift and maybe a little bit of "out" motion.
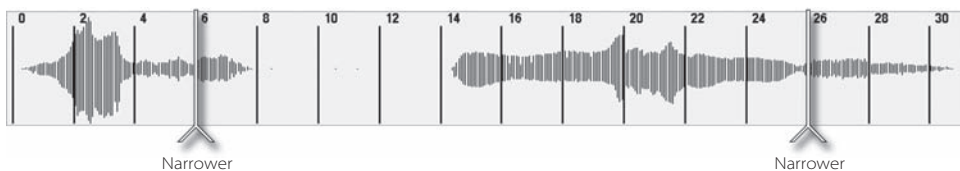
Waveform with sub-visimes for "Was it boys?"

What Bothers Me

If I were to make a list of complaints, watching the animation, they would be these:

- I don't particularly like any of the Closeds (except for the B) in the scene; they seem *too* closed.

- I really dislike the long Closed between frames 9 and 14.

- There's an odd bounce or jitter near the end between frames 25 and 30.

For the overall closed problem, there's a simple solution. Make the Closeds not quite so closed. Starting with the first instance that doesn't look good—the Closed on frame 5— the curve, shown in Figure 4.22, provides two options.

Option one is that we can simply pull the Closed to less than closed, but then we have a bit of a bounce that is unattractive. This is starting to look like a good place for some stepping again. I pulled the Open on frame 4 a little more closed and pulled the Closed key on frame 5 down toward it, to make it look like Figure 4.23.

There is no rule that you cannot revisit previous stages of your work. If you've already gone through an initial pass of opposites and stepping but think that another round of them will help a problem you see afterward, jump back into using those techniques!

Figure 4.22

The Open/Closed FCurve before correcting
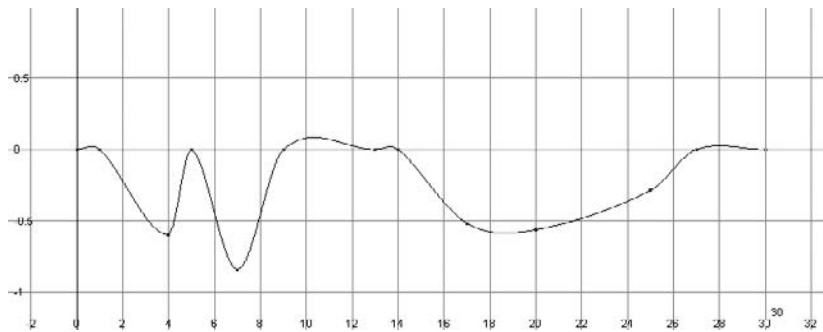
Figure 4.23

Here I stepped the curve on frames 4–5.
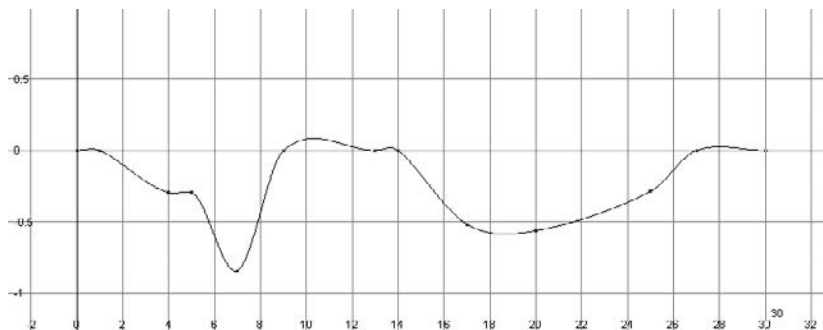
On to the second Closed, which is actually linked heavily with the second problem I listed. The long hold between 9 and 14 is ugly. The easiest way to make a hold that is held too long look better is to shorten it! I'm going to do that by moving the key on frame 9 to frame 10, as in Figure 4.24.

Last but not least in our Closed massacre, just go ahead and delete the Closed key on frame 27 (Figure 4.26), letting the mouth taper to Closed to the end of the scene.

The initial fix we set out to do here is to reduce the amount of Closed. Next, I'd hold the mouth Open a little bit until the B in boys, as shown in Figure 4.25.
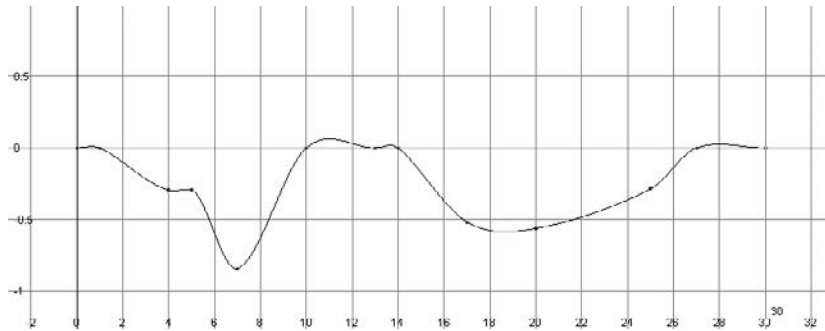
Figure 4.24
I moved the key from frame 9 to frame 10.
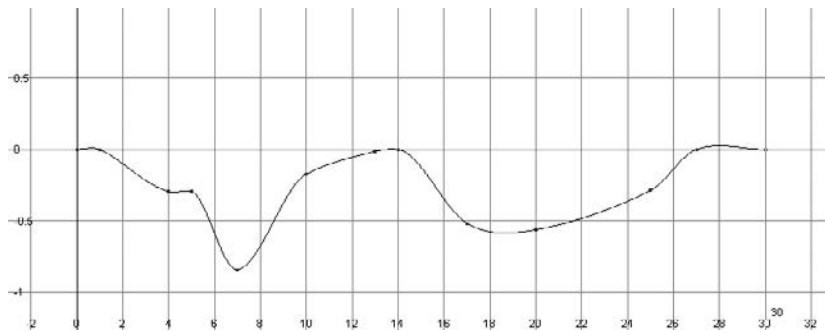
Figure 4.25
The key on frame 9 was pulled down.
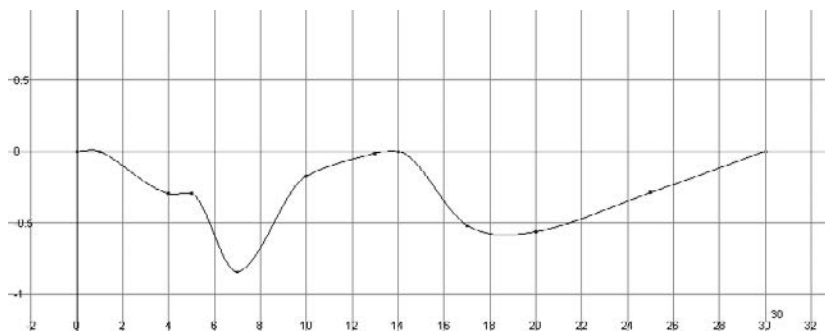
Figure 4.26
I deleted the key on frame 27.

We've addressed concerns one and two, so now we're left with the odd jitter at the end of the word *boys* (frames 25 to 30). As you've likely picked up on, my approach will be to look to the curves for the cause of the problem. In Figure 4.27, we've got both our Narrow/Wide and Open/Closed curves shown.

Looking at the curves from 25 to 30, it's obvious that it's the Wide/Narrow curve that is the delinquent. We actually inserted the key on 26 during our opposites pass, and then the mouth returns to default, as we keyed it to the end (or at least we should have as our first step—remember "Cap the ends?"). The result is a wobbly back and forth that's no good. There are two things we could do: delete some keys and smooth it, or try to step into the shape. Fewer keys is better, so my choice, and one that works, is to just delete the erroneous key and smooth what's left. Smooth curve = smooth motion. See Figure 4.28.

There you have it. We've now gone through two basic lip sync animations, which should get you off to a good start, but the expertise is going to come with practice. There will be more of the same in Chapter 14, "A Shot in Production" where I take you through whole scenes—and in that case, we'll go far beyond just sync—but if you'd like more immediate practice, there are many sound files available to experiment with on the CD. In fact, at this point, almost all the CD contents involving sync and sound are fair game; go play!

Figure 4.27

Looking at the curves can help pinpoint problems in animation, like the odd movement between frames 25 and 30.
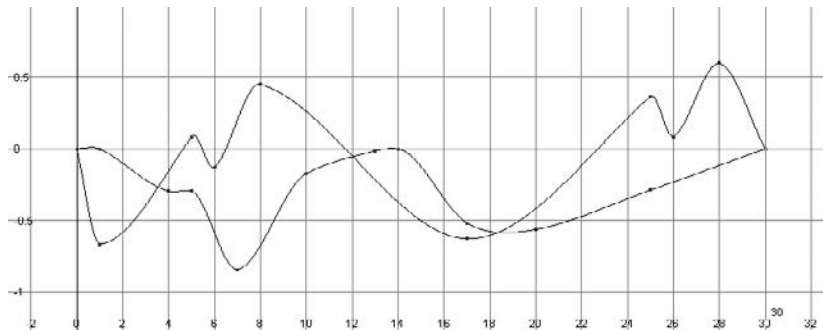
Figure 4.28

The errant key removed, making the area between 25 and 30 smoother.
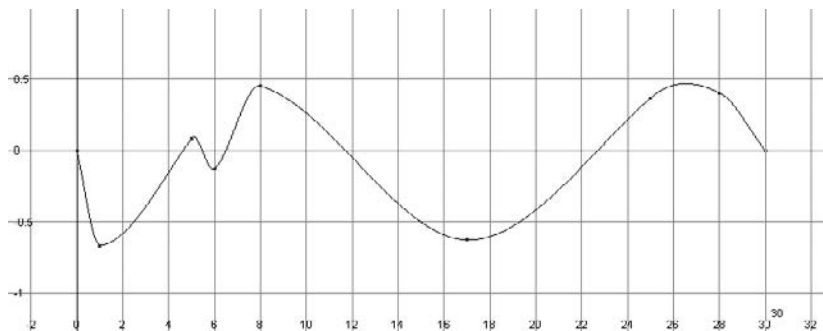
Constructing a Mouth and Nose

Now you may be wondering why, five chapters into the book—almost halfway through—we're taking our first look at modeling. You need to model before you can animate, right? True, but if you don't know what your model needs to do, it's likely not going to be very good at it.

With the simple spline mouth in Chapters 1 ("Learning the Basics of Lip Sync") and 4 ("Visimes and Lip Sync Technique"), there was something that worked well with little effort: mixing different shapes together at once. They cooperated. You could have both the Wide/Narrow and Closed at 100 percent and the mouth didn't look too bizarre. Since we're not going to build a shape for every phoneme, but simply the elements to create the major visimes, the shapes we build have to fit into some technical restrictions to make them cooperate just like the spline mouth. The shape of your character's mouth can be anything you like, but the point layout has to be capable of what you want the face to do. Having points arranged in a way that allows movement makes everything at every stage of the work easier.

- **The best edge flow**

- **Building the lips and surrounding mouth area**

- **Building the nose**

- **Building the teeth and tongue**

The Best Edge Flow

I can't very well just tell you to put a certain point in a certain place for all situations because every character and every face is different. The best point layout or "edge flow" isn't a road map I can draw for you; it is an idea. The best edge flow is always the one that, in wireframe, looks as if you can see your character's facial muscles.

> If you've read the first edition of this book, be aware that the construction techniques I'll show you have changed some from the first, so you'll see differing topologies in some of the visuals. However, all the exact same principles hold true in all of them.

Do you remember in Chapter 3 ("Facial Landmarking") where I talked about how the Smile, Frown, and Scowl all need the same points? That was referring to the edge flow, the layout of those points and their relationships to each other, *not* a specific shape. Building a model of my own face, I can just look at a picture or make a goofy face in the mirror and easily know where I've got to have the points; I can see where the creases are happening. With anything that's not human, or even a human character that's not derived from photos, you're going to need a good idea of how that character will smile, frown, and scowl before you even finish building the model in its default "bored" pose so that when you do get it contorting, it'll do it well. Luckily, the edge flow needs across all characters and emotions are pretty much the same.

As we proceed through this chapter, spend your effort maintaining the point layout, not necessarily the exact shapes you see in the pictures. The most important part of the edge flow in this chapter, and indeed this entire part of the face, is the edges running in and along the nasolabial fold, the edges that flow off the top of the nostril and down along the cheeks and side of the mouth that are involved in the bigger expressions like the smile, frown and scowl.

Modeling in Circles

You're going to be seeing a lot of circles, or at least edges that run in a largely parallel fashion *around* areas that move a lot. Everything to do with important point layout will consist of circles inside circles—the mouth, and later the eyes, all have point layouts that circle them. Not all meshes are going to be perfect circles—in fact, most won't—but the point layout, the way the points all connect together, should be very close to perfect circles. Figure 5.1 is a face model with bad point layout.

The reason that Figure 5.1's layout is wrong is that even though the point layout is clean, it doesn't readily facilitate good facial movement. Creasing in the right areas around

the lips and the nasolabial fold would be almost impossible as those areas are vertically gridded and do not follow a layout even vaguely similar to any expression or emotion. Figure 5.2 shows an example that I much prefer, and here's why: good point layout isn't simply to model *cleanly*, with evenly spaced edges; it is to model for movement. This model's edge flow is running along the areas that will crease, and so even at a glance you should be able to see that this will behave nicely in motion, to and from other poses.

Modeling for Movement

For the facial key shapes you will eventually build to move well, they have to be modeled out of the default shape in such a manner that everything between the default and the extreme keys looks natural; this is why circles in the layout, properly placed, are a good thing. Besides better matching the movement of the face, the circular point layout lets you, the creator of these shapes, more easily keep track of where your model has stretched and compressed because you can see your points at even, regular intervals as they change throughout movement. See Figure 5.3 for a default-to-smirk transition that works. Even though the face is not shaded, you can see where the creasing occurs, where there has been a stretch between rows, and where edges have been forced together.

Figure 5.1

Clean, but bad point layout for the face
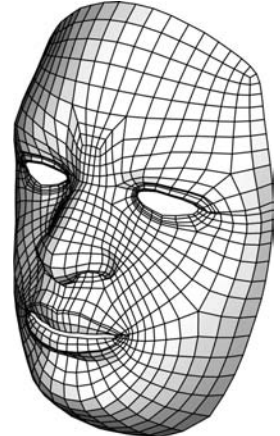
Figure 5.2

A layout that lines up with where the creases will be is a good foundation.

The Big Picture

This book is divided into sections that each relates to a portion of the face. This is going to make some of the modeling tutorial work a little bit disjointed if you're looking to make a head model in one sit-down, but it keeps the book better organized as a reference text, which is how most of you will use it after reading it your first time through.
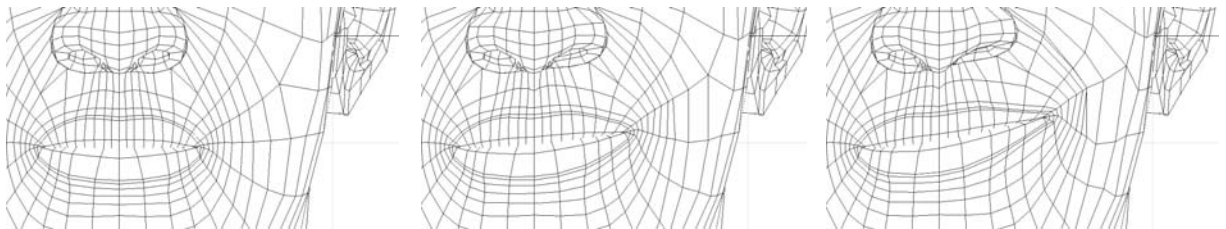
Figure 5.3

This layout provides important feedback on what the face is doing, even in wireframe.
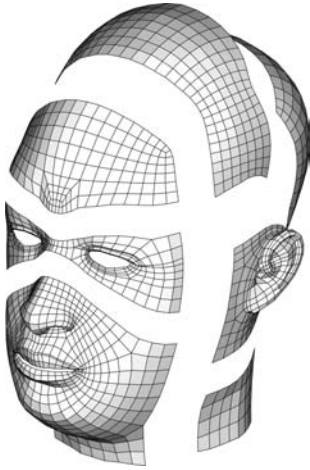
Figure 5.4

How the pieces of the head model will come together

Since the modeling will be broken up, I thought I'd give you an overview of what the full process will be. In this chapter, we will model a mouth, nose, some of the cheeks, a tongue, and some teeth. In later chapters we will model eyes, sockets, a forehead, and ears and then pull this model in with those others and sew them all together. Check out Figure 5.4 for an image showing the pieces that come together. With that out of the way; let's get right to it.

Building the Lips

Here's where I introduce you to "lazy man's modeling 101." It is my course tailored to get you creating a model with as little effort as fairness will allow. Generally, it works as follows: Sculpt a shape as basically and broadly as possible, add a little more detail inside the area you've broadly defined (but detail that can again contribute to the broad shape), sculpt that, add a little more detail, sculpt that, rinse and repeat. That way, when you add more detail, you're adding it to a better and better-defined surface, requiring less and less sculpting. The better defined the surface you are adding to, the less you need to move any new topology from where it is created to where it will end up. Less work for you, less typing for me.

> I'm using polygons in all the book model tutorials since I like the toolset associated with them, and the types of things I'll do are available for most packages and surface types. If you choose another type of object, you'll need to do a little translating of the names of operations and of tools. In that case, the pictures should provide you a good amount of information to work with.

Start by making yourself a 6×3 plane, facing forward on the Z axis, and delete all the "inside" faces, as in Figure 5.5. This will be the place we start our lips. Since we'll want quads *around* the lips, we'll need to get all these quads together in a loop, like an oval racetrack. To achieve that, take the verts feeding *into* each corner and snap them directly to the corner. Figure 5.6 shows how. (After you do this, be sure to merge the verts!)
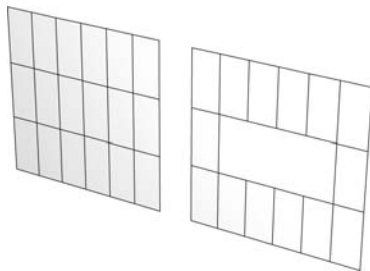
Figure 5.5

Our starting point is a 6×3 plane with inside faces deleted.
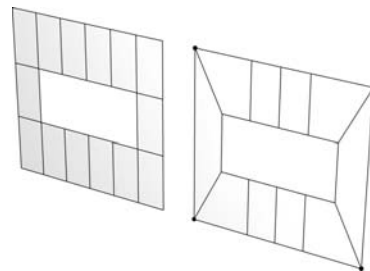
Figure 5.6

The plane after snapping and merging the corner verts
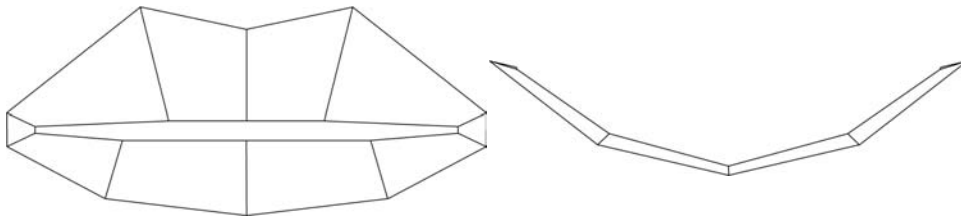
Figure 5.7

The first step toward making the plane into a pair of lips

Now we can really start to make this object look lippy. Go ahead and make it look like a pair of iconic lips, something like Figure 5.7 in the front and top or bottom views; be sure to get enough depth into them. These guys are pretty blocky, but that's okay at this point. It's a crucial part of "lazy guy modeling" that we don't want to overdetail them yet; we can still work with this silhouette for a while to make our modeling easier. To create more detail, though, we *can* start to plump the lips up by adding an edge loop on the inside and another toward the outside to make the place where the lips meet the face kind of sharp. Figure 5.8 shows what I did.
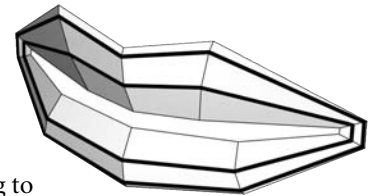
Figure 5.8

Add rows around to provide for plumping.

Extrude the edges along the inside of the lips three times to give us something to work with on the inside so that on shapes we sculpt later, like a pucker, there is some lip geometry to pull forward and roll out. Figure 5.9 shows this work done. Once you have this, you're ready to move on to the next step.

For the sake of keeping the imagery clear, I am not going to include these last few inside edges of the lips you just created in much of the following figures, so if you don't see them in the rest of the images, no, you're not crazy; those edges really *were* there, and should be.
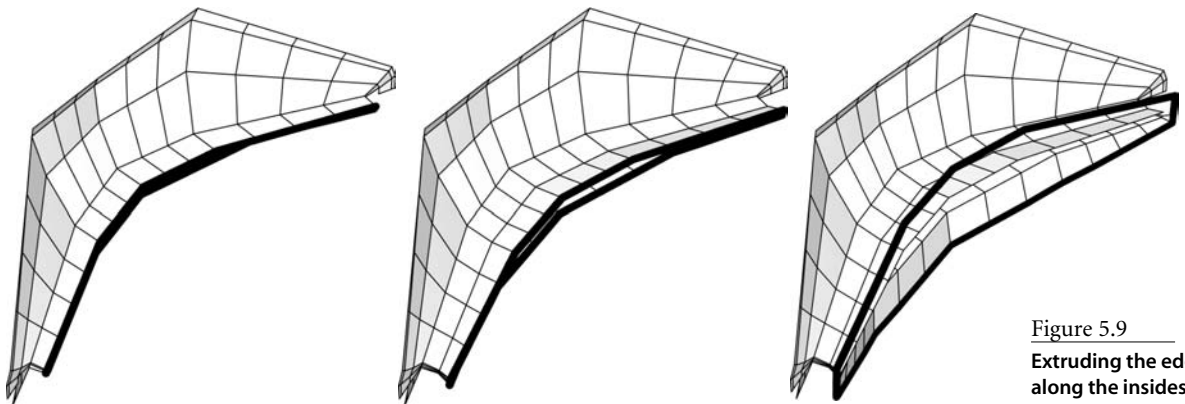
Figure 5.9

Extruding the edges along the insides of the lips

Building the Surrounding Mouth Area

From here, extrude the edges along the outside of the lips and use the newly created area to define a little better how the lips will cut back into the face. Figure 5.10 shows them after being extruded and reshaped. When trying to fill out a large area with detail, it's easier to split edge rings than it is to extrude out at each step and hope you can keep the model smooth, so we're going to do that. Grab the outside edges and extrude them, just as you did a moment ago, but this time define the *outside* edge to the entire mouth area. Figure 5.11 shows what I did, defining the area of a "dust mask" where it would hit on a face, running along the bridge of the nose, down along the cheek, then up and under the chin.

Anatomy time! The nasolabial fold is the line that comes off the top of each nostril and down along your face to the sides of your mouth. As you saw in Chapter 3, that fold is the center of where creasing happens for a smile, sneer, frown, or even just the effects of age. What we'll do next in our model is split the outer edge ring approximately in half. This new edge loop should be placed as the first geometry shaping the nasolabial fold. The new edge (shown in Figure 5.12) is also useful in defining the forward part of the chin.

Now, since we have a good base to build on, we can start to add some poly weight to this object for shaping and detail. Add two edge rings around the mouth to halve each major loop around. Figure 5.13 shows some sculpting after the additions.

By now you must be saying to yourself, "Will we be adding just a smidge more detail to the lip silhouette?" Yes we will. Since a lot of the gross feature alignment has already happened, we can start adding more detail into the model without having to wrangle points too far toward their final homes. To start, at each compass point—north, south, east, and west—add two edge loops between the ones already there. This means four each along the top and bottom and two each on the sides. Figure 5.14 shows what I had after adding and sculpting. Don't spend too much love on the edges at the top of this object, above the lip; most of them will be deleted and replaced by the nose, which we will tackle separately in the next section.
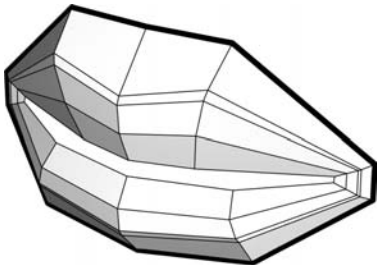
Figure 5.10

Defining the edges of the lips
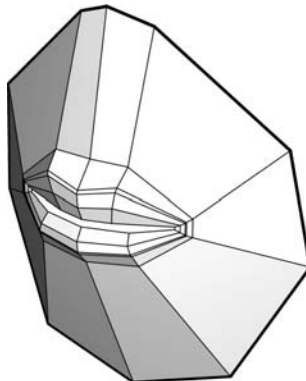
Figure 5.11

Defining a "dust mask" around the mouth
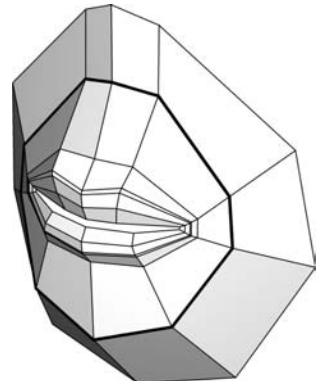
Figure 5.12

Splitting the outer edge ring to begin defining the nasolabial folds
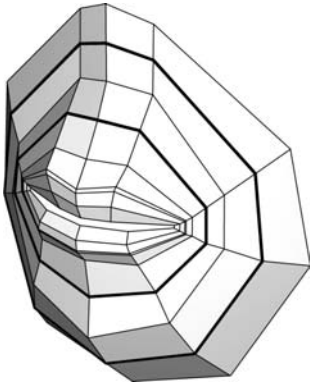
Figure 5.13

Further splitting and sculpting the outer ring
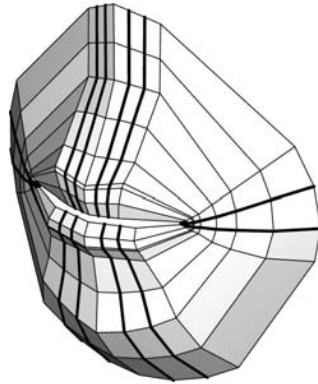
Figure 5.14

Adding more divisions and sculpting
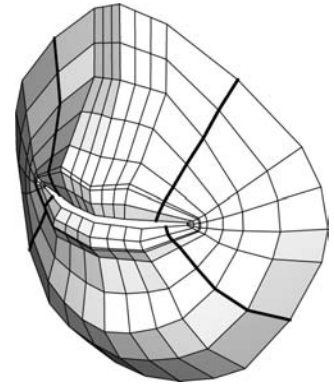
Figure 5.15

It's a recurring theme: divide and conquer!

Now it's time to fill out some of the remaining areas, splitting each one of the diagonals that have a lot of open area, and to sculpt these out to keep the edge flow smooth (Figure 5.15). From here, split and sculpt the areas in the diagonals each one more time, as Figure 5.16 shows.

As we get closer to working on the nose, we should start making some room for it. In Figure 5.17 you'll see what I did. Take the edge loops to the left and right of the ones going straight up, and push those further out to the sides. Then, square the edge two rows above the lips, making slight peaks as the edges change directions (I've darkened the edges and faces involved in this step). There is *no new geometry* here, just some sculpting. This should now give you a good idea of where the nose is going to drop in.
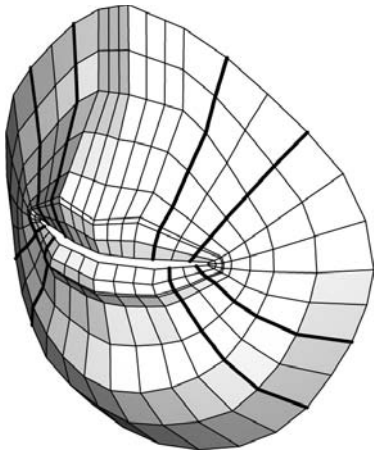
Figure 5.16

Splitting and sculpting the diagonals a second time
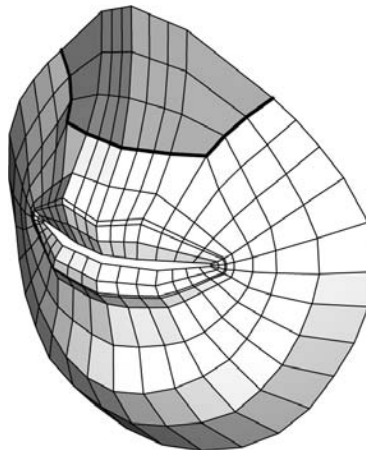
Figure 5.17

Making room for the nose we'll add
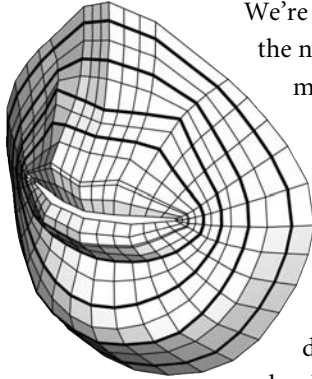
We're almost done with the mouth area, but before we move on to the nose, we still need more detail. A lot of this detail relates to making sure there is enough edge weight to sculpt our blend shapes to have neato bulges and creases in the cheeks when there is a smile or sneer, but a lot of it also has to do with simply making that nose fit once we attach it. To finish up before we start the nose, split each edge ring that runs around the mouth one more time and sculpt it until it is pretty; Figure 5.18 shows what I did. For now, this is all we'll do with the mouth, so go ahead and save this scene where you'll be able to find it later.

Building the Nose

At this point, we'll steer away from the mouth specifically, build up a nose on its own, and then attach the new nose to the geometry we just wrapped up with.

Start in a new scene by creating a 4×3 plane facing forward in the Z axis. This will be the start of our nose; you'll find an exciting 4×3 plane in Figure 5.19.

Take the points leading down and into the corners and snap them right into the bottom corners, as in Figure 5.20. Now you've created quads that run in a grid and also run around the outside bottom perimeter.

Take your new extremely simple object and make a nose. See? You're already done. Well, not quite. Start to define the nose silhouette with the vertical center edge, and use the two edges at the bottom to start defining a plane under the nose and planes along the sides, as in Figure 5.21.
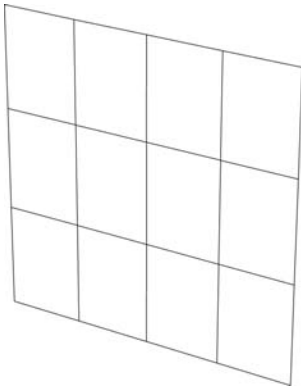
Figure 5.19

The nose begins as a 4×3 plane.
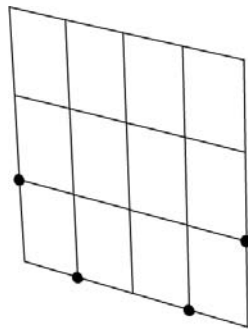
Figure 5.20

Snap the points shown on the left to create the quads shown on the right.
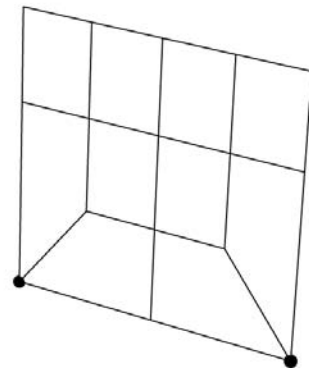
Add four edge loops, one horizontally along the bottom (it will also run up along the sides because of the edge flow), as well as another near the front of the nose, one along the bridge, and one fairly tight to each of the two existing edges running vertically; all of these new edges are highlighted in Figure 5.22a. Resculpt your nose using this new detail. Figure 5.22b shows what I did. Now it's starting to look like something fun to breathe with. Split edge rings along the topside of the nose and then use those to work your sculpt further, as in Figure 5.23.

Now we're starting to get a lot of definition along the outside, where the nostrils will hit the face, but what about the front of the nostrils? We will need to work those out a little more. Add three edges to each side in the very obviously detail-needy areas (highlighted in Figure 5.24a) and reshape them as in Figure 5.24b.
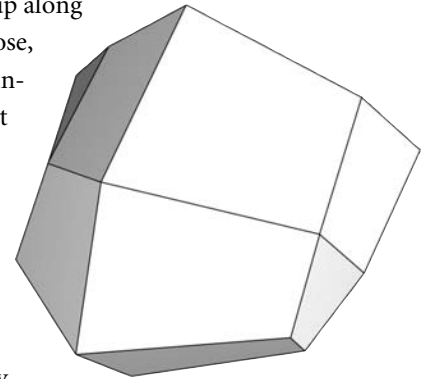
Figure 5.21
Defining the nose plane

a
b
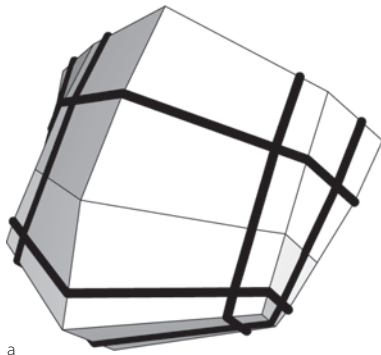
Figure 5.22
Adding four edge loops and resculpting the nose
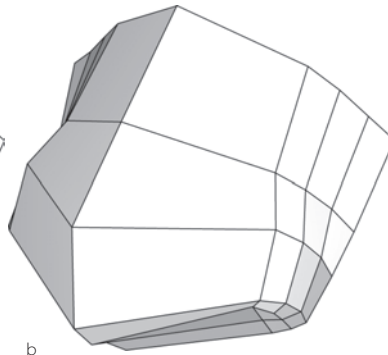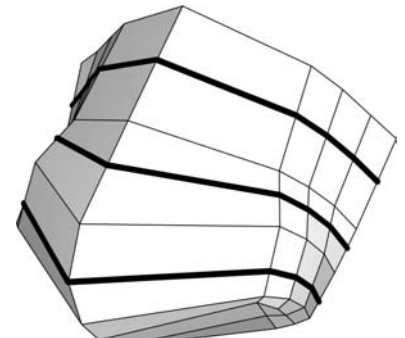
Figure 5.23
Splitting edge rings and sculpting further

a
b
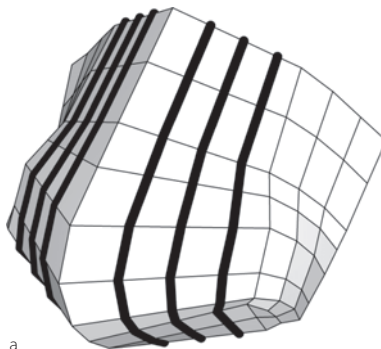
Figure 5.24
To define the nostrils we need to add three edges to each side and sculpt them.
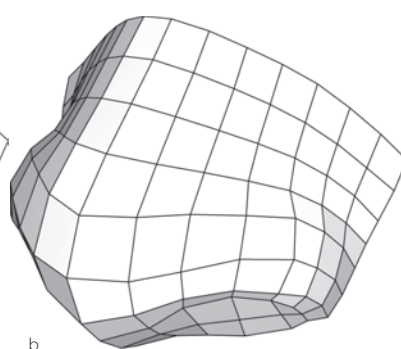
We've got enough detail now to show good edge flow here, so it's time to start getting into the nostrils. Figures 5.25a and 5.25b show some edges before and after removal to make room for other flow that'll be easier for a few steps. If your software permits, be sure *not* to delete the vertices along the borders when you lose the edges; you still need those in the next step. Once you're left with a cross in the nostrils, add edges from every single vertex on the outside of that area into the cross, making it a star, as in Figure 5.25c. You should have 12 edges coming out from the center of each nostril.

In Figure 5.25d, you can see the purpose of this star topology. It allows us to more easily add two edge rings, which now make this begin to look like a nostril. Since we're going to be quad-obsessed with our models, it's time to take that pizza in the middle of the nose and make it happy little squares. Figure 5.25e shows what is left when, just as we did a few steps ago, we delete everything but a cross in the innermost nostril. By drawing new edges as in Figure 5.25f, we've finally defeated the triangle scourge.

Figure 5.25

Creating the nostrils: (a) edges to remove, (b) edges removed, (c) creating a star from the cross, (d) adding edge rings within the star, (e) removing edges from the innermost ring, (f) adding new edges
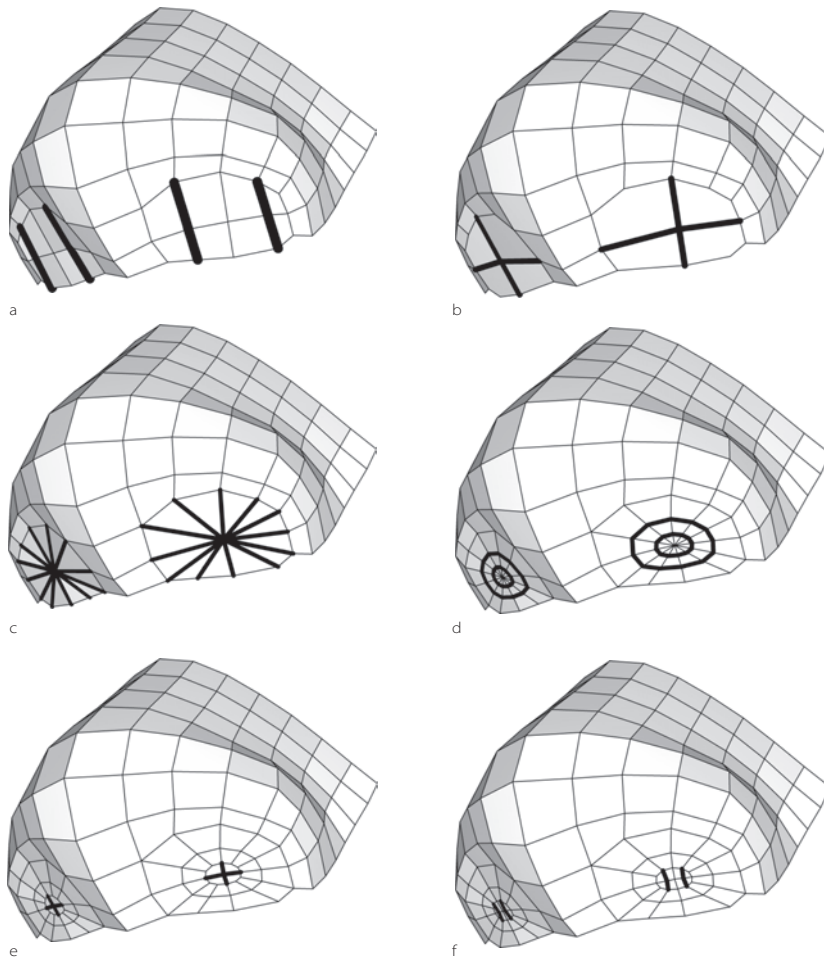
Take the new nostril verts highlighted in Figure 5.26 and press them up and in, each row in more than the last, to give yourself a nostril.

We are now basically done with the topology, except for a few things along the outside edges to make this marry up nicely with the rest of the mouth we made. Extrude edges as shown before and after in Figure 5.27. Wrap the new edges around to a tidy edge flow by snapping each of the new bottom verts you created as shown before and after in Figure 5.28.
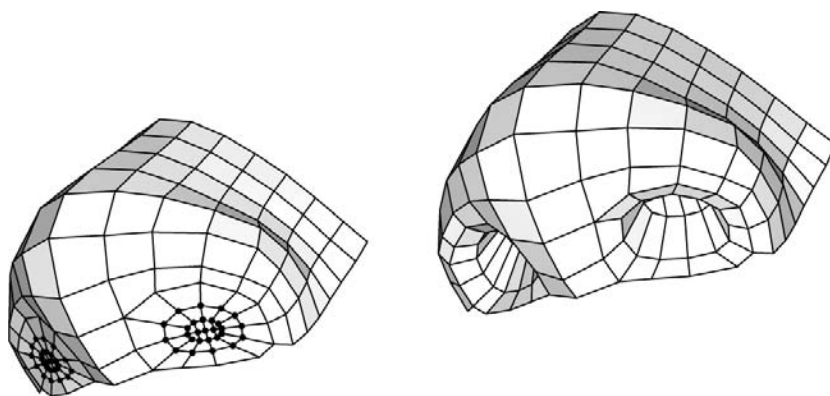
Figure 5.26

Pressing the new nostril verts up and in to create the nostrils
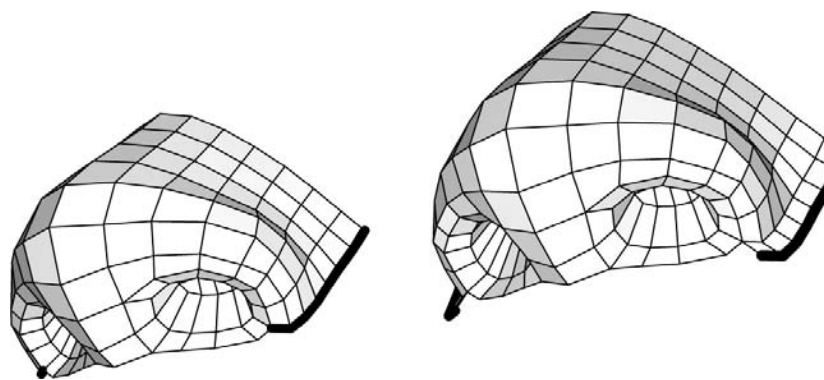
Figure 5.27

Extruding the outside edges of the nose
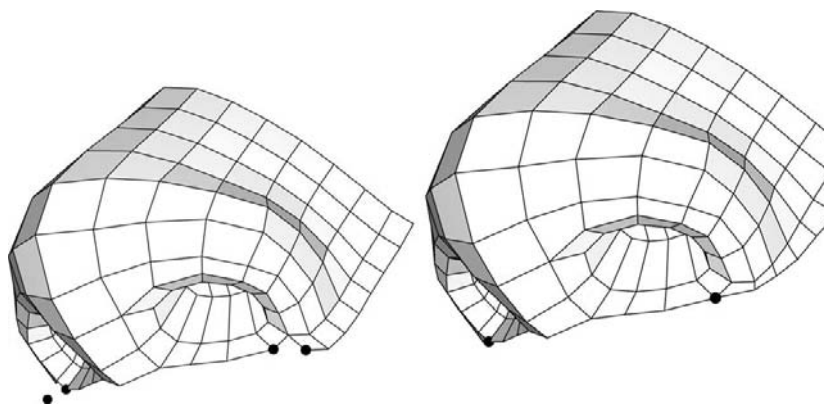
Figure 5.28

Snapping the new bottom verts

To finish this area up, we'll select all the edges along the sides and bottom for extrusion, as in Figure 5.29. There you go! One happy little nose topology, which should provide a good starting point for most noses you'd slap on a person.

Figure 5.29

Selecting and extruding the bottom edges
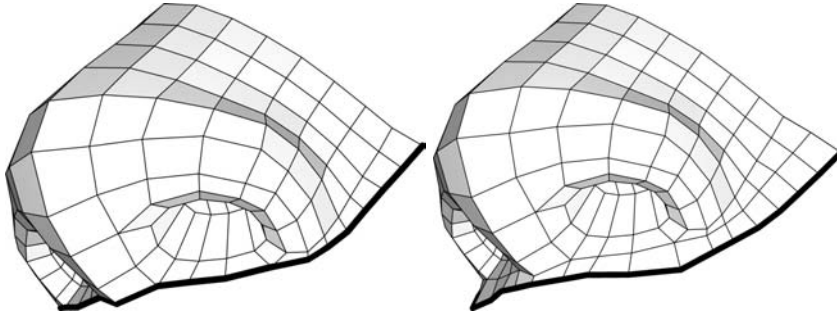
UVS IN TIGHT AREAS

UV unwrapping an area like the nose and nostrils can be a really lame way to spend a Saturday night. A good way to get around that and go get your dance on is to duplicate your object, pelt it (smush it smooth), use a simple UV projection technique, and then transfer the UVs back over to the original. One path I recommend is using a tool like Maya's Sculpt Geometry tool to smooth the duplicate shape until it's very flattened, as shown here.
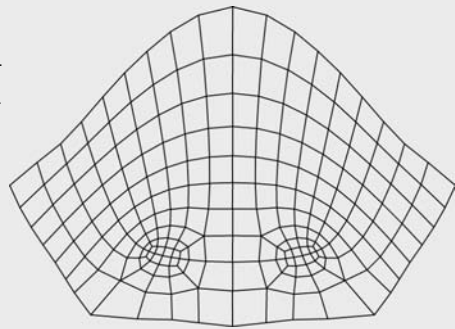
From there you can easily projection map the geometry and transfer the UVs back over to your original. You'll find more about UV transfer and the Sculpt Geometry tool in Maya's help files.

Connecting the Nose and Mouth

We have a mouth, and now we have a nose. Let's bring them together. Go ahead and import the mouth scene into the nose scene and let's start to line some things up.

Once you've got these two things relatively scaled and aligned, you should have *something* like Figure 5.30. Don't get them *completely* on top of each other, but instead let the nose hover a bit in front of of the mouth surface to give you some room to work with the two areas easily. If it takes some imagination to see the way they fit, that's okay; we'll get these together.

In actually connecting these two, start by making them one object. In Maya, that's done in the Polygons module with Mesh → Combine.

Figure 5.31 shows the edges we need to snap together from both surfaces. Choose what's easier in your package, snapping edges or snapping verts, but get the points on the nose geometry to align with those on the face. Figure 5.32 shows a few steps I took.
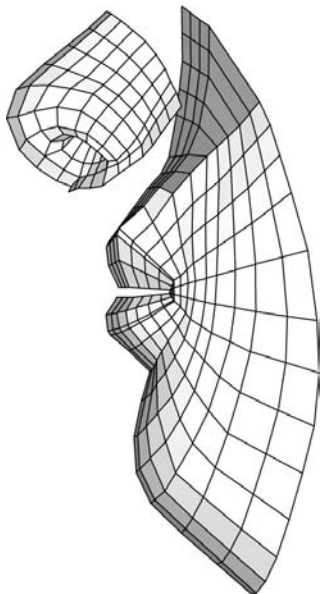
Figure 5.30

The nose and mouth scaled and aligned
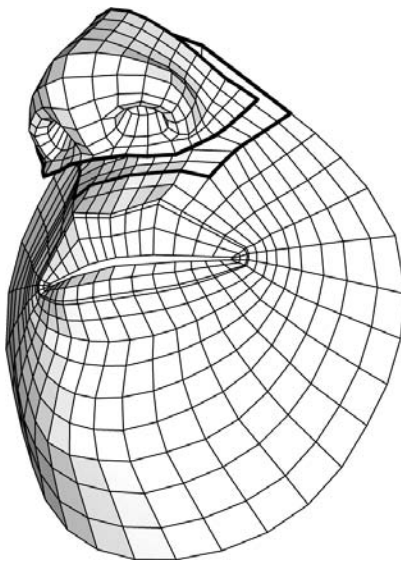
Figure 5.31

The edges we need to snap together
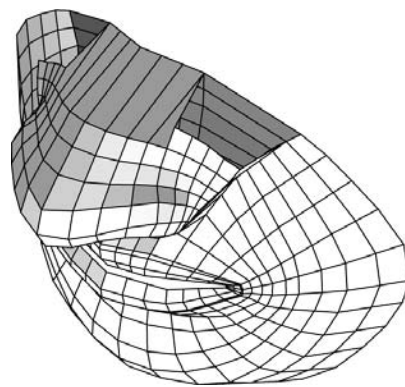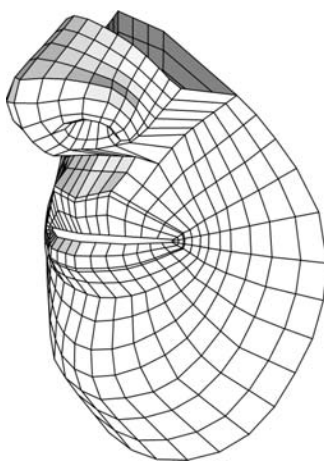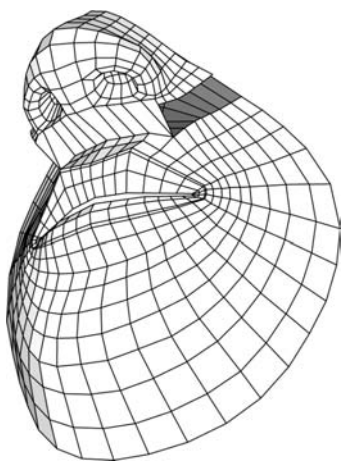
Figure 5.32

Snapping the nose and mouth together
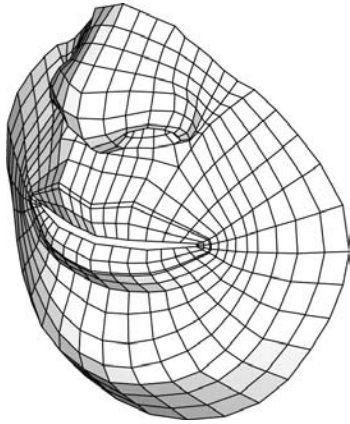
Figure 5.33
The nose verts pushed back into the face
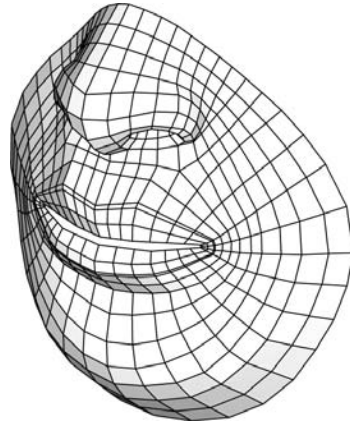
Figure 5.34
The object resculpted to clean up the edge flow

You'll probably notice that as you align the top edges, there are more verts on the nose than on the face. Don't worry about it, because after you've snapped the verts, you can delete the faces on the mouth surface that are occupying the area the nose will need to be in. The snapped stuff should help you get a very clear idea of what to delete. Once those faces are gone, take the nose verts that are hovering out there in space and push them back toward the face. Figure 5.33 shows what I had afterward, and Figure 5.34 is how I resculpted the object to clean up the edge flow, starting first with the outside edge and then playing with the ones inside of the silhouette.

This is *pretty much* the major work on the mouth and nose, but we still need to do a little work pulling some geometry back toward the jaw and cheek. To get that going, extrude 3 more rows from the outside edges of the face from the middle down (for those counting, this is 18 along the whole way around and under, 9 on each side). Figure 5.35 shows the edges to pull, and then the extruded geometry.

Our last step will be to get this whole area prepared for a merge with the rest of the face. Just as we had to do some work to make the nose easier to mesh back in with the mouth, we'll need to get this whole area now, nose included, ready to plug in to the face. To clean up the topology for this, select all the edges along the upper edge of the model, as in Figure 5.36, and extrude it once. After some sculpting, aim for a nice smooth edge along the top, as in Figure 5.37.

Mouth Conclusion

Okay, so now that we have a strong basic topology for the mouth, what's next? This is where the *real* task starts; a whole lot of sculpting to get your model in the shape you want for *your* character. Since all I've shown you is a guideline to good topology, keep in mind that it is okay to add or remove topology, but the key is really to keep a good edge flow that will support motion when we get into sculpting facial key shapes. Now, on to the teeth!
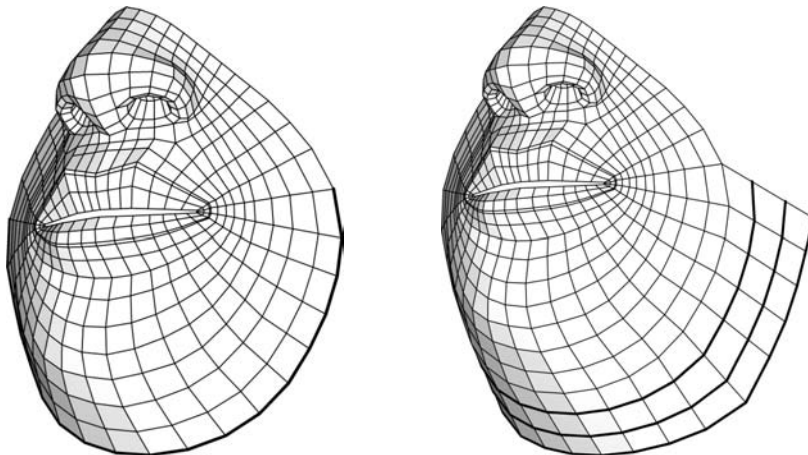
Figure 5.35

Extruding three more edges around the jaw and cheek
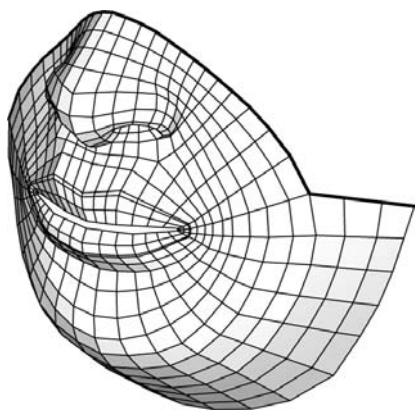
Figure 5.36

Selecting the upper edges of the model
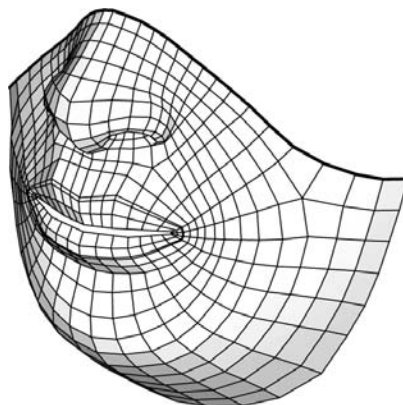
Figure 5.37

The edges extruded and smoothed

Figure 5.38

The teeth-and-gums-o-meter

Building Teeth

I've done a lot of talking about references and things being relative. With the teeth, we have the main reference point for the lips and the shapes they make. You know that someone has their upper lip raised when you can see their gums. When someone's smiling, same deal: the teeth are out there for the world to see, gums and all. Remember the pupil-and-iris-o-meter from Chapter 2? Well, the mouth has its own version, the teeth-and-gums-o-meter (Figure 5.38).
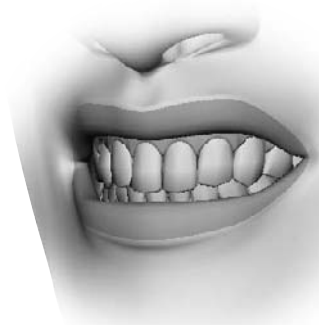
A Real-Life Lesson in Gums

I once worked on a project where the clients had it in their heads that we should never see the main character's gums. They had concluded in their own minds that as a concept, gums were unattractive. The result was that the character looked like she was wearing a mouth guard, or was never really smiling. If you can't see the top of the teeth and the gums, it's like they're not there. If there are no gums above teeth, there's no proof the character is really giving a big smile, raising their lip, because seeing those gums is how we know. There's also nothing to tell you that the character doesn't just have really big teeth, either.

Placement

We'll build the teeth, but that's only half of the battle. On average, it takes me as long to place the teeth in a character's head as it takes me to model them. Properly placing, scaling, and shaping teeth is something not easily done.

One thing that always amazed me was that, in my experience, directors, producers, and executives—even supervising animators and modelers, everyone with an opinion that counted—never asked to see the character's teeth during the model approval process. Seeing the teeth reveals two things: First, if they don't closely match the shape of the area around the lips, they just look fake. Second, stylistically, there are simply right and wrong teeth for a character's look. I don't even mean something as broad as yellow-brown crooked teeth versus perfect pearly whites, either. I mean that there are infinite kinds of teeth, and not many are really interchangeable with faces. This is one of those things that I can't handhold you through, and I can't give you a set of absolute rules—I can just make you aware of it. After I build teeth, I don't consider them finished until after I've built all of my mouth shape key set because I will continue to reshape, scale, and move them as I build the keys until the teeth look the best in the most situations. It can be a grueling process on certain characters.

The Types of Teeth

I emphasize maximum flexibility, addressing the particular needs of each area of the face. With the teeth, we're lucky. They help us identify issues with other facial key shapes, but they themselves—for the most part—don't move. They're just a prop. Since they don't need to move, there are no rules whatsoever for how to build them that I'll preach at you. The following are merely suggestions on how to get them built quickly and painlessly, although as I said, even after they're built, placing them in your character's mouth can take some serious time.

There are really only two major variations on the way to build teeth. First, there are the one-piece teeth, in which the gums and teeth are made of one continuous object, as in

Figure 5.39. These are better for cartoony characters or human stylized characters that are supposed to look like people, just not photo-realistic people. And then there are the one-piece gums and individual teeth, like in Figure 5.40, better suited for more realistic characters.

Polygons or subDs tend to be the better tool for more realistic teeth; if cartoony and stylized is your goal, splines will do your job more quickly and easily. I build teeth out of polygons, and the instruction I'll give refers to one-piece teeth, as building individual teeth is a pretty self-explanatory process. Build a tooth, repeat.
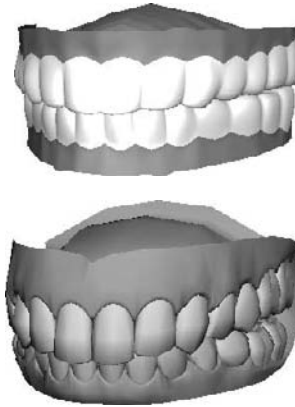
Figure 5.40

Gums with individual teeth are better for photorealism.

Creating Teeth

Teeth are an extremely easy thing to build. I'll use polygons, but I'm going to model according to spline rules, so the lesson information can translate directly, if that's your preference. I'll leave all polys as quadrilaterals (four sided).

My favored approach to building teeth is to start with a face, or plane. Create a plane that has four subdivisions along the length and only one along the height. Create it at a width and height of 1×1 and so it faces forward in the front view (flat in the side and top views, as in Figure 5.41).

Move the plane over to the side so that it exists only in X positive. In the top view, move the points around to create the shape in Figure 5.42. It should involve only X and Z movements, no moving of the points vertically. It's no tough guess to see we're already shaping the greater silhouette.
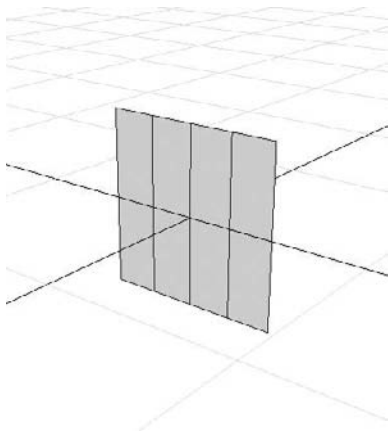
Figure 5.41

Create a 1×1 plane with divisions of 4 and 1.
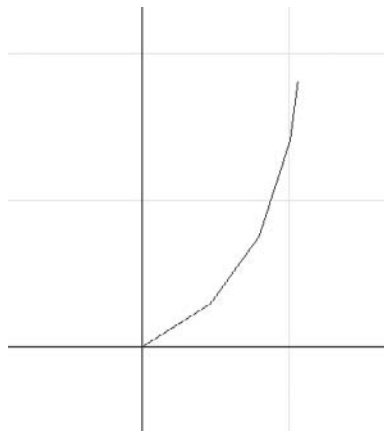
Figure 5.42

A top view of the shape to make
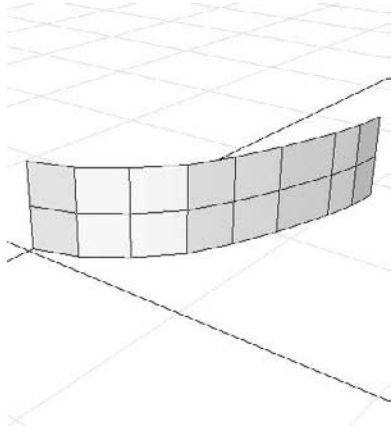
Figure 5.43

Smooth the overall shape, including the new rows.

Grab the lower row and move it up so it's 0 in Y, flat to the axis. No need to be hyper-accurate, just close enough. Select all of the faces and subdivide them at a level of one, then round all the new points into the curve of the shape (Figure 5.43).

Subdivide all of it again, and start to define the teeth. Teeth are not perfectly straight up and down or even in length, and any little detail that pushes us closer to reality is going to help. At the same time, define where the gums end and the teeth begin, as I've done in Figure 5.44.

From here, the teeth just need one more thing before we can start making them a little less flat. Put in one more row horizontally along the front of the teeth so that their profiles are less angular. Whether you decide to add it above or below that middle line is irrelevant, but what is important is to space both rows back out to get the most curvature for the least cost.

Once the normals are smoothed, this is enough detail for TV and most personal projects if you don't plan on extreme close-ups, but there still may be details you want to add or change. One thing that's nice about teeth and polys is that teeth look better when they're not perfectly smooth, and polys do that all for free. If you needed to get closer into the mouth, you'd use stunt teeth (higher resolution), or you could simply use the smooth function to get rid of the visible angular silhouette edges, but for the most part, what we've done here would really be enough. Truth be told, most people don't look too much at the teeth unless you make them.

Let's make this look more like teeth and gums. First, color the gums and teeth separately. Then, make the edges over the gum-tooth divide hard, via Normals → Harden Edge. Do the same again between each tooth; it'll make them look less like one big object, as you can see in Figure 5.46.
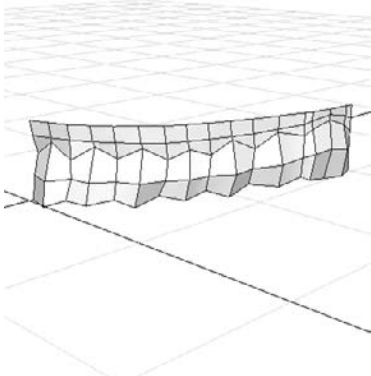
Figure 5.44

The teeth and gums start to separate visually.
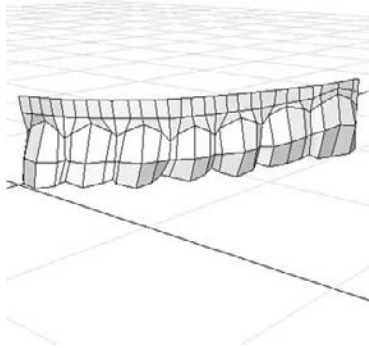
Figure 5.45

Using the new points, create arches at the tops of the teeth.
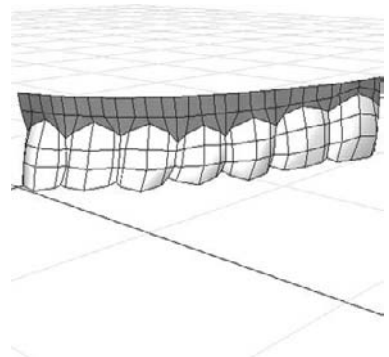
Figure 5.46

Now that's starting to look like teeth!

Shaping the Interior Tooth Surface

As glamorous as this topic is not, it's pretty important to what the audience sees. We'll eventually build our lower teeth out of these upper teeth, and you'll notice that when someone opens their mouth, as in Figure 5.47, pretty much all you see is the inside and topside of the bottom teeth. That directly translates to the inside and underside of what we're building now.

Select the teeth and duplicate them, and then scale them smaller in X, left to right, and bigger in Z, back to front. I'm not giving any magic numbers; just try to get something like Figure 5.48.

On the duplicate, select all the faces and reverse the normals. To do so, choose Normals → Reverse. If this isn't done, when these two objects are combined they won't be able to shade smoothly because the normals go in opposite directions.

Hide the original mesh for now, and work on this new inside one. One by one, grab the points for the inside of the teeth and pull them out in the other direction. Right now their "bulges" are those of the outside of the teeth. See Figure 5.49 for how they should look. Leave two front teeth concave; that's closer to their real shape, anyway.

Next, combine the two shapes. Unhide the original and combine it and the "inside" into one object.

You'll need to use the Append To Polygon tool to connect the two sides of the object together, the result of which is shown in Figure 5.50.

You can see that we've worked in at least an approximation of the proper width of teeth by scaling the inside edge differently, but looking at Figure 5.50, you'll see that some of the edges don't line up. Simply go through and rearrange the shape so that the teeth line up more attractively. Try to leave the front of the teeth and do most of your modifications to the inside, which can afford to be less accurate.
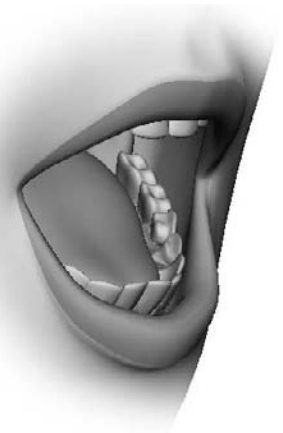
Figure 5.47

Saying aah really shows off the insides of the dental work.
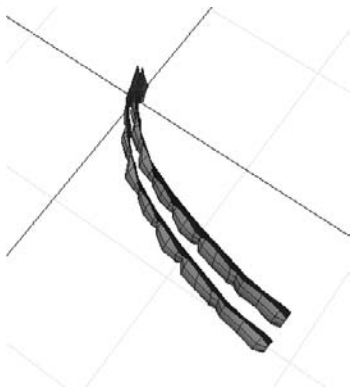
Figure 5.48

The new object scaled and placed, from a perspective top view
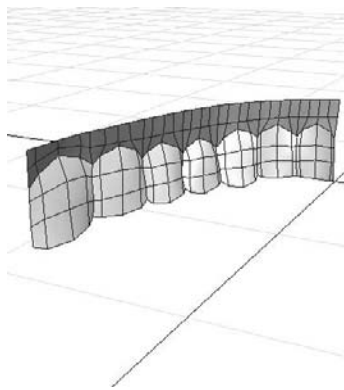
Figure 5.49

The curve on the inside of the teeth should go opposite that of the outside (we're looking at this from the inside).
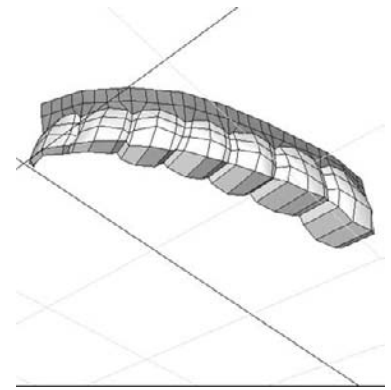
Figure 5.50

The two sides connected along the bottom, from a bottom perspective view
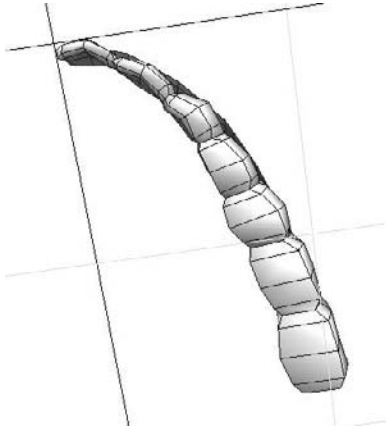
Figure 5.51
Giving each tooth some shape is easiest from the bottom.
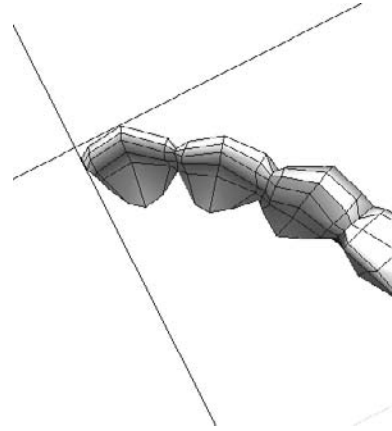
Figure 5.52
The backs of the front teeth run deeper into the roof of the mouth.

The Underside of the Teeth

Looking at the bottom, pull points together at the joins between teeth, as in Figure 5.51. This helps define the proper widths for the teeth and aids the illusion that each tooth is separate.

From here, add one row down the center of the bottom. For the front teeth, this will reduce their boxiness; for the back teeth, it will help us include more molar detail. Select the new row and pull it down a little bit. This softens the front, but it also makes the back teeth look like marshmallows, so for the last four teeth, select the new row and pull it upward, sharpening the edges of those back teeth.

You're almost done shaping the teeth. The last few details have to do with the back of the front teeth and the roof of the mouth. The front teeth anchor to the gums in a very unique way, and to mimic that, select the base of the front few teeth, the three points at the top of each arch on the backside, and pull them back, as in Figure 5.52.

Sculpting the Gums

It's now up to you to further sculpt, smooth, and tweak the teeth themselves. The next step here is to pull the gums into more of a "roof" of the mouth. Select the points on the inside top edge, and scale them horizontally in X until they are flat against the X axis. Snap-To-Grid and the Move tool can also be good for this.

Resculpt the shape so that the new row has an arch in it, as in Figure 5.53. You'll need to pull some of the points near the front toward the back a little to get the right shape.

From here there's the small matter of mirroring what we have (Figure 5.54) to create a whole set of teeth.
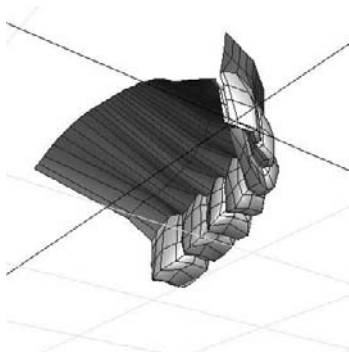
Figure 5.53

Creating something to fill the mouth
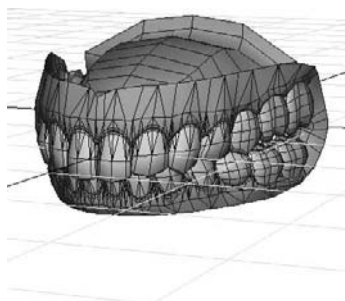
Figure 5.54

The same teeth model with more elbow grease thrown at it
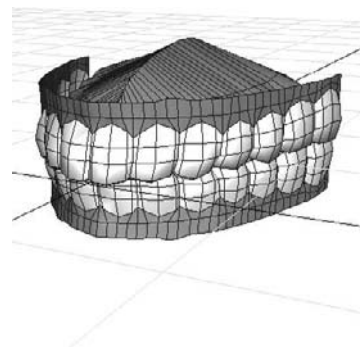
Figure 5.55

A whole set of choppers

Making the Lower Teeth from the Upper Teeth

Taking the teeth we just built and turning them upside down isn't quite enough for them to qualify as lower teeth. I'm not a dentist, and I would be lying if I said I looked deep into medical or dental information to properly justify this process. I'm basing the following teeth on a mirror, a few pictures, and my own observations of what lower teeth look like.

Visually, the main difference between lower teeth and upper teeth is that the frontmost four lower teeth seem to be thinner. The four front teeth on the bottom don't take up as much room as the top front four teeth.

For humans, even though those front bottom teeth are smaller, there are the same number of bottom teeth as top ones. (Trust me; I counted.) So we can use a duplicate of our upper teeth; we just need to reshape them. I duplicated the upper teeth, rotated them 180 degrees in Z, and scaled them uniformly down a little. After moving them around, I got what looks like Figure 5.55.

Figure 5.56

Using a lattice is the fastest way to reshape the bottom teeth.

If you're not fussy, that's ready to rock. If you do, however, want to differentiate between the upper and lower teeth, there is only one tool I recommend using to do so: a lattice. By creating a lattice around the lower teeth, you can make big changes with little effort. I created a lattice with divisions of 5, 3, and 5 in X, Y, and Z, respectively. Figure 5.56 gives a good idea of how to redistribute the shape to look different from the upper teeth—simply thin the teeth up front and redistribute the rest accordingly.

Solidify the lattice's control by duplicating the geometry and deleting the original, and there you are! The tongue will be covered separately, but it can definitely be made to join into this model for more realism. As far as tweaking it goes, in Figure 5.57 are some images from a model I continued on with. The main things to do, if you'd like to continue refining your teeth, is

Three angles on some teeth I took to the next level of detail

to add more points in the join areas, both between the teeth and gums line and between each of the teeth. If you'd really like to add some nice depth to the model, connect the upper and lower teeth together at the back. If you open your mouth really wide, you'll see there's a tendon back there. The model I built here shows all these additions and changes. The process mostly involved smoothing the object, tweaking it, and smoothing it some more.

Building the Tongue

I tend to preach against the tongue at every turn. You can lip-sync convincingly without it, animating it well is extremely difficult, and it's usually more of a distraction from the performance than a help. In a lot of my characters, I never even build it to sit at the bottom of the mouth. Unless you, as a viewer, set out to look at the tongue, you usually won't notice it's not there.

All that being said, for some projects you may want it. The simplest tongue to build is most definitely a squashed sphere. If the proper care is taken, though, this can be made into a very convincing and realistic tongue. If your look is cartoony, simpler is better. Another kind of tongue is built into the bottom of the mouth, just like real life. Since the tongue does have movements it has to accomplish, I do have some suggestions on construction.

Shaping a Basic Tongue

Create a NURBS sphere native to the Z axis with 10 sections and 8 spans. You'll need to rotate it 90 degrees in Z so that there are central rows going up and down, as in Figure 5.58.

Freeze all transformations and then scale the sphere down to 0.6 in X, 0.2 in Y, and 0.8 in Z. If you'd like to build this in the same scene with your lower teeth, pull the tongue back about –1.1 units in Z—that should be in the ballpark of where your teeth are.

Select the first isoparm you can at the back of the tongue and separate the surfaces out, so it looks like Figure 5.59. You can delete the "cap" if you'd like. Now select the last two rows on the newly opened side, and manipulate the points out as in Figure 5.60.

As viewed from the bottom, pull the points so that they look like Figure 5.61. This creates the area where the tongue anchors. If you roll your tongue around your mouth, you'll notice that it's quite connected on the underside.
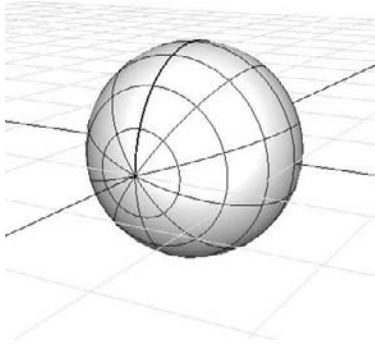
Figure 5.58

A happy little NURBS sphere
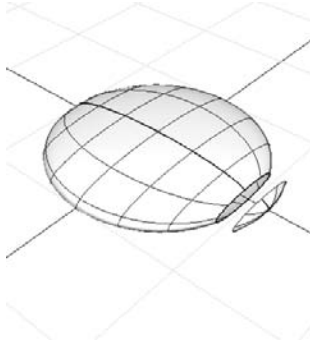
Figure 5.59

Cutting the back of the tongue off

Figure 5.60

Rearranging the open end

We re-create this because without the detail on the underside of the tongue, the position of the tongue, when it's raised, wouldn't be as apparent.

Following along with the teeth model can be handy because you can start to form this tongue model to the underside of the mouth, which will need to happen anyway.

From the side view, try to condense the profile (center) line to the front to more directly connect to the base. Resculpt the surrounding rows to match more closely. After that, select the rows outside of those, and do the same.

Select some of the points on the underside and scale them together in X, to thin them, as in Figure 5.62. This will help form something like the membrane located at the center bottom of your tongue.

On the topside, grab the points at the back, not including the center row, and pull them back and up slightly (shown in Figure 5.63). This will put some more shape on the silhouette when people can see into your character's mouth. Going in to the top view, pull the last row so that it's a little bit rounder. This will very seldom be seen, but it makes the overall back edge look more organic and less like a cliff that just drops off.
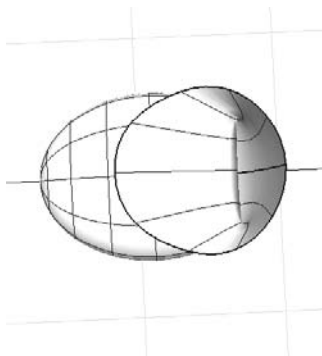
Figure 5.61

Forming the base of the tongue at the bottom of the mouth
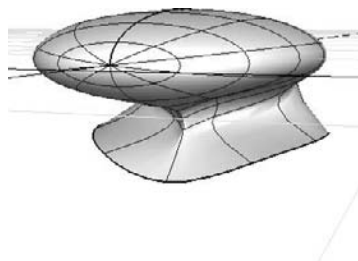
Figure 5.62

Create the look of the membrane under the tongue.
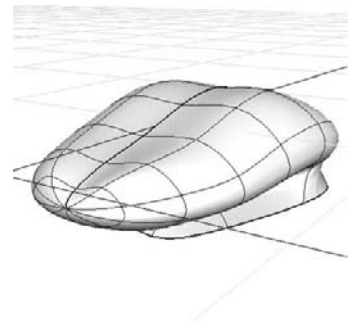
Figure 5.63

Give the back some more interesting curves.
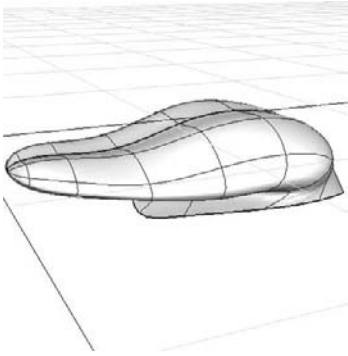
Figure 5.64

Manipulating the tip should yield something like this.
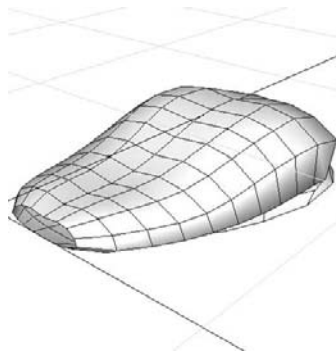
Figure 5.65

Delete the tip after converting to polys
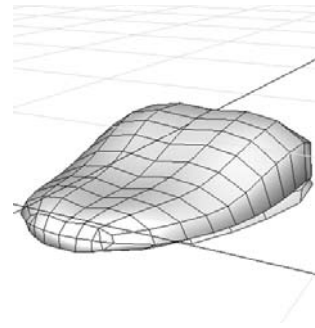
Figure 5.66

Recapping the tip with some new polys

From the side view, grab some rows and pull them down vertically to create more of a wave shape, as in Figure 5.64. You may want to extend the tip to make the whole shape a little bit longer.

If your character is a more stylized one, you may already be done. For a more realistic tongue, read on.

A More Refined Tongue

To make this tongue look more realistic, you will mostly rely on your own eye for what you want, but there are a few more things that you can do structurally to help you along. To go further, convert the tongue into polys. Set your options so that the tongue doesn't turn out to be too heavy. The exact settings are of little consequence; we can add that detail later. Right after the conversion, delete the faces on the very tip (Figure 5.65). When modeling in splines, you have to deal with the sphincter on the tips of your objects; in polys, no need.

Now close the tip back up, appending more polys to the open space. From here, add another row horizontally, and that should give you enough detail to round out the tip, both from the top and side views; see Figure 5.66.

The last thing we'll do to get the tongue into the mouth convincingly is actually attach it to the lower teeth model we have built. Translate the tongue up, or the teeth down— doesn't matter which—so that you can have space to work between them. Delete the inside bottom of the lower teeth, combine the two, and start to attach the tongue, at its anchor, to the teeth model, as in Figure 5.67.

After that, go ahead and sink that puppy into the bottom of the mouth. What I tend to do is flatten the tongue out most of the way to the teeth. This makes it look like the tongue is actually in the mouth instead of another separate object floating there (Figure 5.68).
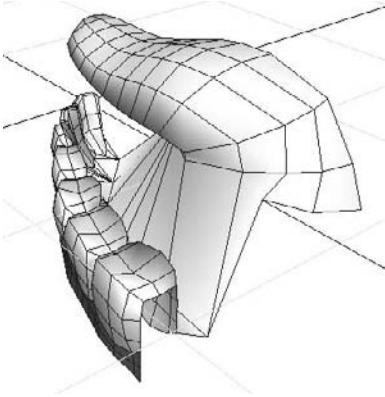
Figure 5.67
Connecting the tongue to the teeth
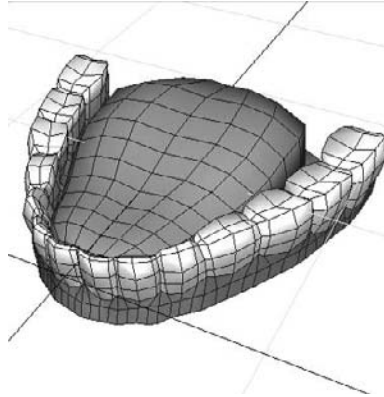
Figure 5.68
The tongue sitting in the mouth

From here it's just tweaking it into what you want to see. The only major thing now would be to pull the back of the tongue back farther toward where the throat would be, as that's where your tongue really sits. Other than that, happy modeling!

The Mouth Wall

That's right, it just keeps going! I can say to you, though, that this is the end of the pieces of the mouth. To keep us from seeing the inside back of the head, the characters will need what I've heard referred to as a mouth sock, a mouth wall, or even a mouth bag. All this does is give all our teeth and gums a little home to live in.

You can continue on from the lips, making more rows, and just pull the extra geometry into the mouth. In most cases, though, it's just not necessary to have that kind of detail. Usually, you can get away with an incredibly low-res object. It's so simple, in fact, that I'm not even going to guide you through it. All your mouth wall needs is enough points around the front so that when your facial key shapes start to move around, it can move around too. That usually means at least eight points at the front, at clock positions 12, 2, 3, 4, 6, 8, 9, and 10 (Figure 5.69).
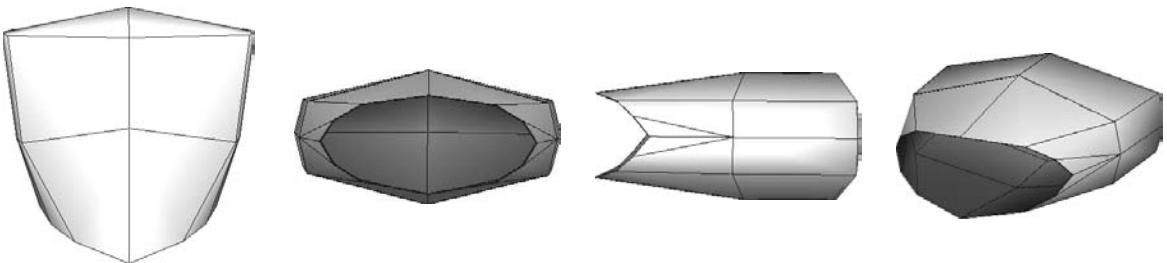
Figure 5.69
The simple mouth wall
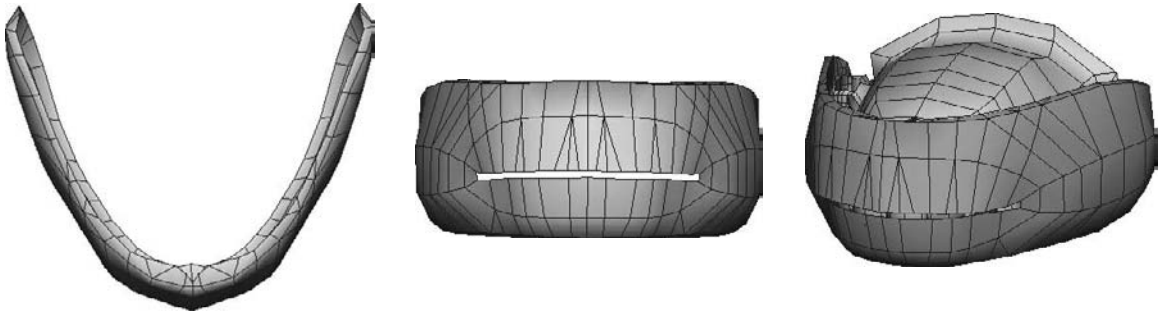
Figure 5.70

The more realistic mouth wall hugs the teeth.

I usually build my mouth walls out of a cube on which I've softened the shading, using Normals → Soften Edge. It does the trick of being unobtrusive so well that I had to duplicate it and color it differently to show you what it looks like. The low resolution rarely shows itself unless there's too much texturing going on in the inside, which there really shouldn't be if you're going with this style of mouth wall. I've worked on several TV series that we shipped using this low level of detail in the mouth—it just works. Figure 5.70 shows several views of the mouth wall object completed. For the times when you really do want some added realism, indeed follow and construct the lips into the inside and then start snapping points to the gums so it's a nice tight seal all the way around. This method is shown in Figure 5.70. The structure of this is only dependent on its ability to open and close with the jaw and to follow the mouth shapes. Other than that, it doesn't matter.

Okay, boys and girl, this is it. This was the left ventricle of the heart of the book, and there's still more heart to come. To switch metaphors, you've got the blank slate on which to create amazing sync and stunning acting; the groundwork is already laid. Next we give that slate some chalk—we build the shapes.

Mouth Keys

We've got a mouth we can set keys on, so let's start creating those keys. Something you have to know right here and right now is that this and Chapter 9 are *work*; depending on which way you execute the work here and in Chapter 9, you are looking at over 40 blend shapes to sculpt. But let's put that number in perspective. In a feature film, you could be looking at hundreds, and at times even *thousands*, of shapes to build, so 40 really isn't almost anything at all. When the first edition of this book came out, the fastest I had ever done a television-level head with a *full* set of blends *from scratch* was in two eight-hour days—the bar was set pretty low on that particular project and I had already been setting up facial key sets for over two years almost exclusively as my full-time job. Some new techniques I have started using, which I will explain in this chapter, have since shortened that to *one* day and increased the quality, but for good results, *expect* this to take longer than that.

- **How to approach the key set**

- **The default shape**

- **Basic and advanced sync keys**

- **Emotion keys**

- **Asymmetry**

Order of Operations

Since most of you will read this book through once and then refer to it many times after that, I organized it to favor the reference. The order in which we present things is a little spread out for an A, B, C and you're done style approach, but it's going to be easy to answer a mouth or an eye question once you're looking back into it. Also, there are many things some of you will need to do that others won't, and once again, this can shake up the order of operations. To help you understand what the real beginning-middle-end of this whole process should be, here is a checklist for you to refer to.

Build the head. Following the instruction in Chapter 5 ("Constructing a Mouth and Nose"), Chapter 8 ("Constructing Eyes and Brows"), and Chapter 10 ("Connecting the Features"), build the head you'd like to use.

UV the head. You'll need to put textures on it one day, and so you'll need to have your UVs laid out. I speak to this a little bit in Chapter 9 ("Eye and Brow Keys").

Build the shapes. Choose the complexity of the shape set you want to have (the two options are laid out at the end of Chapter 12, "Interfaces for Your Faces"), and build the shapes you choose following the instruction in this chapter and Chapter 9 ("Eye and Brow Keys").

Taper the shapes. In this chapter, you'll learn how to "taper" shapes. This is where you split one into many to make sure you do as little sculpting as possible yet still get asymmetry and cooperative shapes.

Create fix, half, and XYZ shapes. There will be combinations of shapes that don't look good and require corrective blends (fix shape), other shapes that require the addition of a shape on their path from start to end (half shape) to make them look good, and others that can benefit from having their X, Y, and Z components separated. Chapter 12, "Interfaces for Your Faces," talks you through all of these.

Add zipper lips. Making the lips look a little stickier can add a lot. It is not a necessary step, but if you choose to take it on, you'd do so here at the very end of all your shape creation, but before any real setup is done. Chapter 11 ("Skeletal Setup, Weighting, and Rigging") contains all the zipper lips information you'll need.

Create a skeleton and weight to it. Chapter 11 is where you see how this is done. You can actually create the skeleton any time you like, but you don't want to bind to it until this point.

Prep your blend. To allow you to create new interfaces you can share, and also to easily attach those you may find or are given, you will need to "prep" your blends. This step also does a lot of automatic connection for you with fix, half, and XYZ shapes. Look to Chapter 12 for more information when the time comes.

Set up your eyes. In Chapter 11, I walk through a toolset that helps you connect up your eyes and eyelids in a way that gets you a lot of great automatic setup with very little work.

Create or attach an interface. The process of creating your own interface that can be anywhere from simple to complicated has been made pretty easy. Even easier is attaching one of the interfaces provided. Chapter 12 shows you how.

Animate! So that all of that wasn't a waste of time.

Preparing to Build a Key Set

News flash: If it has a face that can move, the model you've built is not what your character looks like to an audience. In a scene where your character is asleep, or maybe in a scene where the character is drugged or pretending to be a mannequin, yes, the face you built is what your character looks like, but in all other cases, what an audience will know as your character's face will consist of combinations of the facial key set you are about to create.

The life that can be put into characters continues to amaze me. Whenever I see CGI model turnarounds on DVD special features, I think, "That's not what so-and-so looks like, that's so… dead!" Seeing a model that looks like nothing— it's lifeless; it's just not the character—I have to remind myself that the life was created. It appeared between the modeling and the finished film as the character's range was enabled in rigging and brought to realization as acting in animation.

In regard to the acting, a lot of that creation of character is done in close-ups—it's done with the face. One thing I realize when looking at turnarounds is that you almost never see that base/default shape of the face in the movie or TV show; the face is always expressing somehow. The point is this: The model you're starting with isn't your character. These shapes you're about to build are. Treat every shape like it's the only shape anyone will ever see because combinations of the shapes you build here really *are* all anyone will ever see.

Key Set Construction

The approach I have is simple. I build what I want to see. I grab the points, just as I did when I built the head in the first place, and I move them, and I move them, and I move them some more. Personally, I am very "old school" when it comes right down to it. Before any one shape is approved, I am tweaking practically every point on the face individually.

The truth is, I will start shapes by doing my shape blocking with soft-mod type tools, whether in ZBrush, Silo, XSI, or Mudbox, since they are so good at moving larger masses around. Sometimes, I use joint weighting to help me get the shape built, but only as a stepping stone; the joint itself gets removed before I start using that shape. From there, I will sculpt, on the vertex level, until I am happy with a final result. Then, in the newest part of my process, I extract component shapes from that main sculpt using `ss2_blend_taper.mel`, a tool I will introduce you to just after you learn all about additive shape animation.

After all of this, what you end up with is deformations that are *only* blend shapes, no helper joints, clusters, or any other kind of deformer. By making all the inputs into the facial rig almost exclusively *blend shapes*, you can simplify your life tremendously. You have just one blend shape value to control to get each face shape you want to see, even if initially it was a combination of clusters, sculpt deformers, joints, and point-pulling. When we start setting up four shapes on one slider, our savings in time and effort will multiply without losing us any of the complexity.

Basically, I ask, would you use heavy amounts of riggery in *constructing* your face model and maintaining that shape just for a sculpture? Of course not! You'd model it! I see the key set building process the same way. I model each one.

Default Shapes, Additive Shapes, and *ss2_blend_taper.mel*

The default shape is the most important shape. Everything in this whole book—all shapes, all setups, all groups of key sets—*will not work* if you do not adhere to the rules laid out here for the default shape. The reason is that we'll be using additive shape animation, the default type for most software. Additive shape animation is very powerful and can also sometimes be very difficult to control. Take note of the list of rules for the default shape and do your best to make sure your character follows them.

Your layout, as Figure 6.1 shows, absolutely must have these elements:

- Circular rows all the way into the mouth
- A bored expression/expressionless mouth
- A closed mouth
- Lips that continue from the outside of the face and turn inward to the mouth

Additive Shapes Explained

With *additive shape animation*, used by most 3D software, when two or more shapes blend together, they do not "morph" together and meet in the middle. Different shapes can actually influence the same object at the same time without compromise. They don't *average*; they *add*.
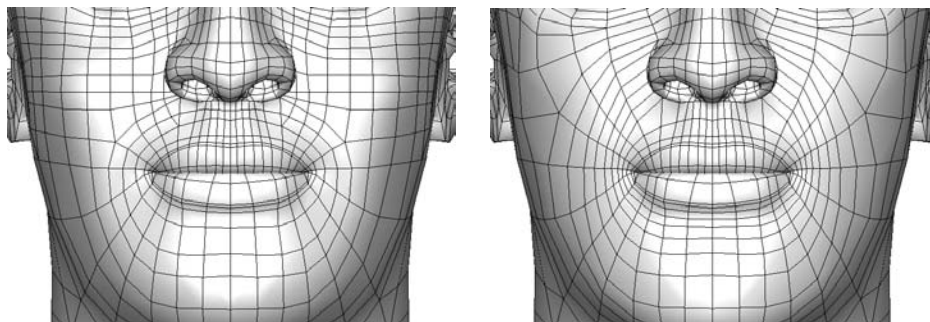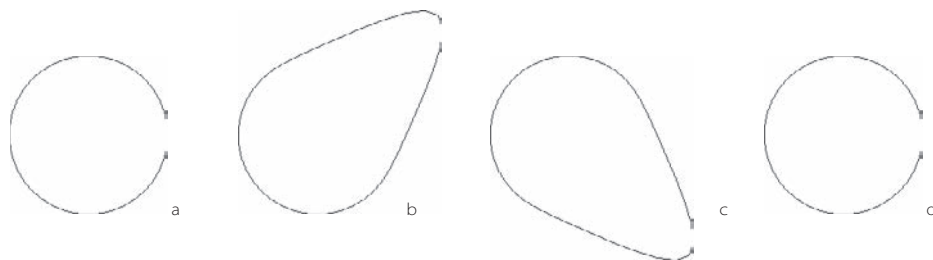
I want to state as loudly as possible and from the highest hill I can find: This concept takes a while to get used to, and if you think that it's easy and you understand it already without too much effort, go back and rethink it. As backward as this may seem, additive shape animation is a concept you don't really understand until it becomes confusing. Understanding it fully will help you fix problems you will almost surely run into with otherwise illogical and strange things happening to your head as you build shapes.

Let's start at the ground floor, explain the principles of additive shape animation, and then apply the logic to a head and see what can happen.

Figure 6.2 shows four circles. The first, the regular circle, is the default, or base shape. The second and third circles, the ones with the bumps on them, are shapes that will be added to the regular circle as blend shapes. The fourth is exactly the same as the first, and that too will be used to add to the first, to help explain just how additive shapes work a little bit differently than you might guess. I will call these shapes A, B, C, and D, respectively.

> FYI, although this is not meant to be a tutorial, if you wanted to make B, C, and D blend shapes available to A, you'd select B, C, and D and select A last. Click Create Deformers → Blend Shape and you're done!

Shape A becomes the master shape, which gets influenced by B, C, and D. For example, once you've created your blend shapes, using B's shape slider will influence the master shape (A) to *apparently* morph toward the B shape (Figure 6.3). Increasing the C slider will influence the default shape (A) to become like the C shape.
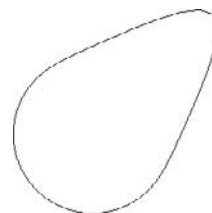
In Maya there are two ways to directly affect the blend shape values. You can open the Blend Shape Editor and use sliders by going to Window → Animation Editors → Blend Shape, or you can open the blendShape node under Inputs in the Channel Box and adjust the attribute values for each shape.

There Are No Shapes, Only Differences

The trick here is that this blend shape stuff is all done *additively*, with a compound effect. When you're using more than one slider at a time, these shapes will quite literally *add* to each other (Figure 6.4); they do not compromise and "meet in the middle," which is what a morph is.

Figure 6.4

B and C both influencing A

To say that Maya *adds* shapes—and that's what Maya is doing; it's *adding* them, not *morphing* them—is to say that Maya looks only at their differences from the base shape and applies those differences. It's a hard thing to describe, but pretend Maya doesn't see a shape at all (it really doesn't); all it sees is what's different about a shape in relation to the base shape.

Here's where circle D comes in. Your first guess (and a very logical one) about the result of adding D into the mix is probably that it would lessen the effects of B and C because it's more circular. That would be exactly where additive is trickier than it looks. D will not lessen the effects of B and C; it will do nothing. D won't do a thing to A. It will have no effect in any way. No matter if you crank that slider up to 1000 or down to -999, it just won't have any effect because there's nothing different about D in comparison to A. When nothing is different, there is no difference to apply, so nothing changes. This is a relatively benign concept to think about when explaining why something has *no* effect. When something *is* changing on your model in ways you don't expect it to, however, the situation can get very ugly and complicated to repair.

Figure 6.5 shows first my default head, which I built all of my shapes out of, and then the same head slightly modified to make the nose thinner from left to right. Let's just say I've already got all my shapes built, but I did this thinning of the nose after the fact, so none of my key shapes have that thin nose. If I were to now make the thin nose a base head for all of those blend shapes I had, at first everything would seem fine.

As I increase the slider for the smile shape, however, the nose plumps back out to its width before the thinning of the nose, because the smile shape (created before I thinned the nose) is *different* in that way. Now, as I add the Open shape, the nose actually gets even fatter than it was in the first place, *adding the difference again*. As I add in the shape to lower each brow, the effect compounds again. Even though I never built a nose that looks anything like the one you see at the end of Figure 6.6, I got there because, as I said, Maya (and any other program using additive shapes) won't care what I built or how that shape looks; it cares only about what *changed*, and if the nose moves out a little bit five, six, seven times, it's suddenly moving out pretty substantially.
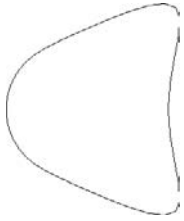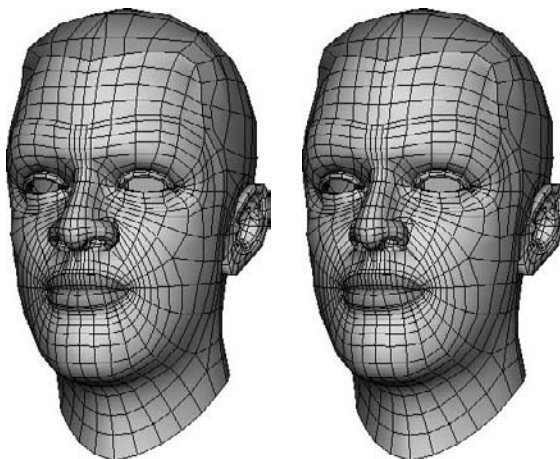
Figure 6.5

Default me (left) and a me that went for a little bit of plastic surgery (right)
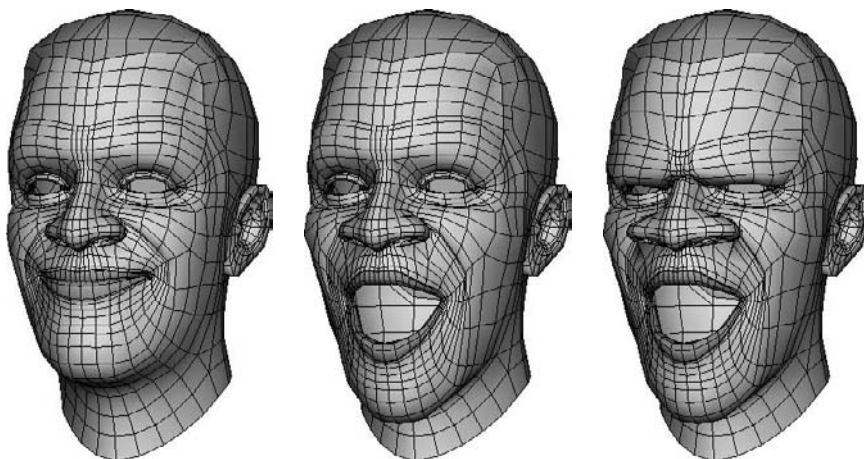
Figure 6.6

Three stages of the nose and its compound transformation

Shapes, schmapes. You always have to be careful with every single point you move and how you move it because the *differences*, not the shapes, are *added*, not mixed. If your character's head turns into a mushroom when you start using your blend shapes, this could very well be your problem—and there's no easy way to fix this after it's busted, either! It just means you're in for some elbow grease and head scratching.

ss2_blend_taper.mel: *Subtraction* of Shapes

Now that we've got you petrified with all things additive, it's time to introduce the notion of *subtraction* through the use of ss2_blend_taper.mel, which you will find on the SS2 shelf labeled Tap. (You'll find notes on loading the shelf in the introduction; this chapter and the following ones assume that you've installed and loaded the shelf as described there.)

Maya now supports the painting of blend shape weights using the Paint Blend Shape Weights tool; this lets you paint each blend shape's effect per vertex. Then you can simply duplicate the object and be on your merry way with your new shape.

`ss2_blend_taper.mel` is a tool that takes a painted blend shape, creates an object resulting from that weighting you've created, and then also creates one with the *opposite* weighting. This way, you get two shapes that mix back together perfectly to the original blend shape target. In this work flow, however, if you really want to take full advantage, there are a few things to understand.

First of all, to get access to the ss2_blend_taper functionality, you need a blend shape. To create a blend shape, select target shapes (or just one) and a base shape and create a blend shape. Now, using the Paint Blend Shape Weights tool, you should be able to paint the effect of the blend. Keep in mind that unless you have a shape set to something besides 0 in the Blend Shape Editor, you won't see any effect. If you *do* have a weight set, then the shape will change as you paint.

Subtraction

When you taper two shapes out of one using ss2_blend_taper, you will get two things that mix together exactly to form the original target shape. If, however, you taper a taper, that's where it gets interesting, and understanding how a blend shape is just addition, you'll see that this is merely *subtraction*.

Let's try an example. If you took a shape where you pulled the brows up (Figure 6.7a), and instead of splitting left and right, split it so the center was separated from the sides (Figure 6.7b), you'd have a shape where the outer brows move up (Figure 6.8a) and one where the middle of the brows move up (Figure 6.8b). No biggie, right? Now take the shape with the outer brows moving up, connect those in as a blend shape to the original, and go through the process again, *this* time splitting left from right, giving you Figure 6.9. In your scene, you've actually got *three* shapes now that will still mix to exactly form the original brows up shape. Are you seeing the fun part yet?

Each time you taper, you create a new fork in the road, with two shapes that can each be their own forks later in the tapering path. Everything tapered after each will always come back to the shape at the juncture. At each fork, you have essentially removed, or subtracted, the things down the *other* path.

This technique also very heavily reduces fix shapes, sometimes called corrective shapes. Since each time you taper a taper, you know what your mix will be, so the danger of those two tapers mixing poorly is zero. You know what they mix to, and since you sculpted that, you're not too worried about it being ugly. This may seem small, but on big-budget feature films, characters can easily have hundreds of shapes. At the core there may only be 60 or so, but the number of all the fixes relating to how those core shapes mix is enormous. Reducing that problem with this tool is neat.
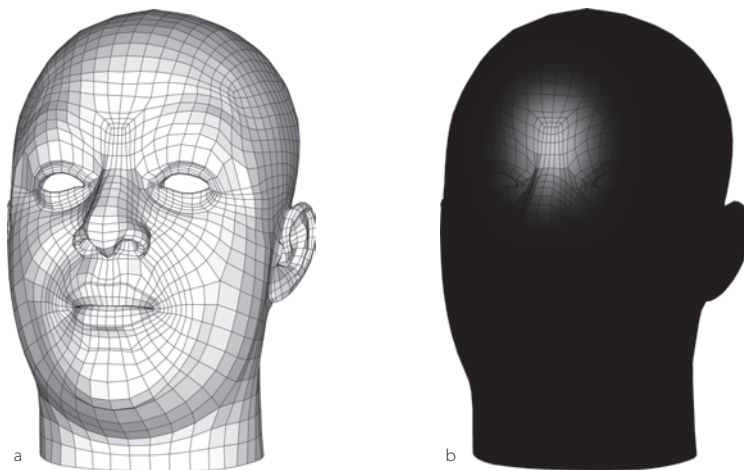
Figure 6.7
**Brows Up, and
then the area
you might paint
to split the center
from the sides**
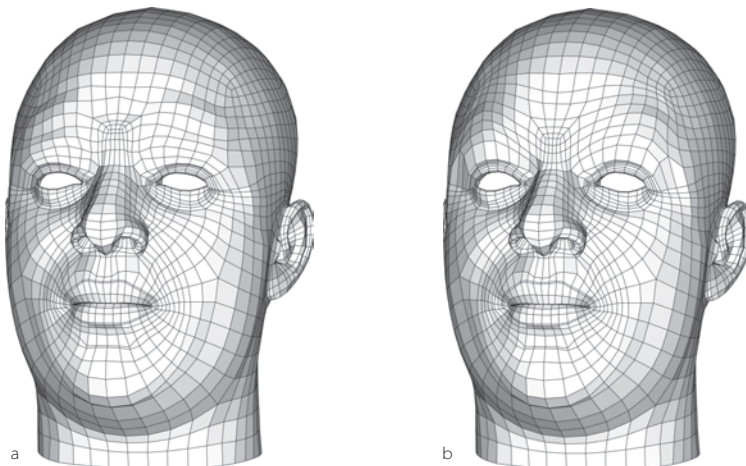
Figure 6.8
**The two shapes
you'd get tapering
the center. The
center of the brows
comes up in one
shape and the out-
sides of the brows
in the other.**
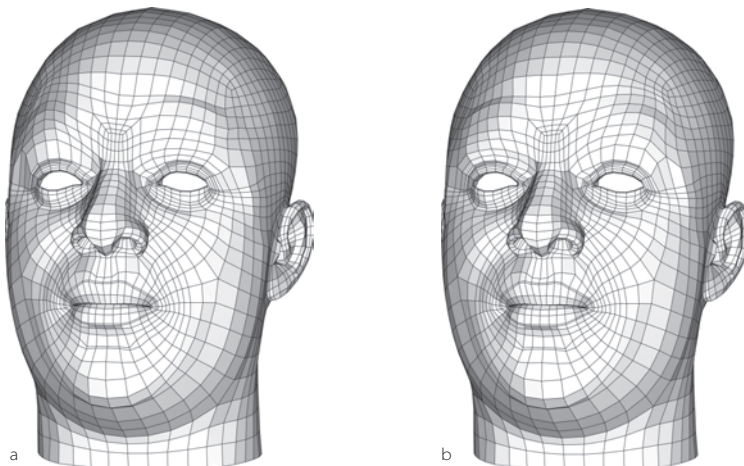
Figure 6.9
**Further tapering of
the sides to create
left and right brow
shapes would leave
you with something
like this.**

Ss2_blend_taper and ss2_blend_inverse

This concept is much easier shown than explained, so let's try another example. Load up taper_cube_sphere.ma and you should see a display like Figure 6.10. What you are looking at is a cube; that cube has a sphere-type shape as a blend shape. Open the Blend Shape editor and play with the slider to see it go from cube to sphere and back again. Now set the slider to 1 and leave it there. Now you should be looking at a sphere (Figure 6.11). Select the sphere/cube object and open the Paint Blend Shape Weights tool; use the settings you see in Figure 6.12. Now, scribble on the sphere. As you do, you should notice that the shape changes. Specifically, the more you paint in a certain area, the more it returns to the cube. In my example, I painted the side that is screen right, so the shape is sphere toward the left and cube toward the right (Figure 6.13).
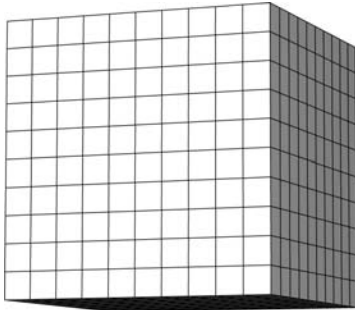
Figure 6.10

A cube, just like what you should see in taper_cube_sphere.ma
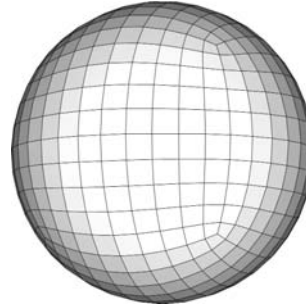
Figure 6.11

When you manipulated the blend shape slider, the cube should have changed into a sphere.
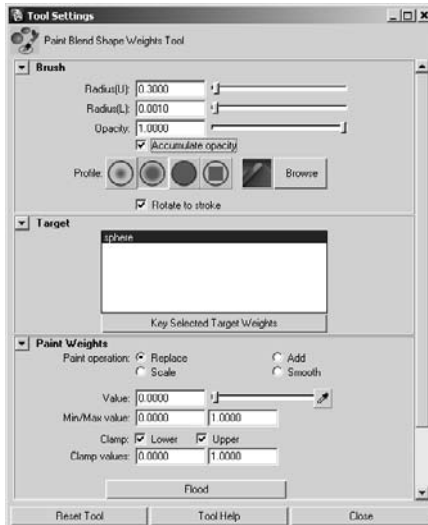
Figure 6.12

Some settings to paint away the blend shape effect
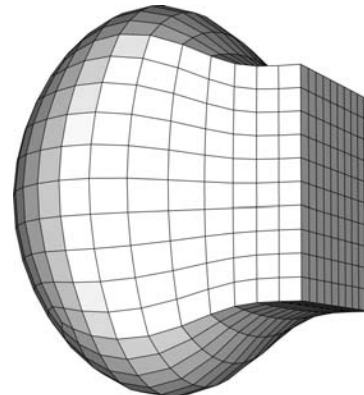
Figure 6.13

The look of the cube/sphere with the blend shape weights painted out toward screen right
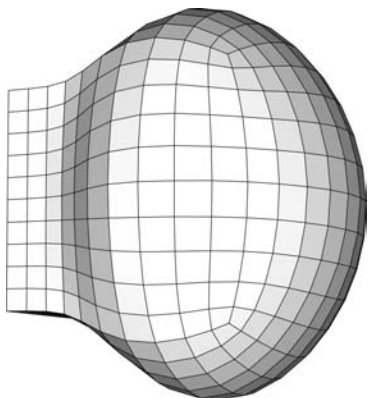
Figure 6.14

The inverse button should swap which side of the cube is painted and therefore change the shape from sphere/ cube to cube/sphere.
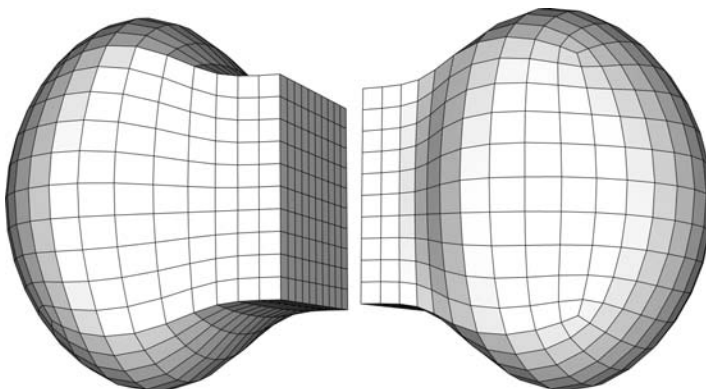
Figure 6.15

Blend taper gives you both what you painted and its inverse counterpart as new shapes.

This is where we'll start using some of the ss2 tools. On the ss2 shelf, hit the button labeled Inv. This is ss2_blend_inverse. What it does is it turns your weighting inside out.

As a result, you should now see something different. In my case, where the right side was like a cube and the left like a sphere, I now have cube left, sphere right (Figure 6.14). Once you've sufficiently hit the button enough and watched the shape pop back and forth, you can look at ss2_blend_taper. Select the object you've been painting, and now hit Tap on the shelf, ss2_blend_taper.

This should create two new objects and select them. Look at them closely and you should see a shape that is the weighting you had when you clicked the button *and* another shape that is what you had when you were hitting the Inv shelf button; mine are pictured in Figure 6.15. The sphere was the first fork and it has split into these two shapes. If you were to now reset the sphere slider to 0 and then delete the original blend shape (just the blend shape, not the object), you could apply these two shapes to the original cube as blend shapes. To do this, select lsphere and rsphere, then cube, and create a blend shape. In the Blend Shape Editor, set both shapes to 1. What's this? As predicted, they make the sphere exactly. Seeing that the addition of the two new shapes is exactly the original shape is the only reason I had you create this blend shape; now that we've proven that, let's clean up. Set all the shape sliders to 0, delete that blend shape, and reapply only *one* of the half-sphere shapes to the cube again.

Forks (Tapering the Tapers)

Let's take it to the next level. Set the only shape slider to 1, and open up the Paint Blend Shape Weights tool again. Now, start painting, say, the bottom part. Press Tap again and you should now have pretty much only quarter-sphere-type shapes (Figure 6.16). Set
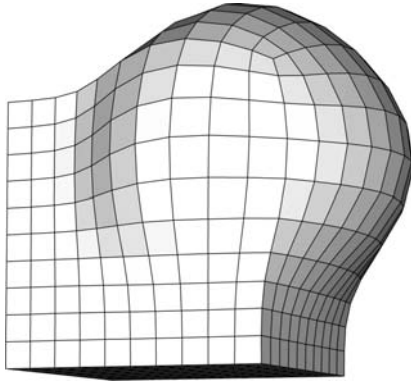
Figure 6.16

Tapering the horizontal halves of the sphere vertically gives you quarters, which, from cube to sphere, looks like a bulge.
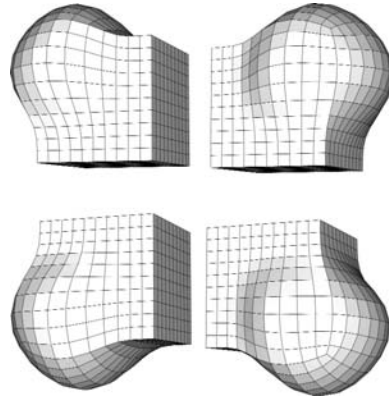
Figure 6.17

All four quarters you'd have after splitting the horizontal shapes vertically

everything to 0, delete the blend shape, and reapply the new shapes into the cube. You'll notice that they, too, add to what they were tapered from, the half-cube sphere. Set it all to 0 and delete the blend shape again; now repeat this process on the other half shape so that you end up with four quarter-sphere-type shapes (Figure 6.17). After clearing the blend out again, plug in all four quarter spheres as a blend shape. Now, if you set all four shapes to 1—guess what?—you're back at your sphere. I hope this illustrates how you can taper the tapers, and at each step, you create a fork in the "it adds back up to the original" road. You can literally do this nearly infinitely if it suits you. In my case, I will talk you through 8 shapes to sculpt in this chapter and another 6 in the brow chapter that are each meant to be split in two (left and right), which ends up in a lot of shapes (again, the 40 or so shapes I'll have you generate are nothing compared to the hundreds that would be done for a real production). The reality of the situation is, however, that I only actually built 6 from *scratch* and got to that final number in large part using this technique. I'll now run you through the most tapered shape to show you what I did.

Scrunch = Lots

In Figure 6.18, you'll see one of my big complicated taper-ready sculpts, what I call the scrunch. The first taper I did was to paint the mouth and some of the cheeks out and taper that, giving me a smile and then a shape that is the combination of a sneer, squint, and brows down, both in Figure 6.19. Then, I took the sneer/squint/brows one and painted out the squint. That gave me the squint and then another shape that had the brows down and sneer (Figure 6.20). From here, I painted the sneer and brows down apart, to give me Figure 6.21. You'll notice the forking that went on. Everything all leads back to the scrunch. I know I can mix my smile, sneer, brows down, and squint together and they'll

look good. I then took all of these, plugged them into one blend, and tapered them all in half left to right giving me eight shapes, all pictured in Figure 6.22. Eight shapes with big mass movement, none of them creating a need for fixes with each other. It's a good thing.
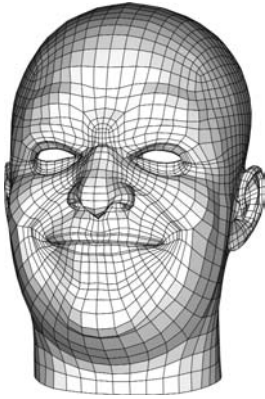
Figure 6.18

The scrunch shape; it can be tapered several times over and save tons of unique sculpting time.
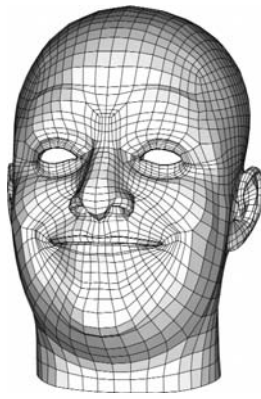
Figure 6.19

Tapering out the smile from the rest of the shape
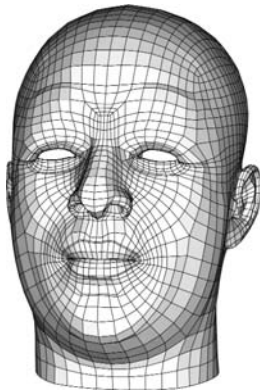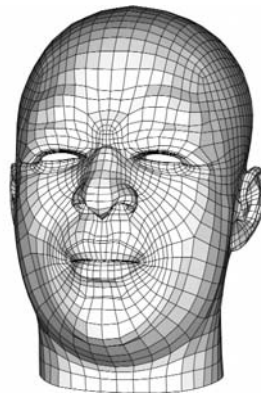
Figure 6.20

Tapering out the squint from what was left after smile removal
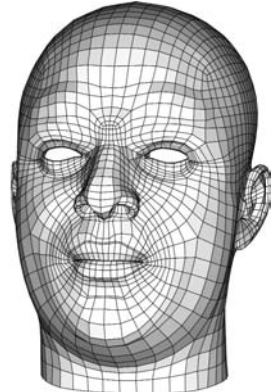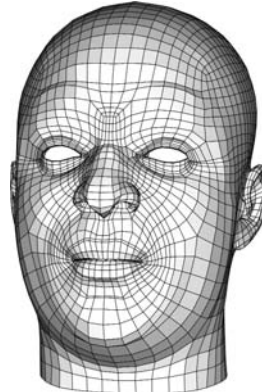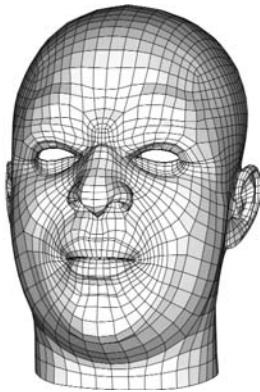
Figure 6.21

Tapering a split from the sneer and the brows down
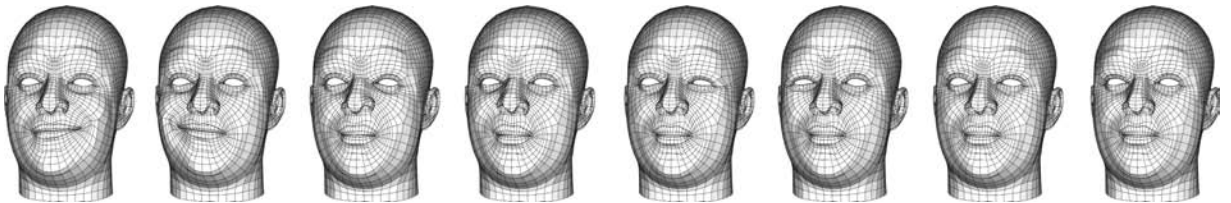
Figure 6.22

Tapering all the previous tapers, this time left to right, gives me eight shapes that all mix very well together.

The instructions from here on refer to the final symmetrical shapes, not necessarily the authoring path you might take to get there. Once you've got a few shape sets under your belt, definitely come back and try this technique to get to some of the final shapes you'll read about. There is no right or wrong about what combinations to try and start from or extract from; I do it a little differently almost every time, but I highly recommend experimentation with it. This technique has reduced my own personal turnaround time on shape sets by an order of magnitude.

COPYING WEIGHTS

You may notice that when you get going with this painting of blend shape weights, you actually only paint in one shape's channel at a time, not the blend shape as a whole. If you want to copy what you have painted from channel to channel, you can use Maya's importing and exporting of weight maps, but I'm too lazy for that and so wrote a tool. The shelf button Cop copies weights from the *first* channel to the rest. This means you can paint in one, copy it to all, and you're on your way. FYI, ss2_blend_taper, the Tap button, will do a taper on every shape in a blend shape, so this copying of weights across shapes can be very very handy for bulk tapering.

The Default Shape Is Bored. Period.

All this additive, subtractive, and ss2_blend_taper talk is why it is incredibly important to make the default shape of your character bored. I hate to say it, but even though the book is titled *Stop Staring!*, these poor characters all need to start off staring, bored, and expressionless. The following images are the base shapes for the models you've seen and will continue to see.

Pete   Sally Ann   Tina   Jason
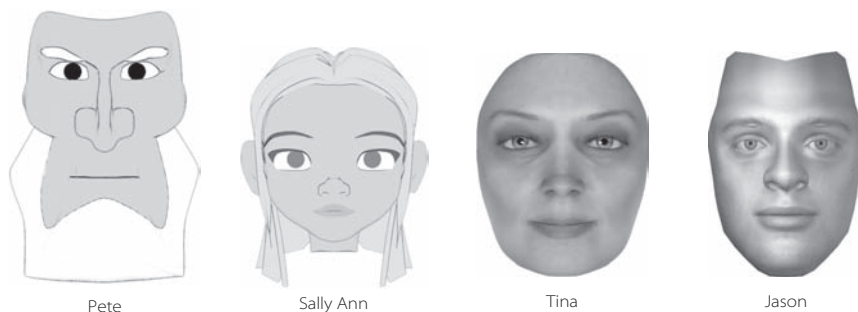
The face you start with, your default, is the one you're stuck with as your base for all these mixes. This isn't to say that you couldn't put a different *facial expression* on there as

the character's standard/default expression—that can be done afterward. It's to say that everything refers to your base shape on a functional level, so leave the canvas open. The complete lack of muscle influence is, in my experience, always the best base, and for that very reason: there's no muscle influence. Nowhere to run *from*; every shape is going *to* its destination. If your default shape is smiling, then building a Narrow, a Frown, and a Lips Up, and so on, and mixing those all together—every one of them is likely to have an element of "un-smile" (not a Frown, just less smile) whether intentional or not. As with the expanding nose example a few pages back, when you mix five small amounts of "un-smile" together, the result will be a pretty sizeable un-smile.

Deciding What to Include

Something I recommend when creating these key shapes is looking in a mirror. It'll make you aware of the entire area affected by each shape, but the trick is going to be building certain shapes so that they *don't* include all of the effects you see in the mirror.

A smile, the first shape we will build, is a perfect example. When you smile, your eyes squint; this is part of what makes a smile very genuine. When we build the smile shape, though, we are going to be using it for more than just smiling. It represents the Wide shape (Wide/Narrow) of the mouth for lip sync and it also represents, obviously, a smile. If we include the squint in the smile shape itself, then we lose the ability to use the mouth portion, the Wide shape, *without* the smiling eyes aspect. This is no good. The squint portion all on its own is useful in any number of other expressions, as well as simply by itself. The Squint will be its own shape. This is the kind of place where tapering comes in very handy; you can make a good-looking shape and then extract components of that shape for individual use.

TERMINOLOGY TIME-OUT

I will use certain terms you may or may not be familiar with, so I'd best describe them all.

Blend shape, morph target, key shape, shape key These are all different ways to describe a shape that is assigned to another (by a blend shape relationship).

Key set A group of blend shapes.

Skinning, binding, or weighting The process of assigning the amount each point (CV, vertex) will follow each joint in a skeleton.

Base shape, default shape The character's shape without any expression, or influence.

Setup, rig Terms I'll use to describe a finished head, all its shapes included and connected to an interface.

In the future, to create a smile in animation, we will add the "smile" we build with the Squint shape. At first this may seem like more work than just having a separate smile, Wide, and Squint that each does a complete job on its own, but in fact it's much, much faster, easier, and more robust this way. If we were to leave the squint in the smile shape *and* have an independent Squint shape as well, we'd end up with a double-powered squint, which, well, would likely not look too good, as Figure 6.23 illustrates.

To deal with problems like that, we'd have to un-animate certain curves, such as the smile, as we moved through different shapes, such as the Squint. That takes *way* longer and is not a fun, creative animation process; it's problem solving on an ongoing basis. The way to get around this is just to separate things out, even if that means we're building shapes that can't really be achieved by a real face. I'll represent any shapes that will need to be built in this method of "knowing non-inclusion" with an image such as Figure 6.24; I'll make it look just like a weight map.

The lighter areas are the ones to build so the face will move realistically; the darker ones show the effects tapering back to the default face. So even though your goal is a realistic smile, you may have to build two unrealistic halves that are tapered apart.

This whole component shape thing is open-ended, but not quite as lunatic as giving you individual muscle controls—which, believe me, is not as glamorous or even as useful as it sounds; it can be very clunky. So, some of this safeguarding against combination-breakages is done by careful selection of the shapes we build, and some is done at the interface level, where we will actually put certain shapes on opposite ends of the same control so that try, try as we might, we *can't* get them to break the face. All that said, you can still rip your face to pieces if you really want to; I'm just making it harder to do it accidentally.

Figure 6.23

A smile with squint plus a Squint equals one ugly face.
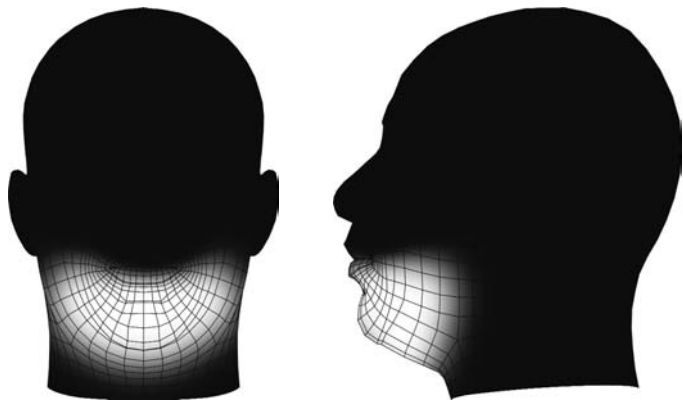
Figure 6.24

The area of effect a shape should have will be shown as if it were a weight map.

What to Build?

I'll have four setups for you in Chapter 12 ("Interfaces for Your Faces"), but there are really only two different key sets to build. For the *simple* setup, we'll build whole shapes, but for all the other setups, we'll take those whole shapes and separate them using ss2_blend_taper.

Something you can do to expand upon the visuals here is to load my head, called `MouthShapes.ma`, from the Chapter 6 folder on the companion CD and actually see the things I describe in motion. You can orbit around the head and look anywhere you need for more elaborate examination.

Binding Sufficiently for Building

Although we're not yet setting our face up for animation in this chapter, the process of key shape building can be greatly aided by setting up a simple jaw bone. Since we've built our model to deform into many different shapes nicely with the layout and default shape, as a side effect we've left ourselves some tight work in the corners of the mouth. By adding a jaw bone, we can open the mouth up to work on it; we can get into the tight spots by simply loosening them up with a simple rig. Instead of guiding you through the same process twice, I'll refer you ahead to Chapter 11, "Skeletal Setup, Weighting, and Rigging," to see how the jaw binding is done. At this stage of the game, the binding can be really simplistic. You don't even need to worry about the rest of the joint hierarchy; you're only, as the heading states, binding for building.

While not at all physically accurate, best results come from the jaw joint being placed at the back corner of the jaw but flat to the X axis, where you'd probably put it if you were guessing. The weighting should approximately match Figure 6.24.

> Be sure to pay special attention to where the mouth corners end up. The points in that area should remain fairly close together so that when the mouth opens and closes, the opening is somewhere between circular and almond shaped.

Building the Shapes

With plenty of information swimming in our heads about additive shapes mixing and coexisting, subtraction, and ss2_blend_taper, it's time to actually get into the work of building shapes. As I said in the introduction, this may take some time, and that's okay. Since in my methods we'll "bake" everything down to just shapes, you can create clusters, do some joint weighting, or otherwise hack and slash your way through getting the end result of the shape. Do whatever you like, as long as at the end of the shape creation, you

make a duplicate of just the mesh, thereby "baking" the deformations into good ol'-fashioned shapes:

> Smile / Wide
>
> Narrow / OO
>
> Upper Lip Up
>
> Upper Lip In
>
> Lower Lip Down
>
> Lower Lip In
>
> Frown
>
> Sneer

Begin all shapes by duplicating the weighted default model and renaming it as the shape you will work on. Each and every shape will benefit from you being able to open and close the mouth at will. Also, you want to work on a duplicate, so you don't lose your default!

Open

Face shape name: jawOpen(1 & 2)
Teeth shape name: teethOpen(1 & 2)
Derivative shapes: N/A

This first shape to build is so easy, I don't usually even think of it as a shape. The simplest way to do this is to take the weighted model, open the jaw joint, and then duplicate the mesh and delete the history so it's just a shape and *not a shape manipulated via joints*. From there, I'd go and clean up the area where the jaw meets the neck (it usually gets shoved inward in an ugly way), to look like Figure 6.25. The teeth, mouth wall, and tongue, if it's separate, need to be shaped to match.

Figure 6.25

The weighting, and more views of the jaw
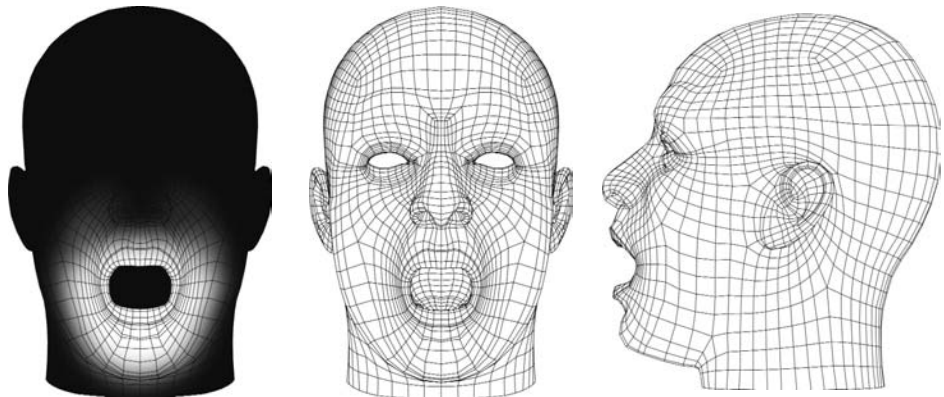
Smile / Wide

Face shape name: smile(1)
Derivative shapes: lSmile(2), rSmile(2)

In the smile (Figure 6.26), you're forced to pull some points in extreme ways; you need to create a crease, which requires tight point work for quite a stretch on the face. If this shape proves too difficult and there's no way to get it to look the way you want, then I recommend going back to the modeling phase and reordering some points around, then starting fresh on the smile. After all, you won't be losing four or five shapes; you'll just be backing up on the one (and the very easy *Open*).

The smile is one of the shapes *most* often easily integrated into a larger sculpture and extracted cleanly using ss2_blendTaper.

I rarely get past the smile in one try. I almost always have to go back and tweak the default shape, but that's okay, it's all part of the process. After you set up a few heads, testing the default with a quickie smile becomes just another part of building the default shape. I recommend building a quick and dirty smile to get the testing part over with fast.
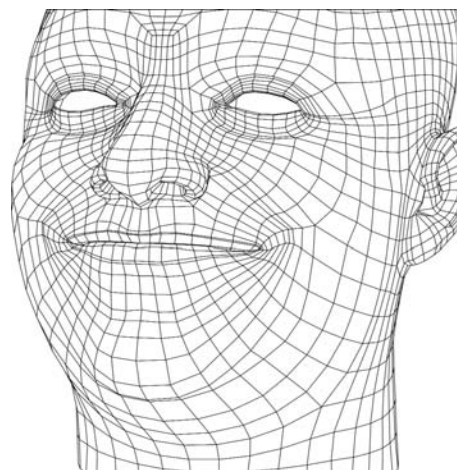
Figure 6.26

A smile

Basic Ingredients

The smile, like all other shapes we build, has important aspects that make it look right. These small descriptions are meant to help you figure out on your own, with a unique character, whether the shape will work for your setup. Each shape will have a different list of things, as each shape's important aspects are different. Go through each one first, then make a run at building your smile, and then read through again, using this text as a checklist.

> The smile list will be more verbose and detailed than other shapes' lists because it also doubles as the introduction to the things you should look for and why.

Inclusion The area affected by the smile shape, as we've already discussed, should look like Figure 6.27. The mouth and the surrounding mouth area have the most effect, and as the shape moves up toward where the eyes would clearly squint, we will fade off the effect and leave that area alone. The smile will later mix with the Squint; this is the main reason to taper off the effect in that region of the face.

Width Every character will differ, but a generalization I've worked with is that in the default shape, the mouth width comes to about the inside edge of the iris. In a smile shape, the mouth is usually wide enough to line up with the outside edge of the iris as in Figure 6.28. It may not seem like much, but properly supported by the right shape and creasing, it's a good guideline.
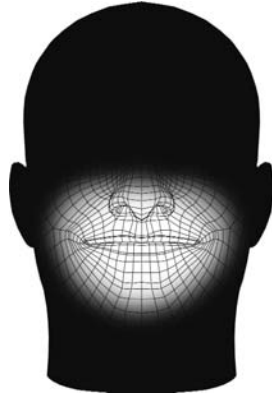
Figure 6.27
The affected region of the face during a smile built to work in cooperation with other shapes

Figure 6.28
The smile width

Depth The depth change from the default should be very noticeable. It is common to build a shape only from its front, but as I've stated before, the face has no front; it's a continuous curved surface. As the mouth spreads left to right, it must also move back. A good gauge of how much it should move is anywhere between half and fully the distance traveled laterally. Figure 6.29 shows this.

Height In most cases, the mouth moves up vertically, one half of the lip height. Take a look at Figure 6.30. If a character has very thin lips, this measurement reference starts to fall apart, and it should be measured by distances, from where the lips meet to the nose. Between one-fourth and one-half of that distance is a good place to move to. Someone with a long droopy face will really lift their whole face as they smile.
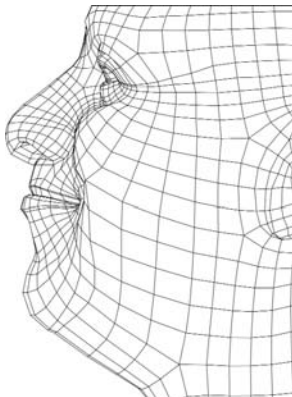
Figure 6.29
The smile depth

Figure 6.30
The smile height

Two creases on each side   There are *generally* two creases on each side of the smile and a space between them. Commonly, it is a misperception that the mouth goes all the way up to the crease in the smile, but in reality that's not generally the case (although it's a perfectly acceptable stylistic choice). The corner of the mouth pulls up and out and generates a crease in the same area that is shadowed in the base pose. The most noticeable crease on the face, the drape-like tucking back of the cheek area, is also shown in Figure 6.31. The area between these two creases bulges slightly.

Advanced Ingredients

Beyond just the end shape, other considerations are important. We must concern ourselves with the path the points took getting to their destination and how the shape looks when opened.

Path   Here's one of the places where our clean structure helps us the most—it gives us an easy map for identifying problems. When I think a shape is getting close to completion, I'll look at it in an animation. I'll set my shape up as a blend shape on a default head. On frames 0 and 20, I set keys keeping the mouth at default. On frame 10, I set a key on the shape I'm working on. Then I loop the animation and watch the mouth go into and out of the shape. What I'm looking for is the points' paths. After staring at a shape looping long enough, you'll notice certain points that are disagreeing with the overall motion. Figure 6.32 shows a good transition over a few frames.

If a point is not cohesive in its movements relating to other points, it will need to be made to cooperate. Otherwise, once it's textured and mixed with multiple shapes, who knows what ugly stuff could happen?

Figure 6.31
The shadowed mouth corners become one of the creases, and another appears. The area between the creases bulges slightly.
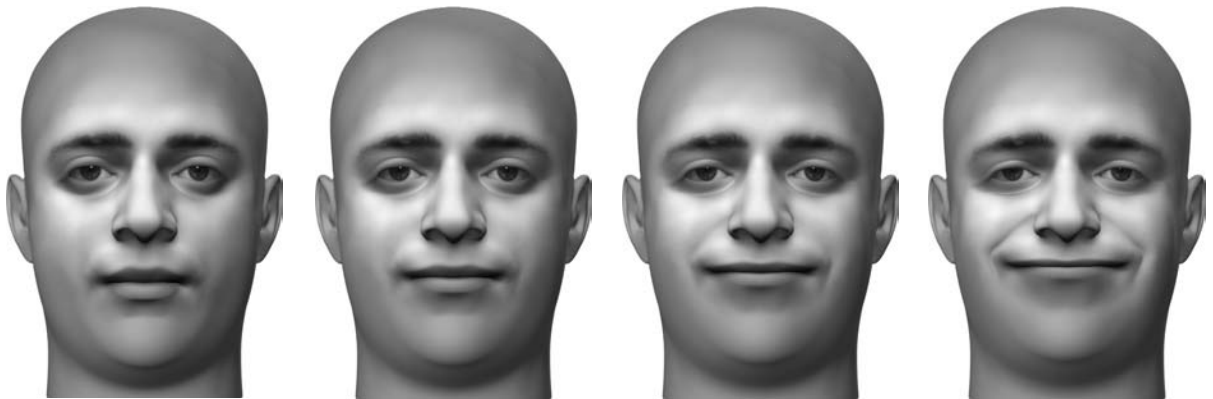
Figure 6.32
A Default-to-Smile animation to show the paths of points.

Open Combining this shape with the opening of the jaw, you should be able to peer to the inside edge of the mouth and make adjustments accordingly. It's easy to forget about the inside of the mouth—don't. The most likely places to freak out when combining multiple shapes are the areas hardest to see, such as the inside edge of the lips and the mouth corners. Luckily, opening the mouth to cross-check this on every shape gives us a better look at both. Frequently open the mouth and reshape both those areas so that they are very clean. Sometimes it may be necessary to slightly compromise the shape as it appears *closed* so that it *opens* cleanly. This whole system relies on the mixes of these shapes cooperating; compromise of a minor detail in favor of a good mix is *almost* always a good decision. Figure 6.33 shows the combo shape.

Style

In the next few paragraphs we'll talk about the dos and don'ts that are tied to working with different styles, be they realistic or cartoony.

Don't do the cartoon unless you're doing cartoons Figure 6.34 shows you exactly how *not* to build a smile. This type of shape has etched itself into our minds as viable, due mostly to the way a drawn smile looks, which is too bad. It works in drawings, but not so much in 3D. The corners of your mouth can't simultaneously pull up higher than the center. On characters who are decidedly *not* human, this look can be made to work. If you recall the poster from *Finding Nemo*, the shark actually pulled it off nicely, but there was a cheat— his teeth and gums bent along with the curve. We'll talk about that more in Chapter 13, "Squash and Stretch and Squoosh."
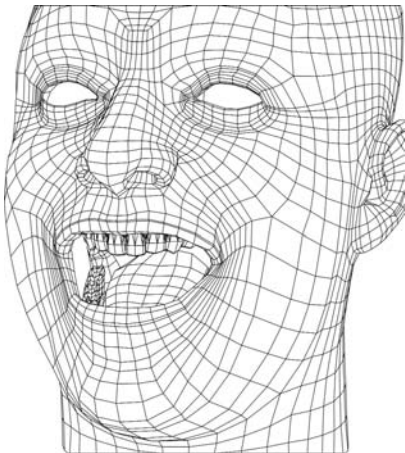
Figure 6.33

The smile in combination with the open shape
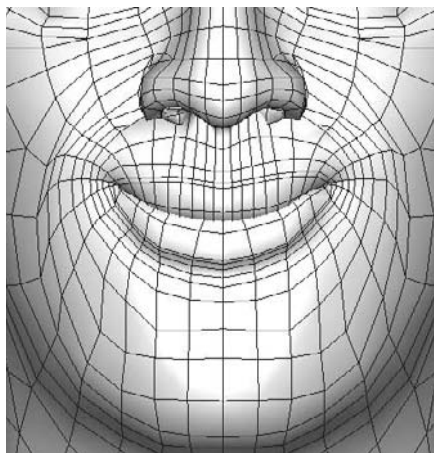
Figure 6.34

A very bad smile, and the culprit behind our impression of why we think that shape is what a smile looks like
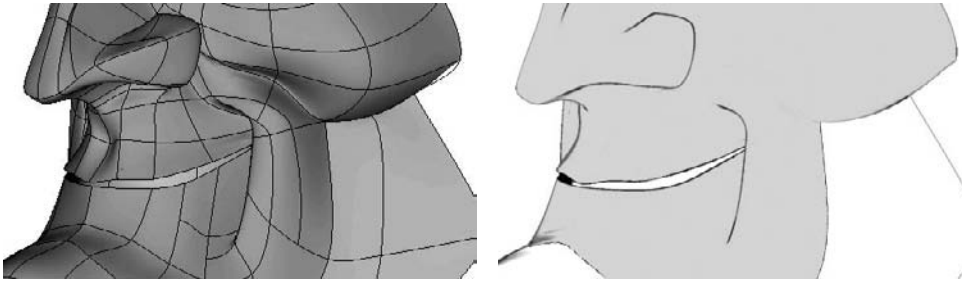
Figure 6.35

A male toon smile, shaded to show how severe the shape can get and then rendered properly to show the final effect

Cartoon male A smile meant for toon shading is largely the same as in regular 3D, but certain things need to be done differently. Usually, in toon/vector renderers, there are two things that are going to cause a line to draw: (1) A big change in the direction of normals and (2) a big difference in distance to camera. You may have to twist and contort the mesh pretty hard to satisfy one or both of those criteria. In one of my characters, Pete, the shape of the mesh to create that line looks like Figure 6.35.

This is obviously very weird in shaded mode, but rendered, it works convincingly. When working with toon characters, always take the shape way too far because you will lose a lot of surface detail and have to rely on large shape changes. As a result, judging toon shapes in shaded view is almost useless; you have to render, render, and render again because that's the actuality of what your audience will see. The last tip for cartoon smiles: Ignore that "Don't do the cartoon thing" section preceding this one!

Cartoon female Cartoon females are tough. The trick is to give them the expression without otherwise moving their face. You don't want as much creasing as you do on males; it becomes very unattractive very fast. If you're working on an old hag, sure, fire up the creasers, but for cartoon females in general, it's all lips, nothing else. Figure 6.36 show's Sally Ann's smile.

Figure 6.36

Sally Ann's decidedly more subtle smile

Narrow / OO

Face shape name: narrow(1)
Derivative shape: lNarrow(2), rNarrow(2)

The second half of our Wide/Narrow pair, OO needs to be modeled into a pucker that, combined with a little bit of Open, gives us that OO. As you may have guessed, the Narrow shape should be less wide than the default, and it should move forward. The lips should plump as they shift into the shape. The Narrow used for most of the visuals here took me approximately 4 hours to build. The smile, Narrow, and Frown usually take longer to build than other shapes. Figure 6.37 shows the Narrow *beauty shot*.

The Narrow usually does *not* benefit from integration with other shapes and then extraction.
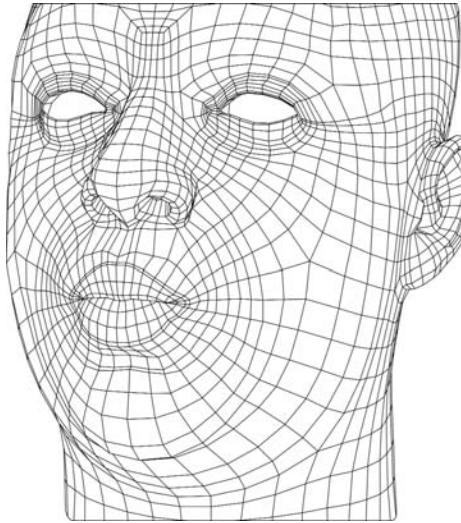
Figure 6.37

A Narrow
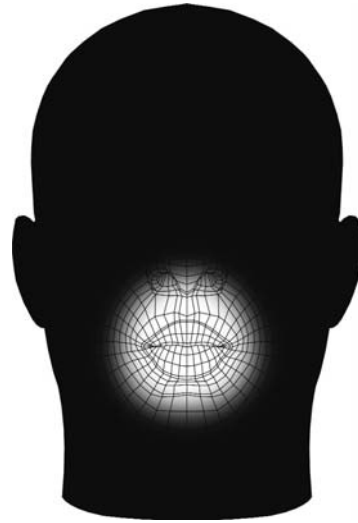
Figure 6.38

The affected region of the face for a Narrow shape

Basic Ingredients

OO or Narrow shapes have a pretty easy process to them because you can scale the whole area, shape the outside rim as you want to see it, and then work out from that area, including the rest of the face in the shape and smoothing the rows of points outward.

Inclusion The Narrow has no hard and fast inclusion rules. You can choose to taper its effect quickly or have it subtly affect areas all the way to behind the eye. The more you affect, the better it will look but the more time-consuming it will be to build. See Figure 6.38.

Width The Narrow shape is usually a little more than half the width of the default mouth. I emphasize *usually*. This shape we're building is to be thought of as the *furthest* we'll take the Narrow to, so it should be pushed to an extreme. To establish the width, I usually select the points that define the lips' outside edge and everything within that and then scale. From there I'll tweak the geometry around the edges to fatten up the outside rim. Try using the Sculpt Geometry tool! By shaping certain areas and then selecting vertices and using the Sculpt Geometry tool's smoothing, you can usually get a lot of the major point-wrangling done *for* you! This is pictured in Figure 6.39.

Height The Narrow shape can sometimes actually be a little taller than the default. In most cases, though, it should be the same height as the default. The Narrow should never ever be shorter in height than the default; that would create a look of the mouth shrinking, which is not an effect we would usually want to achieve.
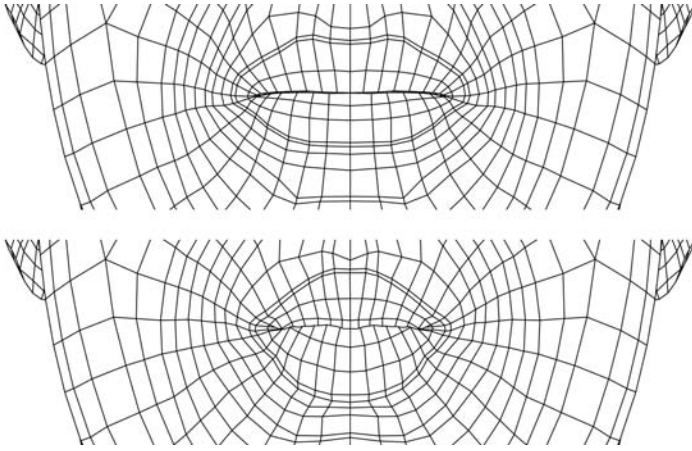
Figure 6.39

The Narrow width
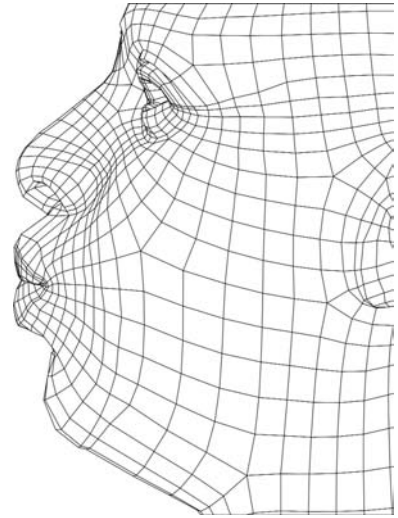
Figure 6.40

The Narrow depth

Depth The Narrow shape should move forward. How much can be based on the character, but it should always move forward some amount. As the width is reduced so drastically, the mass has to go somewhere. Figure 6.40 shows this.

The inside moves out In a good Narrow shape, the rows that are inside the mouth have to move toward the outside. This shape is the main reason I have you build your mouths past the point where you can see them on the inside. There's a row in the default shape at which your lips meet. In the Narrow shape, that row gets moved forward. The row inside of that row is now also a meeting point. You may need to take a close look at Figure 6.41 to see this.
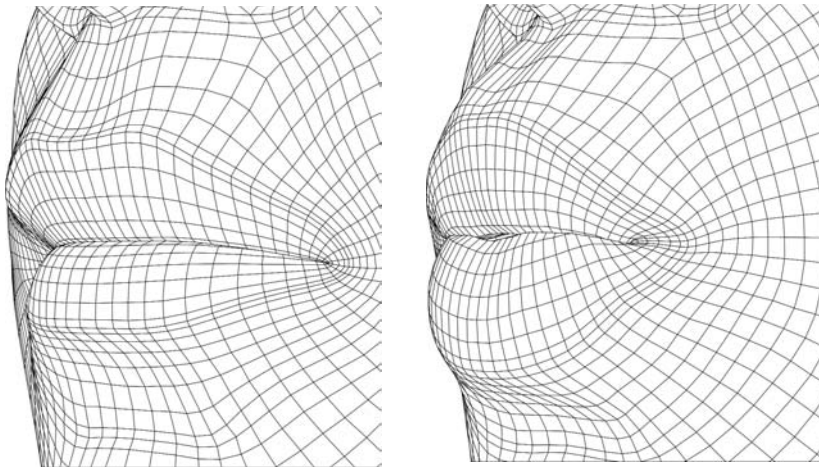
Figure 6.41

These two frames show that the rows of points actually roll out and forward in a Narrow, they don't just push.

Don't do the keyhole! I'm borrowing the name from a friend I used to work with; he called it "the keyhole." Don't do it. It's bad. The keyhole is another—in fact, a more common— approach to building an OO-type shape. I instruct you to narrow the mouth, but there really are other ways to create the look of an OO shape, and that is to tighten the sides of the mouth vertically, to pucker and pull the middle vertically apart, as in the first image of Figure 6.42. It does kind of portray the look of an OO, but that is more of a pucker than a Narrow. We *will* be able to get that look through combinations of other shapes (including this one, partially), but that shape is not *this* shape.

The second image of Figure 6.42 shows a keyhole-style Narrow with the open shape mixed in, and hopefully you can see why we don't want that for this shape. You can't get AHs, OHs, any of those kinds of shapes, and you get that weird, well, "keyhole" shape. If you can avoid it, don't ever build an OO/Narrow shape that looks like Figure 6.42. Again, we'll be able to get that look when *closed*, but, we'll get it through combinations, not direct sculpts.

Advanced Ingredients

With the Narrow being so heavily involved in lip sync and expression, the path it takes and how it mixes is incredibly important to making it as effective as it can be.

Path If you've followed the structure the way I've laid it out, there's almost a built-in road map to track this. When you've first gotten your lips looking good, you can then turn your attention to the skin leading up to them. The easiest way, after the lips are done, is to (from the front view) pull points along the *track* they're already on. Figure 6.43 is a series of images showing you the path.

If, from the front view, you keep a point roughly on its own "line's" trajectory, you're in a good position to get the shape done quickly. With the Narrow shape, you just have to keep the points lined up and spread the stretch out.

Figure 6.42

The dreaded keyhole style OO. Don't be a statistic!
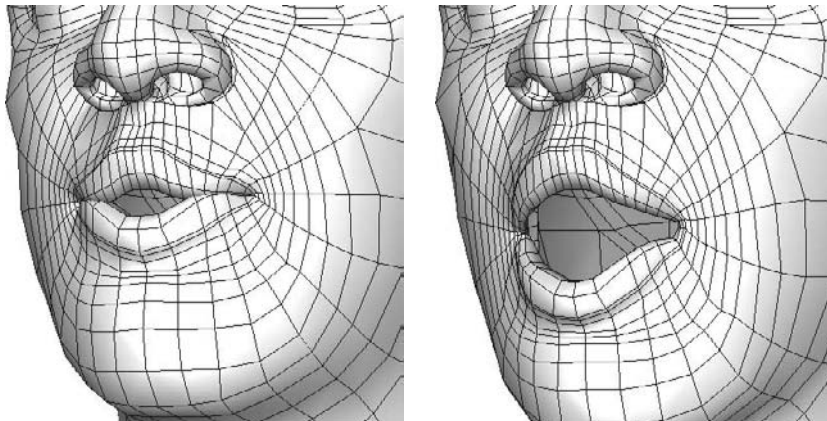
Figure 6.43

A Default-to-Narrow animation to show the paths of points

Open Combining the Narrow with the opening of the jaw, you'll likely get a very strange shape if you open the mouth wide and up. Figure 6.44 shows this odd but still correct version of the shape. Although you'd reduce this shape by the time your mouth got that open, this combo would look right with the mouth less open.

Figure 6.44

An Open Narrow

Creasing For all the talk of creasing I've done thus far, the Narrow, one-half of the most important cycle of animation, is in fact crease free. If your character has, as a default, creases in their face along the smile lines, this shape should reduce or remove them. Generally, this is one of the smoothest shapes of them all. In most cases, the Narrow should suck the sides in slightly, so the areas usually creasing are pulled taut.

Cartoon Style

Both male and female cartoon characters have the same considerations with this shape. The Narrow doesn't need to include as much of the face as a realistic character's Narrow because it's likely we won't see that shape anyway after it's all tooned out. We merely want to be sure that the shape dissipates over the face in a ramped manner so that mixes can work out. Toon Narrows can usually be done very quickly. Figure 6.45 shows Sally Ann's and Pete's Narrows.

Figure 6.45

Sally Ann's and Pete's Narrows
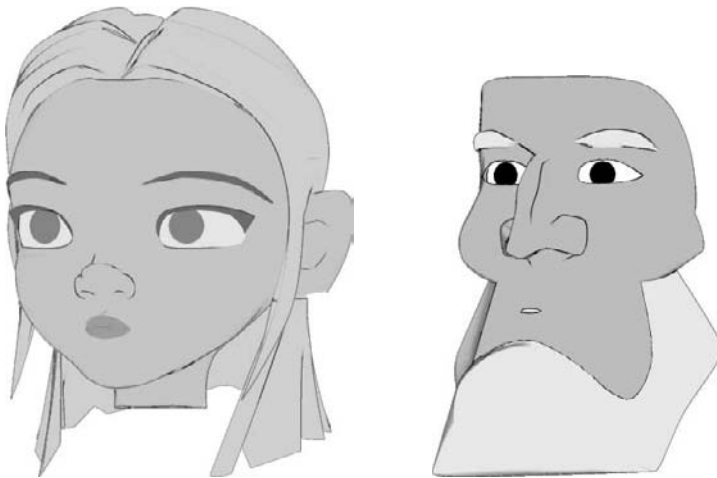
Upper Lip Up

Face shape name: uprLipUp(1)
Derivative shape: lUprLipUp(2), rUprLipUp(2)

The smile will need some teeth-baring to help it look like a true EE shape. To create an F, we'll also need to pull the upper lip up, and to make the sound of a SH, we'll need the same. All of that leads us to the Upper Lip Up shape (Figure 6.46).

The Upper Lip Up is usually something that combines well with other shapes like the Lower Lip Down or even sneers.

Basic Ingredients

For our particular purposes in this system, looking at a raising upper lip in the mirror may not give you all that you need to keep it a happy contributing member of the shape set, so what follows is some important info.

Inclusion If you pull your upper lip up in real life, it causes a sneer. Since a sneer is something we'll have as an independent shape, we don't want that included in this shape. For the Upper Lip Up, the affected area will include only the lips, and the points above that need to be readjusted to smoothly line up again with the face (Figure 6.47).

Width and Height The Upper Lip Up has no width change from the default; see Figure 64.8. The upper lip should form a smooth M shape with its silhouette. There are two main pulls vertically above the fangs, and the area in the middle is basically dragged along for the ride. The height should most definitely clear the top of the teeth and reveal some gums.

Depth The Upper Lip Up should pull its peaks back slightly, but only as much as is needed to follow the contours of the face. It should most definitely not sink into the face; see Figure 6.49. The center should not move back at all because the teeth are in the way.
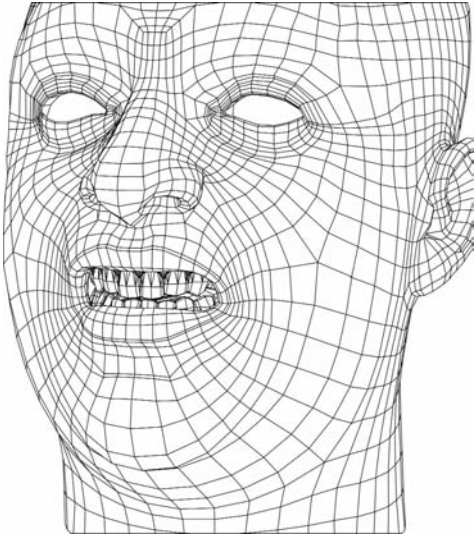
Figure 6.46

An Upper Lip Up
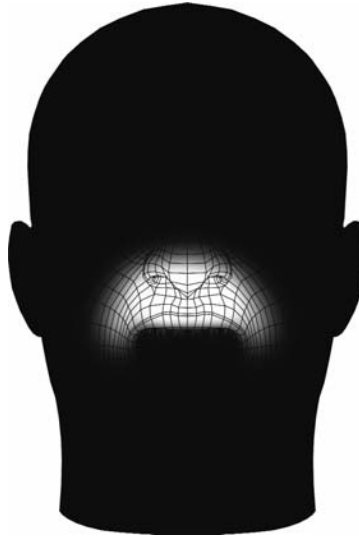
Figure 6.47

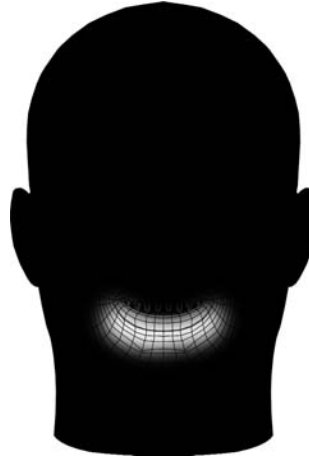**The affected region of the face during an Upper Lip Up built to work in cooperation with other shapes**
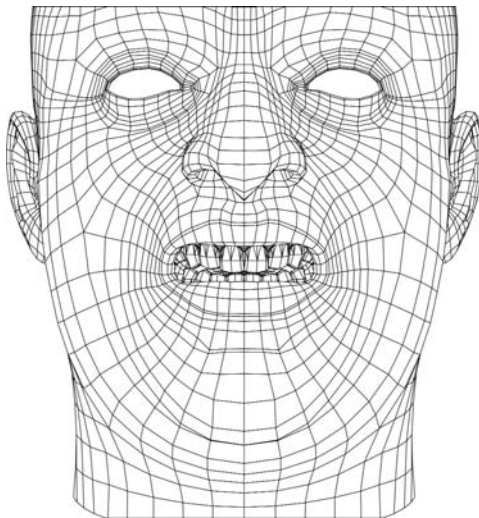
Figure 6.48

The proper placement of the peaks of the Upper Lip Up should be roughly above the fangs.
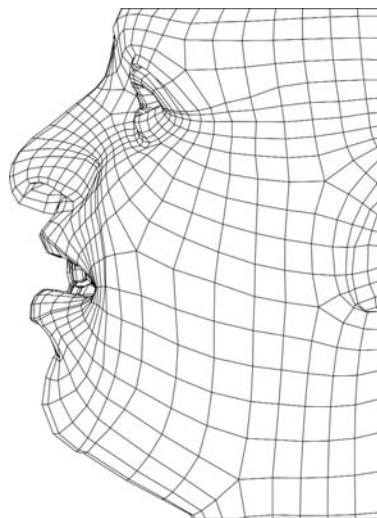
Figure 6.49

Upper Lip Up depth
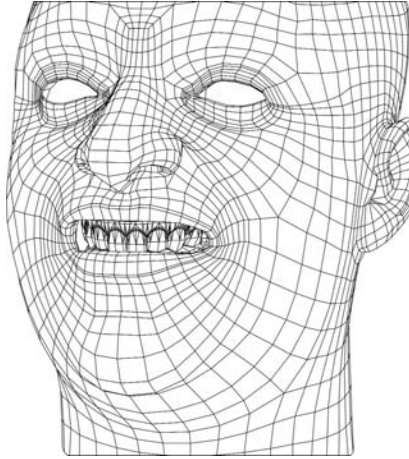
Figure 6.50

A good mix of the Upper Lip Up with a smile
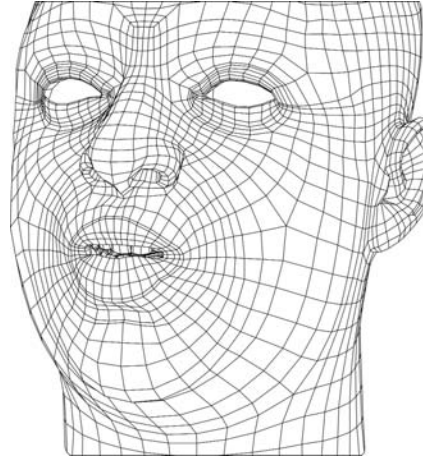
Figure 6.51

A mix of the Upper Lip Up and the Narrow

Mixing with the smile/Wide One of the first things to check after you've roughly shaped the Upper Lip Up is its mix with the smile. This mix is one that will occur often. The combination can take a lot of work and very strongly affect how the Upper Lip Up looks alone. When judging the mix, cut yourself some slack. If you've got each shape individually looking good and they mix together attractively at around 50 percent to 60 percent strength each, then you're fine. Also, this mix isn't very attractive, but you're deciding whether it looks incorrect rather than checking to see if it's "cute." This looks like a job for Figure 6.50.

Mixing with the Narrow Don't worry about it too much. If you can get 25 percent to 50 percent of this shape mixing onto a 100 percent Narrow, you're doing great. You've got to lean your decision about good/bad more heavily on the Narrow shape because it's more important. See Figure 6.51.

Advanced Ingredient: Path

Since we're not going to build the sneer into the shape, the points really are sandwiched in tightly. Pull the points sort of like a sneer but don't create the crease. Try to dissipate the shape out using as few rows as possible, but make use of the rows on the sides of the nose and even the areas where the nose is anchored. Figure 6.52 shows a progression from default to the upper lip up shape.

Cartoon Style

For both male and female characters in toon styling, this shape is really easy. Since you don't need to affect the whole face, it's perfect for toons because you can't see surface detail anyway. For this style, really only focus on the silhouette created by the lips, and that's your only concern besides how it mixes with the Wide/Narrow. See Figure 6.53.
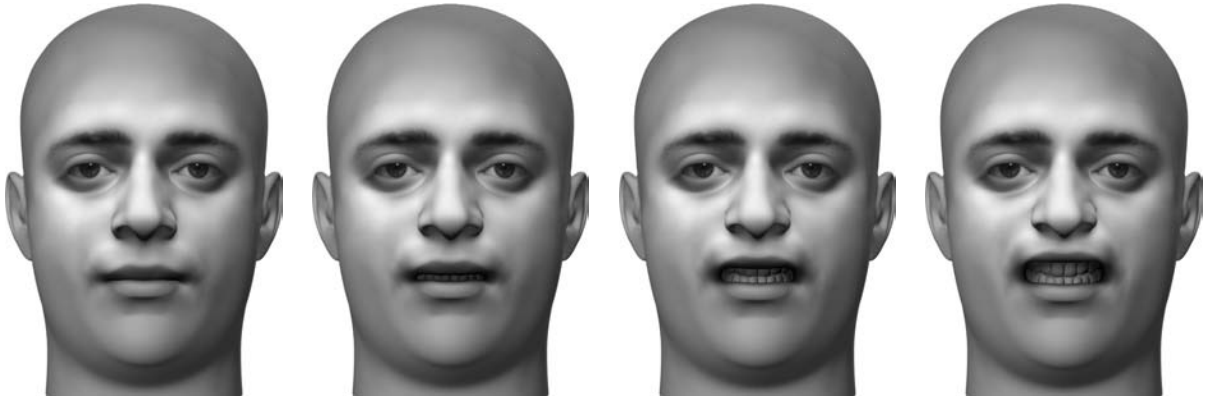
Figure 6.52

A Default-to-Upper-Lip-Up animation to show the paths of points
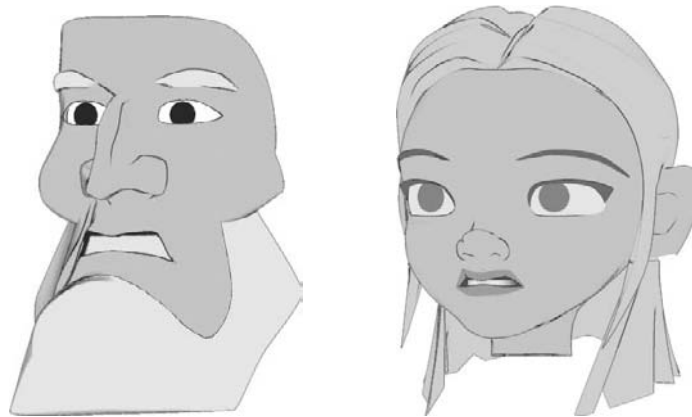
Figure 6.53

Cartoon Upper Lip Up concerns are all aesthetic.

Upper Lip Down

Face shape name: uprLipDn(1)

Derivative shape: lUprLipDn(2), rUprLipDn(2)

There are really only two good ways to describe this shape: (1) the upper half of a good rolling-lips-in B,M,P shape or (2) "I did a bad, bad thing." For some reason there's a shame aspect to this shape that I've never quite been able to put my finger on. Take a look for yourself at Figure 6.54. The main use of this shape is as the top half of an M.

There are images in this section in which the jaw is opened for clarity. I must emphasize: *there is no jaw influence*. The jaw is open merely so you can see into places you couldn't otherwise.

The lips curled down/in like this aren't usually made easier or better by combining them with other shapes for tapering.
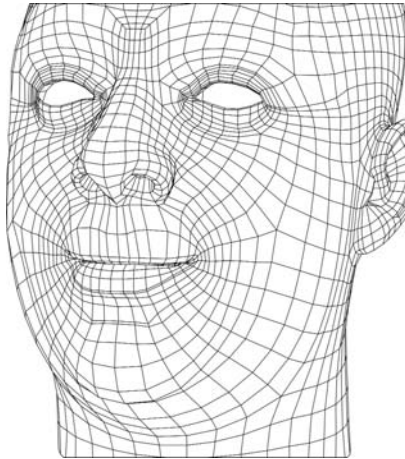
Figure 6.54
An Upper Lip Down
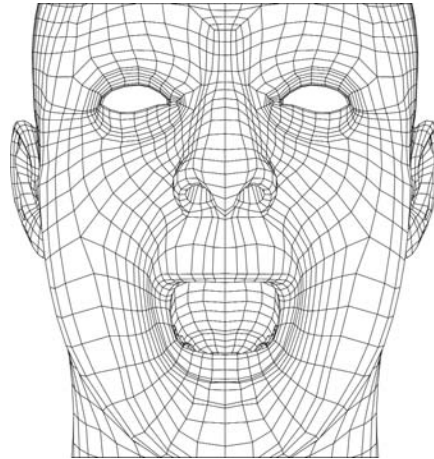
Figure 6.55
Upper Lip Down is more like a roll inward than a down movement.

Basic Ingredients

Although labeled down, this really is a "down and in"; how far that reaches on the face and how wide it goes is all something to keep an eye on.

Inclusion The inclusion of points on this shape should match exactly those on the Upper Lip Up; see Figure 6.47.

Width and Height The Upper Lip Down has no width change from the default. The height of this shape can be a strange one to wrap your head around, so peek at Figure 6.55. The actual shape can be far beyond reality; it can be a shape that stretches deep into the mouth and doesn't really look like a real thing you can do with your mouth because it needs to work during the whole transition. Usually, to build a realistic "Upper Lip Rolled In" shape would mean that the transition would intersect the teeth. The Jaw is open only to help you see that the upper teeth are completely covered.

Depth As I mentioned earlier, the shape needs to cover the upper teeth, Figure 6.56 shows a cross-section. Again, *the jaw is not actually open for the shape*, just for the visual.

You'll also notice that I modeled some bulging on the outside of the lips too. This helps to accentuate the overall shape of the lips leading into the mouth.

Rolling it in In my experience supervising others building key sets, this and the Lower Lip In are the shapes most commonly done wrong. Figure 6.57 shows it done right. There can be a tendency to simply flatten the lips to each other, which doesn't look nearly as good as having the lips rolling in. The contact point with the lower lip should become the area that was once above the lips, while the lip itself is inside.
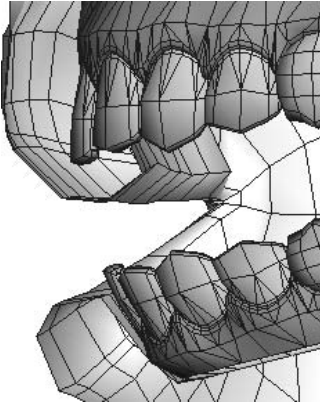
Figure 6.56
The depth goes into and behind the teeth.
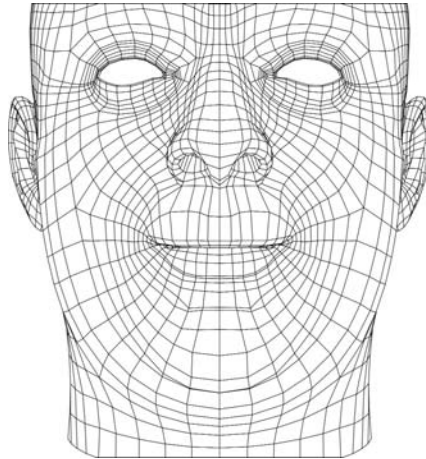
Figure 6.57
The Upper Lip rolled in

Advanced Ingredients

As with most shapes, there is a little extra to be aware of if you really want to tune this shape.

Path Much as with the inclusion, pay special attention to this as the opposite of the Upper Lip Up. You should create and watch a cycle of animation going between Upper Lip Up and Upper Lip Down; the motion should be as smooth as possible. See Figure 6.58.

Open The mix between the Upper Lip Down and the Open is a simple one. Keep it clean. No wayward points, no problems. Figure 6.59 shows a good mix.
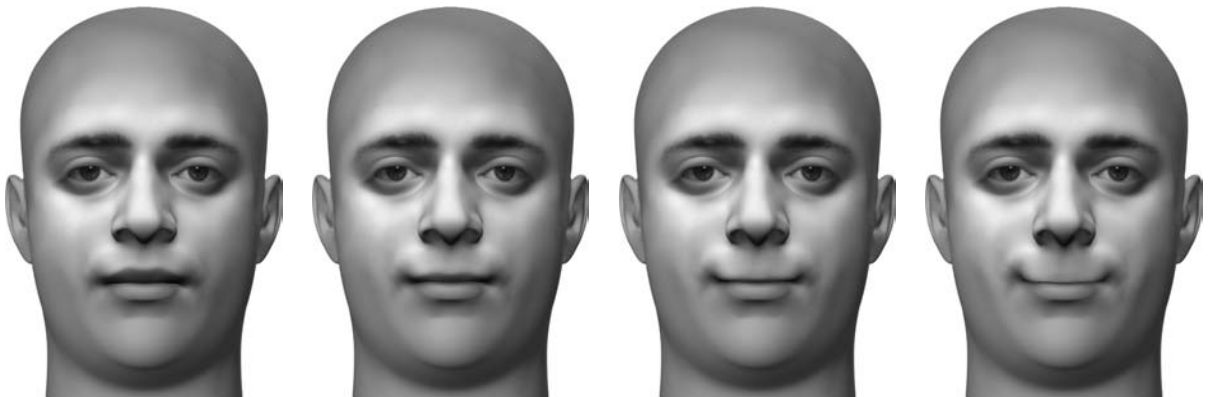
Figure 6.58
A Default-to-Upper-Lip-Down animation to show the paths of points
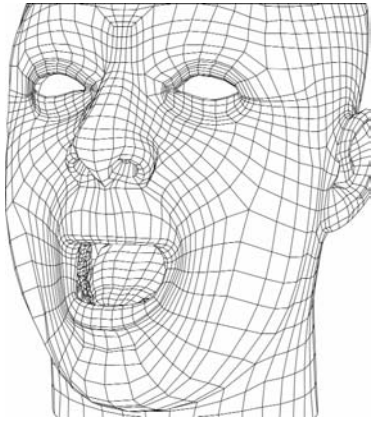
Figure 6.59
The Upper Lip Down mixed with the Open
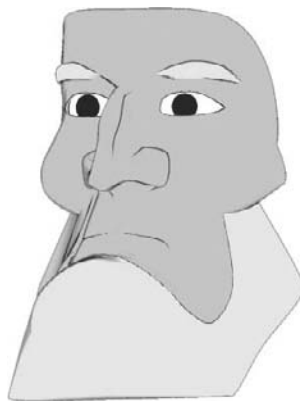
Figure 6.60
With toons, if it looks like teeth are covered, you're done!

Cartoon Style

As long as the lips disappear into the mouth, for a character of extended style, that's enough (Figure 6.60).

Lower Lip Down

Face shape name: lwrLipDn(1)

Derivative shape: lLwrLipDn(2), rLwrLipDn(2)

This shape (Figure 6.61) is the second half of a pair with the Upper Lip Up. These two combined create a SH, or at lesser values, they create a real EE shape in conjunction with the Wide/smile. As there's no creasing associated with this shape, and not a lot of geometry below the lips, most descriptions will be very short. This shape is very much the opposite of the Upper Lip Up shape. Most everything mentioned there can be flipped vertically and applied here.

Basic Ingredients

Even though most of what you need is called out in Upper Lip Up, it's still good to cover the basics.

Inclusion The Lower Lip Down mirrors the Upper Lip Up. The affected area is very similar, just upside down, and, well, without the nose in the way. See Figure 6.62.

Width and Height The Lower Lip Down has no particulars as far as width goes. As with the Upper Lip Up, place the main peak of the pull around the fangs of the *upper* teeth, as in Figure 6.63. The two shapes together should look very paired. Use your Upper Lip Up shape as reference for what you do here. The height, or drop in height, should match that of the Upper Lip Up—you should be able to see gums. The Upper Lip Up is included in the image for visual aid; it is not a part of the shape.
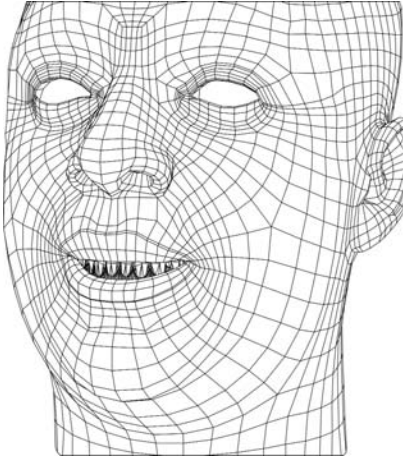
Figure 6.61

A Lower Lip Down

Figure 6.62

The affected region of the face during a Lower Lip Down built to work in cooperation with other shapes
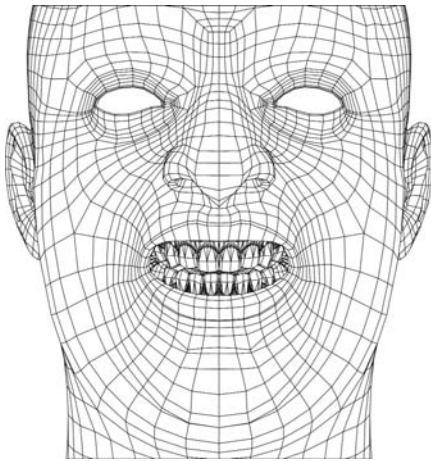
Figure 6.63

The peaks in a Lower Lip Down line up with its counterpart, the Upper Lip Up.
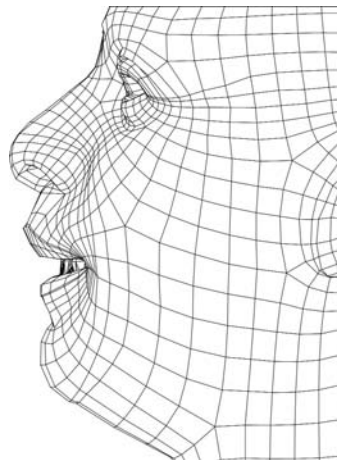
Figure 6.64

The uneventful depth of a Lower Lip Down, here just to provide you with a side view

Depth The Lower Lip Down doesn't really move forward or back as a rule, but take a look at Figure 6.64 anyway.

Mixing with the Wide/Narrow and Closed The instruction in the Upper Lip Up section applies exactly to this shape.

Advanced Ingredients and Style

All items in this area can be derived exactly from the Upper Lip Up. Toon examples of Lower Lip Down are shown in Figure 6.65.

Figure 6.65

**Toon Lower
Lip Downs**
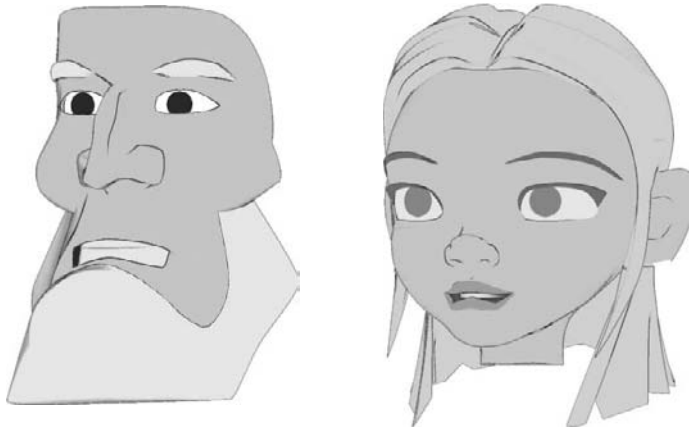
Lower Lip Up

Face shape name: lwrLipUp(1)
Derivative shapes: lLwrLipUp(2), rLwrLipUp(2)

Absolutely all concepts in the Upper Lip Down apply to this shape, the only difference being that it is upside down and the lower rather than upper lip. Figure 6.66 shows views of the shape as it is completed according to the instruction in that section—of course, flipped upside down. Figure 6.67 shows toon versions of the LLU shape.

Frown

Face shape name: frown(1)
Derivative shapes: lFrown(2), rFrown(2)

The Frown (Figure 6.68) is not something we've done too much talking about yet. The Frown is obviously the other side of the Smile/Frown pair. In the setups that I teach, the Smile and Frown are on opposite ends of the same control. For this reason, as we had to do with the Upper Lip Up versus the Upper Lip Down (which also will share a control), we must strive to make shapes living on the same control behave like a pair.

Basic Ingredients

You might think the frown is just a reverse-smile, but you'd be so, so wrong.

Inclusion The Frown includes the same area of effect as the smile does, but the emphasis is different. With the smile we spent a lot of time in the cheeks and the creases, as they were high and obvious focal points. The area below that seemed to follow in tow. Here, the area below the mouth has the focus, and the area above is just along for the ride. Figure 6.69 shows this area.
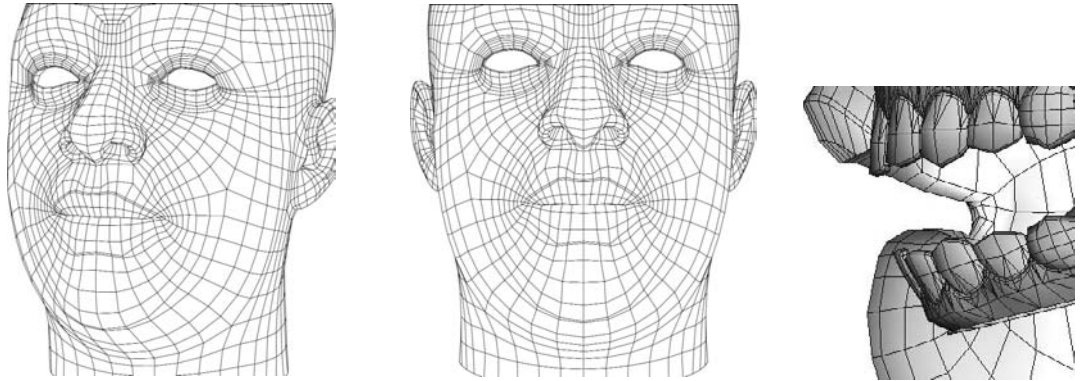
Figure 6.66

The Lower Lip Up completed by mirroring the instructions for the Upper Lip Down
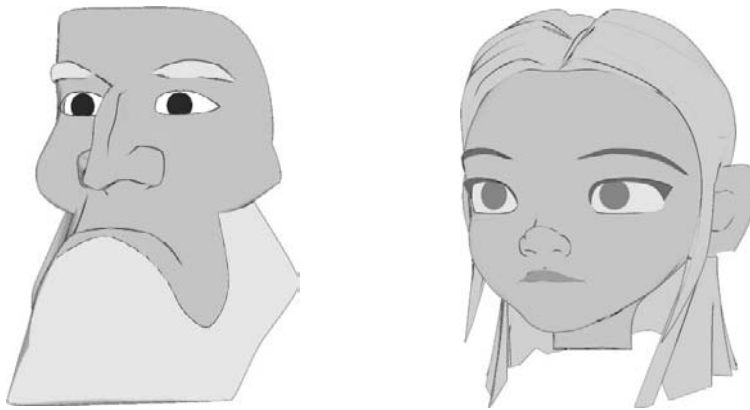
Figure 6.67

The toon version of the Lower Lip Up
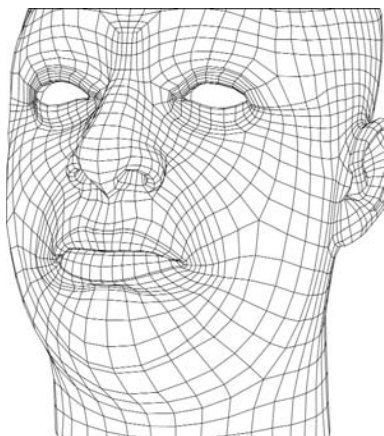
Figure 6.68

A Frown
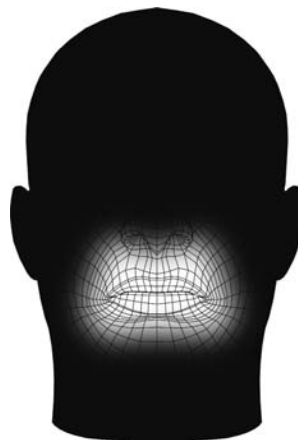
Figure 6.69

The affected region of the face during a Frown built to work in cooperation with other shapes
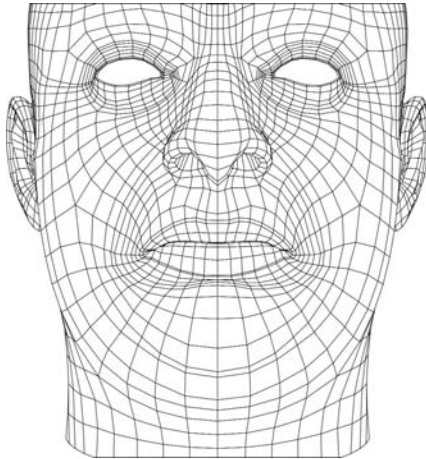
Figure 6.70
The width of Frown
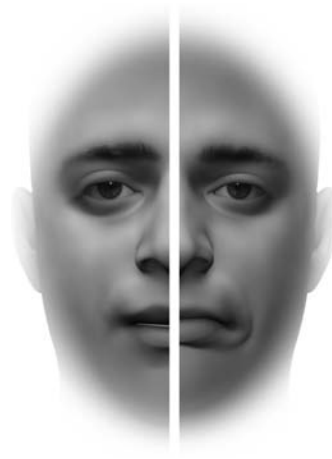
Figure 6.71
The center doesn't move; the edges pull down, quite a bit.

Width The Frown is slightly wider than the default but also slightly narrower. Take a look at Figure 6.70 and then let me explain: In a Frown, the mouth is pulled downward at the sides. As the muscles pull down, the upper lip is forced down into the area where the lower lip is. What it does to get around the lower lip is just that—it gets pushed around the lower lip. The Frown has a unique distinction among the shapes because the mouth corners are not actually the outside edge of the mouth. The area of the lips just above the corners are the outermost areas, and the overall shape ends up slightly wider than the default. The lower lip is very slightly compressed by this action and ends up narrower across.

Height The height is different at different points in the shape. In relation to the default, the center of the lips is identical. A Frown has little effect in the center of the mouth. The corners, on the other hand, pull down to approximately the height of the lower edge of the lips—but the greater effect on the skin makes that *look* like it's quite a bit lower; see Figure 6.71.

Depth As shown in Figure 6.72, the Frown pulls back as much as it pulls vertically, sort of. The corners of the mouth shouldn't move back too far, but the area that creases shuttles back approximately as far as the corners move sideways.

The Bulges This same group of points from the smile will create the crease for the Frown shape. The Frown creates a very small crease down and to the sides of the mouth. The area between the mouth corners and that crease bulges as in Figure 6.73.
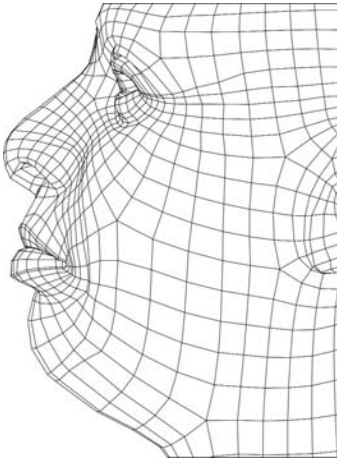
Figure 6.72

Parts of the Frown pull back, but not the lips so much.

Figure 6.73

That familiar bulge

Advanced Ingredients

The frown, done well, can actually get pretty crunchy - here are the things that take it from passable to great.

Path We've all heard the expression that it takes only 4 muscles to smile but 40 to frown. This is pretty close to true, so where the smile shape needed to look fairly cohesive in its overall point motion path because there are so few muscles involved, the Frown can be less organized. The complicated motion involved in a frown allows us some leverage in this regard. Figure 6.74 traces the awkward path(s) of points.

Figure 6.74

A Default-to-Frown animation to show the paths of points
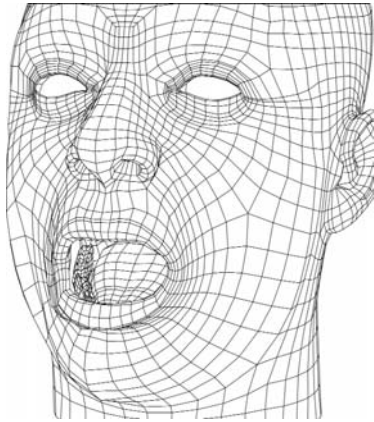
Figure 6.75

The mix between the Frown and the Open should be very compatible, and the inside edge of the mouth should look quite similar to the Open all by itself.
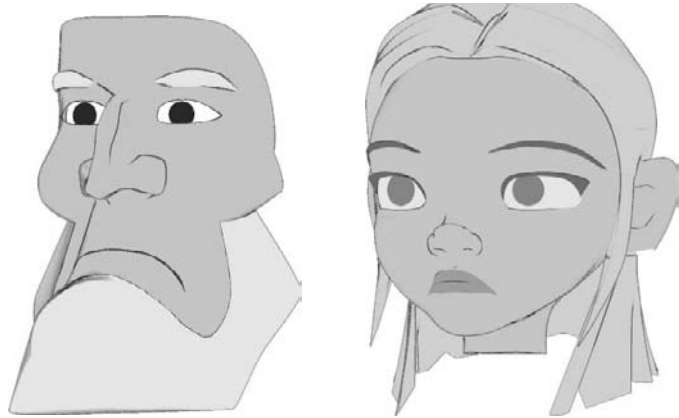
Figure 6.76

With toons, if it looks like teeth are covered, you're done!

Open The Frown Open should look very much like the default Open. This is the one shape for which it's beneficial not to mess with the inside of the mouth too much. The Frown, that rainbow shape, should happen mostly on the outside of the mouth and involve the surface mass, not the inside. Figure 6.75 looks inside.

Cartoon Style

Take a look at Figure 6.76. In this shape the need to create the creases on the sides of the mouth is unnecessary—in toon shading, there's no point in making a partial crease since it'll just show up as spotty anyway. Ignore the bulges and the creasing, and also the points regarding the seam not taking over the rest of the shape. In toon shading, this is all perfectly okay—again, assuming that the mixes involving the basics, the Wide, and the Open work well.

Sneer

Face shape name: sneer(1)
Derivative shapes: lSneer(2), rSneer(2)

The Sneer is just that. Scrunch your nose, or lift your upper lip, and you'll have a good idea of what the shape should look like; either that or look at Figure 6.77. By creating the shape all alone, we can add it to a Frown to create a Scowl, have a Sniff shape, or add it into the Upper Lip Up shape for more reality.
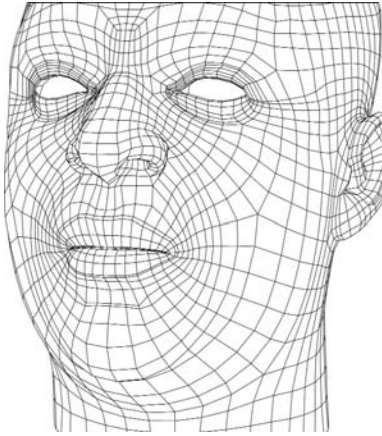
Figure 6.77

A Sneer
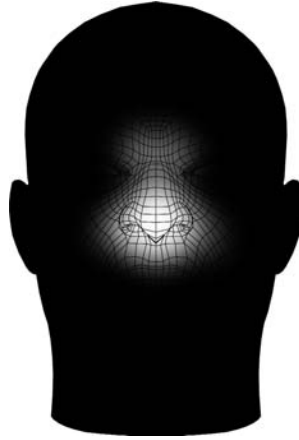
Figure 6.78

The affected region of the face during a Sneer built to work in cooperation with other shapes

Basic Ingredients

What smells?

Inclusion The Sneer's main area of influence is along the base and sides of the nose, as in Figure 6.78. If you intend to use this shape to create the Scowl at animation time, it's not required but it's a nice touch to include the area up on top of the nose. In a Sneer, the muscle that flexes pulls vertically. As the nose and cheek are pulled up, that same muscle pulls the middle of the forehead down and some of the skin on top of the nose down. You can end up with a bit of a scrunched nose, and that's a fantastic detail to add.

Width and Height The Sneer does not affect the width of the mouth or the nose. The Sneer moves the base of the nose up. My advice is to start by moving it too far up; you can always pull it back down. During a Sneer, the nostrils anchor with the rest of the face, angling up. See Figure 6.79.

Depth There is no characteristic depth change associated with this shape; see Figure 6.80.

The crease The crease created in this shape should be on the same set of rows that lead out to the crease on the smile. To have them occur on different rows will cause an unattractive rollover of the points and the model stops looking like skin. Figure 6.81 shows it done right.

Advanced Ingredient: Path

Much like the more complicated movement of the Frown, not all points are going to move uniformly in the Sneer. See Figure 6.82. Of special note are the points on the cheek, just outside the main area of creasing. They move up and also curl in (as viewed from the front) toward the bridge of the nose.
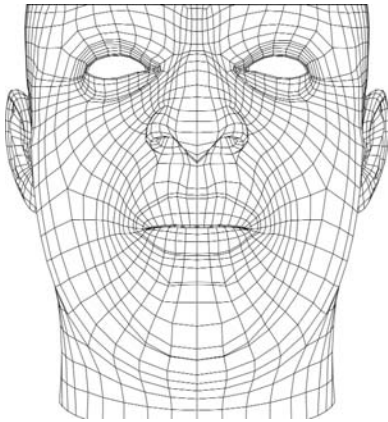
Figure 6.79

The Sneer width and height
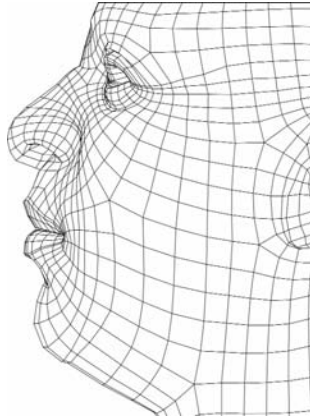
Figure 6.80

A side view of the Sneer
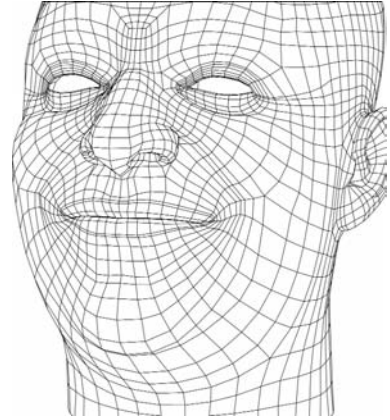
Figure 6.81

The crease in the Sneer needs to be a continuation of the crease in the smile.

Figure 6.82

A Default-to-Sneer animation to show the paths of points.

Cartoon Style

Making this shape seen in toon style can be tricky, but so satisfying when you get it right.

Male As with the smile, to get this line to draw may take some odd work. I have found that I have to pull the points that in a regular model would usually crease *waaay* up into the face on toon models. Whatever it takes to draw the line is what it gets! Figure 6.83 shows a successful attempt.

Female Also as with the smile, Sneer lines on toon females are almost never a good idea. The best thing to do is get the silhouette of the nostrils to look angry. The shape doesn't end up looking like much if it's not combined with other things like the brows and lids; take a peek at Figure 6.84.

Figure 6.83

In toon males, try to evoke a line draw behind the nose.

Figure 6.84

In toon females, the effect should be minimal; the shape works best mixed with others to create emotions.

Joint-Built or Soft-Mod Shapes

Well, the bulk of the shapes are done; there are just a few more that are much simpler. The following shapes are achieved one of two ways: One, much like the Jaw Open was—by weighting, manipulating joints, and then duplicating the mesh. The other involves using soft mod tools, which, to be honest, is now my preferred method.

Mouth Move Left/Right

Face shape name: Not used in simple setup

Derivative shapes: lMouth(2), rMouth(2)

This is actually two shapes, left and right, but I'll just talk through the left. For asymmetrical shapes, the way they get split in two from the symmetrical shape leaves something to be desired because it effectively paralyzes one side. By having this left-to-right motion available, combined with our asymmetrical shapes, a sideways smile does not have to remain static on the face; it can actually move the whole mouth over to the side. Figure 6.85 shows the LMouth shape.

This, besides the Jaw, is all that I'll usually create using joints, since it's just so easy to do it that way. I'll usually place a joint back around where the jaw is, weight it to include the mouth and some of the nose, and taper off from there. Remember, this is not a joint I leave in; it is added and weighted merely to create this shape, which is then duplicated. Figure 6.86 shows the area of effect.

From here, simply rotate the joint to get a shape such as in Figure 6.87. Duplicate it and you're done!
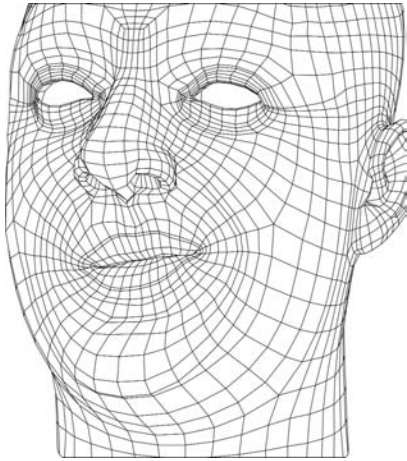
Figure 6.85

The LMouth shape

Figure 6.86

The affected region of the face during mouth moves built to work in cooperation with other shapes
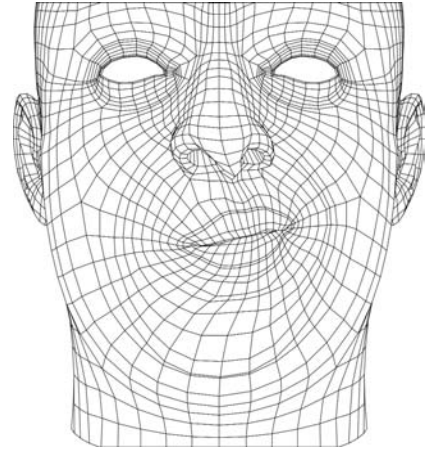
Figure 6.87

A front view of LMouth

Jaw Left/Right Forward/Back

Face shape name: Not used in simple setup
Teeth shape names: teethFwd(2), lTeeth(2), rTeeth(2)
Derivative shapes: jawFwd(2), lJaw(2), rJaw(2)

Another set of simple ones that can all be created by simply manipulating the jaw joint. When you're done with these, as with all key shapes, you should duplicate the mesh. When building the Jaw_Fwd, be sure to only translate the jaw joint, no rotations. By doing so, you can use the opposite of the shape as a jaw *in/back*. Also make sure you do the same with the teeth mesh since they'll need to pair with these movements. A little intersecting/poke-through is okay, too; these, like all other shapes, are meant to be mixed, and that can be fixed at animation time—it's not a big deal. See Figure 6.88 for both the forward and left shapes.

The Tongue

Face shape name: No face shapes
Teeth shape names: tongueOut(1), tongueUp(1), tongueTipUp(2), lTongue(2), rTongue(2)
Derivative shape: N/A

The tongue will get very little in the way of shape keys, and achieving those is very easy, so they will all be put together in one section. The easiest way to make these is to weight a tongue quickly and manipulate bones to shape it. Duplicate the shapes to "bake" them when you're done. All of the images have the mouth open so you can see the tongue, but there should be no degree of mouth Open in the shapes themselves. (You build the shapes with

the mouth closed—shapes that will never actually be seen by themselves—because other-wise, you'd have your Open mouth shape and as you add in a Tongue shape that is *also* open, the mouth would "double Open," that is, break or dislocate. You'd have to counter-animate your Open shape closed to use your tongue shapes—and this is not acceptable.)

Out By pulling most of the points in the tongue forward and up, you should be able to create the shape needed for *TH* sounds. See Figure 6.89.
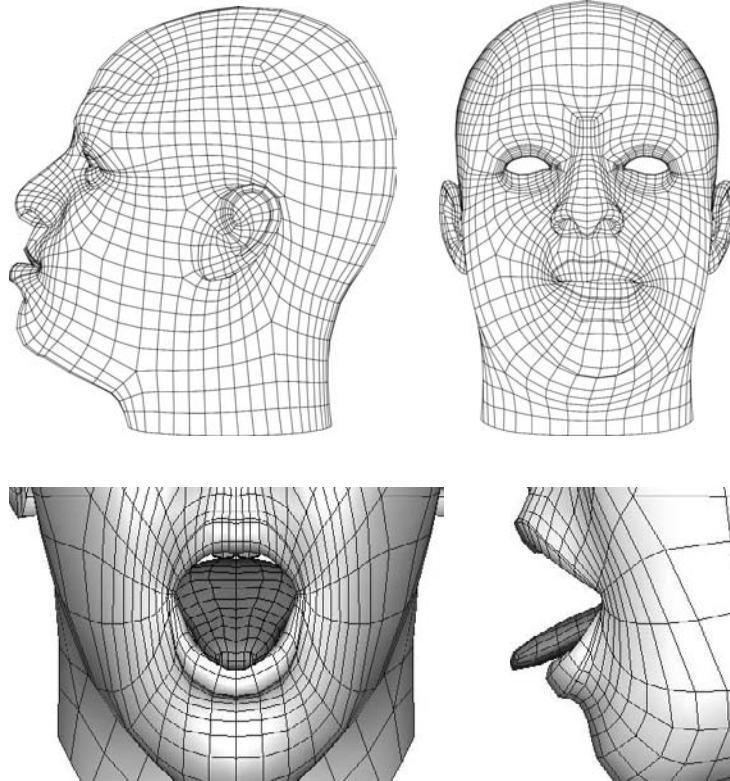
Figure 6.88

Pushing the jaw forward can help in sync with sounds like OO, and it can also do a lot for emotion—more than you might realize.

Figure 6.89

Tongue Out

THE MOUTH WALL

For the mouth wall object; you'll need to build accompanying shapes for all for the mouth shapes. This is another reason I quite like the low-resolution one I showed you in Chapter 5 ("Constructing a Mouth and Nose"). For anything that you have as an "extra" to the regular head object, you'll have to connect its blend shapes to those of the head using expressions so that everything moves together. This will be the case if you have separate brows as well. I'll discuss this aspect further in Chapter 11.
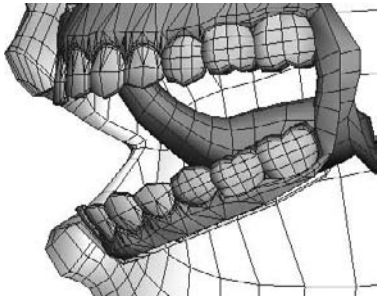
Figure 6.90
Tongue up
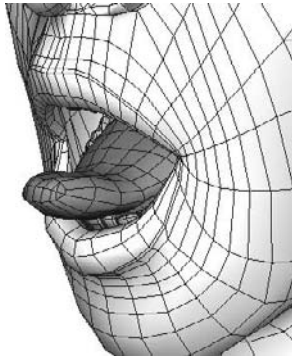
Figure 6.91
Tongue Tip Up
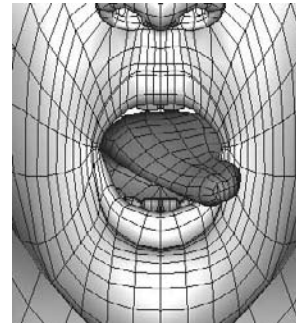
Figure 6.92
Tongue Left/Right

Up Figure 6.90 shows the Tongue Up. The second half of the only necessary shapes for a simple tongue is the tongue rolling up. This shape will help us create Ls and Ns. Make sure the points all evenly curl up to the top; you'll need to build this bigger than reality because it will need to reach the roof of the mouth with the mouth both open and closed.

Tip Up By turning just the tip up, not the whole tongue, you can get some extra flair into some of your sync, using this in some places you would otherwise use the whole Tongue Up. See Figure 6.91.

Left/Right By turning the tongue from side to side, you can get some extra character into the tongue, even though this isn't at all a necessary shape. Figure 6.92 shows some left/right action.

Animating and Modeling the Eyes and Brows

Well, *here we are. What Part II was to the lower half of the face, Part III is to the top half of the face. With the mouth, and especially with sync, the focus is functional—the bulk of the work is in convincing people that the character is speaking. Here, in the eyes and brows, the goals have flipped. The eyes and brows convince an audience that our character lives, and so emotion has priority over function. Our characters plot the things they do before they do them, they react—in short, they think.*

First I'll review and expand upon the concepts I talked about in Chapters 2 and 3 ("What the Eyes and Brows Tell Us" and "Facial Landmarking," respectively), and then I'll guide you through creating a tool to see some of those concepts in practice. From there, you'll learn about what I think is the most important part of facial animation, the eyes, and how to create focus and thought. At the end of Chapter 7, I'll go over how some of the different emotions are actually achieved, in contrast to how they've commonly been explained. In Chapter 8, I'll show you how to build the top half of a human face, and in Chapter 9, you'll be guided through the different key shapes and their individual goals and needs. On with the show!

Building Emotion:
The Basics of the Eyes

The brows and the eyes tell us what we need to know about a character's thoughts. Primarily, the brows have two major movements, brows Up/Down and brows Squeeze. The brows Up/Down alone don't tell us a whole lot about emotion; they are used in conjunction with the brows Squeeze and different combinations of the lids. Generally, brows Squeeze is in every emotion; regardless of type of emotion, it denotes thought.

The upper lids tell us the alertness of a character, and the lower lids intensify emotions. The eyeballs mainly just communicate where a character is looking. The subtext of that can lead to some powerful emotion, but the eyeballs themselves don't say a whole lot; it's the entire eye area acting together that creates a feeling. That said, the effect of the angle of the head itself can make all the difference in the world to an expression. It can change the viewer's perception of all the things listed above.

If you need a refresher introduction for any of these topics, take a peek back at Chapters 2 and 3; you should find all that you need.

- **Building an upper face for practice**
- **Rules of the eyes and brows game**
- **Example animations**

Figure 7.1

What a handsome face!

Building an Upper Face for Practice

In Chapter 1, "Learning the Basics of Lip Sync," you created a simple mouth to work with and got a taste of the mouth setup in action. We didn't do the same thing for the eyes in Chapter 2, so we'll do it here. Many of the behaviors of the eyes are better to see and do yourself than to have me explain them. It really is much better if you can play along.

Everything to do with emotion is subjective. The same choices made for scene A could be all wrong for scene B. This section is going to boil down to the choices I would make in certain situations and the reasons why.

Modeling the Pieces

The face I'll use to describe how the eyes and brows work is called Box Head, shown in Figure 7.1. You can load this scene, BoxHead.ma, from the Chapter 7 folder on the companion CD.

> I recommend that you actually go through and construct Box Head by yourself. In Chapter 13, "Interfaces for Your Faces," I talk about expressions, and some more intricate work with expressions, but the majority of setting up your more complicated character is done with the automatic setup buttons (you'll learn about those in Chapter 13). By doing the work here yourself, you can get some good easy practice in expression writing, which, if you want to design your own interfaces, you'll need to know!

We're going to construct and rig an extremely simple eye area for you to see the concepts I explain. We'll build the face "backdrop," cut out eyes, make flats to represent the brows and eyelids, and make a sphere and flatten it for our eyeballs. After that, we'll load in the spline mouth from Chapter 1 and give Box Head a mouth!

The Face

Create a plane of Width 1, Height 0.4, with 10 subdivisions along the width and 4 along the height. By choosing the Z axis option, we'll create the plane facing forward in the front view, where we'll do our work with this face.

> Planes can be created by selecting Create → Polygon Primitives → Plane ☐.
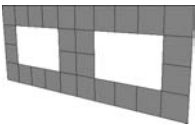
Figure 7.2

The grid with the eye holes already punched out

Delete the faces that are missing from Figure 7.2. Select the outside edges of the holes and scale them down in Y. Now select the points that define the top of the holes and pull them higher. These will be our eye sockets. Select all the points around the outside perimeter of the grid and scale them out—we want the "face" to have a bigger edge around it. Make the lower edge reach farther than the others, as in Figure 7.3; the mouth will have to live there eventually. Rename the plane Face.

The Brows

Create another polygonal plane, this time of Width 0.4, Height 0.1, with subdivisions along width and height of 1. Move this shape to –0.25, 0.2, 0.2 in X, Y, and Z respectively. This is to be our right eyebrow. Create a lambert material and make it black.

> There are many ways to create a material. The fastest is to right-click over the object and select Assign New Material from the bottom of the marking menu.

Rename the plane RBrow. Duplicate RBrow, and move it to 0.25, 0.2, 0.2. That should place it on the other side of the face. Rename it LBrow. You should start to see the beginnings of a *very* simple face (Figure 7.4).

The Upper Lids

Create yet another plane, this time of Width 1, Height 0.25, with subdivisions of only 1 in both width and height. Move the new plane to 0, 0.2, 0.01 (Figure 7.5). Rename the plane UprLids.

The Lower Lids

Duplicate the upper lid(s) and move it down to –0.225 in Y (Figure 7.6). Rename it LwrLids. Make both eyelids children of Face and then freeze the transformations of the eyelids (Modify → Freeze Transformations). This is done so that later, when we apply expressions, we can be sure the lids' translations at default are 0, 0, 0.

> When freezing transformations, if it doesn't seem to work, you may need to check your settings in the option box to make sure that all boxes (scale, rotate, translate) are checked.
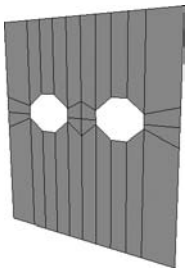
Figure 7.3
The grid will provide the backdrop for the face.

Figure 7.4
Now, that is some good-looking brow action.
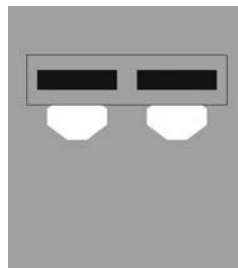
Figure 7.5
The upper lid plane is outlined where it should be placed.
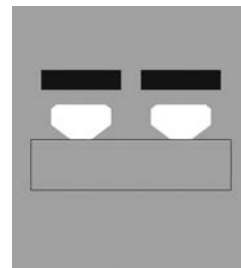
Figure 7.6
The lower lids placed just below the silhouette of the eyes

The Eyeballs

Create a polygonal sphere of Radius .8, Axis Divisions of 20, Height Divisions of 4, and make it native to the Z axis. Move the sphere to –0.25, 0, –.01. Scale the sphere to 0.1, 0.1, 0.01. You should have a very flat sphere sitting in the right eye socket of your face. Rename the sphere REye, and assign it the same material of the eyebrows, black.

> Since we already have a material created, right-click over the object and from the marking menu at the bottom, select Assign Existing Material; then select the material you created for the brows.

Figure 7.7

Box Head is almost born. There's just one more noisy bit to go…

Duplicate the eyeball and move it across the other side to 0.25, 0, –0.1. Rename the new object LEye. Your new practice face should look like Figure 7.7.

Save before you continue, just in case any problems arise. The one last thing to do is *import* your spline mouth from Chapter 1 (or load it from the CD). It should show up right in the middle of Box Head. If it doesn't, feel free to move it into place. Select Mouth (the spline itself) and then Face and parent them, making Mouth the child of Face. Move Mouth to 0, –0.3, 0.1 and scale it to 0.25 uniformly. Duplicate Mouth and scale the duplicate to 0.01 uniformly—very, very small (Figure 7.8). Now, be sure you have construction history turned on, and loft Mouth and Mouth's duplicate together. Once this is done, turn construction history back off. Now, so you can see it, assign the black lambert material to the loft, and you're ready to go!

Parenting Our Face Together

Now that we have the pieces we need, it's time to rig them up for use. Let's start with the eyeballs. Create a locator and scale it to 0.1, 0.1, 0.1 so that it's very small and not too obtrusive. Duplicate the locator and name the duplicate Eyes. Make both REye and LEye children of Eyes and then make Eyes a child of Face. We will use this locator to control our eyes' positions in the sockets.

Duplicate the original small locator and rename the duplicate Brows. Parent both eyebrows to Brows and make Brows a child of Face.

Rigging Our Face

The first thing we'll need to do is create a slider control, similar to the one we made in Chapter 1 for the mouth, so we can control the things that we need to.

Figure 7.8

Box Head looks mild-mannered, but the things that come out of that mouth…!

Creating Our Control

We'll make one slider control out of a locator and a circle and duplicate it to create the other ones we'll need.

ANOTHER WAY TO GO

In Chapter 12, "Interfaces for your faces," I'll show you how to use the tools provided to generate controls in a fast/easy way. You can skip ahead if you want to cut some corners and set up Box Head in a more point-and-click sort of way, but I recommend building it up from scratch in this chapter, either following along with the expressions or replicating them with utility nodes to give you a better understanding of how it all fits together. There's plenty of time to speed things up and use tools, but it's always worth it to understand what's going on under the hood.

Create a locator, scale it to 0.25 uniformly, and move it away from the face. Rename the locator Ctrl_Prnt. Now create a NURBS circle of Radius 0.1 and native to the Z axis. Make the circle a child of Ctrl_Prnt and rename the circle Ctrl. If you now type zeros into the translate channels for the circle, it should center itself on Ctrl_Prnt (Figure 7.9).

In the Attribute Editor, go to Limit Information and limit Ctrl's motion so that it can only travel between –1 and 1 in X and Y axes and cannot move in Z, a minimum-maximum limit of 0 and 0.

Now, with Ctrl still selected, open the Channel Control (Window → General Editors → Channel Control). Select all but translateX and translateY from the left-side window and hit the Move button on the bottom-left side of the window. Now the only attributes you'll see for Ctrl are translate X and Y. Go ahead and close the window.

Figure 7.9

A NURBS circle is the slider of choice for most of my setups; hiding locators makes selection easy.

If you're having trouble locating the particular windows for applying translation limits, see the tutorial in Chapter 1.

The circle is now going to be used as a slider for controlling aspects of the face. You can move the slider's location without affecting its output value by moving it from the Ctrl_Prnt level. Ctrl_Prnt can be anywhere you like in your scene, just as long as values for the Ctrl itself are 0 and 0 in X and Y; we'll be using those attributes to drive our expressions.

Rigging the Face Control

Duplicate the Ctrl_Prnt hierarchy (the locator and circle, both) and rename the duplicate *circle* Ctrl_Face. (The locator's name is of no real consequence.) Select Face, and in the Channel Box click the rotateY attribute. If you then right-click, you can select Expressions from the menu that appears.

In the Expression Editor, type this:

```
Face.rotateY = Ctrl_Face.translateX * 15
```

Box Head looking top (screen) left and then bottom (screen) right. I had to cheat and move his eyes to help the images because with his parallel lines, both poses tended to look very similar!

When you've typed that in, hit the Create button on the bottom-left corner of the window to create your expression. Now click another attribute of Face's—which attribute doesn't matter. Enter the following in the expression window:

```
Face.rotateX = Ctrl_Face.translateY * -35
```

You can enter any expression in the Expression Editor in relation to any object and attribute at any time. The only danger in doing so is overwriting another expression that you've just written. To keep that from happening, you need to clear the window; to clear the window, you just have to select an attribute that has no expression.

Throughout this chapter, remember to select the circle, not the locator!

As before, hit the Create button to make your expression take effect. If you close the Expression Editor, you should be able to drag the Ctrl_Face slider left, right, up, and down and see the whole face move, as in Figure 7.10. Set the slider to 0,0 and we'll continue with our setup.

Rigging the Eye Control

Duplicate the *original* Ctrl slider hierarchy again (*not* the one with Ctrl_Face), and move it away so it has its own space. Select the circle and rename it Ctrl_Eyes.

Select the locator that is parent to both eyes; it should be named Eyes. In the Expression Editor, enter and create both these expressions, one at a time:

```
Eyes.translateX = Ctrl_Eyes.translateX / 10
Eyes.translateY = Ctrl_Eyes.translateY / 10
```

The eyes posed on opposite corners of their range

As before, create both expressions and then close the window. When you move the new Ctrl_Eyes slider around, the eyes should move (Figure 7.11). Once that's working, set the Ctrl_Eyes slider to 0,0 and keep moving along.

Rigging the Upper Lids

Duplicate the original Ctrl hierarchy, move it away to its own spot, and rename the circle Ctrl_Lids. Select UprLids, and enter the following expression:

```
UprLids.translateY = (Ctrl_Lids.translateY / 5)
```

Notice the parentheses; they're included because of how we're going to change this expression in just a moment. When you move the Ctrl_Lids slider, its up and down motion should control the upper eye lids' height. There's one problem, though. Select the Ctrl_Eyes slider and move it around. See how the eyes are moving around and the lids are not relating to them? Figure 7.12 shows that when you pull the EyesCtrl slider up, you have a sleepy-eyed character, and when you pull it down, you have an alert character.

Now, maybe for some people that's good enough, but not us. Knowing what we know about lids and eyes' relationships, this expression needs work.

Having read Chapter 2, you know that the upper lids should follow the eyeballs' motion so that we aren't spontaneously changing expression like this. I was animating this effect manually myself for over a year when a friend of mine who also was doing the work of facial setups smartly decided that maybe this should be automated because it's something you always want to happen. Taking his lead, we'll need the upper lids to consider the *eyeball* movement as well.

Since we want to mimic the eyes' motion as well as what we're doing already, the easiest thing is to simply add the eyes' expression into the lids' expression we already have. On UprLid, change the expression from this:

```
UprLids.translateY = (Ctrl_Lids.translateY / 5)
```

to this:

```
UprLids.translateY = (Ctrl_Lids.translateY / 5) + Ctrl_Eyes.translateY / 10
```

When you modify an expression instead of creating it, you must first select the object and attribute so the old one appears. When you've finished with your changes, you click the Edit button instead of the Create button to update it.

Now if you test the Ctrl_Lids up and down motion, you'll see that it does the exact same thing as before. The difference is apparent when you use the Ctrl_Eyes slider. The lids now move up and down with eyeballs, too! To reiterate, all we did to create this effect was to *add in* the same math we're doing for the eyes themselves.

> This expression leaves something to be desired since, if the eyes look all the way up, the upper lids can't close to the bottom. For the level this face is at, that's an acceptable flaw. In the automatic setup, there's a more robust expression for the upper lids' movements. For most of the Ctrl_Lids slider's movement, it behaves like this, but for the last part of the slider's range, the expression calculates the total remaining distance between upper and lower lids and moves to a percentage of that distance based on the slider's value. Closed will always mean closed regardless of where the eyes are, but the lids, when opened, will follow the eyes' motion as well.

Rigging the Lower Lids

You may have noticed that in the two previous sliders, up and down have an effect as well as left to right. For our Ctrl_Lids slider, the up and down movements control the upper lids and the left to right motions control the lower lids.
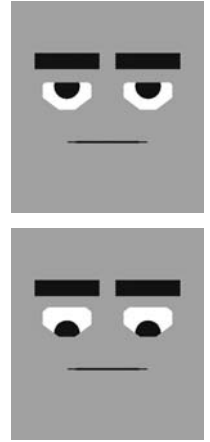
Figure 7.12

The ol' eyes-up-being-sleepy and eyes-down-being-excited just doesn't cut it.

Select the plane named LwrLids and type in this expression:

```
LwrLids.translateY = -Ctrl_Lids.translateX / 5
```

This merely links LwrLids to the left and right motion of that same slider used for the upper lids; don't miss the minus sign! Moving the Ctrl_Lids slider up, down, left, and right can create all sorts of combinations for the eyelids (Figure 7.13).

Rigging the Brows

As with all the other pieces, we'll need to create a control for the brows. Duplicate the original Ctrl_Prnt hierarchy again and rename the new circle Ctrl_Brows.

Select the brows' parent object *Brows* and enter the following expression:

```
Brows.translateY = Ctrl_Brows.translateY / 15
```

That will make the eyebrows move up and down. Now we need to fake some emotion. I've talked a lot about what is and is not right on a human face, but this is decidedly not very human. For this face, and for an introduction to the interface style and for practice, I'm going to go with some more classic cartoony poses. Select LBrow and add the following expression:

```
LBrow.rotateZ = Ctrl_Brows.translateX * 10
```

And to the right brow add the same, but with a minus sign in front of the expression so that the right brow does the opposite:

```
RBrow.rotateZ = -Ctrl_Brows.translateX * 10
```

What that added, effectively, was the ability to set sad and mad poses like those in Figure 7.14.

Re-Rigging the Mouth

To fit in with our new control scheme, let's connect the mouth to a slider as we did with the other kids. You can now use Ctrl itself, and not a duplicate, as this is the last slider we'll need for Box Head. Rename Ctrl Ctrl_Sync, and you'll need to make one more adjustment. Open the Attribute Editor and limit Ctrl_Sync's motion in Y so the maximum is 0. Now select Mouth, open the MouthShapes node under Inputs (below the

Figure 7.13

Different slider positions yield interesting expressions.

Figure 7.14

The brows' control in different positions can create most anything you might need on such a simple character.
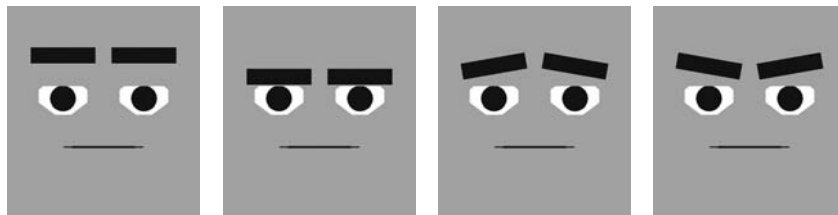
Channel Box), and then select and right-click over WideNarrow. Once in the Expression Editor, select WideNarrow from the list on the right, and in the expression that appears, rewrite the whole thing to read like this:

```
MouthShapes.WideNarrow = Ctrl_Sync.translateX
```

And then change the expression on the OpenClosed attribute to this:

```
MouthShapes.OpenClosed = -Ctrl_Sync.translateY
```

You've now got yourself one rigged-up face that works very similarly to the more complicated setups later on. For ease of use (and the reason we moved the expression on Mouth over to a new slider), you can now, if you like, turn off locators' visibility (Show → Locators (Off)) and you won't select the wrong things, just your new sliders. Also, if it makes it easier for you to differentiate them, reshape the circles to be more like icons as I've done in Figure 7.15, or label them.

Using "Box Head"

The best thing I can do for starters is take you through some examples of things like the tilt of the head and the eyelids following the eyeballs, which you've heard about but not yet seen in action. Here I'll acquaint you with the tools, and then we'll use the face to create some expressions and emotions so you can see in practice how things work.

The tilt of the head, in action Just do it. Just move the Ctrl_Face slider up and down to alter the tilt of the head, and watch as the eyeballs' relationship to the brows changes dramatically because of distance relationships and perspective (Figure 7.16). This is how I recommend getting most of the brow Up/Down effects, by moving the head rather than the brows. Granted, the proportion in this setup is as if our character had a 4-inch forehead, but it does make the point and gives you something very obvious to practice with.

The eyelids following the eyeballs Take the Ctrl_Lids and slide it downward so that your new character looks unimpressed or sleepy (Figure 7.17). Now move the EyesCtrl around and watch the lids follow—no matter *where* the eyes are looking. Even on this simple face the added reality of the lids tracking is pretty neat, but when you get this on a realistic face it's creepy. I find myself playing with this part of the setup for hours, even though I've seen it a hundred times before.

Adding the lower lids Go ahead and create yourself a little angry face. Pull Ctrl_Brows down and to the right, tilt the head forward to condense the space between the Brows and Eyes further, and take a look (Figure 7.18). Now move Ctrl_Lids to the left, adding some squint into the mix. Bounce back and forth including, and not including, the squint to see the big difference it makes. As I've said before, it intensifies this as well as any other expression.

Okay, playtime's over for now, but to keep you fresh on the uses of things, Table 7.1 is a cheat sheet for Box Head's interface.

Figure 7.15

A snapshot of my own little icon creations for each slider: top is the face, next the brows, then the lip sync control. After that are the lids and the eyes

Figure 7.16

The expanded and contracted distances perceived during tilts of the head are pretty extreme.

(a) up

(b) down
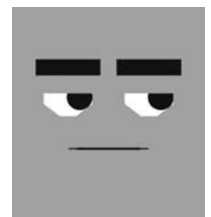
Figure 7.17

The eyelids' tracking is extremely helpful in maintaining expressions.

	CONTROL ACTION	FACE ACTION
Table 7.1	Ctrl_Face up/down	Tilts the entire head forward and back. Condenses and expands the vertical distances between features.
Box Head Cheat Sheet	Ctrl_Face left/right	Turns the head left and right, only in a limited way because this face is really only meant to be seen from the front.
	Ctrl_Eyes up/down	Moves the eyes up and down within a range.
	Ctrl_Eyes left/right	Moves the eyes left and right within a range.
	Ctrl_Lids up/down	Moves the upper eye lids up and down. Shows alertness.
	Ctrl_Lids left/right	Moves the lower lids up and down. Increases and decreases emotional intensity.
	Ctrl_Brows up/down	Moves the brows up and down. Only applies contextually, has no guaranteed effect without other influences.
	Ctrl_Brows left/right	Moves between the brows looking sad and mad.

Rules of the Game

In the real world, our eyes move around a lot. They move to look at different things we need to know about, or just want to observe. Our eyes also sometimes move not just *to* things, but *away* from them as well. We avoid eye contact or shield ourselves from things that are too bright, for example. I've said before, and I'll elaborate now, that the eyes themselves tell us next to nothing about emotion. It's all in the context, and it's all in the timing.

When I say context, I mean in plot-related scenes, immediate situations, and also in physical surroundings. The eyes looking down when the brows are up and have a sad shape to them gives a different effect than when the brows are down with a mad shape—and further variations are possible by changing the height of the lids. Try to erase any preconceived notions of specific eye positions meaning different things, because right now we're going to lay down new types of rules. With lip sync we had visimes for most of the important shapes. Most of those have pretty solid definitions, but some, like R and T, had referential or relative definitions: wider than this, narrower than that. With the eyes, the level of focus or distraction is almost 100 percent referential and relative.

Almost, I say, because there are a few rules.

Figure 7.18

An angry face on Box Head, with and without the squint/lower lids

Eye Rules: Focus and Distraction

Most everything I consider a rule for the eyes has to do with focus and distraction, both for the character and for the audience. There's the focus as tied to the motion, there's timing, and there's involuntary distraction (which can rip an audience out of your scene).

Focus and Motion

The eyes move around, but not randomly. In real life when people are having a discussion and a person is darting their eyes around, their eyes aren't in constant motion. They move, and they stop. After a period of time, they move again, but they stop again. It is

highly unnatural behavior for our eyes to not focus on something, anything, if they can, which is what causes the moving and stopping as opposed to a constant, even scanning. The eyes are moving from one focus to another. I tell you this so that in the next sections dealing with specific instances of focus and distraction, you'll realize that eye motion, even if it's ongoing, is not constant. There are pauses and breaks. The eyes cannot scan across a room; they must bounce from focus to focus. This is the nature of the movement. Disregard it and lose your audience. The one apparent hole in this methodology is when someone's eyes are following something that is moving—which, really, is the same rule of focus; it's just that the focus isn't still.

Some of you may be thinking, as I myself did for some time, that this eye motion rule does not apply to stylized characters. Unfortunately, it does. Even the most ridiculously styled characters in CG must have eye behavior reflecting realistic human motion. The likely reason, I've come to realize, is the way that CGI looks. An eye in computer graphics, even a badly modeled and textured one, looks a lot like an eye. Maybe it's the way computers have perfected specular highlights, maybe it's the quality of renderers—who knows. All that matters is that since the eyeballs look like eyeballs, we expect them to behave that way.

Think of a green eyeball of a monster: Mr. Mike Wazowski. Even he, as odd and far from reality as he was, had realistic timing, motion, and acting in that big ol' eye.

Timing

A focused character, besides having a posture that illustrates this, will behave in a focused manner in the face and especially the eyes. For animators, it can be very tempting to—well, animate. Sometimes the temptation to move things can ruin an effect we're trying to create. Eyes generally move very quickly, but in creating the illusion of focus or intensity, we need to hold back. It is okay for a character to hold a stare for a while. By interrupting the stare too soon, we would dilute the intensity or sabotage the intensity we were after.

Involuntary Distraction Is the Enemy of Performance

Distraction is the enemy of performance. If the audience is distracted by anything born of our animation, they're looking at the animation, not at the character in the scene, and they're missing what's happening. With most of the things you animate, like full body shots, you won't have this problem; they're not as susceptible to this. With the face and the eyes, though, there is so much potential for fatal distraction that you might find yourself focusing on what *not* to do rather than on what you want to do.

Brow Rules

The rights and wrongs, dos and don'ts for brows are pretty sparse, but here they are.

Limit Your Range

Try, as a conscious effort, not to ever let your brows get to the extremes of their range. It will happen, and for good reason, but if you stop yourself from maxing your brows out, you'll force yourself to be a little bit more resourceful and creative with all the tools at your disposal. I'm far more willing to believe a character who is sad than one who is the saddest he's ever been in his entire life, so sad that his face must hurt from the muscle contortion. I like to give myself that range to play with, but animation on the brow almost always looks better when it lives pretty close to the default shape. Also, as with the mouth, opposites and stepping all apply as simple good general animation principles. If you have a character who's mad on his first line of dialogue, then even more angry on the second line of dialogue, what can you do? If you blew all your range on the first line of anger, you're stuck on the second. Keeping things in a range helps a lot.

Darting Motion

Your brows don't move slowly. You can try it if you like, in a mirror. Try moving your brows up slowly; you can't. On the way down, it's eas*ier*, but still not very normal. Brows tend to jump into a pose, hold that pose, and then drop back out of it.

Sometimes the Best Shape Is No Shape

My favorite CGI facial acting shot ever—so far—is in *The Lord of the Rings: The Two Towers*. Gollum is a sickly looking outcast, helping the current owner of his "precious" ring. There's a scene where he is talking to himself—not just musing, but clearly of a damaged and divided mind—and the camera cuts help differentiate the two personalities. In one moment, the whole thing went from looking like some of the most beautiful computer animation and motion capture to surpassing all of that and becoming real. In one shot, Gollum draws back in the frame and just says, "What?"

What made this scene stand out for me is that for much of the film, the character's facial expressions, while wonderfully shaped and animated, were, well, *always* expressing—going from one extreme to another. There was never a moment's rest in the face. In that one shot, the character started with an angry expression, and an intense glare, and then bang! The muscle tension released, the eyes widened slightly. That was it. The animator resisted the urge to shoot to the opposite spectrum for effect; they stopped it in the area of "nothing," no shape. It was the absence of a shape, the release of the tension, the character's real, genuine, tangible shock at the dialogue exchange that blew me away. The character had been ripped out of himself, for just a moment—a real reaction. It showed me something I might have known, somewhere deep down, but never acknowledged: getting out of a shape can be even more powerful than going into one. I've looked for ways to use this since, and it has been a remarkable tool in realizing certain emotions and moments. Hats off to whoever animated that scene—great work!

Order of Operations

This is the order in which I like to do things in regard to the face; there are some production issues, but I'll address those. Also, this list is not complete, as there are still mouth emotions to address, but that won't come until the last chapter; on this list they would appear right before finesse.

1. Sync
2. Head tilt (up/down)
3. Eyes
4. Eyelids
5. Brows
6. Finesse

Sync

I do my sync first, to get my timing down. This applies to *all* animation I do. If a scene is mostly pantomime but there happens to be sound, I'll do the sync first; it helps me get into the timing and feeling before attacking big sweeping motions. I'll also sometimes create myself a dopesheet using my sync timing.

Head Tilt

I do this second, but there are a few catches to what *second* means. In a big full-body acting shot, I'll do the full-body acting after sync and this third, but in a close-up shot, I will do this second. I treat the tilt of the head as its own entity apart from the rest of the posing of the body. If I work on a floating head in a scene such as we'll do in a minute, up is up, down is down. If I'm working on a character who is already posed, like the one in Figure 7.19, up and down is a range defined using that pose as the zero-line.

In this step in my order of operations list, I've written "up/down" only, and that's because I don't usually like to add in any other head movements until the rest of the steps for the face animation are completed. The up and down gives a good base motion, but

(a) baseline   (b) down   (c) up
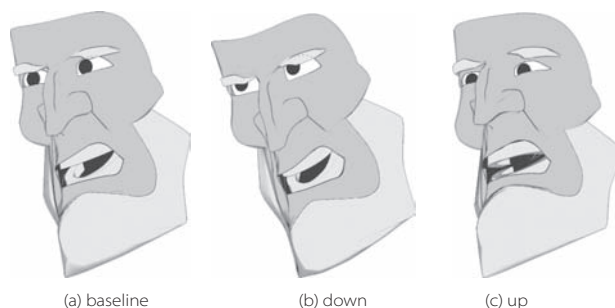
Figure 7.19

A pose from a scene, and how to interpret up, and then down, using that pose as your new base line; it's all merely relative

With only the tilt of the head and the eyes, you can start to create expressions and thought processes.

after that, if you get the whole head swooping and turning all over the place, it can be hard to keep focus as you continue your work on other things, like the eyes and brows. This potential drawback to the process we'll actually use to our advantage later. By adding those extra head motions after we've done the rest of our work with the face, we'll make the minute details a little harder to follow, and usually that just makes them look better; you can't sit and nitpick at a moving face! Sneaky, sneaky, sneaky.

Eyes

This is completely interchangeable in list order with the tilt of the head. In fact, I've only made them separate steps to keep the two thought processes separate for instruction. In my own animation, I do the two at the same time, but I only recommend doing that yourself after you've really learned to distinguish the individual goals. By getting the head and eyes moving early, which is all I've done in Figure 7.20, you get into the real feel of the scene before laying on the more obvious and uncreative brows.

Eyelids

This encompasses upper lids in both expression (wide, narrow) and function (blinks). This is the point where the emotion really starts to come through, as in Figure 7.21. We're looking for excitement levels, good places to blink, just getting into the thought process of the character. The lower lids come in here, too, and add in all the thought and intensity that they do.

I don't trust this guy.

Brows

Last but not least on the explicit steps are the brows (Figure 7.22). I got in the habit of doing these last (these and mouth emotions) when I started to *really* get into facial animation. At first, doing these last was a teaching aid I forced on myself to learn about the other things on the face. It worked so well that I realized brows had actually been hindering my animation—they're a crutch. At this point, I've just gotten used to putting them on at the end, and I recommend it. They can add a lot, but I really think of them as the last resort for creating an expression. Usually, they are the icing—at this point, after all the preceding steps, the expression is already there.

"No, no, I meant, Santa *is* real!"

Finesse

Once all the pieces are in place, there's inevitably something that needs to be changed. If you're doing it right, layered animation always has a little bit of do-over and repair. If you're thinking so far ahead that you're not doing things in your Eyes pass because of something you're going to do in your Brows pass, you're not giving each layer its proper, individual, unique attention—you're animating straight-ahead out-of-order! This is where I will decide that part of a scene isn't working; it's where I'll add in other motions on the head and shift keys around to make thought happens before sound.

Example Animations

Well, since this is an eyes-and-brows chapter about acting, let's act. We'll start with a sound file and a scene from Chapter 4, "Visimes and Lip Sync Technique." To be lazy about it, if you saved the scene you worked on there, you can import that and copy the curves from the locator MouthControl to your new Ctrl_Sync slider. The animation should come over fine. To get in practice, as you should, you can also animate the scene again. Personally, that's what I recommend.

I'll do quite a bit of explaining throughout this section, especially in the first example, where I've split up some of the steps to a few sub-steps to give every little thing attention. After that, I start to move faster, only explaining the things that are less obvious given the instruction thus far. These scenes could be taken further, but a lot of that last step is frame-to-frame finicking, which is not a fun thing to talk through and often comes down to "I just like it this way better!"—you can tweak these on your own.

For the rest of the chapter, you'll need to refer to the animations on the CD. I'll drop in pictures of frames from the animation here and there, but to get a feel for what I'm saying you really need to see and hear the motions.

> If your scene is not lining up with my numbers, double-check that your frame rate is at Real-time [24 fps] in Window → Settings/Preferences → Preferences → Settings. Also check that you're playing back in real time, under Window → Settings/Preferences → Preferences → Timeline.

"What Am I Sayin' in Here?"

To start, import the "What am I sayin' in here?" sound and/or scene you worked on before. For those of you starting fresh, you'll find the sound, `WhatAmISayinInHere.wav` and `.aif`, in the Chapter 4 folder. For this scene I blocked my frame range at 0 to 35.

Time check: This process and result took approximately 20 minutes' work.

A finished version of the scene file, `WhatAmISayin.ma`, is in the Chapter 7 folder on the companion CD. An AVI as each step is completed can also be found on the CD:

    WhatAmI_01_Sync.avi

    WhatAmI_02_Tilt.avi

    WhatAmI_03_Eyes.avi

    WhatAmI_04_Lids.avi

    WhatAmI_05_Brows.avi

    WhatAmI_06_Finesse.avi

I won't have notes here about the Sync step in these sample animations, as that's covered in the mouth chapters.

NODDING

When I say "nodding," it means not only dropping the head down, but also overshooting the pose and then correcting. It gives a nice biting motion, and it's something we people do a lot of in speech—we almost throw our head forward and then catch it, like a nod cut short.

Head Tilt

I've talked before of animating the head to the music of the dialogue; now I'll describe actually doing that. In this delivery of "what am I sayin' in here," the *what am I* sounds pretty even to me, in both tonal quality and volume. Listening to *sayin*, you can hear a pretty distinct jump in both volume and tone. For me, when the music goes up, so does the head. The sound of *sayin* is approximately from frames 12 through 18, so on frame 12, I'll set a key on the Ctrl_Face to tilt Box Head up. We don't want to have this movement look like an *exact* relationship between the music and the head, so instead of dropping it again right away, I'll look to the next sound or two and see if they have a reason for me to keep the head up.

Frame 12

The next word, *in*, sounds about the same to me in tonal quality as *sayin*, so I'll hold the head up for that sound, too. Moving along, the next word is *here*. Here is a definite drop in tone, so on frame 25, I'm going to push the head back down, I think, even further down than level. Since *in* lasts until about frame 20, I'll set another head-up key on 20, leaving the motion between *in* and *here* to be 5 frames long. That's a pretty big motion in a pretty small space, so to keep it from looking odd, I'm going to turn that downward motion into a nod. To do that, I'll just bounce back up a little higher on frame 30 and hold that until 35, the approximate end of the scene.

When you're animating the head to sync after the rest of the body has been animated, all these motions I'm describing can be applied on top of your existing posing. Just use the existing poses as the zero, or baseline, for the motions. Moving the head as part of sync can help you hold an overall body pose longer.

Listening to and watching that, most of it looks okay, but the head creeps up slowly from frame 0 (I set a default key on all sliders on frames 0 and 35 before I started, "capping the ends"). That slow creeping motion bugs me. What I decided to do was to hold the head lower until right before the first higher key. I set a low key (not super low, just a little bit lower than default) on frame 7. After that, just because I though it would look more like a pose and less like a drift, I put another similar low key on frame 2.

Eyes

The order in which you animate the parts of the eyes and brows is less significant than with the actual lip sync, but do try to animate some head tilts and the eyes first. With the eyes, there are a million ways to go. I'm going to pretend, for this scene, that the character is trapped in a box and is addressing no one, or a crowd—there's no specific person he's talking to. To show that, I'm going to have him look around some.

> Animations for the eyes and lids should, in almost every case, have linear function curves during both the motions and the holds.

I'm going to pick a few locations, basically at random, for the eye darts. Most eye darting, or looking around, happens perceptibly in the left to right more than the up and down, so I tend to favor picking locations closer to level. Eyes, as I mentioned earlier, go to places quickly and stick, so I tend to key into a pose, middle-mouse drag the time slider (to advance the time, but not the state), and set the same key again. I don't want to have the eyes move in timing with the tilts of the head; that would make the motions look like a dance. I moved the eyes (character) left on frame 3 and held them there only until frame 5; then on frame 7 moved them over to the right, holding that until frame 10, and finally brought them back to center on 14 and left them there for the duration of the scene. By having the character do most of the motion early and then centering for the last half, it creates the feeling that the character himself is wondering something, and asking that question of whoever he's looking at at the end, the only sustained position.

Frame 10

Eyelids

There are two parts to this: eyelid heights for emotional effect and, of course, blinking. Let's start with heights. This line has got an elevated tone throughout, so I'll likely leave the eyes slightly more "bugged." I raised the eyelids on frame 4 and tapered them slightly (very slightly) down to frame 21. That's because the word *here*, although a tonal drop, does have a distinct volume hit. I want to make *here* have some impact, but in the same way that it's already impacting. In a little bit of an opposites approach, I lessened the incoming key, then on frame 24 jumped it back so the upper eyelids widen some more, and then held that pose through the end.

> Sometimes (though not always), bouncing eyelids up just to hit a single key causes them, during their return motion down, to look unnatural; that's why I chose to hold the pose through the end.

Now for blinks. One basic suggestion for when to blink is during big motions of the eyes. The range over which our character is looking most definitely meets that criterion. I'm going to blink the eyes by moving the Ctrl_Lids slider down on frame 2.

I'm not, however, going to blink on the second motion of the eyes; that would turn this into the blinky-blink-blink show. Generally, stay away from groups of blinks for functional reasons. For emotional effect they're great, but groups of blinks show disbelief, shock, confusion, etc. Since this guy is asking a question, he may be a little bit concerned, but I don't think he's in shock or disbelief. Putting a blink on the second eye move would cause an emotional side effect, so I left it out. My first instinct, moving forward, is to just leave the rest of the scene alone, but there is something else to consider. In conversation, there's a subtext in blinks.

When I say something, if I continue to stare at you without blinking, you won't know when it's your turn to talk. If I instead say something and blink, it shoots you the message, albeit subconsciously, "Okay, it's your turn to talk." If there's no blink, there's no message. It's another fun little experiment to try at home: talk and then don't blink. It's likely that you'll hear no response to your statement. In any case, this subtext makes me want to blink the eyes near the end of this line. After scanning the line a few times, I'm realizing that exactly where we have the eyes widening on *here* is where I want to blink. That's fine. I'll just change the widening into a blink instead. The word *here* still gets its eyelid animation hit—it's just a blink instead of a widening.

Raising the lower eyelids—the Squint—is an emotional intensifier; it adds thought. Using that approach, I'm looking for where thought should be communicated. Listening to the sound, and watching what I've already animated, I see that the character seems to do his thinking up front, when he's darting his eyes around. Also, it's usually smartest to change lower lid poses at the same time as upper lid poses, making blinks perfect transitions. I animated the lower lids up (Ctrl_Lids left) from frame 2 to frame 21, then back to default on frame 24. It basically appears between the two blink keys. Another thing this did was to create more punch on the word *here*, as it's now getting a widening of the eyes. See how it's all relative? Since the lower eyelids were tight, going back to default looks wide.

Frame 21

PRODUCTION NOTE

I did it in this example, but in real-world production it's almost always a bad idea to blink in the first or last 5 to 10 frames of a shot unless you're expressly asked to by your director or supervising animator. Editors will murder you. Editors need some flexibility in exactly where to come into and out of your shot. If you put blinks in that zone, and the frame they choose to cut to/from has the eyes closed, it causes a "hook-up" problem with shots around it—extra work for you and extra grief for them.

Brows

Watching the animation, you'll notice that there already seem to be brow Up/Down motions due to the head's Up and Down. Many people animate the brows to volume. Instead, animate the tilt of the head—it's a very similar perception. The difference is that the brow Up/Down due to perspective in head tilts more accurately reflects reality, and the brows don't look manic.

Use the brows mainly to reinforce. In this situation, I like the seeming raise in the brows created by the upward tilt of the head during *sayin*. I don't, however, just want him to be "Mr. Brows in the Air," so instead of pushing the brows up, I'll push them down before-hand—this is basically using opposites, or treating it like an anticipation. I set keys for the brows Down on frames 4 and 10, and they return to default on frame 13, approximately at the right time for *sayin*.

> Do not concern yourself too much with lining up all of your keyframes for poses on the same frame quite as stringently as you might on the body. There are few enough things to keep track of in the face that the inaccuracies actually make it look better, and it's not very difficult to manage.

That's about all I want to do with the brows. As an animator, I'd like to go in and key all over the place, but I don't think it'll add anything to the performance. I don't look at it and feel a lack of brow Up/Down, so I'm not going to add any more.

On other setups, the brows will work together a little bit differently—you'll create the mads and sads out of combinations of the shapes you have available. With Box Head, though, we've got some pretty simple stuff. Sad and Mad. Sad can double for a lot of things: the right smile with a subtle Sad on the brows can be happy; it also portrays shame. Sad generally portrays the softer emotions, or even the lack of confidence, which is the way I hear this line. The character is just a little bit confused, asking a question. Asking is a lesser form of pleading; they're in the same category, one that indicates a little bit of weakness. Since the whole sentence is pretty much in the same tone, and I'd like to hit each portion a little bit harder, I'll use stepping. I went to the end of the scene, choosing the most extreme sound and pose first, which I only want at about 70% strength for the shape. Then I backtracked. I set a key on 27 so that the pose holds until the end of the animation, then between 13 and 21 *sayin in*, I set some keys back up a level, about 40% to 50%, creating a "step."

> It was no coincidence that I chose the range between 21 and 27 for an expression change. I used the blink as a device to help change expressions more believably. Blinks are good for that.

Frame 4

From there I created another step, even higher, between 3 and 10 to give *what am I* some sort of impact, and left the key I already had on 0 that goes back to default. Watching the scene through, you don't see drastic motion on the brows; you just see some acting as the brow shape shifts slightly throughout the line.

Finesse

So here's where there are really no rules, and it's up to what I or you like and don't like. I'll add in some motions on the head left to right and see what it feels like. In this stage, you should really have something that you're reacting to on an emotional, not functional, level. If your character doesn't seem at least a little bit alive, take a look at each step again, seeing if it can steer you toward something you missed or could use more or less of.

Move the head like the eyes Not in all cases, but in some, I like to move the head along with the eyes. Making the head reach a little bit as the eyes move really takes away the feeling of the character wearing a neck brace. In this scene I'm only going to move the head left to right, as that's where the eyes are looking. I moved the head (character) left on frame 4, then (character) right on frame 9, and then back to the middle on frame 13. Leaving the head fairly still, or at least *facing forward*, during the last part of the line where I have Box Head addressing the screen/audience, gives it some focus.

Frame 35

Scene choice Next, looking at the scene, I decided I really liked the bug-eyed look for the delivery, so wherever the eyes are wide (such as Frame 35), I made them wider.

Making thought happen first This scene is too short to bother trying to move the shifts in expression ahead. In short scenes, you should be more concerned with the overall expression being pretty homogenous so that it will read in the short time an audience will see it. I'm going to leave this as it is. In longer scenes, by shifting the acting portions of your animation ahead, you can create the effect that the character *thinks before they do*.

Here's something really funny you can do later: By copying the animation curves from these sliders to sliders on some of the more refined looking setups, you can actually recycle this animation onto a photo-real or any kind of head if you like. It's funny to see Box Head performing the same line side by side with another character!

I think we can all agree that what we have here is not going to win any awards, but I think we can also agree that we got very far very fast. That is the goal at this stage of the learning, so let's keep on it!

Beautiful Perfect

"Listen up buddy, there's two kinds of people in this world: big dumb stupid heads like you, and super beautiful perfects, like me!" Woosh! That's some snarky attitude for a little girl!

Since the other two sound files from Chapter 4 are both also very short questions like the last example, I'm going to move right along to some other sound files that can provide more instruction. To proceed, import `BeautifulPerfect.wav` from the Chapter 7 folder on the CD into your Box Head scene. I put my scene range at 0 to 250. A finished version of the scene file is on the CD as well: `BeautifulPerfect.ma`.

Time check: This should take, on your own, about 30 to 45 minutes total.

I added one little twist in this one, just for the sake of instruction. Sometimes, as with this sound, there may be too much dead space (nothing) at the head of the sound. To move the sound so it starts earlier, right-click the Timeline and go to the Sound option at the bottom. Select your sound from the submenu and go to the option box. In the Audio Attributes is a value labeled Offset. By changing that number, you can influence when the sound starts; a positive number pushes it back that many frames, a negative number makes it happen that many frames earlier. For this scene, I type in a –30 and am using a range of frames 0 to 250.

An AVI of each step as it's completed can be found on the CD:

```
Beautiful_01_Sync.avi

Beautiful_02_Tilt.avi

Beautiful_03_Eyes.avi

Beautiful_04_Lids.avi

Beautiful_05_Brows.avi

Beautiful_06_Finesse.avi
```

Head Tilt

I love to animate to the actress in this sound piece because she's very musical in her delivery, and you know I like to use those musical flows as inspiration for head motion. For *listen up,* there's an upward shift in tone during *listen* and it's sustained through *up*, so I tilted the head up and kept it there. *Buddy* provides a fantastic shift down, in both her tonal quality and in how sharp it is. The *listen up* has unwittingly become a great anticipation for *buddy*. For the next big chunk, *there's two kinds of people in this world*, there is a nice little punch on her delivery of *two* and another on *people*. You can't hit every shift with the head, but you can stow those two sounds away for different tools, such as some of the later brow and eyelids stuff. I tilted the head higher for the time before *people* and then shot back down again on that word. I held that height until after *world*, where there's a silence and the actress clicks her mouth.

This is the bread and butter. This is the good stuff. You should hope to always be so lucky as to have an actress to pause and click her mouth between lines. The perfect time to shift expressions is between lines, or phrases, almost never during. When an actor makes a noise, takes a breath, does anything in between lines, you are given a playground to do with as you please. You can bounce the character into an extreme pose, for just that sound, if it's fitting. You have a perfect, infallible spot to change expression, which otherwise can sometimes be hard to find, and that's what we're going to use it for. For this stage, it'll just be moving the head up, but we'll do something at this point on every pass through.

Big and *dumb* both climb tonally, so I'm going to step the head higher into those both and then slam it back down with a nod on *stupid*. *Heads like you* only really peaks on *like*, so I kept the head at the same level as after *stupid* and then popped it up briefly on *like*, inadvertently causing a nice nod on *you*.

For the next section, *and super beautiful perfects like me*, the character is obviously off in world of her own wonderfulness, so I'd say posing her head toward the sky is a good idea. I stepped it down to ease in the downward movement over *perfects* and then brought it back down in another nod on *me*.

Frame 26

Eyes

The scene implies that she's talking to someone, and since it's not important who it is or where they are, I just picked a place, somewhere offscreen left, that became the eyes' home base. Now, through this performance, she seems pretty sure of what she's saying and who she's saying it to, so I held her eyes pretty much on that one focus. During the spots where she's obviously searching for the words *big dumb* and *super beautiful perfects*, I darted her eyes up and around. I picked two spots away from whoever she's talking to. I shot her eyes up and (screen) left for *big*, then up and (screen) right for *dumb*. Knowing how eyes move, they only take two frames or so to get to each location and then hold there until they move again. I did almost the same thing for the second "search" for *super beautiful perfects*. I returned her gaze to her offscreen focus, for *me*, as the nod provided a great time to do so.

Eyelids

For *listen up buddy*, the upper lids, much like the head, shoot wide open for *listen up* and are dropped lower for *buddy*. Later on, with *there's two kinds of people*, I decided to emphasize the dismissive, contemptuous nature of the sound by intensifying her expression with a squint, in two steps, on *two* and *people*. From there nothing eventful happens until she looks up on *big dumb*. For that, I blinked right in line with that clicking sound she makes. I adjusted the lower lids slightly, to track upward in relation to that eye movement.

Frame 101

The eyes return to her primary focus on *stupid*, so to transition her back into "reality," I gave her another blink. A blink paired with a nod of the head, and a change in focus of the eyes, really starts to show a strong acting transition there, which is good. I also used the blink to drop the lower lids back down—I was starting to run out of range with them so I used the strength of the overall shift to hide a "reset" of the lower lids. Before and after the word *you*, I left the lids where they were but punched the word *you*.

After that there's nothing too major until she looks skyward again with *super beautiful perfects*. I threw in a blink at the start of that and shot the lower lids up higher for the duration of that part of the line. It helped her look much prouder of herself because it created more focus on her statements of her own fantastic amazingness. I blinked on *perfects*, and here's why: a friend of mine who also knows all about this stuff (and in fact taught me a lot about it) noticed that blinking on percussive sounds gives them a great visual punch. As the mouth closes and releases, so do the eyes. It creates a great whole-face involvement with the sound. I don't do it on all percussive sounds, only on the ones it fits, like the *p* in *perfect*; it's almost always a trial-and-error process. From there all that's left is a blink on the return from her gaze up, to whoever she's talking to offscreen.

Frame 189

Brows

I really wanted to intensify her through *listen up buddy*. I felt that she wasn't telling the other person what's up as much as the dialogue requires. I dropped the brows low but didn't give them any real expression. Starting at *there's two kinds* I gave the brows a little bit of sad shape, which, with the brows down low and the head tilted forward, and the kind of line this is, creates an air of arrogance. Remember, I was looking for a way to hit that part of the line earlier in the process—and finally found it here! I both raised and saddened the brows for *big dumb*, using that blink and mouth click as the place to transition, which is now turning into a great little attitude moment. As she returns down, there's really two things to accent, *stupid* and *you*. To save myself range, I decided to not drop the brows on *stupid* but instead just shift them to angry and then drop them and lose the expression on *you*. The reason I did it that way instead of dropping them first and then adding mad on *you* is that I liked the look of the dropped expressionless brows better, and putting them second makes that expression more her "final" destination than a transitional pose. This last pose also looks like the expressions near the start, giving her a more consistent performance.

Frame 35

The next shift is the skyward gaze, for which I did a pose similar to the one I did for the first. It's a good idea to do that if you can; it creates almost an anime three-frame cycle, where you bounce between your established poses. Used well, going through your three-pose cycle strengthens the scene—people are more likely to remember it. Just don't do it for *everything*!
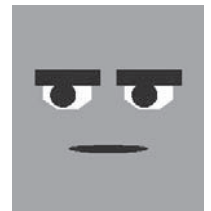
Finesse

For this one I was pretty happy with the overall feeling, so all I did was put some of the left-to-right motions of the eyes into the head movement as well. After that, since this scene is a little longer, I moved all of the animation three frames earlier, just to see what would happen, if the illusion that thought came before action would work. In the emotion, the eyes, and the head, it was great, but my sync fell out of—well, sync. I hit Undo and then shifted only the other four sliders (excluding Ctrl_Sync) ahead, and that worked great. That few frames of difference really helps the mind behind that square.

Default Grey

So, if you were in a world filled with colorful, photo-real, perfectly textured models—with hair and shaders and soft-body dynamics and all that jazz—wouldn't you be a little grumpy to just be a grey box? Box Head is. From the companion CD, import `DefaultGrey.wav` into a scene with Box Head. I blocked the range at 0 to 550 frames. A finished version of the scene file is on the CD as well: `DefaultGrey.ma`.

"I'm default grey. Stupid grey. Boring. Doof. You'll get yours, red. Flashy, oo! Look at me, I'm red! Oh you, srr err razafraz…"

Time check: This should take almost a full hour from start to finish.

An AVI of each step as it's completed can be found on the CD:

    DefaultGrey_01_Sync.avi

    DefaultGrey_02_Tilt.avi

    DefaultGrey_03_Eyes.avi

    DefaultGrey_04_Lids.avi

    DefaultGrey_05_Brows.avi

    DefaultGrey_06_Finesse.avi

Head Tilt

This is the first example involving a big breath. I treat breaths just like musical sounds: an inhale is up and an exhale is down. For this opening sigh of discontentment, I crept the head up until the peak and then dropped pretty swiftly on the exhale. The first actual phrase, *I'm default grey*, also has a great up and down to it. As with all sounds like that, I crept the head up during *I'm default* and then nodded the head down on *grey*, right where the sound levels out. It gives the word some impact, just like the vocal performance. After that, the actor makes a sheesh, or quick exhale sound; I'm going to do a motion like a nod, but upward, as if he's tossing that sound out. It visually matches the sound and its "whatever" tone. I'm going to drop the head for *stupid* and then do another of those reverse nods for *grey*. When an actor delivers a scene consistently, you're likely to run into these

repeated sorts of motions. Until *boring*, there's a hold, nothing big happens, but *boring* is tossed out pretty hard, so I decided to nod on that sound but return the head to where it was previously. I did the same on *doof*. To get more impact on *doof*, though, I actually crept the head higher after *boring*. To nod the head down to the same level as *boring* was a bigger movement from this higher start point.

All through the *oo flashy oo look at me I'm red*, I crept the head higher and higher, but I bounced it up and down as I did. The sound was very banshee-sounding with warbling, so I mimicked that in the head's up and down motion. After that the actor breaks into a lower-level *oh you, son of errr arr* and various other noises. I just dropped the head down for that, and that was the end of my work on the head Up and Down for now.

Eyes

I dropped the eyes for the defeated-sounding sigh at the start. Now, with all these things going on, this guy's really starting to look pathetic. Eyes down, as I've said before, doesn't automatically create sadness; it just works sometimes—like now. I decided to make straight down his "reality" point, so I held it for a long time; that makes it look as if he's actually focused on something. What it is is irrelevant, but it's something. When he then moves his eyes (character) right briefly, that just looks like where his eyes settled as he was thinking, not necessarily a focus. I moved the eyes there for the *sheesh*, and then quickly moved them to the other lower corner on *stupid*, and then picked another position on (character) left as yet another sort of "thought" point for *grey*. He stays there through *boring* and then goes back to his dejected "home" position on *doof*.

Next was a very specific timing thing. I'm not crazy about characters looking at each other too intently if it's not clear why they would. I have Box Head look at whatever "red" item is next to him, but made the shift on the word *yours* before *red*. I could have done it earlier in the line, but that might denote some real conflict between Box Head and the color red. By making it ever so slightly before the word, it creates more of a sense that he's just angry and looking for someone to blame. I thought that was a better direction. If you want to see the difference, in your scene make the eyeline change earlier; the sense of more contempt and history between Box Head and "red" is obvious.

From here, the eyes stay on their new home focus until he gets into the heavy mocking sounds, where I shot the eyes upward. Mocking often leads to eyes upward; I don't know why, it's just an established thing in both life and cartoons. As the warbling sounds continue, I moved the eyes back toward his focus and held them there for the rest of the scene. This now does what I was talking about earlier where I chose not to shoot the eyes over too early. He's really decided to make it personal, so now that's fitting. It also was a form of stepping over several poses. By not having "red" be the object of too much intensity earlier, we can go back to that pose and make it stronger with a hold, ending on a stronger note.

Eyelids

I don't often blink character's lids slowly, but a big exhale is one of the times it fits. I blinked the eyes slowly so that the fully closed eye was right on the peak of the upward head motion for the sigh, making the tilt down seem even longer and more painful, drawn out. If I did it later, it would cut that time visually. Using my friend's technique of hitting percussive or closed mouth sounds with blinks, I hit the *m* in *I'm* with a blink. I also blinked again on the first *grey*; the nod seemed like a good place to throw in a blink (nods usually are; the two actions strengthen each other).

    I left the lids until the word *stupid*. On *stupid*, I brought up the lower lids, creating a slight squint, just for the one word, giving the character extra contempt for a moment, which seemed to be in the vocal performance anyway. *Boring* was the next sound I keyed on; I blinked, and on the blink return brought the lower lids up too. The combined head nod, blink, and change now in pose is making *boring* really have some punch. I left the lids as they are except to move the lower lids out of the way as Box Head looks down, until *oo flashy*. As there's a real attitude shift from anger to mocking, I widened the eyes there, creating a sarcastic feeling. They stay there until he looks back down, where I blinked for the transition (it's always a good idea to blink on emotional transitions).

    After that, and for the rest of the scene, I pulled the lower lids up and upper lids down slightly, creating more of a narrow look for the eyes, clearly an angrier appearance.

Frame 160

Brows

For the first portion of the line all the way up to but not including *stupid*, I just put the brows in a sad pose and punctuated the head movements. On *grey*, I dropped the brows low and removed the sad expression so they were level. Happening over the tightening of the lower lids, this created a great emotional shift. You can see him going from unhappy about his colorless situation to angry about it, even though I didn't go as far as to actually turn the brows to the mad side. On *you'll get yours, red*, I actually made the brows angry, dropping in a hint of the pose I'll return to at the end and adding some strength to the statement.

    For the whole mocking section, I moved the brows up and sad, creating a decidedly weaker appearance, perfect for mocking. I accented various words and sounds, but nothing major. As he finishes up his little mocking moment, I pulled the brows back down and into an angry pose. I was tempted to bounce the brows along with the various interesting sounds, but it looked stronger to leave them held in that position.

Frame 464

Finesse

This I decided needed work, and that's a normal part of the process. I didn't *feel* the shifts in emotion as strongly as I wanted to, and I also didn't feel as if some of the emotions

themselves were really as strong or as linked to the sound as they should have been. First off, the easiest thing was to begin with the head left-to-right motions. For those I started by copying the motions of the eyes. (I literally copied the FCurve and shrunk it down.) After that, there's something I like to do during disbelief, sadness, anything with which the character doesn't really agree; I shake the head. Just shaking your head like saying no is a great little subtlety. During *I'm default grey* I threw in some shaking. I also did the same at the end during the mumbling nonsense. The muttering paired with the shaking and the angry expression turned into feeling almost like disapproval more than anger, and I thought it fit really well.

Frame 376

Something else that jumped out at me was the sigh at the start. The brows seemed to hold tension by staying up instead of releasing tension along with the sound and the head motion. I decided to leave the brows' upward climb, but then I dropped the brows. I made the drop happen after the head was down. By making the drop on the brows later, I really dragged out the defeated impression, and it also made it less a flex and more of a release. If it all happened at the same time, he'd be moving into a pose instead of falling into defeat. This also gave me an opportunity to use the brows to accentuate some of the sound in the long hold following that. By adding a brows Up motion on *I'm default*, it just accentuated all that was going on elsewhere in the face, on both the Up for that and the Down on *grey*. Dropping the brows at the same time as dropping the head, at the same time as the blink, and all of that in time with the sound works well for me.

After all that I just slid the emotion stuff up a few frames, so the thought happened before the sound, and I was done!

Continuing and Practicing

We'll continue this in Chapter 14, "A Shot in Production," where we take more shots through a facial animation process from start to finish. Now that you've got a feel for the type of expressions you can create using combinations of techniques, it's time for us to move into the process of building the other most important area of the face, the eyes and brows and the keys that area needs.

If this chapter has done anything, I hope it has shown you why I leave the more obvious things like brow poses for later and things like smiles and frowns for even later. I really hope this has shown you how much emotion you can create with very little, even with the complete absence of a smile or frown!

To continue on with practice, there are more sound files available all over the CD, mostly in Chapter 14. Another thing I frequently do for practice purposes is record sound off movies and TV to sync to. Commercials are actually my favorite, as they usually self-contain most lines. Pulling from a movie, you can run into a minute-long line that doesn't mean too much out of context, whereas in a commercial, it's all wrapped up for you in a

few seconds and makes some sense. Something I don't recommend, though, is to roto-scope your acting from the actors onscreen; it can actually block your creativity, because what the person is doing fills your head with those motions instead of you being able to make up all new ones that relate to the sound.

Constructing Eyes and Brows

The eyeballs and the area around them are not too difficult to model for movement, but there are definitely some things you can do to make them move more easily for you. The main motions are a squeeze of the brows, the raising and dropping of the brows, blinking, and, of course, squinting. When things in 3D computer graphics move, they always perform best when they have a "track" to follow, a point layout already pointed along their route. In pursuit of what we know about the movements, we're going to build the eyeballs first, to have a reference for our lids; then we're going to build the lids/sockets out of a *mostly* circular layout, to allow the squinting and blinking; then we'll connect all of that to a very gridlike layout for the forehead, for the raising, dropping, and squeezing of the brow.

- ■ **Building eyeballs**
- ■ **Building eye sockets**
- ■ **Building the forehead**

Building Eyeballs

In real life, eyeballs are not spheres, but building them that way makes our lives significantly easier. We can use rotations to move the spherical eye around without worrying too much about the eyeball poking through the eyelid.

Making eyeballs is really about as easy as it gets. The best way to start is with a NURBS sphere (in Maya, choose Create → NURBS Primitives → Sphere ❏). In the option box, make the sphere 8 spans by 8 sections, and make it in the Z axis. When it appears, it should be flat to the Z axis, essentially pointed toward the front and back.

Right-click over the sphere, and from the marking menu select Isoparms. In the perspective view, click and drag the first isoparm forward, to around where the iris will start. It'll be red as you move it and turn yellow as you release it. Holding Shift, do the same again, pulling the next isoparm just barely forward of the last. You should now see another yellow line.

Do the same again; hold Shift and drag. This time, release the isoparm where you think the pupil should be. What you're doing is defining where the different parts of the eyeball will be.

If you do not Shift+click as you drag new isoparms, each new isoparm selection will override your last one. By Shift+clicking, you can continue to add more.

Once more, Shift+click and add one more isoparm, just inside the last one you created (Figure 8.1). Once you have all four new isoparms drawn, create them by choosing Edit NURBS → Insert Isoparms. Select all the points near the front of the sphere and hit R, or click the scale manipulator in the toolbox. Press the Insert key to make the scale manipulator's pivot movable. When the icon changes, drag the pivot so that it is lined up with the line deepest in the eye; this should be the one that was there as a part of the sphere originally since all the lines you added should have been forward of that. Now, by hitting Insert again, you've returned to regular scale control. Scale the selected CVs inward and backward, toward the center of the eyeball. This should create a bit of a dish (Figure 8.2), making the eye look like the empire's ultimate weapon.

If you get strange results using Insert Isoparms, try going into the option box and using Edit → Reset Settings.

You'll notice we're not adding the cornea yet; that's because we'll build the cornea out of a separate sphere later. By doing so, and adding a transparent yet shiny material, we can generate the same kind of specular highlight over all the different surfaces of the eye, both the cornea and the "white" of the eye. If we were to add just a contact-lens-style cornea over the eye, it might highlight differently from the rest of the eye, and as a result, the eye might not look as wet.
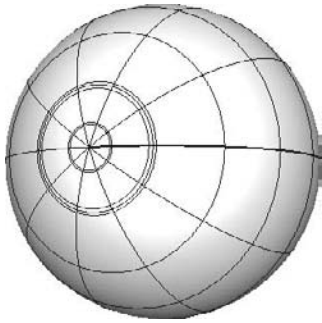
Figure 8.1

The sphere with the extra isoparms added
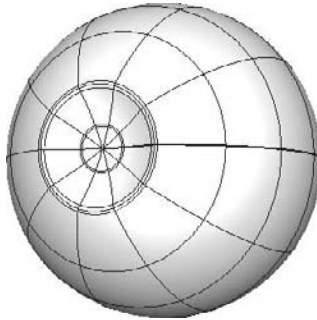
Figure 8.2

The crater in the eye will be where the iris and pupil go.

Two Ways to Model the Pupil

There are two ways you can proceed from here, with little or no real functional difference. You can keep what you have and sculpt the iris and pupil forward, a method that has its own advantages and disadvantages, or you can cut a hole in the eye for where the pupil will be.

Sculpt the Pupil from the Eyeball

By sculpting the iris out of the existing object and applying the right materials (I went with a largely transparent Blinn), you can actually generate an extra specular highlight on the pupil. This may seem undesirable or strange because that area is actually supposed to be an opening into the inside of the eyeball, but as luck would have it, the extra highlight actually helps the eyeball look more real. Eyes, as you know if you've ever tried to build them, can be tricky. They're easy to make, hard to make well. Part of what's difficult is the feeling of them being wet. The extra highlight helps to make the overall look more wet.

To sculpt the iris in this way is quite simple: Select the smallest rows—the ones closest to the tip—and pull them forward, as in Figure 8.3. That little bump, textured, will work just fine as a pupil.

Cut a Hole

The other way you can go, instead of pulling the points out, is to actually detach the surfaces where the pupil starts and put another object behind the opening. To do that, go into isoparm select mode, and select the isoparm where you want to open the hole. Separate the two objects along that isoparm by choosing either Edit Curves → Detach Curves or Edit NURBS → Detach Surfaces; either will work fine.
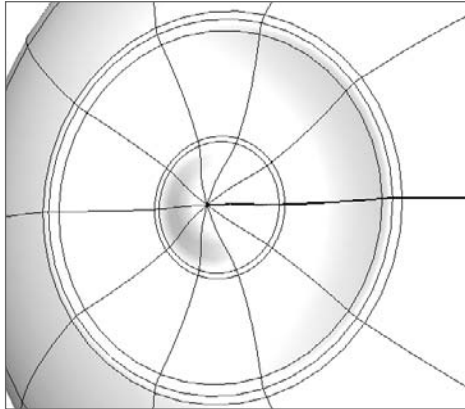
Figure 8.3

Shaded properly, this bump can make a very nice pupil.
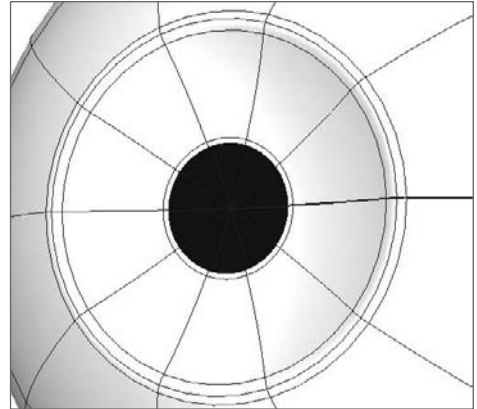
Figure 8.4

Chopping geometry out and making a hole for the pupil

Now take the piece that was cut, shape it, and place it behind the pupil opening as in Figure 8.4. If you wish to make the pupil dilate, you should make this back piece extend quite far so the pupil can have a wide range to open and close.

Building the Cornea

Just as with the eyeball itself, start with a NURBS sphere of 8×8 in both spans and sections and make it in the Z axis. This time, from the side, select the frontmost points and simply pull them forward. Now scale the whole thing up slightly, making this another surface running all the way around it. Did you blink? You're done! Take a look at Figure 8.5. You'll have to apply materials and textures to the cornea to be able to see through it, but there you go! Parent the cornea to the eyeball and you've got yourself an eye!

In more stylized characters with bigger eyes, you may want to skip adding the cornea bump. A regular sphere should work fine and cause you less hassle. Sometimes, even on humans, I'll use a regular sphere; the specular highlight travels the surface a little better, even though it's less accurate. It all depends on what you want your model to look like!

If you'd like to create more varied shading in the transition from the main sphere to the cornea, you can add another isoparm before pulling points forward.

Building the Eye Sockets

The area surrounding the eyes is interesting when it comes to topology. Every character will likely end up a little different, but there are general edge flow ideas that are universal. There are a lot of things the whole area can do *when you consider it as part of a larger*
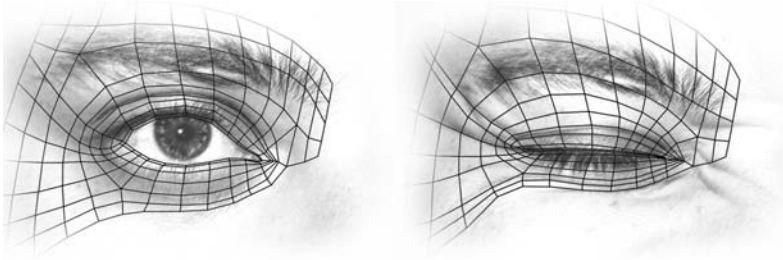
Figure 8.5

An overlay of topology on a photograph to illustrate what the edge flow is meant for

Figure 8.6

The epicanthic fold

expression, but on its own there isn't really a whole lot of unique stuff it does. The main muscle affecting the lid area in a way that steers topology is the *orbicularis oculi*. For the most part, it just bunches everything up; I'll refer to that motion mostly as a squint. When you squint, there is a pretty big compression of the whole area. As with the mouth, or any area covered with skin, when an area compresses, you usually get creases, but generally the skin by the eyes is more prone to finer groups of creases than down by the mouth, where you usually get one or two big creases. The creases in this higher area push up and in toward the eye; they even move forward when you consider the skin off the side of the eye around the temple. To get these compressions working, along with the blinking of

Figure 8.7

The flow of the upper lid folding over the lower lid

both upper and lower lids *and* the lines that run off to the side that form crow's-feet, we'll need more than just a *simple* circular layout. What we'll need is something that is circular for the most part but also has a linear, almost "gridlike" area off the side that leads away from the face towards the ear. To take all of this and complicate it further, the lower eyelid actually tucks up and under the upper eyelid where the two lids meet at the outside corner of the eye. Sounds like a lot of items for our topology checklist, no? Well, it probably is, but luckily the work to get there isn't too bad at all.

Figure 8.5 shows a side-by-side view of some eye topology laid over a photograph of an open eye and a squinting eye. The topology overlay is a portion of what we will build in this chapter. In Figure 8.6, I've overlaid some edges pointing out the epicanthic fold. In Figure 8.7, you can see the corner of the eyelid highlighted, where we've pulled the upper over the lower, and then in Figure 8.8, the scrunch lines below the lid and at the top outside of the cheek are shown. That will cover all the points we need covered. Since we know where we are going, and some of the reasons why, let's quit talking and get there already.

Start by creating a 5×4 plane, facing forward on the Z axis, and then cut out all of the faces that are not a part of the perimeter. Figure 8.9 shows the plane as it starts and then with the center cut out.

Figure 8.8

All the areas of creasing shown at once

**the polygonal plane
starting point**
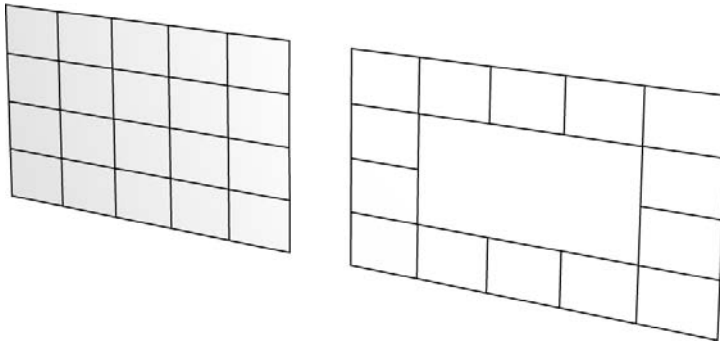
**The plane corners
pre- and postsnap**
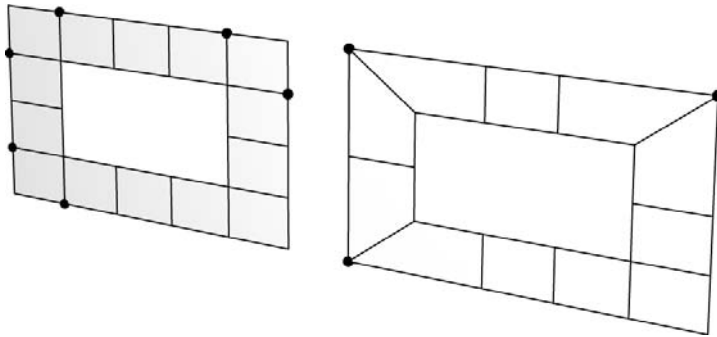
As we did with the mouth, take the verts that *lead into* the corners and snap them right to the corners, but this time, leave one bottom corner alone (the bottom right, if you're looking at this object from the front view), as in Figure 8.10. This will give us the basis of good topology that will work for both circular-style deforms around the lid *and* the linear-style deforms that we'll need for the crow's-feet.

Sculpt the plane with the hole and snapped corners into a ringlike shape to start to form the eye area. Do your best to make the top part define the epicanthic fold, the crease in your eyelid that exists even when your eye is open and unscrunched (Figure 8.11), and make the lower edge align with where you will want the bags under the eyes to end. (I know, I know, not every character has bags under their eyes, but picture them waking up after a crazy night, and imagine where the bags *would* be; make that the edge you sculpt.) Figure 8.12 shows where my bags *would* be… if they were there.

> For older characters with baggier eyes, many of the rows going around need to terminate closer to the corners of the eyes, and usually more geometry would be needed.

The next few steps will help us enable the upper eyelid to overlap the lower eyelid. To get that process rolling, split the path around once. This will actually generate two edges—one up/down, the other left/right—passing through the same square corner, creating a full cross in that corner. After some sculpting, I had what you see in Figure 8.13.

Figure 8.11

The area of creasing above the lid
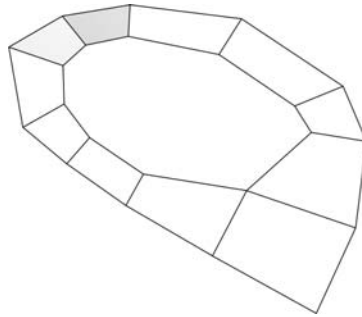
Figure 8.12

A three-quarter view of the first real shaping of the eye area
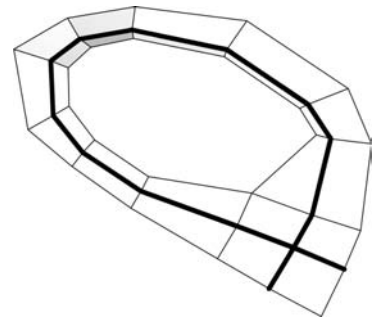
Figure 8.13

Split that ring and get to sculptin'.

Select and extrude all along the inside perimeter of the object for a total of two new rows of new edges; then sculpt them into an eyelid silhouette as best you can, as in Figure 8.14 and Figure 8.15. Think of the new innermost edges as the point at which the eyelid meets the eye. These will serve as the primary eyelid silhouette.

Now we're going to need the flow of the upper eyelid to run off the end of the lid and smoothly onto the face, but right now, there aren't really edges that can do that. What we'll need to do is have an edge flow off the upper lid. The first step in creating that from what we have is to snap the verts in the outer corner of the eye silhouette together, making that corner a triangle. Figure 8.16 shows a before and after.

Add an edge loop to split the faces off to the side, but stop it when it hits the triangle; don't take it all the way into the corner (Figure 8.17). What that did was give you extra edges for sculpting, but it also turned that triangle from the last step into a quad again. Good job.
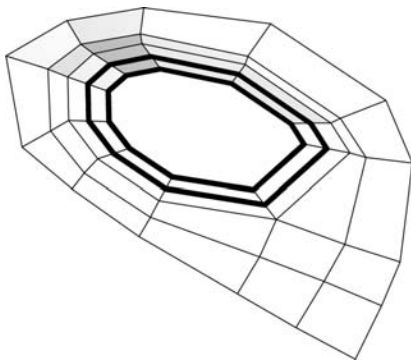
Figure 8.14

Add two edge loops.
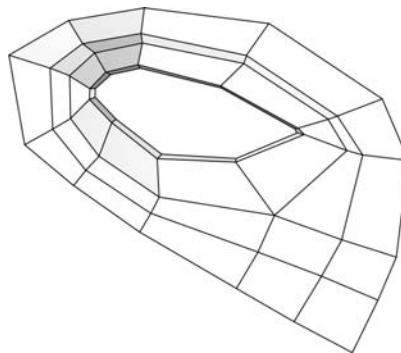
Figure 8.15

Sculpt the new edge loops tightly in to define the eyelid's silhouette.

A before and after view of the corner of the eye. Take the two verts shown as they are on the left, and snap them together so they look like what you see on the right.
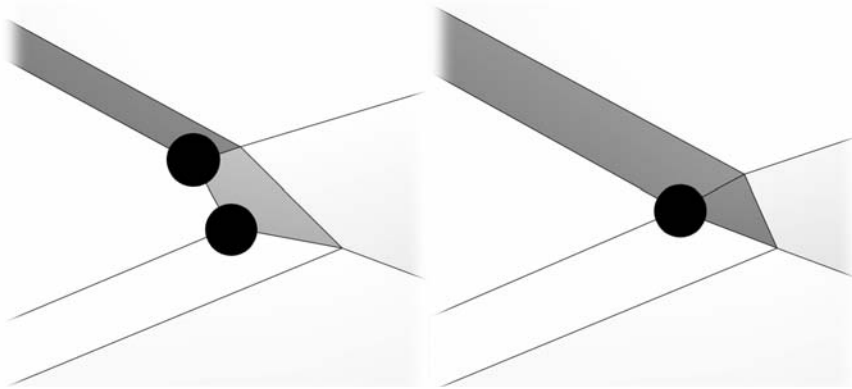
We have all the topology we need to create the overlap I've talked about. All that's left is to actually make it look like an overlap. Work with the geometry you have until you can get something like Figure 8.18. The edge flow off the lid now should be pretty easy to see.

Believe it or not, that was the bulk of the hard part. We just need to add edge rings and extrude in a good sequence and most of the rest of this is extremely easy topology. First, add two edge rings around the eyelid, and then sculpt using the new points to start to show where the eyelid actually turns in toward the eye, as well as sharpening the epicanthic fold. Take a look at Figure 8.19.

We've pretty much hit the limit of what we can do with the detail we have available, so either we're done or it's time to up the level of detail. If you guessed the latter, then you were correct and should split every edge all the way around the object. Pay attention to the crow's-feet area, and add two rows of edges below the lid and none above. Since the new additions won't automatically smooth themselves out (Figure 8.20), you'll need to take all the new stuff and sculpt it some to make full use of the added weight (Figure 8.21.)
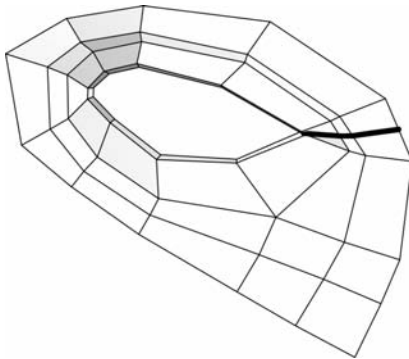
Figure 8.17

Starting the upper-over-lower flow of the lids
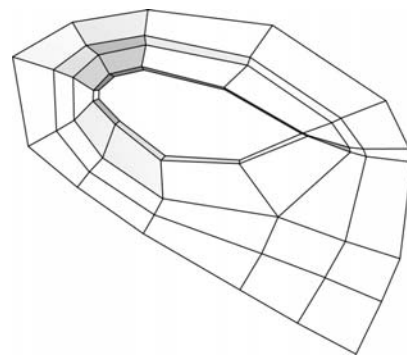
Figure 8.18

Sculpt the new edge along closer to the one below it.
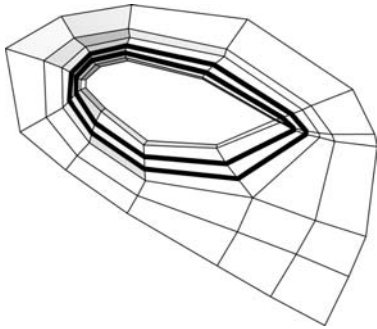
Figure 8.19
Add new detail and use it for sharper definition.
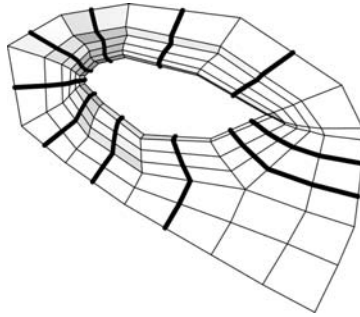
Figure 8.20
Split the edge rings the way you see them split here, once each section but twice under the outside lids' meeting point.
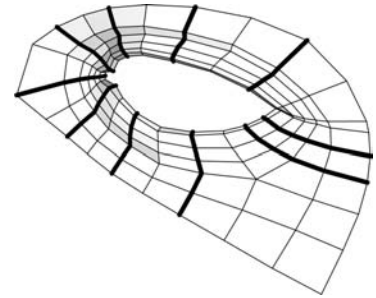
Figure 8.21
Sculpt your new detail to cooperate cleanly with a nice even edge flow.

Creating the Tear Duct

At the inside corner of your eye, you are probably used to seeing a tear duct. If you haven't already, take the available geometry and frame it so that the tear duct has five edges: one on the inside and then two each on the top and bottom. We've got the tear duct framed, now let's fill it in. Create/append polygons to make, on the very inside, a triangle, then a quad one row of edges out from that, like the new faces framed in Figure 8.22.

Split the quad, but not the triangle, just as we did with the corner of the eye where the lids overlap, and once again you've created all quads, as in Figure 8.23. Just a little bit of sculpting and the tear duct should be pretty well defined topology-wise (you can always add more detail if/when you need it).
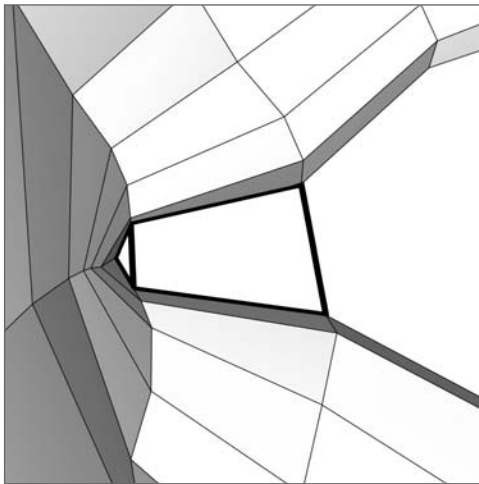
Figure 8.22
Boxing in the tear duct area
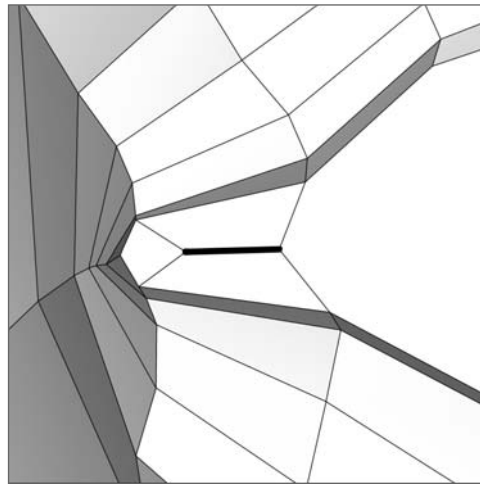
Figure 8.23
Add some detail, and use it to soften the shape.

To start our eye area's trip up onto the brow and forehead, grab all the edges along the top and side perimeter and extrude them once. Make it look like Figure 8.24.

There is a fair bit of space between the half-brow we are making and its counterpart, which we'll make on the other side of the face. To prep for that, and the full span of the brows, extrude the two top edges on the inside a total of four times and pull the outside edges out once. This is now officially half of the model, so the line toward the center should get snapped flat to the axis for later mirroring. Be sure to start a little bit off the bridge of the nose. Figure 8.25 is what I did with the new stuff.

Building the Forehead

Extrude the entire new top up three times and sculpt it like Figure 8.26. This will create the bottom half of the forehead.

Figure 8.24
Extrude along the outer top and side.
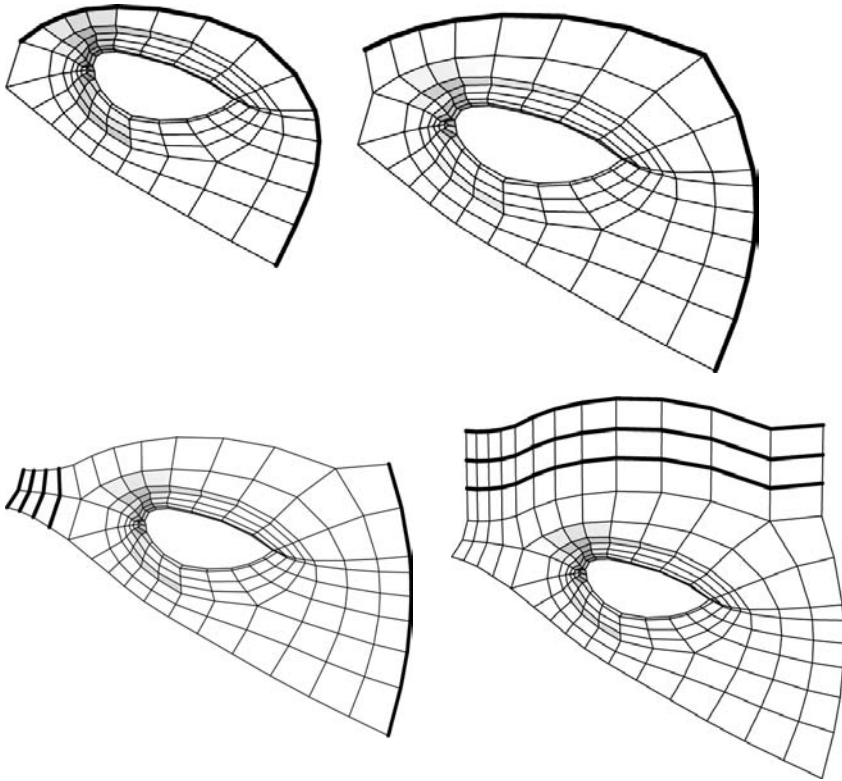
Figure 8.25
Pull a few rows toward the nose and temple.

Figure 8.26
Drag up the upper edge to start a forehead.
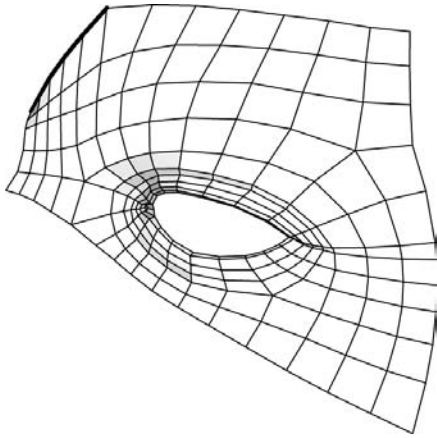
Figure 8.27

Collapse the area right in the middle of the brow down to manage a transition from a lot of rows on the nose to fewer on the forehead.
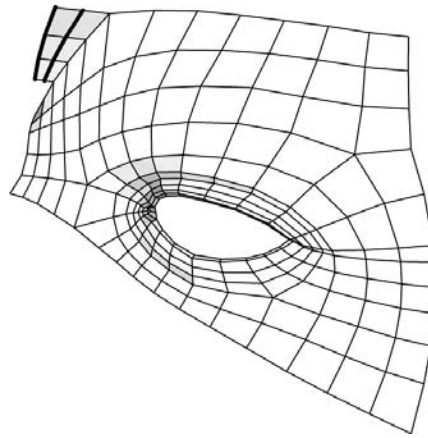
Figure 8.28

Extrude toward the center line of the head.

Just as we did with the topology surrounding the eye with the edge flow off the lid, we're building the forehead this way for good reasons. We need to create an edge flow for the eyebrows that enables furrowing, like an angry face. The edge flow that comes up and over the bridge of the nose drives directly up and into the forehead where the muscles on the left and right squeeze and create a furrow. To be able to get that motion and deformation right, you need a good bit more detail there than you'll have elsewhere in the area. We actually already have enough for that kind of deformation now, but the rest of the forehead has significantly less need of this kind of density, so we'll do some things to reduce the top edge of the model we have now so that as we extrude it up later, there is less clutter.

Count out five verts from the center line, *including* the center line, and pull the verts down on an angle (45 degrees or so should do the trick). This will mean you'll need to pull the points below them down, too; any way you get there, try to end up with something like Figure 8.27.

By taking that area down, we expose to the side the edges that *were* along the top. Take the top three of the edges that are on an angle and extrude them toward the center two times, aligning the innermost along the axis like the points below it. Figure 8.28 should help clarify.

This next step is pretty easy, and that is to snap some of the verts below the new edges up to their counterparts and then merge them. What you have now is your fully realized furrow topology, which should look something like Figure 8.29.

Figure 8.29

Button the open area up by snapping and merging the verts shown.
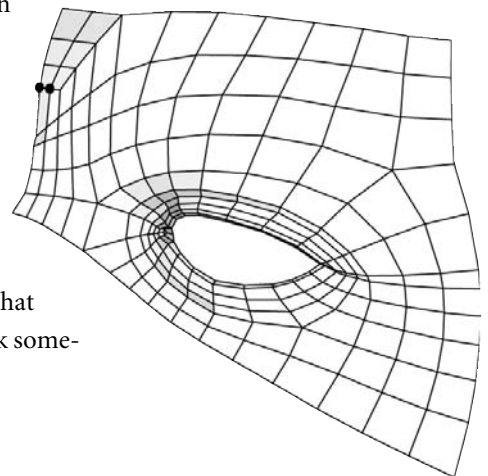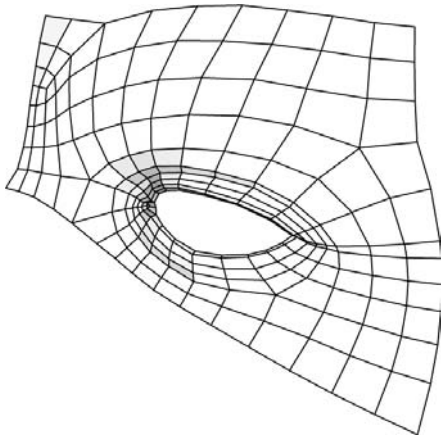
Figure 8.30

A little bit of sculpting and you're almost done with this area!
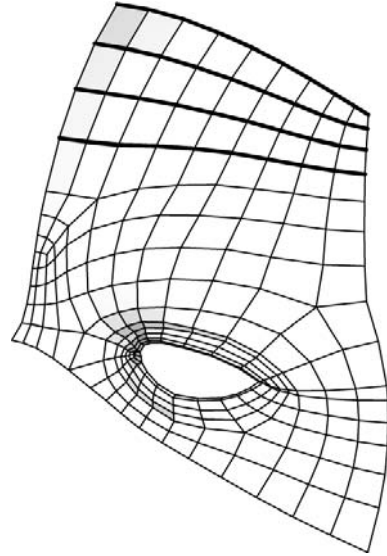
Figure 8.31

Extrude and sculpt for a change.

Sculpt what you have now, and really keep an eye on defining the different parts of the brow. Use the detail you've added to shape the top of the nose. Notice how that area at the top of the nose is a different thing than the base of the brow and where the muscles and bone on each side of the brow dive in and collide with the center. Figure 8.30 should show enough differentiation on the shading to show you all these topology needs interacting on the surface.

We're almost at the point where you get to deal with the symmetry of the model, where you've got two sides to play with, but first let's wrap up a few loose ends. We still need to finish out the top half of the forehead and cap and clean where the eyelids wrap around to meet the eyes.

Select all the top edges and extrude them up four times. Then push the new detail back in a bit of an arc and start to define, if you can imagine, your character's upper forehead and hairline. Figure 8.31 shows the work I put into it.

Brow Hair

There are several ways to get brow hair on a model, and it's not a decision I'll make for you. There are options. Look at them and decide what's best for your character. For some styles, the best thing to do is just to build eyebrows into the main structure itself, as was done with the head in Figure 8.32. If you do that, try to keep your rows as organized as possible so when you're building shapes, you have a good layout to follow.

Miscy the Miscella-neous Man (a char-acter of mine who was horribly erased in a power outage) had the "built-in" brow type.

For Fur or PaintFX Eyebrows

Depending on your software, creating fur or any other kind of hair may involve some extra objects that play nice with the underlying technology. For example, if you were to use Maya PaintFX, you *could* draw strokes in midair, but the technology behaves better when the strokes are drawn on a NURBS surface. For either PaintFX or fur, you can create objects in the exact shape of your brows and place them on or just below the surface, as in Figure 8.33. At render time, you can hide them, leaving only the hairs.

When it comes time to build your key shapes, you'll have to build accompanying shapes for these extra brow objects or use a something like a wrap deformer to force them to stick to the face surface. If a NURBS object is shaped exactly like the brows (the hair), then they are not shaped exactly like the face, and you'll have to approximate the shapes on the face with your brow shapes or hope your wrap does a perfect job with points that are not in the same place. It can be done (Figure 8.34), but it's more grunt work than is necessary.

Figure 8.33

Before and after brows in the shape of brow hair
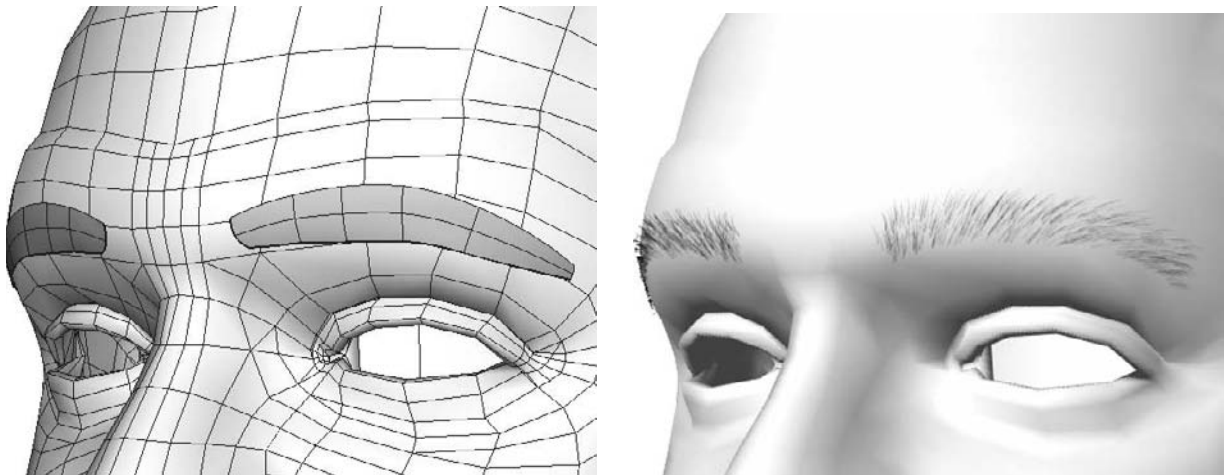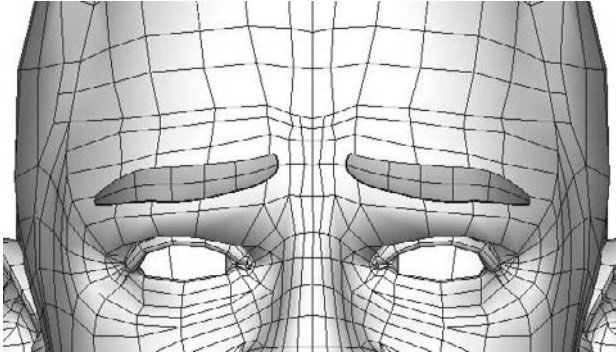
Figure 8.34
Since the objects don't line up exactly, there is interpretation and a lot of work in keeping the two moving together exactly.
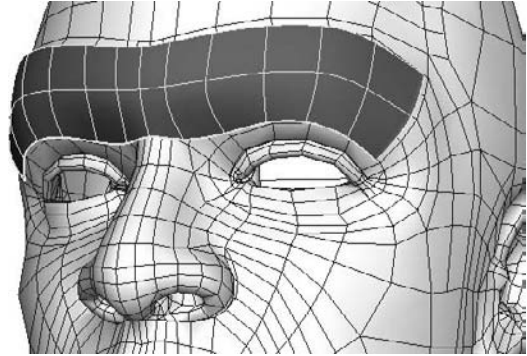
Figure 8.35
The NURBS object I use to keep the brows on my character attached. Its CVs match the underlying poly mesh.

The smarter thing to do is to match the poly (or subD) geometry exactly point-for-point with NURBS around the brow area, as shown in Figure 8.35. This is extremely easy to do, using snap-to points. With each accompanying key shape built, you can again simply use snap-to points and mimic the shape perfectly. This makes the construction of shapes centralized—you just make the face shapes and any NURBS surface can be forced to tag along. As before, at render time you can hide the surface, leaving only eyebrow hair.

You could, technically, use clusters and constraints on every point to glue the two objects together, but the extra time that method takes compared to just snapping the points manually for the relatively few brow shapes is a close call. The clusters method will also slow interaction slightly. I don't recommend it; I prefer the "roll up your sleeves and trace a few shapes" approach.

Separate Brows: Technical Extras

I'll talk about this again in Chapter 11, "Skeletal Setup, Weighting, and Rigging," but when using separate objects for the brows, you'll need to connect all the key shapes together for the brows and the face. It'll be a simple expression or connection tying each brow shape to the corresponding face shapes, like these:

```
browShapes.browsUp = faceShapes.browsUp
browShapes.browsSqueeze = faceShapes.browsSqueeze
```

If you don't do this, the face will cooperate with all the interface elements, but the brows will just lag behind. To do the same thing with connections, open the Connection Editor and highlight faceShapes.browsUp on the left and faceShapes.rowsSqueeze on the right.

Detailing the Inside of the Lid

Meanwhile, back in "getting this eye model done" land, select all the edges along the inside rim of the eyelid and extrude them in three times. Make the first two for the most part straight back and into the eye socket (Figure 8.36)**,** but take the third and fan it out,

finishing the inside edge, as in Figure 8.37 (views are from inside the head, if you are disoriented). If you want to make the way the tear duct catches light just a little nicer, take the new points that are directly connected to it, but behind, and pull them forward so that that second row is also forward of the eyeball; this will make a little rim that will occasionally catch a nice glint of light (Figure 8.38).

There are only two more steps to go, and the first is to mirror this whole model over the axis. Now that you see the way curvature is bridging the axis, you may notice things that are discontinuous, too sharp or too shallow right in the middle, leaving you with some sculpting work to do; I ended up with what you see in Figure 8.39.
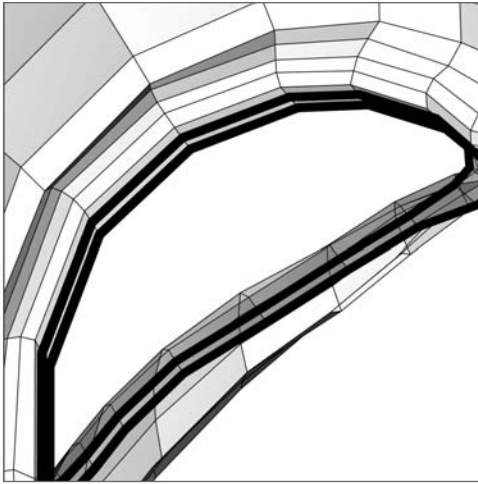
Figure 8.36

Two more rows in
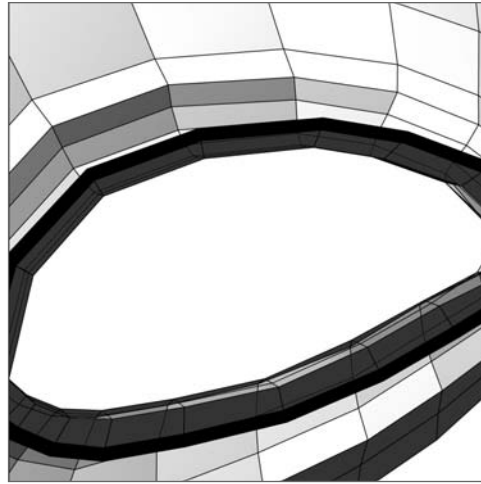
Figure 8.37

Another row out
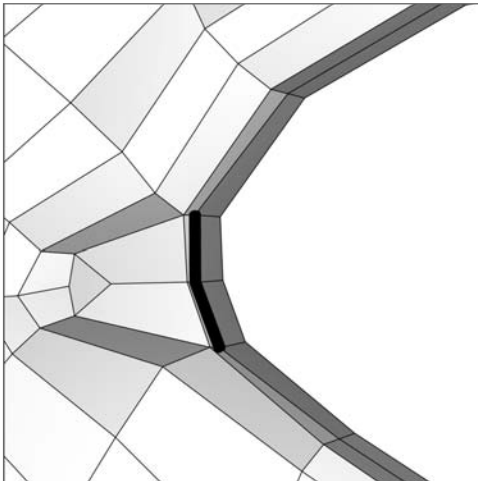
Figure 8.38

Some sculpting to ensure good lighting
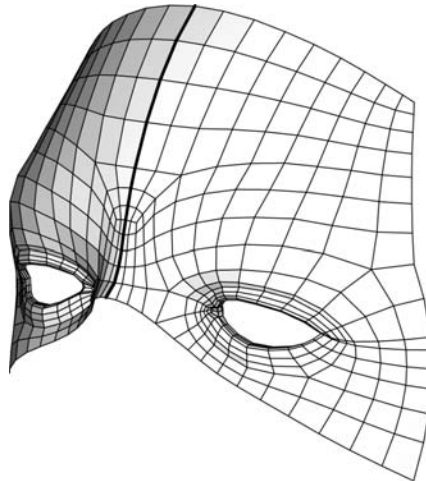
Figure 8.39

The mirrored model
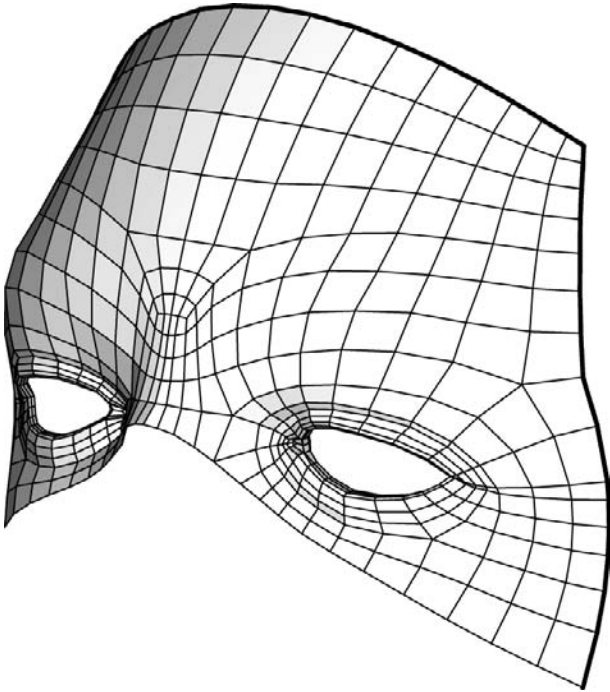
Figure 8.40

Select the outside edges all the way around except for the bottom for extrusion.
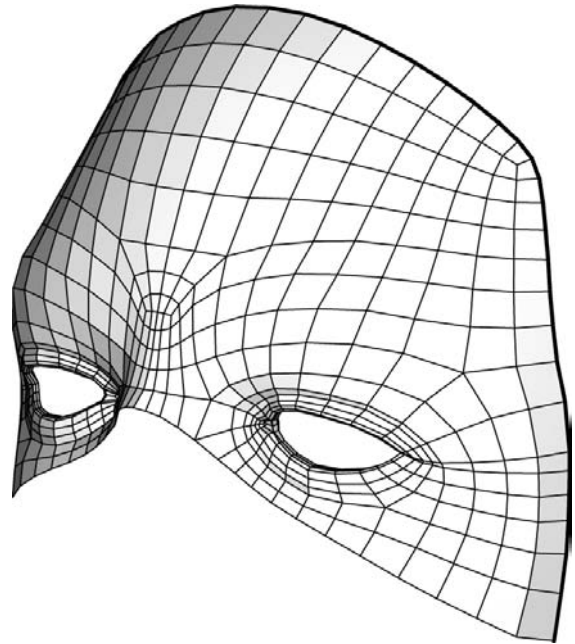
Figure 8.41

The extruded outside edge

The last thing we will do with this model is extrude one more time along all sides but the bottom, framing it nicely to fit in with other pieces, as shown in Figures 8.40 and 8.41.

There you have it! The main area around the eyes and brows is all set to go. The only remaining area that requires significant topology love is the ear, coming up in Chapter 10. The rest is super easy!

What you have now, as I've said before, is a general topology to this area, and almost every character will require modification. You could add more weight to the model or lighten it up. You could customize the hairline—you could do anything you want, really.

If you've gotten this far, you have a structure that will do what you need it to come time for deformation. When it comes to adding and deleting more geometry, remember this: The structure I've walked you through here is the way it is for a reason. Try to maintain the overall edge flow.

Eye and Brow Keys

In Chapter 6, "Mouth Keys," we looked at all the keys to build for the mouth, which is easily the more complicated of the two areas for keys. This is the other, simpler area. With the brows, it's shorter, sweeter, and though it has just a few more technical details, overall it's a much faster process. I can't recall the last time a brow key set took me more than one single sitting to build. As soon as you get into using textures or separate brow objects to help create a character, things can heat up as far as complexities and time go, but not so much that I can't talk you through it!

A reminder: As with the mouth shapes in Chapter 6, I recommend you have the whole head built before tackling the shapes here for the brows. I've organized the book in such a way that all things mouth are in one area, all things brows are in another, and all things rig are together as well. This makes building your first head the first time through the book a leapfrog event, but it serves as an easier way to find what you need when you're looking for "that one thing about the brows."

- **Brow shapes and bump maps**
- **Building the shapes: standard and stylized**

Brow Shapes and Texture Maps

There is a major divergence in key set styles at this point. I've talked about how you can animate all the shapes you need by making simpler shapes and combining them. This is true, but for certain more stylized characters, the easiest thing is to just build what you want to see.

With humans, we'll build Brows Squeeze, Brows Mid Up, Brows Mid Down, Brows Out Up, and Squint. With more stylized, cartoony, or anthropomorphic animal characters, you'll need to change that list (at least in your mind) to Brows Squeeze, Brows Sad, Brows Mad, Brows Up, and Squint. You'll name the shapes the same as the realistic head shapes (to ensure that the setups provided will work), but you'll build the shapes according to a different set of criteria.

For many of the brow shapes, there will be a lot of creasing of the skin to get the point across. With the shapes on the mouth, it's usually best to build the detail into the geometry so that at all angles you get a true distortion of the silhouette. With the brows, you *can* choose to do it differently; although the creases in this area are more numerous and in some cases *longer* than those around the mouth, they are not very deep, and they have less global effect on the overall silhouette of the head. For most of the creasing that goes on with the shapes in this chapter, I recommend getting the creasing effect by using texture maps and setting up either expressions or connections to link the strength of the texture to the blend shape it should happen along with. There are a number of ways to do this: bump maps, normal maps and displacement maps. I'll focus on the simplest of the three, bump maps, but the same basic technique will work for any of them.

UV Mapping Information

I will not get into full texture mapping because I really have no place preaching on a topic on which I am most decidedly *not* an expert. But it is important to talk briefly about the subject, as we'll do some texturing in this chapter. We're going to use textures to create much of the creasing detail in brow shapes, and some variety of bump maps are simply the best tool for the job; this includes displacements and normal maps.

To understand texturing, you have to understand about UVs. (*UV* stands for the U,V coordinates used to locate textures, as opposed to what you may be more used to, an X,Y coordinate system.) Models have UVs, which are a second set of points that mirror the ones used to define the geometry of your head. The UVs can be arranged over an image, and whatever imagery falls in the regions defined by the UVs then appears on the model on the corresponding poly faces. Programs provide a number of ways to go about the mapping of UVs, but for the sake of ease and simplicity, I'm going to talk only of the information *most pertinent* to what we're doing here and of the methods specifically for bump maps in Maya. (See Figure 9.1.)

Figure 9.1

A face ready to be mapped. (Modeling a shape with the eyes closed sometimes makes for a better result in UV mapping.)

Maya's online help is extremely robust and offers good tutorials and walk-throughs for different mapping types. I recommend reading up a bit before proceeding.

TYPES OF DEFORMATION MAPS

Three types of maps that are relevant for the discussion in this chapter have to do with faking finer deformation, and they are bump maps, displacement maps, and normal maps. In this book we'll work mostly with bump maps, but you may also want to explore displacement and normal maps on your own. For higher resolutions, you'll use displacements, and for lower, and especially games, normal maps.

What Is a Bump Map?

A bump map is an image in which the luminance (white-to-black) value is interpreted by a renderer as a fake for depth on the surface of the model. Even if the image you use for bump mapping is in color, Maya will look only at how bright each pixel is and assign that as a depth. This is why most bump maps are black and white: it's easier to predict the effect.

If you work with mostly default settings for a bump map, 50% (0.5) gray is flat; there's no bump effect. Black will shade deepest, as if it's cutting into the surface, and white will shade tallest, as if it's bulging out. A smooth ramp from black to white would create the look of a constant-angle slope from deep to tall.

What Is a Displacement Map?

A displacement map is similar to a bump map, except that at render time (and this is an important difference), it actually creates new geometry. So, where a bump map makes the render shade as though the shape has changed, a displacement map actually changes the shape. The big difference you'd see is that in the case of a bump map, the silhouette will never change, but with a displacement map it most certainly will.

What Is a Normal Map?

A normal map is an image in which color (RGB) values are applied to the model as a fake for surface angles of the model. The R, G, and B channels work as X, Y, and Z of a vector, respectively, to "pretend" the surface is pointed in different directions than it really is. There are two main *spaces* for normal maps you can use in Maya: object space and tangent space. Object space means that the RGB (XYZ) refers to an angle relative to the object's pivot. Tangent space is pretty much the *difference* of the angle from the surface normal. I could go into more detail, but it is easiest to cut to the chase and say that you want to learn about and use *tangent space* normal maps.

Cylindrical Mapping

To get UV mapping started, *cylindrical* mapping is the magic stuff. Imagine putting your head in a tube (open on the top and bottom) and then exploding your head and looking where it splattered. In conjunction with other tools, this is a pretty good starting point, despite how painful it sounds.

To see cylindrical mapping in practice, select your model, and then, in the Polygons menu set, click Create UVs → Cylindrical Mapping.

> In Figure 9.1 you can see that I diverged from the base face model built in Chapter 7 ("Building Emotion: The Basics of the Eyes"), as I expect you probably did too, which is okay; it was a starting point. Don't focus on the exact points and UVs I use. Instead, keep track of the overall goals and affected areas in each step.

Open up the UV Texture Editor by selecting Window → UV Texture Editor. If you select your head in the 3D view, you'll see it in here all splattered. Inside the UV Texture Editor, right-click over the area where you see your face and change your selection type to UV. Grab any points (UVs) that decided to jump off into outer space and pull them back into the main area occupied by the rest of the UVs of your model. These UVs will mostly look like streaks because you see the edges trailing between the UVs that stayed in a good range and those that didn't.

In the UV Texture Editor window, select Polygons → Normalize. This should move *all* your UVs into a good UV range. (In the UV Texture Editor, you have a grid that goes from –1 to 1 in U and V. A "good" range is the area in the positive 1 of both U and V). Now let's use Maya's nifty-dandy UV Relax tool. For this part, I can't tell you *exactly* what to do, but in fits and spurts, use this tool to relax the UVs out until you've got it so there are no overlapping UVs (no UVs from different parts of the face occupying the same area). Play with the different settings in here and see how they affect your mesh; again, I can't tell you exactly what to do. I can only nudge you in the direction of some tools. What I ended up with for my model is shown in Figure 9.2.
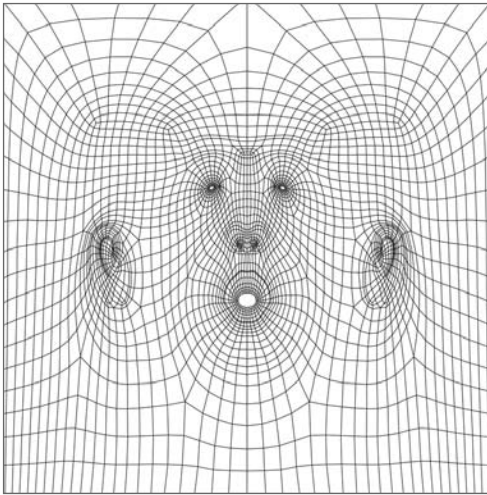
Figure 9.2

The head model in a cylindrical projection, after normalizing polygons and relaxing UVs so that no UVs overlap

> In Maya, you can manipulate UVs in the UV texture editor the same way you do anything in any standard Maya viewport; hot key W is translate, R is scale, and E is rotate.

If you've got the head cleanly laid out, you're ready for textures. You can move UVs around, and if you load an image into the color attribute of the material assigned to the head, you can actually line your UVs up to a texture; when you go into the UV Editor,

you'll see that image in the background. This is obviously not a complete texturing tutorial, but it should give you enough information to follow along with the brow shape textures.

Multiple Bump Maps

We're going to have many separate bump maps on some of the more realistic heads. Therefore, we'll have to have maps that all line up with each other because you can't separately position each one. I'll describe it in more detail along with each shape, but the way to set up multiple bump maps takes a few steps:

1. UV-map your head, as we did in the previous section.

2. Create your main color map to work from. This by itself is a very involved task, one that could take hours or days.

3. Once you have your mapping where you want it, create new 2D texture files and bump nodes in the Hypershade.

4. Connect those texture files and bump nodes in a chain that links all the way back to the base material.

Figure 9.3

The color map I'm using

That's what you'll need to do. The following sections will show you how you'll do it.

First, as I said, you need to get your color map done. I'm impatient, so I usually just forge ahead at this point, get the bare minimum UV and texture work I need done, and move on. That's probably not the best thing to recommend; it's just what I do. In my model's UV set, the ears aren't even mapped and the top of the head is just recycling part of the cheek (Figure 9.3); I'm only interested in getting these bump maps on the brow, so to me, those details are left for dead on the side of the road.

For my head, which is me, I'm using photographs put together in a JPG as my color map. What can I say? I'm a cooperative model!

Connecting a Color Map to Start From

To hook the texture into the color attribute of the material in Maya, select your object, open the Attribute Editor, and click the rightmost tab, which should be whatever material you've assigned to the head. In the Common Material Attributes section (Figure 9.4), select the checker icon to the right of the Color slide bar.
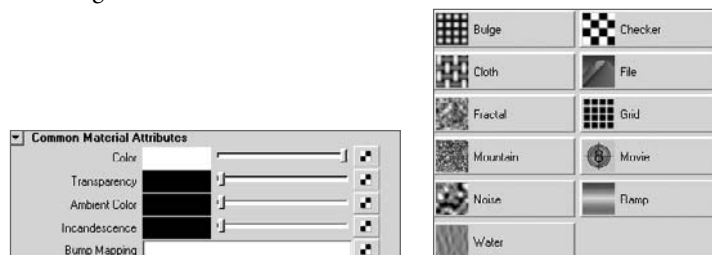
Figure 9.4

Click the checkered icon for the color attribute and you get a window in which you select a file texture.
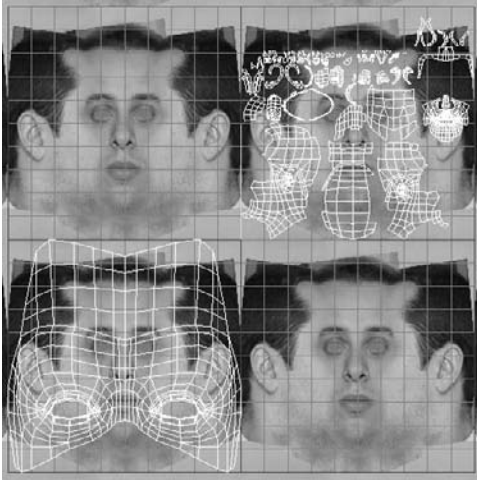
Figure 9.5

The color map is now visible in the UV Editor, and it's pretty apparent that the UVs need to be moved around.

From the next window, select File as the texture type, which opens yet *another* window; click the folder icon next to Image Name under File Attributes. Now you can finally go track down your texture map. When you're done, you can close all of those windows, and you should have a texture on your model (Figure 9.5). Your mapping may be wonky, and need some UV manipulation work to make it look good, but that's the basic process of how you get a color map on a model. The image you chose will now show up in the UV Texture Editor as well for you to do your UV placement.

Connecting a Bump Map

Select your object, then open the Hypershade window (Window → Rendering Editors → Hypershade). When it opens, click the icon for Graph Materials On Selected Objects or, under the Graph menu, select the option of the same name.

After choosing this option, you should see your model's shading network (Figure 9.6). A shading network is a series of nodes connected in various ways to tell Maya *what* to do with your model, material, and textures at rendering time and *how*.

You should see a place2DTexture node, with lines and arrows connecting that to a node labeled "file*n*" that shows your color image, which in turn is connected to whatever material your head has, and that material, finally, is connected to a shading group.
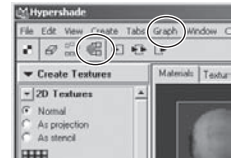
> In polygonal texturing, you don't need the 2DPlacement nodes and can delete them if you like. I will delete these for visual clarity in the examples.

To create a bump map, you need two inputs: a bump node—something to tell Maya to create bump mapping—and an image to tell the bump node exactly *how* to do that bump mapping. The Hypershade is divided into two areas, the lower of which is your work area, and that's all we're going to worry about. When you graphed the network, the work area is where it appeared. Right-click in the work area, but not over any of the nodes, and you should get a menu from which you need to choose Create → General Utilities → Bump 2D.

Figure 9.6

The shading network of a head with a color map

(You can also do the same from the Create menu in the Hypershade.) Select the new bump2D node that appears and open the Attribute Editor (Figure 9.7); you can double-click the node to do so as well as using standard menus or Ctrl+A if your hot keys are at default settings.

Figure 9.7

Click the icon to load an image to use as your bump map.
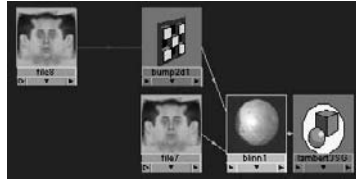
Figure 9.8

The shading network with the bump node now included

Select the checker icon next to Bump Value, click the folder icon in the following dialog, and load your color map image for now. Back in the work area, middle-mouse drag from the bump2D node to your *material* node. A small window should appear; when it does, select Bump Map. A line should now connect your bump node to your material, as shown in Figure 9.8.

If you now do a render, you'll probably see one extremely ugly bumpy head. This is because the color map isn't very well tailored to be a bump map—it's too varied—but that's not the point right now; learning to make that connection in the Hypershade is. On the CD, in the Chapter 9 folder, locate `Bumpy1.jpg`. Copy it (and all the other Bumpys) to your computer. Now go back and reset the image the bump map uses to `Bumpy1.jpg`. You won't need to re-create the connection to the material; once it's there, it stays unless you delete it. If you do a render using `Bumpy1.jpg` as the bump map, somewhere on your head you should see *UP* written using depth only (Figure 9.9). The letters *U* and *P* are written in white on the bump map, meaning they move forward/up.

The letters are blurry so that they will ramp out of the head. To see what happens without the blur, load `BumpyYuck.jpg` as your bump map file. Basically, it doesn't look good.

Figure 9.9

This guy is going up, I guess.

BUMP MAP VALUES DON'T "TRICKLE DOWN"

You may have a concern about a mathematical trickle-down effect on the bump maps—namely, that a 0.5 value one farther down the chain than another 0.5 value would actually be read as 0.25, assuming that Maya would calculate 0.5×0.5, etc. Don't be concerned. It seems that all bump nodes connected via the Out Normal: Normal Camera method are dealt with in apparent disregard of the others mathematically. A 0.5 is a 0.5 is a 0.5, no matter where in the chain of nodes it appears and regardless of the values of those before it.

Connecting a Second Bump Map

Now to make a second bump node and include it in the network. In the Hypershade, graph your network and right-click over some empty space again. Create another bump node (Create → General Utilities → Bump 2d), and when the new node appears, double-click it to open its Attribute Editor. **BEWARE:** If you try to middle-mouse drag this bump node onto your material and choose Bump Map, you'll sever the connection with the old bump map, not something you want to do. Since this is an additional bump map, the way to get it into the network is a little different that it was with the first map. Middle-mouse drag from the new *second* bump node to the *first* bump node, which will open the Connection Editor (Figure 9.10).

Click the checker icon next to Bump Value, choose File from the options that appear, open the folder, and find `Bumpy2.jpg.` in the Hypershade.

> Be very careful to connect the *bump* nodes to each other, not the image file nodes! If you can't see Out Normal and Normal Camera as options in the Connection Editor, there's a good chance you've selected the wrong nodes. Also, make sure Show Hidden is checked in the Connection Editor filters.

On the left side of the Connection Editor, click Out Normal, and on the right side, click Normal Camera. After that, your shading network should look like Figure 9.11. Now do another render to take a look at your handiwork; it should resemble Figure 9.12.

Both bump maps should be on the head simultaneously, `Bumpy1.jpg` pulling the letters *U* and *P* forward, and `Bumpy2.jpg` sinking *B*, *M*, and *Y* deeper. To get one more practice run, because you'll need to know this well, open the Hypershade, create another bump node, stick `Bumpy3.jpg` into it, and connect the new bump node's Out Normal to the *second* bump node's Normal Camera. If you do another render, the result should look like Figure 9.13. You'll always connect the newest one to the previous one—sixth to fifth, fifth
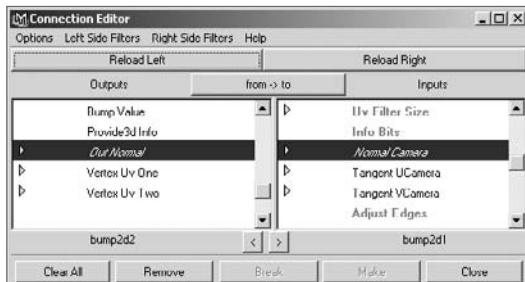
Figure 9.10

Connect the Out Normal to the Normal Camera in the Connection Editor.
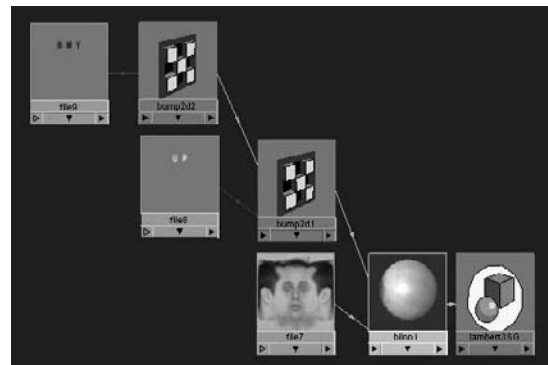
Figure 9.11

The shading network now has two bump maps.

Figure 9.12

The two bump nodes are both affecting the head simultaneously—U and P from the first and B M Y from the second.
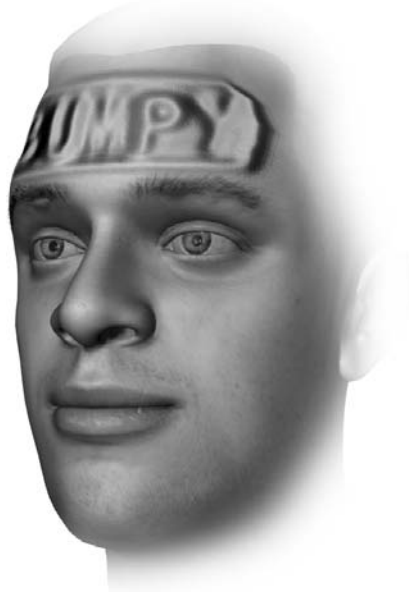
Figure 9.13

I get a book, my chance to speak to the world, and what do I do? I write *bumpy* across my own forehead.

to fourth, fourth to third, all the way down. You can see how you can continue to connect bump maps this way infinitely! This is how we will connect different bump maps to different shapes to get fantastic detail in brow expressions that would otherwise require insanely detailed meshes.

Bump Depth and Alpha Gain

You may have noticed a second attribute on the bump node called Bump Depth in the bump nodes. That value is one way to animate the intensity of a bump map in relation to the shapes. Another way is to control the alpha gain on the incoming file texture node, affecting the color the texture sends in for Bump Value. In the examples in this chapter, I'll talk about Bump Depth, but both are equally viable ways to animate the bump.

Building Realistic Brow Shapes

Wow, with all that technical know-how, we can *finally* get down to the shape-building business. As with the mouth, I'll guide you through building symmetrical shapes and leave the splitting into halves until the end; it's just easier that way. Also, the criteria breakdown will be much simpler than that of the mouth because there just aren't as many points or varied needs per shape. The brow keys, being significantly fewer in number and significantly easier in scope, also give me the opportunity to cover a second style.

In the following sections, I go through realistic shapes; after that, in "Building Stylized Brow Shapes," I follow with a "sister" set of shapes to create for cartoonier characters using my two toon models Sally Ann and Pete. (Use one of these sets of shapes or the other, not both.). All that *and* I'll revisit exceptions to both sets in Chapter 13.

BrowsOutUp

Face shape: browsOutUp(1)
Derivative shapes: lBrowOutUp(2), rBrowOutUp(2)

This is not *quite* as simple as just pulling the points up on the brows; it's raising the brows along the surface of the head while favoring the outside. The center area between the brows should not move much if at all. To give yourself an idea of what this should look like, look in a mirror and raise your brows, but try to keep the middle of your brows and more importantly your *eyelids* still (don't let yourself get bug-eyed!). You should look pretty much unimpressed. That's the shape (Figure 9.14). This is one of the shapes that is most definitely going to benefit from using bump maps to emphasize the look.

Inclusion The area to affect (Figure 9.15) starts down by the temples and can go all the way up to the top of the hairline, although the intensity should be above the arch in the brows and taper in effect from there. The points between the brows and the eyelids should also be moved, but they need to be moved carefully, which I'll describe in a moment. With this shape, there may be a desire to pull the eyelids open wider; you shouldn't. That's an effect best achieved at animation time.

Figure 9.14
browsOutUp
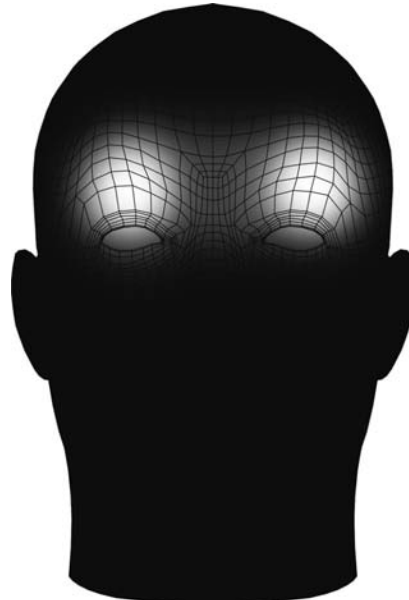
Figure 9.15
The area of effect for browsOutUp

Figure 9.16

A comparison with the default brow shape and browsOutUp
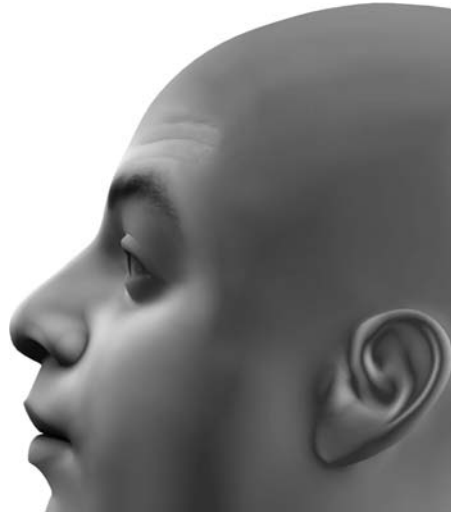
Figure 9.17

Always check your shapes from all angles, and remember that your character has a skull!

Height The browsOutUp shape for realistic motion really needs a reference. Different people can arch their brows more or less. For my head, using myself as reference, I raised the brows approximately one eyebrow higher (Figure 9.16), so if this was on top of a default head, the brow hair would sit just above the old brow hair location. That height is focused over the arch and tapers back to the default shape toward the middle of the brow.

Depth The main thing here, as with all brow shapes, is to be sure not to collapse the skull or move the eye socket. When you raise points from above the eye to along the brow, make sure to move them forward too (Figure 9.17), so that they move into the position of the points that were there before, creating the look of skin rolling over a skull instead of the appearance of a gooey no-skull made of malleable mushy yuck.

Creasing As I discussed in earlier chapters, creasing happens at the focal point of movement and tapers away from that; the brows are no different. I put some creases pretty much following the shape of the geometry of the forehead, with the most intensity over the arches of the brows, as shown in Figure 9.18.

Figure 9.18

An extreme close-up and an overblending of the crease texture to give you an idea of what the creases should/might look like

With all of the creasing images for the shape descriptions in this chapter, I cranked up the effect of the bump maps to double their usual values. This is to give you clearer visual information, even though it makes the model pretty unattractive!

USE REAL REFERENCE FOR QUALITY

It doesn't matter whose face you use, your own or somebody else's. It also doesn't matter if that face looks nothing like your character. When it comes to realistic brow keys, *always* use a reference. This will enable you to get the texture maps for creases looking real and to create the shapes with a look that is not too simple. Everyone's face contorts in different ways, but all of those are better than what you'd come up with if you just tried to make it up on your own. I've tried to work from scratch several times with decent results, but it never looks as good as when I use a reference. The added realism simply injects fantastic quirk and character into a model, even if no one ever recognizes who that character came from.

Texture naming and expression If you want to use a texture like the one shown in Figure 9.19 to create some nice creasing, be sure to rename the file node browsOutUp_Tex and the bump node browsOutUp_Bump. The expression you'll need to type in will be as follows:

```
browsOutUp_Bump.bumpDepth = clamp(0, 1, FaceShapes.browsOutUp * 1)
```

Replace both 1s with the value that looks good for your bump map and your model, which will vary. For my model, I used 0.2.

There is more discussion on expression writing in Chapter 12, "Interfaces for Your Faces." You will not *need* these expressions hooked up until you're at that stage anyway. If you're uncomfortable with expressions, come back to link these bump maps after you've read Chapter 12 and have the rest of your head hooked up to an interface.

Figure 9.19

This is a look at the important portion of the bump map image.
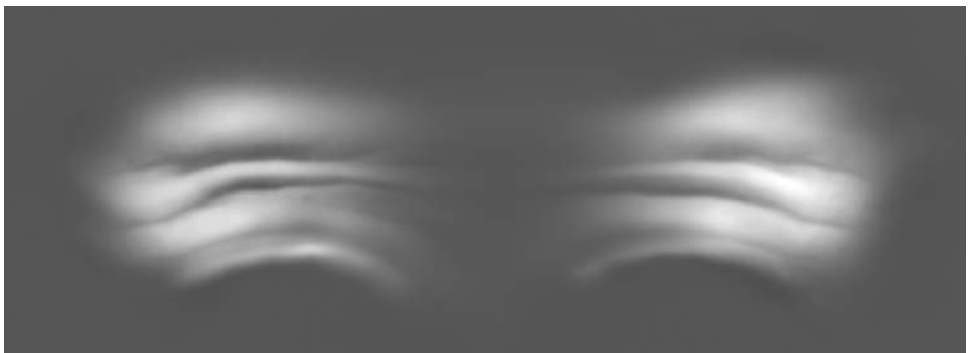
CONNECTIONS

In Maya, a slightly cheaper way than expressions to create correspondences between shapes and bump maps is through the use of utility nodes. Each place you see me write out an expression, you could re-create the same thing using utility nodes and connections. For example, this expression is something you could re-create by using a multiplyDivide node and plugging FaceShapes.browsOutUp into the .input1X of the node using the Connection Editor:

```
browsOutUp_Bump.bumpDepth = clamp(0, 1, FaceShapes.browsOutUp * 1)
```

This would create a relationship whereby any number you put into the .input2X of the multiplyDivide node would act as the multiplier. In the first example I used 0.2; to re-create that here, you would put 0.2 into the .input2x. Then, if you wanted to mimic the limiting effect of the expression, the clamp, you could create a clamp *node* and plug the .outputX of the multiplyDivide node into the .inputR of the clamp. That clamp node added on just means that whatever result you get after the multiplyDivide will be limited by the clamp node. Now, connect the .outputR of the clamp node to the browsOut_up_Bump.bumpDepth and set the min/max to 0 and 1; voila! You've re-created the expression, only it runs *faster* than an expression, increasing your scene interaction speed.

Extra brows naming and expression As with texture maps, if you have separate brow objects to connect—or rather follow along—with the controlling object, the head, you'll need some expressions or connections there too. I named my extra brow object Brows, and I named its blendShape node BrowShapes after I finished creating all the shapes and setting up a blend shape relationship. If you do the same, naming each shape similarly as you do for the face, your expression should look like this:

```
BrowShapes.browsOutUp = FaceShapes.browsOutUp
```

All brow expressions should look similar, directly equating the BrowShapes shape to the FaceShapes shape. These are actually perfect candidates for using connections instead of expressions, where, using the Connection Editor, you can directly connect FaceShapes.browsOutUp on the left and BrowShapes.browsOutUp on the right, as is the case with *any* shapes you make that need to *exactly* correspond to those on the head itself.

browsOutDn

Face shape: browsOutDn(1)
Derivative shapes: lBrowOutDn(2), rBrowOutDn(2)

This is a simple shape, which can be derived really easily as the opposite of browsOutUp. This shape is the drop of the brows (Figure 9.20). Something deep down inside me dislikes this shape because it doesn't really exist, but we

Figure 9.20
The browsOutDn shape

need it to make other shapes exist. The browsSqueeze comes up later, and its real shape involves dropping. You can't drop your brows without squeezing them, but you can squeeze them without dropping them. That means that we've got to build *squeeze* and *down* separately.

EXPRESSIONS FOR LEFT AND RIGHT DERIVATIVE SHAPES

For right and left versions, if you're building for more than the simple setup (the process was described in Chapter 6 and the setup is described in Chapter 12), be sure to substitute those left and right names for the ones in the expressions—for instance, to connect the right and left shapes and textures, you'll first need to make two textures, one for each side. The right one's expression for the texture would read like this:

```
rBrowOutUp_Bump.bumpDepth = clamp(0, 1, FaceShapes.rBrowOutUp * 1)
```

(Here, 1 is a number that you change based on what looks best for your model and bump map, which will be a guess-and-check process.) And for the secondary brow object, you'd have this:

```
BrowShapes.rBrowOutUp = FaceShapes.rBrowOutUp
```

You can see that they both directly relate to the shape on the face. For the left side, replace rBrowOutUp with lBrowOutUp. Now once we hook up the model to an interface, these other pieces that bring the look of each shape together will follow along automatically with the main face model.

Inclusion Include all the same points and in the same amounts as you did for browsOutUp. The area of effect is shown in Figure 9.21.

On very rare occasions, the option is to not build this shape at all! Sometimes, with really unpredictable and varying success, you can quite literally use the opposite of browsOutUp. In the setup of my head I use here, that's the case. I didn't have to touch a single point. I typed in –1 for browsOutUp and called it a day.

Height I usually build this shape so that its height isn't too much higher than the top of the eyelids (Figure 9.22). Something you should know, too, is that browsOutDn can tend to look a little bit sad. This, browsSqueeze, and browsMidDn all push the brows down. In combination during animation, that effect is tripled. Since it pairs nicely with the browsOutUp, this is the one that I decided will affect the area in the center of the brows the least.
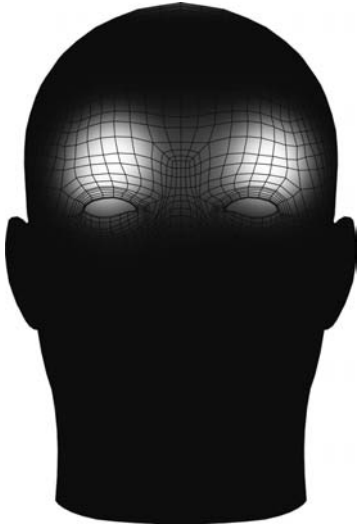
Figure 9.21

The area of effect for the browsOutDn is the same as that of browsOutUp.

Figure 9.22

The height of the browsOutDn is about as much *down* as browsOutUp is *up*.

Depth As with any of the other shapes that move the brows down, try to keep the area underneath the brow ridge *plump* looking (Figure 9.23), curved outward, not collapsing inward.

Creasing There is no creasing that we'll tie to this shape directly.

Texture naming and expression There is no texture that we'll tie to this shape directly; it buddies up with two other shapes in effect, and both of those others have texturally created creasing.

Extra brow naming and expression If you have another brow object tagging along, it'll need this expression:

```
BrowsShapes.browsOutDn = FaceShapes.browsOutDn
```

browsMidUp

Face shape: browsMidUp(1,2)

In the cartoonier version of this shape, I'll just refer to it as Sad, but for more realistic characters, I want you to think of browsMidUp as the middle area of the brow moving up. A sad expression made by a person will involve a brow squeeze as well. Here (Figure 9.24), it's just the middle moving up. It's not compressing laterally or anything, just moving the middle area up.

Figure 9.23

The area under the brow ridge needs to look like the skin is bunching, not hanging.
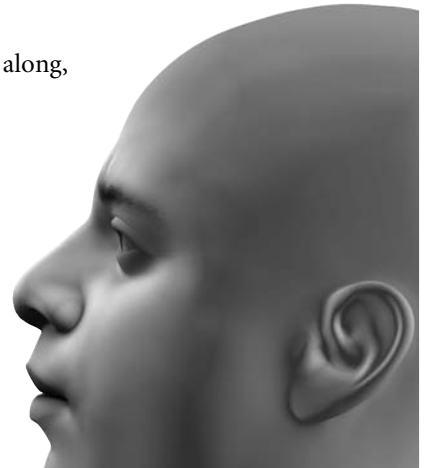
Figure 9.24
The browsMidUp shape
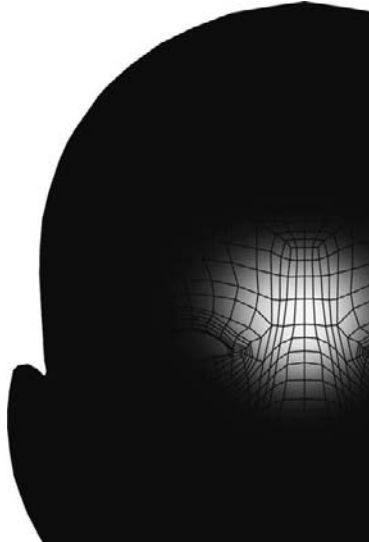
Figure 9.25
The area of effect of the browsMidUp

Figure 9.26
The height of the browsMidUp shape as compared to the default brows

Inclusion Much as the description and name state, this is strongest in the middle of the brow, low; around brow ridge height, and the effect tapers in all directions, as in Figure 9.25. This shape's inclusion should be almost perfectly inverse with that of the browsOutUp. As this takes shape, you may have the urge to push the outside of the brows down, to create a more sad shape. This will create a conflict in movements with the browsOutUp shape, so just keep the motion mainly to the middle.

Height The middle brow area should move up approximately one brow height, much like the browsOutUp shape, but this time (Figure 9.26) with the focus in the middle and tapering to the outside.

Depth The issue here is the same as with the browsOutUp: be sure not to collapse the skull or move the eye socket. As you move the middle of the brows upward, carefully pull the points from below the brow ridge forward as they move up (Figure 9.27), creating the illusion that the skin is moving over bone.

Creasing The creases for the browsMidUp should be the "missing link" from the browsOutUp shape. With browsOutUp, we terminated the creases toward the center of the forehead, and that's exactly where these are (Figure 9.28).

Texture naming and expression To keep track of everything and to be able to copy these expressions, name the file node for the texture browsMidUp_Tex and change the bump node to browsMidUp_Bump. (The texture is shown in Figure 9.29.) Connect them in series with any other bump maps as described earlier in the chapter. This is the expression you'll need:

```
BrowsMid_up_Bump.bumpDepth = clamp(0,1,FaceShapes.browsMidUp*1)
```
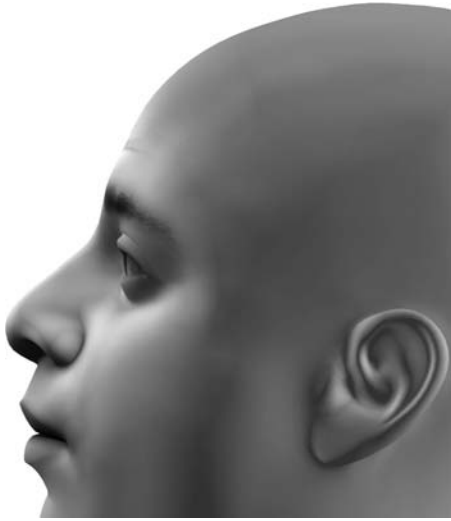
Figure 9.27

Once again, be aware that you'll need to fake the look of skin moving over bone by moving the points as if they were.

Figure 9.28

A close-up and overblending of the creases associated with browsMidUp

I tend to make all of my creases in one big image that has all of them and then cover parts of that image to create the maps for each shape. By doing so, you can be assured that your creases are cooperative, so the creases created with your browsOutUp shape become one with the creases from your browsMidUp shape and any other shapes too. If you don't, the two might not merge together cleanly, and you'd have all these different lines that don't seem to relate to each other, hurting all the hard work you put into creating them!
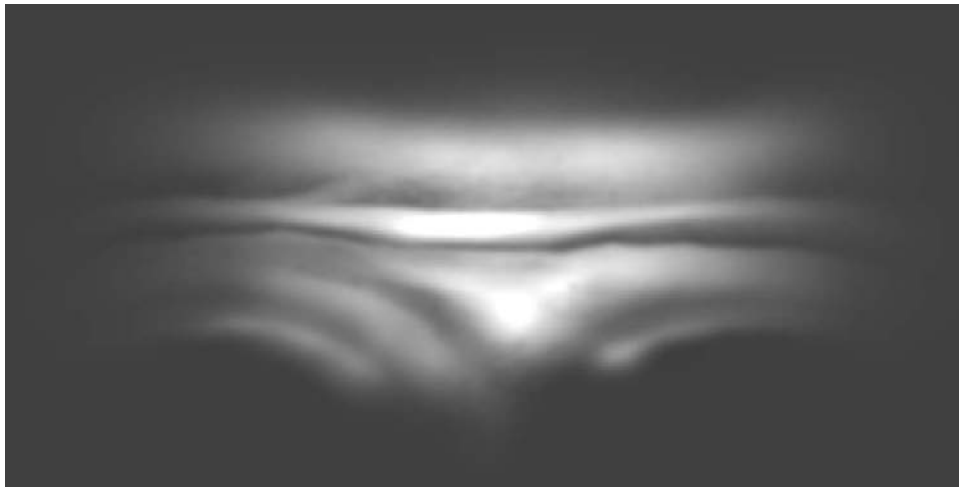
Figure 9.29

The crease texture I used for my browsMidUp

Extra brows naming and expression If you're using an extra brow object, you'll need to connect it to the main head. Make the name for this shape BrowShapes.browsMidUp. If your naming is all correct, you should be able to type this expression:

```
BrowShapes.browsMidUp = FaceShapes.browsMidUp
```

Remember that if you have an object that merely needs to shadow the face for the purposes of providing a surface for fur or PaintFX, you can use snap-to-point to copy the shape you create on your main mesh to your extra object.

browsMidDn

Face shape: browsMidDn(2)

browsMidDn (Figure 9.30) is the exact opposite of browsMidUp; where that shape basically looks like Sad, this pretty much looks like Mad. In fact, they're so conveniently opposite that you can use the same creation trick as with browsOutDn, but this time, it's opposite browsMidUp.

Inclusion The inclusion area for browsMidDn (Figure 9.31) is exactly the same as for browsMidUp. Try not to push the outsides of the brows upward, making a Mad shape. That's not necessarily wrong; it's just that in animation you'd get that from using this in combination with browsOutUp shape.

Figure 9.30
The browsMidDn shape
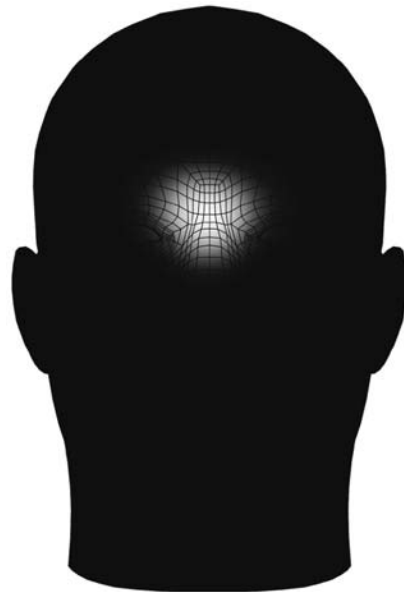
Figure 9.31
The region affected by the browsMidDn

Height Compare the height of this shape to the default height, in Figure 9.32. Pushing the middle area of the brows down gets tricky because the nose is in the way. It will likely happen regardless, but try to keep an eye out for causing a ledge where the brows drop near the top of the nose. It's hard to do; you have to compromise your shape a little bit, but the result is a more natural nose/brow barrier.

Depth When you bring the brows down, you'll want to make sure to pull down the points underneath the brows (Figure 9.33). If you don't, a real ledge can form, where it looks like the brows are melting over the area beneath them instead of moving it with main motion.

Creasing This is going to vary based on your reference, which I will again stress you should really have. There are two main kinds of creases between the brows, as I described in Chapter 3, "Facial Landmarking." There are *vertical* creases and *bunching* creases, and of course there are combinations of those two. When I squeeze my own brows, I don't get two vertical lines; I get a messy mush of varying odd shapes. To create this in the texture, in Photoshop I rendered 3D clouds and masked them so only the area I wanted bumpy was. My wife, on the other hand, does get those two vertical creases; it's all going to depend on who you look to for reference. For my model (Figure 9.34), I cheated and gave myself both types of creases, because it just reads better visually in black and white.
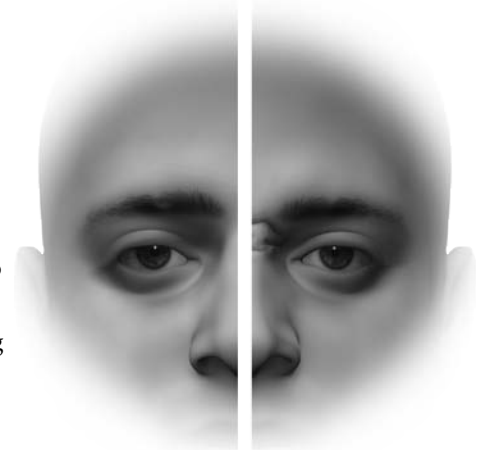
Figure 9.32

A comparison with the default shape to show a reasonable height for the shape
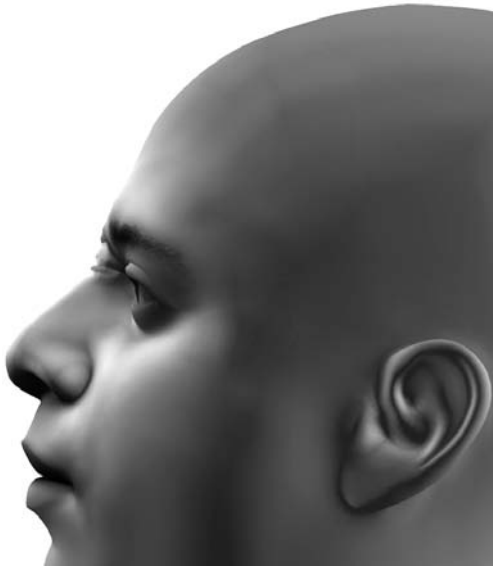
Figure 9.33

Maintain the feel that it is skin and the area under the brow will look good.

Figure 9.34

A close-up and extra-strength version of the creases made in a browsMidDn shape

Texture naming and expression Figure 9.35 shows the crease texture. Name your file node browsMidDn_Tex and your bump node browsMidDn_Bump. Write this expression:

```
browsMidDn_Bump.bumpDepth = clamp(0, 1, FaceShapes.browsMidDn * 1)
```

I don't have to tell you what to do with the 1—you already know.

Extra brows naming and expression For your tag-along brow-buddy you'll need this expression:

```
BrowShapes.browsMidDn = FaceShapes.browsMidDn
```

browsSqueeze

Face shape: browsSqueeze(1)

This is the thought process embodied as a shape (Figure 9.36). Anytime you need thought, this is what you use. Even though your character is in a default overall pose, this should make them look like they're at least thinking a little bit about that nothing they're staring into.

Inclusion The brow's squeeze should affect approximately the same area (Figure 9.37) as the browsMidUp and browsMidDn, but it's a little bit wider in its reach and not as tall. This shape is used in combination with each of those to give them their proper shape. In more complex setups, this shape can also be used on its own for portraying thought. This and browsMidDn can sometimes overlap a little bit in what they do, so try to really keep them distinct, focusing on what each one needs to do and not giving in to the temptation to make them both almost the same!
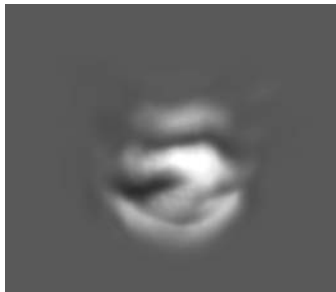
Figure 9.35
The crease texture for browsMidDn

Figure 9.36
The browsSqueeze
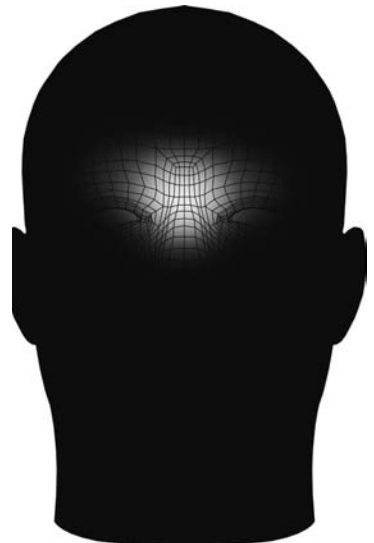
Figure 9.37
The area of effect for the browsSqueeze

Height This is one place to be very careful about overlap with browsMidDn. There should be some downward movement with this shape, but very, very slightly—not even a half-brow height (Figure 9.38).

Depth As was the concern with the browsMidDn, just make sure not to create too much of a ledge under the brows (Figure 9.39); keep that under-area sort of "plump."

Creasing This (Figure 9.40) has almost the same bump map as browsMidDn. Usually, I make both from the same map and alter them slightly, favoring the lumpy, more turbulent look for the browsMidDn and the vertical creases for this.

Texture naming and expression This is probably becoming routine. The texture is shown in Figure 9.41, names are browsSqueeze_Tex and browsSqueeze_Bump, and this is the expression:

```
browsSqueeze_Bump.bumpDepth = clamp(0,1,FaceShapes.browsSqueeze*1)
```

Extra brows naming and expression For the extra brow objects:

```
BrowShapes.browsSqueeze = FaceShapes.browsSqueeze
```
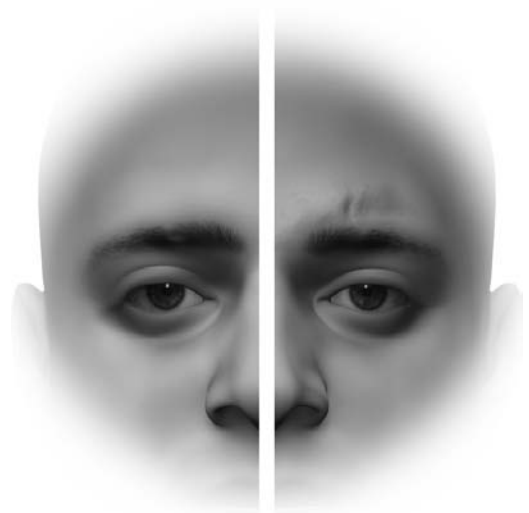

Figure 9.38
The height of the browsSqueeze is pretty uneventful.
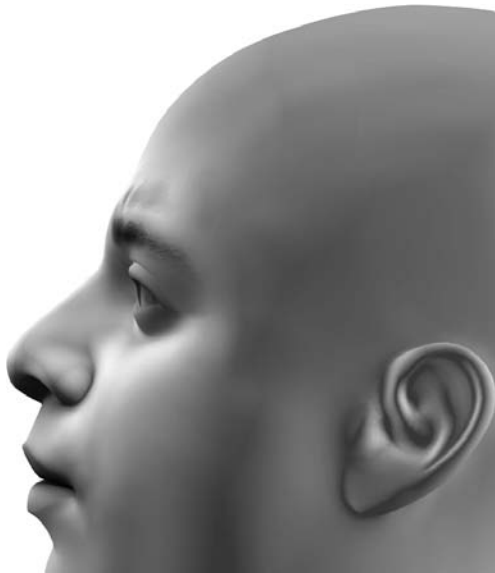
Figure 9.39
The depth of the browsSqueeze is also pretty unsurprising.

Figure 9.40
The creasing for the browsSqueeze is among the most important for creating emotion. With it, you don't have to pull the brows so close together that they're touching, but you still read the expression.

**The crease texture
for browsSqueeze**
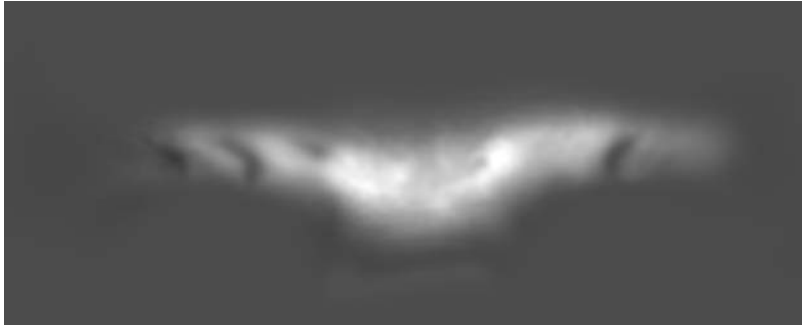
squint

Face shape: squint(1)

Derivative shapes: lSquint(2), rSquint(2)

The Squint (Figure 9.42) is the third of only three shapes that will be split in half for asymmetry in all of the brow keys (browsOutUp and browsOutDn being the others). In some cases, for the Squint, it might actually be easier to build the one-sided keys manually, as there is absolutely no overlap in the effect of the right and left shapes.

This shape should be achieved by the combination of the lower eyelid joints' rotation and blend shapes. The actual look of the shape without the lids is pictured in all images of this section except for Figure 9.43. The reason for the combination of effects is that the lower lid gets manipulated through joint rotation, which is tied through (math) expressions to the eyeball. For this and the upper eyelid to function properly, the expressions need to know where the lower lid is at all times; as a result, the Squint, which needs the lower lids involved, must be created as a combination of influences, shape, and joint, which you will control independently.

Inclusion The Squint's area of influence (Figure 9.43) is to the outside and around the eye, with the emphasis on the outside edge where upper and lower lids meet. The effect travels all the way down, well onto the cheek and the side of the face, but must be carefully tested in combination with the Smile to assure that the mix is acceptable. To a certain degree, Squint plus Smile should create a more genuine-looking smile.

Figure 9.42

**The Squint, with lower lid
joint rotations added**
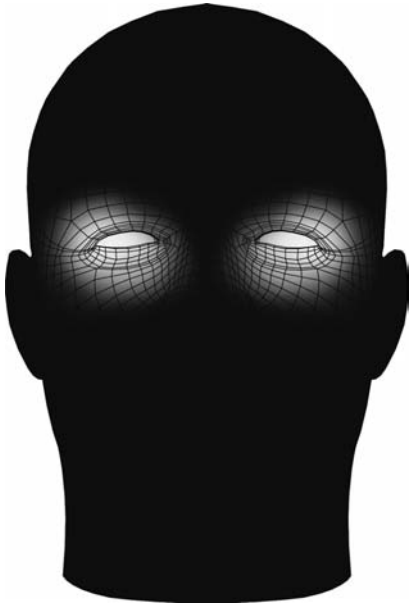
Figure 9.43

The area of effect for the Squint

Figure 9.44

The height(s) of the Squint

Height The motion of the Squint pulls all areas in toward it, so the points above the eyelids should be pulled down, and the points below should be pulled up. Pictured in Figure 9.44 is the height of the shape alone; remember, you'll be able to dynamically change the height of the lower lid using the lower lid joint (once it's in there!).

Depth The area by the temples and the side of the face (Figure 9.45) should be pulled forward for this shape. As points are pulled up and down toward the Squint, make sure they all seem to travel over a surface, not just a cheek-imploding pull toward the eye.

Creasing This is probably the hardest crease texture to create. There should be some creasing created by the geometry out to the side where the outside of the brow meets the cheek, and the bump map should generate some crow's-feet and follow along the shape that creases when you combine this with a smile, shown in Figure 9.46.
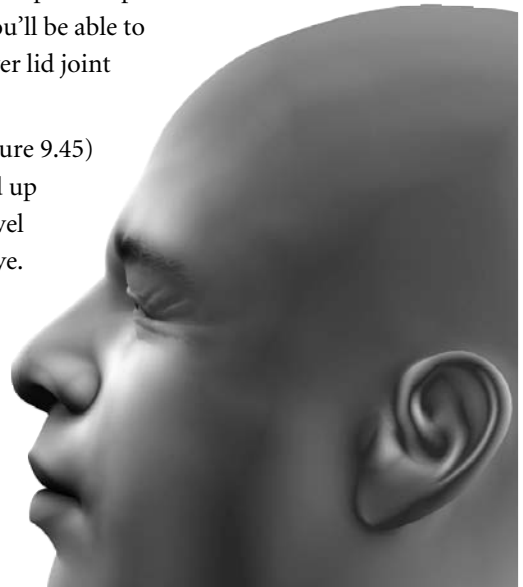
Figure 9.45

The depth of the Squint may be one of the most important factors. You should pull the corner forward as if it's being pushed by the gathering mass of skin there.

Figure 9.46

With the crease map turned up so high, virtual me looks so old!

Figure 9.47

A look at the bump map texture for the Squint

Texture naming and expression This texture (Figure 9.47) is going to be simply Squint_Tex and Squint_Bump, with an expression that reads as follows:

```
Squint_Bump.bumpDepth = clamp(0,1,FaceShapes.squint*1)
```

Extra brows naming and expression For an extra brow object, such as a NURBS plane that provides PaintFX a surface to live on:

```
BrowShapes.squint = FaceShapes.squint
```

Building Stylized Brow Shapes

I'm now going to take you through a second set of shapes that will occupy the same names and same general rules as those we've completed already, but they're a little bit looser in their interpretation. This is not a set of keys you build in addition to the previous ones; you build one set or the other. None of the interfaces are designed to work with both sets of keys (nor would it make much sense if they were!).

With the mouth, the one set of rules and images should have given you enough information to translate into various styles using your imagination. Here, with the brows, I'm taking you down one of those style paths. I'll focus on toon characters and their own fun details.

MIXAPALOOZA

With the mouth, there were certain shapes that needed to mix well for them to be "acceptable." With the brows, every last one of these has to be able to sit mixed at 100 percent with any other (barring any *one* part of the brow being up *and* down at the same time; come on, that would be ridiculous). The best thing to do, since there are so few points to deal with, is to create a new blank head and assign all your new brow shapes to it in a blend shape relationship. As you mix them together, you'll likely see problems, some big, some small. You can then go and adjust the original target shapes and interactively see the mix update. You can work out the mix problems and see the results instantaneously! See Chapter 6 if you need a refresher on the Blend Shape Editor.

Fun Fact: Cheating the System

For example, let's say you don't want to build a browsSqueeze shape to mix with both your Mad and Sad shapes (replacing the browsMidUp and browsMidDn shapes for this style). As a result, the way they get set up with an interface, they'll bounce a little bit when moving between one another, but let's say you don't care about that either. You just want a Sad and a Mad and that's it. Well, to use the setup buttons (described in Chapter 12), you'll still need a shape to sit in for the missing browsSqueeze shape. All you have to do is duplicate a blank head, your default, and rename it browsSqueeze. When it comes time to hook it up as a blend shape to your main head, include it as you would a shape that did something. The setup buttons won't know the difference either way, you'll get no errors, and the performance hit related to a head that is no different from the base head is negligible!

browsOutUp

Face shape: browsOutUp(1)
Derivative shapes: lBrowOutUp(2), rBrowOutUp(2)

Since this is a new set of shapes, really, there's a different way to think about them. For a more stylistic approach, make your browsOutUp key more of a "Brows Raise." Make the whole brow lift, center, and outside. Figure 9.48 provides a couple of examples.

Inclusion Include areas from right above the lids all the way to the top of the forehead—in tapering effect, of course, focusing on the brows themselves. I'll reiterate that you should include the area *between* the brows as well.

Height This shape should pull the brows up as high as the design of your character will allow. With real humans, you want to limit the motion at *just barely beyond* extreme, to keep yourself in check as you animate. If your character isn't human, however, take this as far as you can. You'll notice that on Pete, the brows shoot clean off of the forehead! (You know, I really should build a top for his head one of these days.)

Figure 9.48

Pete and Sally Ann's browsOutUp
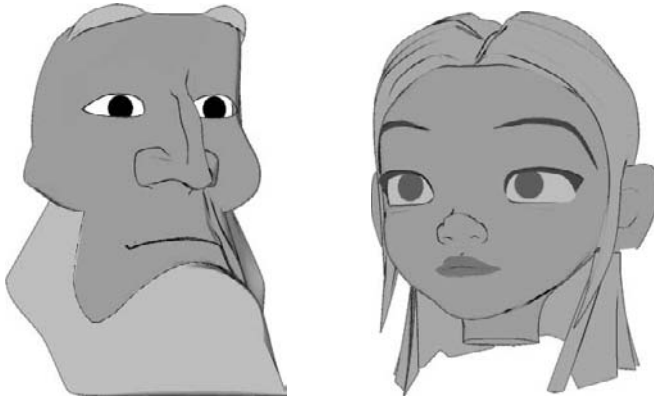
Depth With realistic characters, you had to make sure you were maintaining the illusion of a skull; if you weren't careful, you could collapse the skull and widen the eye socket. With these more stylized characters, that isn't as much of a concern; you can get away with more when your character doesn't look real.

With this shape, you're likely to run into an issue that you might not run into with less range; as you pull the brows up, you also have to pull them slightly back to keep in line with the silhouette of the skull and the established profile. If you don't, it might look like the eyebrows are launching off of your character's head.

Creasing This is all up to you. Sometimes a stylized character benefits from these, sometimes they do not. In any case, if you need them, always shape them like the character's brow silhouette to make sure they look like part of the same motion and effect.

Expressions All the expressions related to the first browsOutUp apply exactly the same here.

browsOutDn

Face shape: browsOutDn(1)
Derivative shapes: lBrowOutDn(2), rBrowOutDn(2)

This shape (Figure 9.49) can be figured out almost exactly the same as from the regular browsOutDn described earlier in this chapter, only don't build the Sad factor into it. The horizontal crease at the top of the nose that could be generated from the mixing of all the down-moving shapes is actually somewhat desirable in non-human characters!
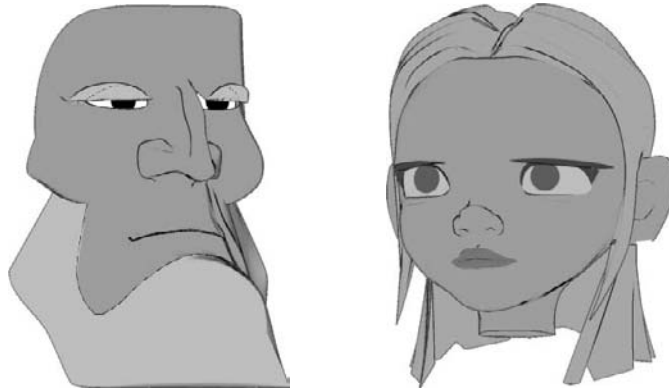
Figure 9.49
Pete's and Sally Ann's browsOutDn
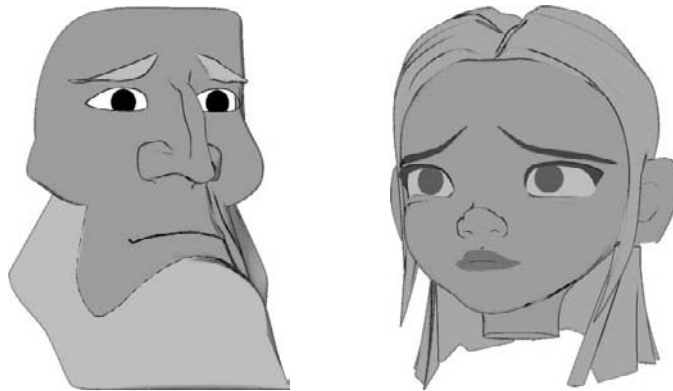
Figure 9.50
Toon sad shapes

browsMidUp (Sad)

Face shape: browsMidUp(1,2)

Where it was important to not think of this as *Sad* in the realistic shape set, this time, that is exactly what the shape is (Figure 9.50): Sad. It's Sad. Destitute, suicidal. Okay, maybe not that extreme, but the rule for this shape is that there really is no rule, except for it to look Sad.

Inclusion With this Sad shape, you can include more of the brows than with the regular browsMidUp. If you want to push the outside areas of the brows down, to create an even *sadder* shape, do it.

Height You can pull the middle up as far as you need and the outside down as far as you need. It's hard to give rules here, as the shape and style this refers to could be anything! One artistic note is to favor a curve of the brows instead of a straight line (like Box Head in Chapter 7); it tends to read better in most styles.

Depth With the portions that move up, keep them in line with the silhouette of the skull; with the pieces that move down, keep them tight to the face; otherwise, it might just look like the brows are melting!

Expressions All the expressions related to the first browsMidUp apply exactly the same here.

browsMidDn (Mad)

Face shape: browsMidDn(1,2)

Being a pair with browsMidDn, that was Sad, so this is…wait for it…Mad! As with most other shapes in this second set, many of the rules we followed to approximate reality are out the window; your goal in this shape is anger, hatred, all those good things that start fights, almost any way you can get them using brows only (Figure 9.51).

Inclusion This should include the same points and same amounts as those in browsMidUp (Sad). Even though many rules are out the window, shapes that pair together on control sliders (which we'll set up in Chapter 12) should have reasonably paired areas of effect; it makes the transition between the shapes more believable.

Height You can pull the brows up at the brow arch if you like, as well as pulling them down in the center (which would have been a faux pas in the first style of browsMidDn). The heights here are going to be a stylistic choice for you and your character and hard for me to describe.

Depth My comments about skull silhouette and plumpness under the brow ridge from previous shapes apply here, as well.

Expressions All the expressions related to the first browsMidDn apply exactly the same here.

Figure 9.51
Toon Mad shapes
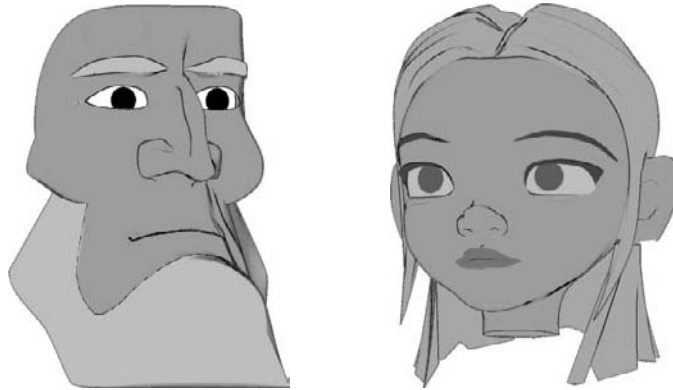
browsSqueeze

Face shape: browsSqueeze(1)

It's very tricky to decide whether you even need this shape; Figure 9.52 shows toons with and without a squeeze shape. If you build a degree of squeeze into both the Sad and the Mad shapes, because their rules are now more lenient, having this compound those could very well be ugly; in some instances you may not need browsSqueeze at all. When you do want it, the instruction in the first set will cover you just fine.

For information on adding a non-shape shape, see the sidebar at the start of this second key set called "MixaPalooza " and specifically the section in it called "Cheating the System."

Squint (Happy Eyes)

Face shape: squint(1)

This is the biggest difference in shape styles from the realistic set. The guideline that you make it a combination effect between a shape and the lower eyelids' rotation still applies, but there's a lot of added shape in the lower eyelid too (Figure 9.53). This time, the lower lid needs to appear like a rainbow shape, an upward curve, peaking in the center. By itself, this should look like a toon happy shape, but that can change based on the combinations of this and other shapes.

Inclusion This should include the same areas as did the regular Squint, but the focal point should be more underneath the lower lid than out to the side of the eye. Also, the pull on the outside of the brow should be stronger; because if you have less detail, you need to show the effect with the detail you *do* have.

Figure 9.53

Toon squints can look peculiar without other emotions happening at the same time. I tend to make them much more extreme.

Height This is a mix of up and down pulls: the outside of the brows should pull down, and the lower lids should pull up. Don't pull either too far; it can start to look odd pretty quickly. Don't let either vertically move across the pupil.

Expressions All the expressions related to the first Squint apply exactly the same here.

Tying Up Loose Ends

Well, this is the end of the key shapes that you'll need in order to do fantastic sync and act-ing. Here are a few more things you should know, however; some questions are answered, some extra info exposed.

If you find yourself wondering about some really extreme shapes—I mean, we're talk-ing *loony* poses, things clearly not obtainable by combining the keys described here and in Chapter 6—yes, they exist, but we just didn't build them. Of course the situation will arise with a need beyond what we've done here, and there is a solution: specialty keys. The key shapes described here are the workhorses—they're the ones that are going to carry you through 99 percent of your needs—but there are going to be times when you require more. That's okay, that's normal, and that's part of the process. To build a specialty shape for a scene is not uncommon.

The key is to *not* build all of those possibilities all at once and all first, before you even start animating or could possibly know what they are. You don't need them yet. They're the icing that you apply in the extreme situations that absolutely call for them. So if you find yourself needing an extra key shape to punch that one emotion, that one scream—go for it. I'll say this: it probably won't play nice with the other shapes, so you'll need to ani-mate them down as you animate the specialty shape in.

One more piece of advice: take the keys we've built, pose the head as close to that spe-cialty shape as you can get, duplicate the head, and start working from there. Even in those

extremes, you can use the tools you've created here to get you there faster and easier. Also, don't forget that in this new edition of the book, I'll take you through some squash and stretch techniques. What you're looking for might just be in that section!

Asymmetry (Tapering)

To take the browsOutUp, browsOutDn, and squint shapes and make their derivative left and right versions, look at Chapter 6 and its description of the process for using the ss2_blend_taper tool; it's the same here as it is there.

Pupil Dilation Keys

Some of you may be wondering about pupil dilation. Personally, I think it's overrated and hard to use effectively. If you really, really want it, though, make one shape that shrinks the pupil down to nothing. You can control it through the Blend Shape Editor and type in negative values to make the pupil bigger. Yuck. Pupil dilation: Don't fall into the trap! Don't overuse it!

The Stop Staring Expressions

I recommend that you write the expressions or make the connections to the main head using utility nodes for the bump nodes and brow shapes for the sake of the learning. However, I have added a button to the Stop Staring shelf that writes all the expressions or does the connecting for you—of course, assuming that your objects, shapes, and nodes are all named exactly as described. If any shapes are missing or if there is any misnaming, the script will bring up an error and tell you what node/name the problem is in relation to. It won't be able to exactly tell you how to fix the problem, but it will tell you where that problem is so you can zone in on it.

All the bump maps' expressions/connections will lean on 0.2 for the blending strength. Even after using this automated approach, you may need to go in and modify the expressions or nodes manually. But replacing 0.2s with 0.3s or 0.1s isn't too much work for an ol' hand at expressions and connections like you'll be after we're done with you!

Bringing It Together

It's time *to take all of these little pieces we've built, bring them together into one head, weight them, and rig them for use. The first thing we'll need to do is stick the pieces together. After that, we'll build an ear and neck to finish off the whole head. Next we'll set the head up for rigging, both for the shape-based rig I've used for all of the images and for a skeleton for a video-game-style rig, which is set up without blend shapes but instead only with joints. If you're following along in order to create a full head, you'll need to complete this skeleton setup before doing the shape-building work in Chapter 6 ("Mouth Keys") for the mouth and Chapter 9 ("Eye and Brow Keys") for the brows.*

Connecting the Features

The eyes and brows have a structure that they need for the type of movements they do. The mouth and the area immediately surrounding the mouth, including the nose, also have their structural necessities. What we'll do now is build up the last remaining big feature, the ear, and then take each piece of the head, pull all of them into a scene together, and attach them to each other to give ourselves a full head model.

- ■ **Building the ear**

- ■ **Assembling the head pieces**

- ■ **Building the back of the head**

Building the Ear

With only one major feature missing for us to finish up before we slap it all together on the head, we'd best get to working on that one feature. As usual, start by creating a polygonal plane. Make it a 5×3, this time in the X axis, so that it is sideways to the rest of what we have built; just as an ear usually is. In another step that should be familiar by now, blow away the center faces, leaving only those faces that are along the outside of the plane. A pair of planes, that I'm sure you recognize, await you in Figure 10.1.

Position your camera so that you are looking at the plane from the side (so it is flat to camera), or just pop into the side view. Looking at the plane this way, snap the verts that lead to the corners right into the corners, but leave the bottom-right corner as it is now. Figure 10.2 shows the before and after.

Sculpt what you have now around like a swirl. As you work the geometry, don't worry too much about anything but the side view here; the 3D is a little hard to get into on this shape just yet. When you make the swirl, try to make the line that is highlighted in Figure 10.3 intersect itself the way you see in the image. Make it so that the top part of the swirl only really has three edges above the "middle," or "equator," of the shape.

Figure 10.1

A 5×3 plane, then the same plane, but with the middle deleted
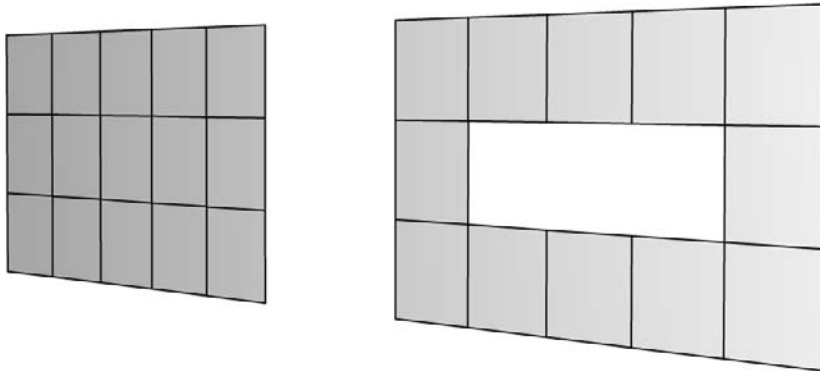
Figure 10.2

Snap and merge the verts on the left plane to the corners as shown in the right plane.
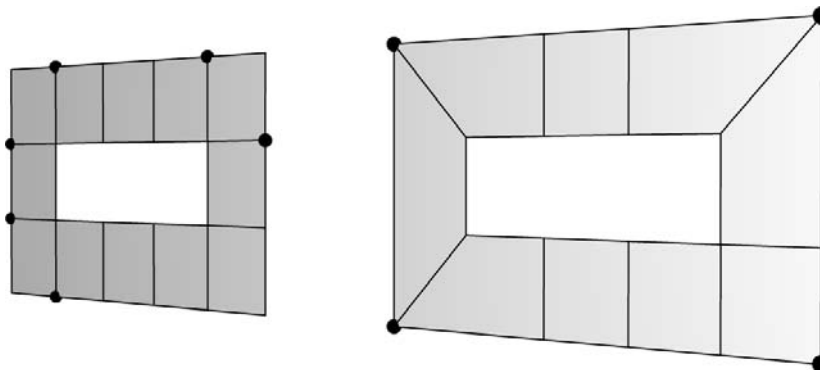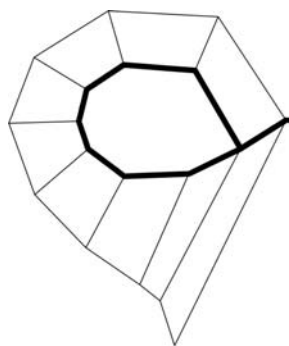
Figure 10.3
Sculpt the plane into a swirl.
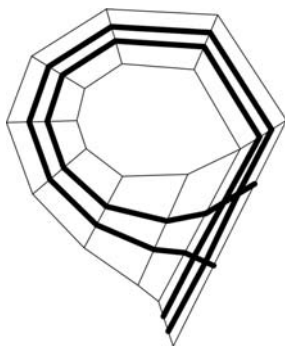
Figure 10.4
Add edge loops to the circular direction around the swirl.
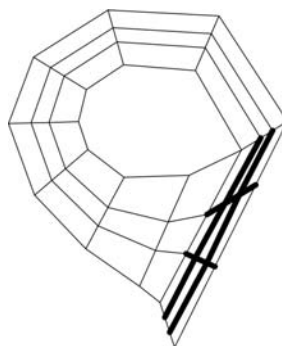
Figure 10.5
Edge loops added around the ear will overlap themselves twice in this area and may require some manual edge addition.
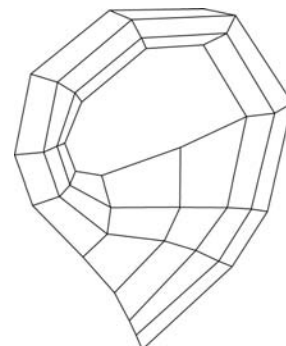
Figure 10.6
It's starting to look a little like an ear now.

In the last step before we start to put some 3D into this thing, create two new edge loops around the circular track (Figure 10.4). After some work, you'll end up with a pound sign (or number sign) edge flow in the bottom-right face, since it needs to be divided two ways in two directions; I've highlighted that area in Figure 10.5. What we have now is enough to start really shaping the ear, and this area specifically is to be the *top* part of the ear. (When I say top, you know that little nub that sticks out toward the front of your ear? Well, this is the start of everything that is the ear *above* that.) It's a little hard to describe what to do next, so take a peek at Figure 10.6 to see my efforts. Use the two edge loops that travel along the inside of the object to pull out and start to form a slightly cylindrical cross section around the outside. As those edges go back into the meatier, broader surface in the middle of the ear, make sure they spread out. This is where the edge of your ear, the rim that goes along the outside, will merge cleanly back into the rest of the ear.

With the start of the ear definition in place, we can take the first steps to *refining* that definition. Split edge rings along the swirl direction two more times in the places shown in Figure 10.7, and use that to make the sculpting you did in the previous step smoother and rounder. Rounder, that is, except for the inside of the curved part of the rim; make that cut in even harder, and start to define the rim around the ear. Near the bottom, where that rim is now sharper, keep the pair of edges close together, as in Figure 10.8. A few steps from now, when we start to work on the bottom half of the ear, that will help you identify some key edges.

Around the ear, add edge loops as shown in Figure 10.9. This is a good time to start to shape the rim of the ear that is near the front as flat to the head since this will smoothly transition into the face in a few steps. Take some of the new edges in the flatter area and tighten them up to create some of the bump an ear has from front to back in that spot; check out Figure 10.10.

Since most ears don't have giant lemon-wedge-shaped holes in them, let's get rid of the hole. Grab the five flattest connected edges along the bottom inside edge of the hole and extrude them up three times, as shown in Figure 10.11. Taking the perimeter points from the new polygon peninsula, and starting at one bottom corner and moving along the edges and verts one by one, you should end up with a completely sealed up ear model, or at least the top half of one. Make sure to merge/weld the new vertices so that they actually are connected and not just really really really close. Sculpting from here really is mostly a character design question, but Figure 10.12 shows what I did.
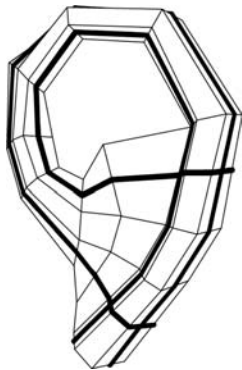
Figure 10.7

These new edge loops will allow you to round the rim around the ear.
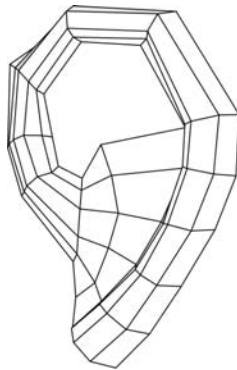
Figure 10.8

Tighten the edges to each other near the back inside of the ear to create distinct forms of the ear.
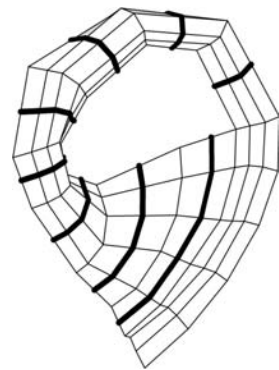
Figure 10.9

More edges to add
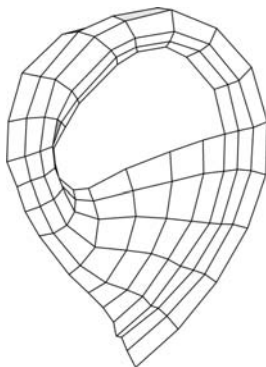
Figure 10.10

The newest edges add better curvature to the ear.
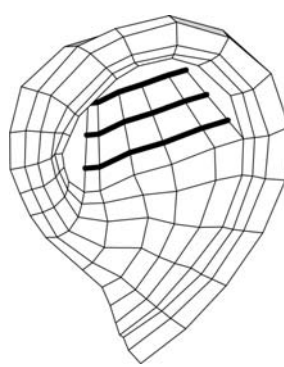
Figure 10.11

This new geometry will allow you to fill the hole in the ear.
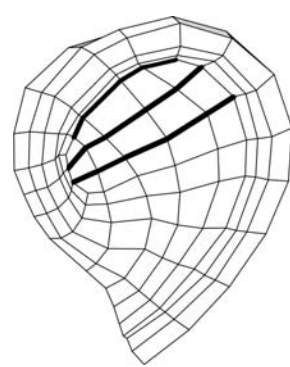
Figure 10.12

Snap the new geometry to that surrounding it on the inside of the ear.

Bottom of the Ear

That pretty much cleans up the majority of the upper ear stuff until we start modeling it back toward the head, so let's start working on the bottom part of the ear. This next set of steps on the ear is probably the trickiest modeling tutorial in the whole book, so check and double-check your work by comparing it to the images. I recommend reading a few steps ahead before completing any one of them. Now that I've got you all terrified, the good news is that when we get to the actual head assembly, it's super easy. I promise.

The first step in the bottom half of the ear is to extrude some edges out along the front of the ear. If you are counting this means, along the front edge (which runs down and under the rim, if you have been following the images closely), you need to grab 13 edges. Take those 13 edges, extrude them twice, and pull them down pretty much in line with the ear rim you've got, as in Figure 10.13.

If you've been following along closely, there should be three rows that run together closely all the way around the ear rim. Since the rim pretty much ends on most people right around this area, we're going to have that happen in the model too. Take the vertices along those three edges and snap the top ones and bottom ones toward the middle one, just on the last two verts before they run off the geometry. This should give you something like Figure 10.14 where three edges all dive into one.

Once you merge all those vertices, you've managed to pull some unnecessary weight out of this area, but there is some topology that may not texture or move that well (you know, all those high-stress ear shots). Once this is all cleaned up to where you are sure you don't have duplicate faces, edges, or verts, just delete the one span of the middle edge that is involved in the three-to-one, which if you compare with Figure 10.14, you can see that it's missing in Figure 10.15. There you go, all quads again.
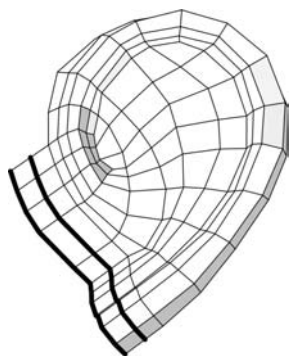
Figure 10.13

Extrude two new rows toward the front.
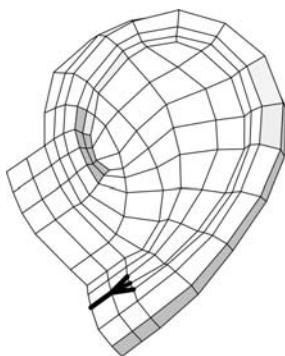
Figure 10.14

Snap the three rows for the ear rim into one.
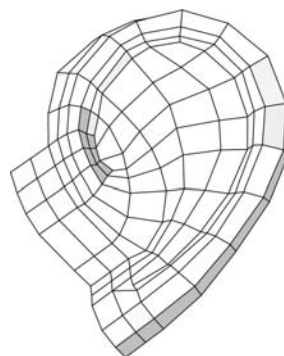
Figure 10.15

Delete the edge at the bottom of the rim to make everything quads again.
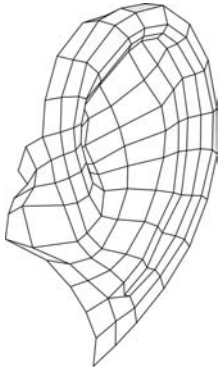
Figure 10.16

**Start to sculpt into the
ear canal.**
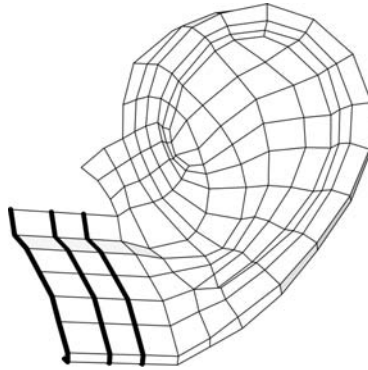
Figure 10.17

**Extrude three more rows toward
the lower front of the ear.**
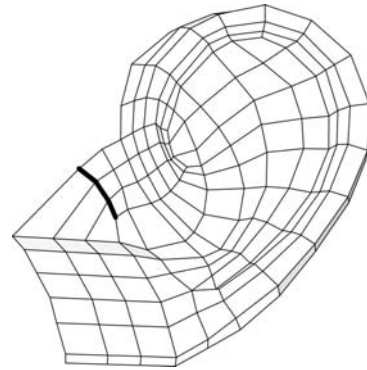
Figure 10.18

**Snap the top of the new geometry
to the polys above them.**

It's hard to tell just now, but these new faces are the ones that will dig into the head and
form our approximation of an ear canal. Figure 10.16 shows the new faces taking a poke at
the brain. Sculpt this stuff to move quite a bit in toward where the head will be. Don't be
afraid to go too far with it; you can always bring it back out later.

Take a look at the stuff you just pulled out from the ear. From the top forward point on
that, count down to the fourth edge, select that edge and all others along the front, exclud-
ing the top three, and then extrude that group of edges three times forward. The extruded
bunch is shown in Figure 10.17.

What you should be looking at is a new wedge where there are three edges along the
top of the extrusion you *just* created and three above that from the previous step. If you
snap those together, as in Figure 10.18, you've reached a big moment in your ear topology
adventure. Once you sculpt this out a little bit (Figure 10.19 shows how far I got before
stopping for coffee), take a little break and notice how we've got almost a *pretzel*, or even a
knot of edge flow. Oftentimes, trying to get an ear to flow into, out of, and as part of the
rest of a head costs a lot of extra geometry. This little knot flow isn't the be-all and end-all,
but it definitely can help with keeping the area tidy and inexpensive.

From this point, all we need to do is get ourselves an earlobe and push this back toward
the head. That may sound easy, but this is the potentially tricky area I referred to earlier in
the chapter, so keep sharp. Don't try this at 3 a.m.; you'll just end up cursing me. From the
center of the knot and down, select edges and extrude them, but exclude the last two.
Repeating for sanity here, do not extrude the last two of the front edges, on the bottom
under the rim. We have other plans for them. Take a good look at Figure 10.20 for this.

Take the topmost new vert created from that last extrude and snap it up onto the front
part of the top of the ear, one vert up. Do the same at the bottom; snap the new vert to its
counterpart closest from where it was pulled out, which in this case is down. Figure 10.21
shows the points to snap.
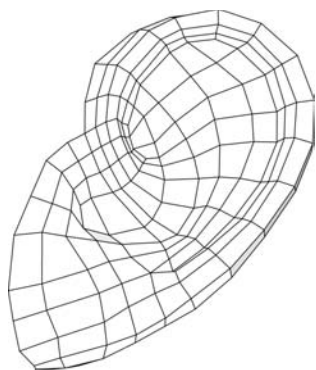
Figure 10.19

Start to sculpt the lobe.
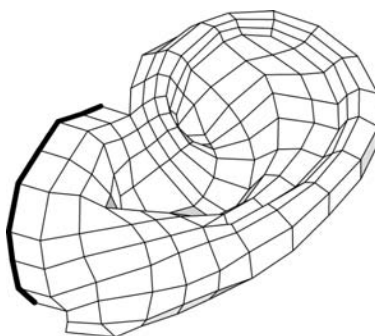
Figure 10.20

Extrude the front edges of the pretzel geometry once.
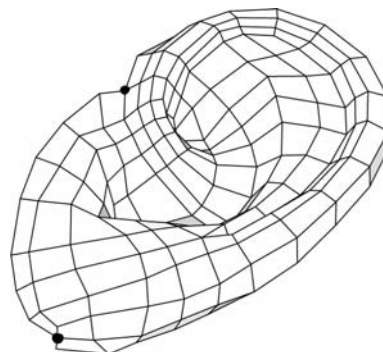
Figure 10.21

Snap the new corners to the old topology as you see here.

Select all the edges along the perimeter starting at the knot intersection in the front, then all the way around back and under, but stop two short of where there is a hanging quad. This is a difficult one to describe, so Figure 10.22 contains three different angles of what to extrude. Extrude these once only. With the new geometry, snap the vert up at the front/top to its counterpart on the surface, as shown in Figure 10.23 (again, every time you do this in any step, weld the verts together afterward). Start to flatten the geometry in the front, as it will actually now form a little of the side of the face and not the ear proper. Along the back and bottom, you are still very much in ear territory and defining the back side of the ear and the beginnings of an ear lobe.

As we zero in on ear completion, select almost the entire perimeter again, but once again, leave that hanging quad on the underside and one edge behind it. Extrude all of that once, as in Figure 10.24, and then once again snap the new verts to existing verts on the mesh, like Figure 10.25. Now we should have our ear lobe geometry, as well as a tight flow around the outside of the whole thing.
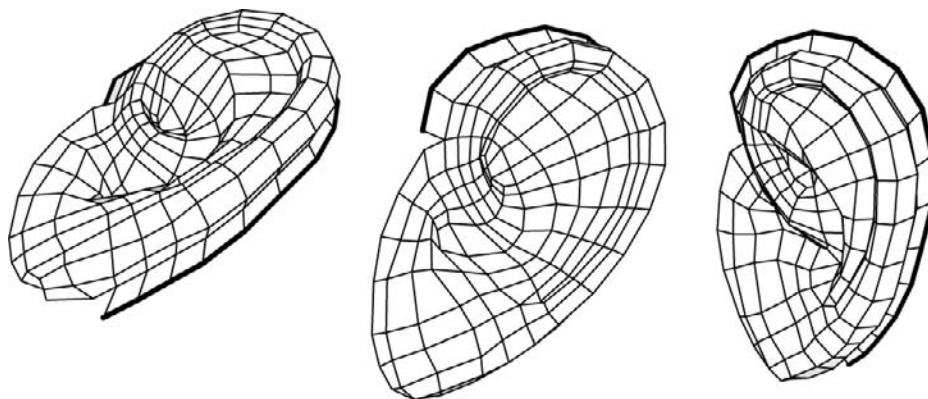
Figure 10.22

Three views on the edges to extrude as we start to frame the ear for placement on a head.
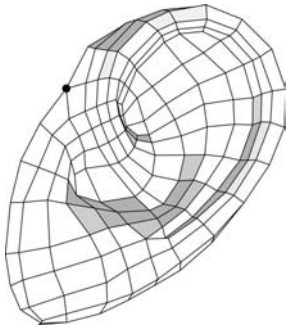
Figure 10.23

Snap it, merge it, love it.
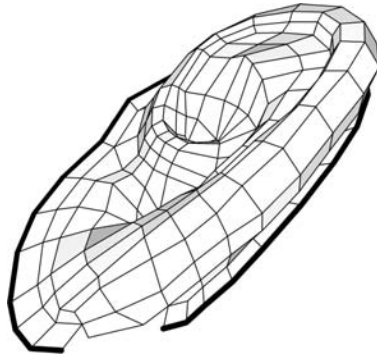
Figure 10.24

The last tricky extrusion around the ear
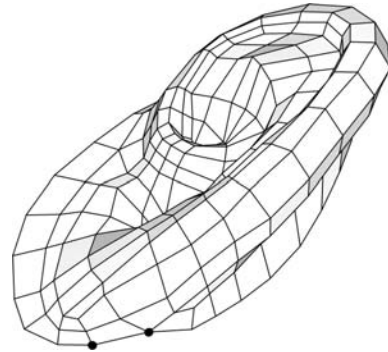
Figure 10.25

Snapping the last of the tricky extrusions

Extrude the entire perimeter once and you should really be able to see how the ear itself is done (except for sculpting it to your own designs), and now all we're left with is getting this ready for cooperation with the rest of the head. What I had before continuing is shown in Figure 10.26.

Preparing the Ear to Join with the Head

You need some more geometry to start sculpting with, so begin by selecting all the edges except for the four frontmost, and extrude those out a grand total of four times. It's hard to envision just now, but if you take a look at Figure 10.27, you can see how the row farthest back is where we'll be sculpting a little bit of the neck definition once we get to the full head assembly.

For our final trick, we will be grabbing all the edges along the front and, for old times' sake, extruding them forward once, just as in Figure 10.28.
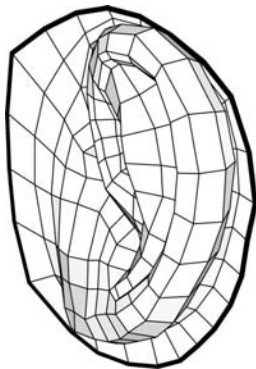
Figure 10.26

Extrude once around the whole thing.
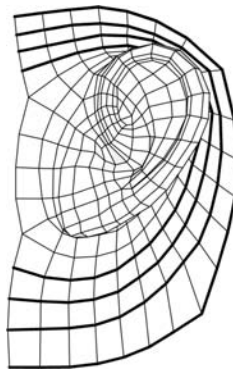
Figure 10.27

Extrude all but the front four edges four times.
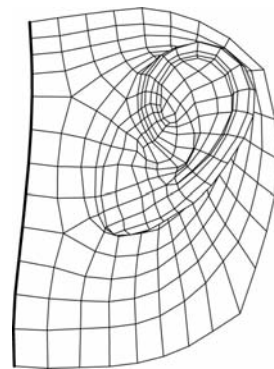
Figure 10.28

Clean up the front edge by extruding it once.

There you have it! An ear and some of the geometry that runs that ear into the head. One last bit of advice on the ear. As you take this part of the model and make it your own, always remember to keep an eye on probably the biggest ear modeling fumble: Too often an ear looks pasted onto a head. Even in the work of otherwise very talented modelers, you'll see this croissant that is taped to the side of the cheek. Keep an eye on that and be really objective. In fact, get someone who is not into CGI, and get their opinion on that issue specifically. "Hey, mom, does this ear look like a croissant taped to the side of the head?" If they laugh, you may not be quite done yet. Try to make sure that there is little or no symmetry between the silhouette of the top of the ear and that of the lobe. The top will usually stick out farther than the lobe. The vertical "length" of the curve at the top of the ear tends to be greater than that of the lobe. Generally, no part of the outer ear silhouette should push back toward the head far enough to make the lobe look like it sticks out farther than *any* part of the ear.

Assembling the Head Pieces

Bits and bites. Little thingies, teeny self-contained, one-off models. Well, this is where we bring things together and *actually* build something we can use. The areas we've built so far as individual pieces all need to deform quite a bit through the different poses they have to hit, and therefore they benefit from a lot of topological pickiness. That said, we are left in pieces. This next section is the glue between important bits. To be blunt, this is the part that isn't nearly as important topologically. If you were to ignore this next section and go off and do your own thing with five-sided polygons, triangles, and just a rat's nest of topology connecting the important parts, it wouldn't be the end of the world. But the tutorials thus far have been tailored to make the connection of all the pieces work out pretty well. If you're interested in seeing that all work out, keep truckin' good buddy.

The first thing is, of course, going to be making a plane and cutting out the center. I'm kidding.

What we'll really do is pull all the pieces we've built elsewhere together into one scene. Once these are all together, place them and scale them so that a few things are true, as illustrated in Figure 10.29:

- The placement of the eye/forehead area to the mouth/nose area is such that there is a gap, but only a gap about the size of one row of faces (Figure 10.29a).
- The back edges of the mouth/nose area should line up with the back edges of the eye/forehead area (Figure 10.29b).
- There is at least some implied silhouette between the mouth/nose and the eyes/forehead (Figure 10.29c).

- The ear is flush with the side of the face implied by the nose/mouth and eyes/forehead (Figure 10.29d).

- The ear is spaced, like the upper and lower halves of the face, approximately one face row apart (Figure 10.29e).

If any of that is not true, then get stuff as reasonably into that checklist as possible through placement and scale, then do some sculpting until it's at least *close*.

Figure 10.29

Alignments: (a) top to bottom; (b) front to back; (c) aligning along the nose; (d) aligning the ear to the head side to side; (e) aligning the ear to the head front to back
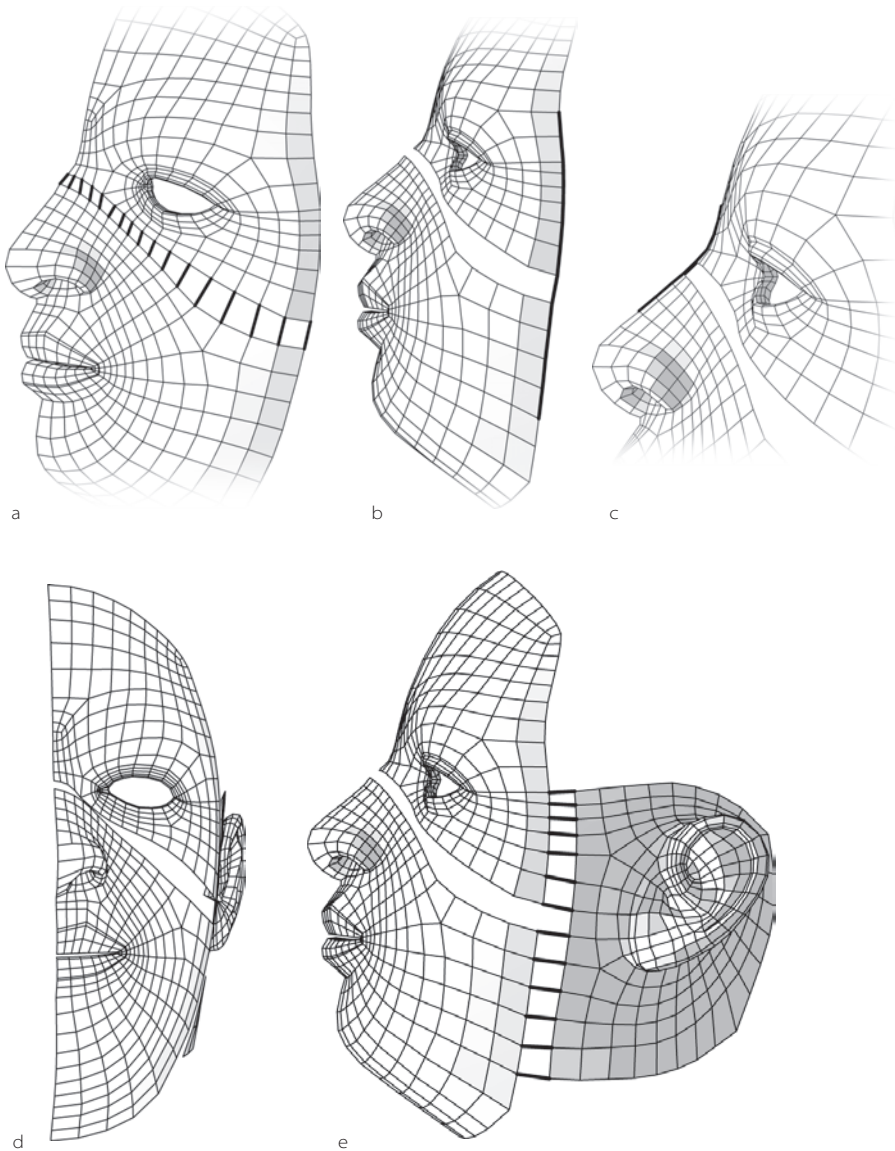
Mirroring: Working on Half of the Head

We built the lower and upper parts of the face as whole, meaning both left and right, with a little sculpting. That approach has been beneficial because it means we don't either dip in or poke out at the axis. But now, assuming we've done that in those individual models, let's nuke half of it so that we're working on only half the face and getting double the result for our effort. After we've placed, scaled, and sculpted, delete one side, then combine all these things into one polygonal mesh.

The first step to the final assembly is to bridge the gap from the upper to the lower face. If you've followed the tutorials pretty closely (not necessarily in shape, but in edges and verts), then you should have exactly 16 faces to create for that to happen. Now, they may not align perfectly, but that's okay; you can always sculpt and arrange after the fact. Just get the gross stuff and smoothing of the flow in place since every new step adds a lot more geometry, which affects your perspective on the overall edge flow. After you've merged the upper and lower face (the edges that need to meet are highlighted in Figure 10.30), you should have one *face* mesh; something contiguous from top of the forehead to under the chin.

Figure 10.30

Merge and tidy the top/bottom connection.

Now, it's time to invite the ear to the party. Aligning this properly can be tricky, and you can choose to do it artistically or by counting edges or both. The top of the ear area should align (with one face's worth of separation) with the crow's-feet edges on the face (Figure 10.31a). The edge where the ear topo has a five-point star of edges should align with the edge that does the same off the corner of the lower eyelid "bags" (Figure 10.31b). By count, this means that the sixth vert counting away from the bottom of the neck/chin aligns with the bottom corner vert on the ear geometry (Figure 10.31c).

With all these correspondence points, bridge the ear to the face, which should result in 12 new faces and something like Figure 10.32.

a   b   c

Figure 10.31

Aligning the ear to the face: (a) align the crow's-feet; (b) align the top of the cheek to the top anchor on the ear; (c) align the neck/chin divide.
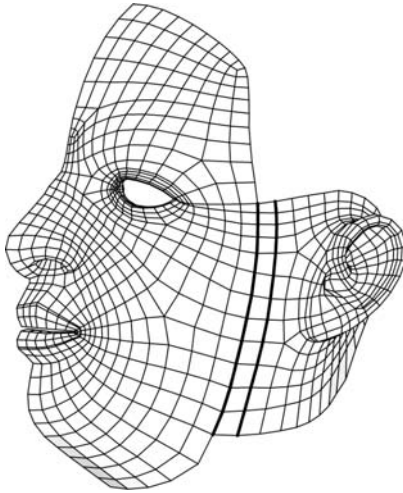
Figure 10.32

Merge and tidy the front/side connection.
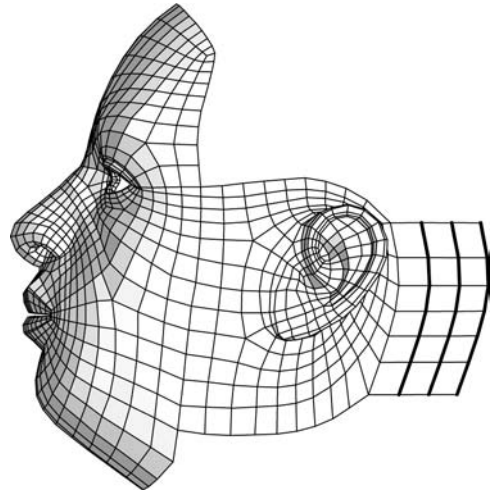
Figure 10.33

Pull three new rows back to form the back of the neck.

Hey, this is starting to come together! Let's get started on filling in the areas we don't yet have, starting with the back of the head. Select the 6 edges along the back of the ear (if counting, edges along the ear perimeter, starting from the top, edges 11 through 15), and extrude them three times, just as in Figure 10.33.

Snap the last of the new edges flat to the axis, which should align them so that they are in the same plane as the middle of the cut-in-half face we're already working with. Take all this and start to sculpt toward what I have in Figure 10.34, a back-of-head and a neck that is rounded and pretty much tops out vertically where the base of the skull is.

Imagine, if you will, a car with a convertible top. Now, imagine that something like that is going to come out of the back of the head and cover it up in connection to the forehead. To do this, extrude the top of the new edges up twice and pull them up, just like the ones in Figure 10.35.

Sculpt the new edges to pull the top new edges toward the forehead. Snap these verts to the forehead verts, skipping two each time. (There is a close-up image in Figure 10.36 showing snaps and skips). You can leave those forward verts snapped, but in the images for a few steps, I'm going to pull them back from the forehead for clarity. With the other edge loop, sculpt it to approximately what it looks like in Figure 10.37 so that it defines what you can imagine *as viewed from the side*, the northeast edge of the eventual skull.

Along this new convertible top for the head, split the edges twice through each section, as in Figure 10.38, and use the new edges to round the silhouette out as best you can.

Once again, add two more rows (Figure 10.39) to each section and continue the rounding of the silhouette, making full use of the new geometry. The better a job you did on the last step, the easier this one is, so each time you add detail, do your best to sculpt it cleanly before adding more.
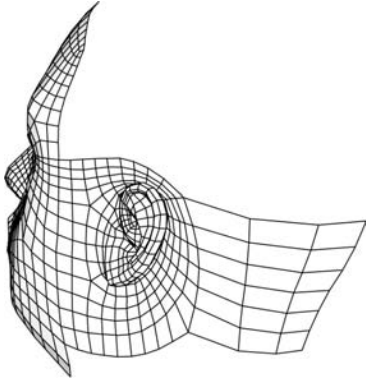
Figure 10.34

Sculpt the back of the neck.
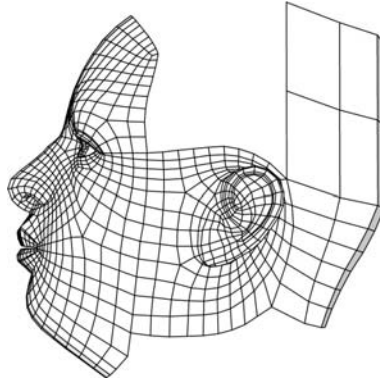
Figure 10.35

Pull two rows up and over.
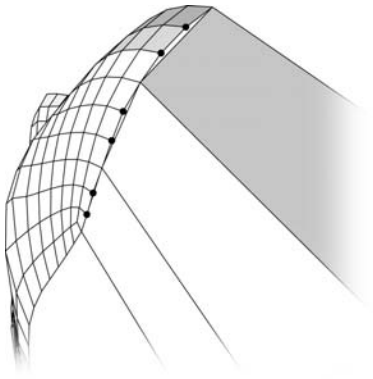
Figure 10.36

Snap the new top rows to those atop the forehead.
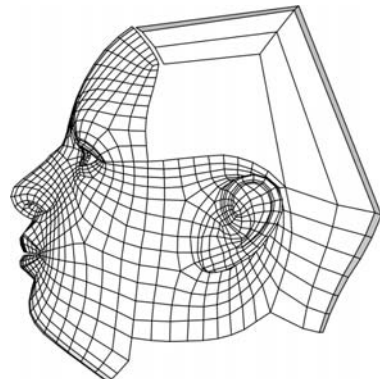
Figure 10.37

Sculpt out the back/top of the head.
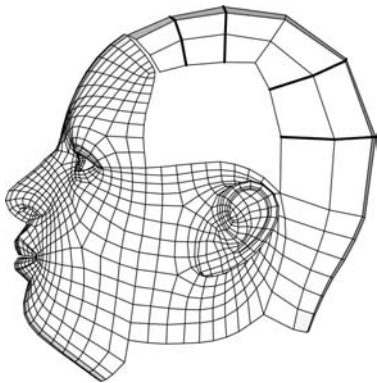
Figure 10.38

Add two rows to each span up and over; then sculpt them round.
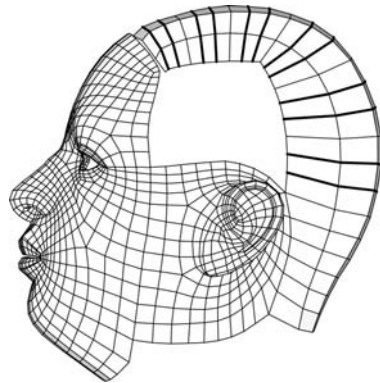
Figure 10.39

Rinse, repeat.

This is pretty much the detail level I'm going to take you to around the head silhouette from the side, but if you look at Figure 10.40, you can see that to align this properly with the forehead, we'll need to match up the number of edges/verts in the other direction, perpendicular to the edge direction we've been adding to. We'll jump in and split edge rings again, each section with two new rows, but instead of along the silhouette like last time, this time do it up and over the head.

If you haven't already figured it out, you now have exactly the number of verts on this piece of up-and-over as are needed to snap vert-for-vert to the top of the forehead, so go ahead and do that; be sure to weld the verts once you have. Figure 10.41 highlights the vertices I'm talking about.

So, we have made ourselves a head, but that gaping hole in the side would leak during a storm. We'd be best served to plug that hole ASAP. Select the edges that are flat along the top of the gap, and extrude them down nine times. (Honestly, you could extrude the ones at the bottom and it'll all work out the same.)

If you snap the outside verts all the way around the new geometry to the verts that are lining the opening on the head, you *should* end up with a totally sealed-up head. From there, you probably have a fair bit of sculpting to do to align all the edge flow in all directions along the new area. Figure 10.42 shows the extrusion, and Figure 10.43 shows everything snapped and sculpted.

Well, don't jump out of your seat, but except for a little of work on the neck, you're already done with your head. Surprise! To truly wrap this up, select all the edges along the bottom that are facing down, skipping all those that are part of what was originally the mouth/nose model. Extrude the edges down once (Figure 10.44), and then snap the vert at the front onto the vert on the jaw area in front of it, just as in Figure 10.45.
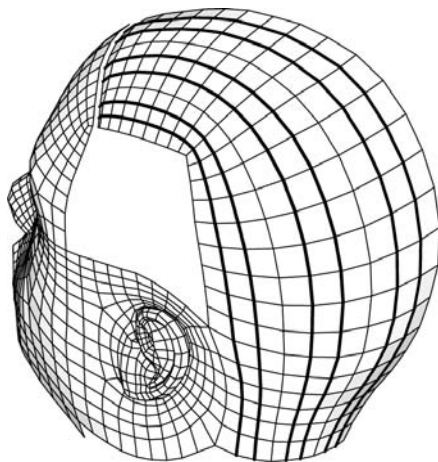
Figure 10.40

Add two more rows the long way around the head for more rounding.
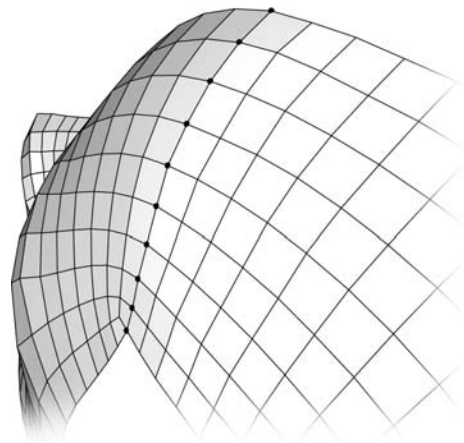
Figure 10.41

Now you have enough vertices to merge to the forehead properly.
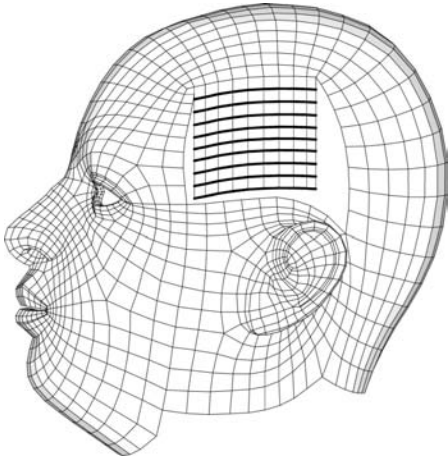
Figure 10.42

Extrude the top edge of the hole down nine times.
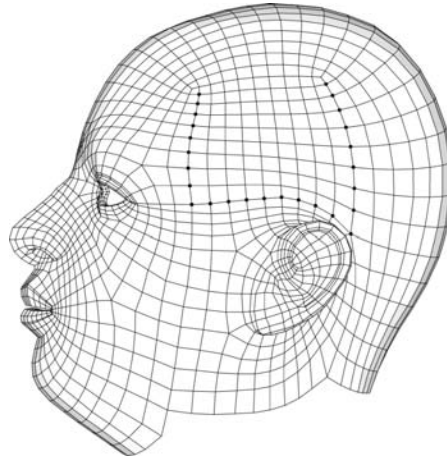
Figure 10.43

Snap and merge all new verts along the perimeter to those bordering the hole to clean it all up.
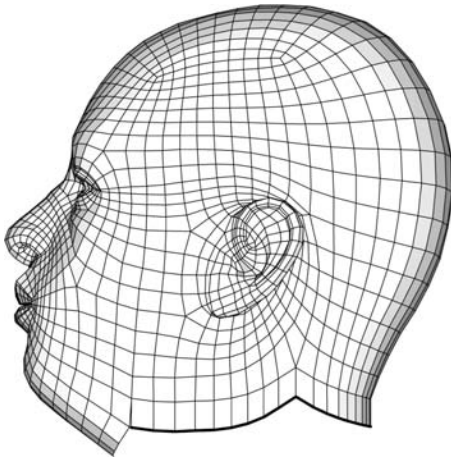
Figure 10.44

Extrude around the sides and back of the bottom of the head.
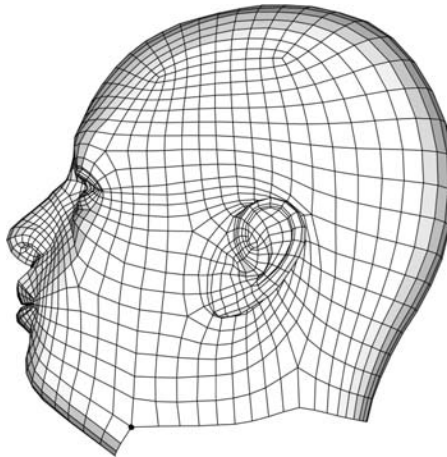
Figure 10.45

Snap the front of the new edge to the chin.

In what will be the last bit of geometry creation I take you through on this head model, grab all edges along the bottom and extrude three times, to form what will be the beginnings of the neck. Sculpt that so that it is reasonably flat along the bottom, and there you have it (Figure 10.46)! That should easily connect to whatever it is you might want to do with the rest of the neck and body. "Where's that book?" you say? Hey, don't look at me.
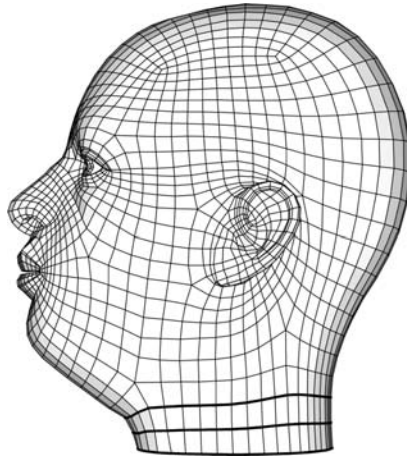
Figure 10.46

Extrude the neck down twice, and call it a day.
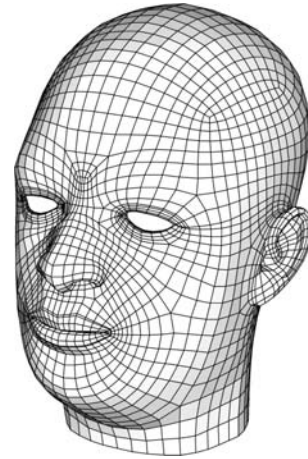
Figure 10.47

Mirror the geometry to create the whole head.

a

b

Figure 10.48

The wrong way (a) and the right way (b) to shape the chin/neck silhouette

Since we have been working on only one half of the face, go ahead and mirror this geometry to get a whole head to look at (Figure 10.47). As you work your model to your design, you may want to bounce between working on half the face and the whole face to be sure you are keeping close watch on how the middle edge looks. Well folks, there you are, the head, ready to take to parties or long walks on the beach. Good times.

Silhouetting the Chin

Now that you have a chin and neck all together, I wanted to point something out that can really take a good model and make it look bad, and that is the silhouette of the chin. Admittedly, the model I have helped you build is much more, well, "pudgy" around the chin and jaw, and not all people are shaped quite like that, but it's one of the main ways you'll see someone look under that area. Something done far too often in CGI is pretending that the curve under the chin of a human being looks like the chin of an cartoon hero, meaning it starts at the corner of the jaw and shoots out in a straight line, making the underside of the jaw a horizontal plane of manliness. But that just isn't usually the case in reality. The curve under a chin slopes pretty happily down to the neck. The look of a square jaw comes from shading near the outside corners of the jaw, not from the silhouette between the jaw and the neck. Figure 10.48 shows two images depicting the wrong and the right ways to shape the chin/neck silhouette; they are not so much a part of this tutorial as they are informational.

Skeletal Setup, Weighting, and Rigging

I'll be the first to admit it. This chapter is a hodgepodge. This is where many tips, tricks, and cheats have found their home since, really, they don't belong anywhere else. Yup, you've wandered into the second-hand store on Stop Staring Street.

The first thing we'll really dive into is the weighting of the head. Pretty much everything in a "Stop Staring" head is joint driven except the neck, head, and eyes, so this isn't a whole lot. After that, I'll teach how to make use of the ss2 eye rig to get a lot of functionality into your eye setup, and finally I'll talk a little about "zipper lips" and getting the corners of the lips to look just a little bit *stickier* than they would otherwise.

- **Weighting the head**

- **The ss2 eye rig**

- **Zipper lips**

Weighting the Head

Weighting the head to the skeleton is really the "backbone" of the whole head structure. Before you can weight any points to any joints, however, you will need to have a skeleton to weight them to.

Placing the Joints

Before we can weight anything, we'll need to create joints to weight to. In the animation module, go to Skeleton → Joint Tool. Once you're using the Joint tool, you simply click to create a joint and click again to create another. When you're done creating joints, you simply press the Enter or Return key and the tool "completes."

Placing the Head and Neck Joints

Figure 11.1 shows where I put my joints. I started with a master joint, one simply to be parent over all others (it's a habit), then I clicked in the same spot to create the neck joint. I next clicked where I wanted the head to rotate from, a point approximately where the corner of the jaw is as seen from the side view. After that, I added a head "end" joint. This is not necessary for any technical reasons, but it makes selecting the head joint easier because it draws a connector from the head joint to the head end joint.

Placing the Eye Joints

The placement of the eye joints is a very particular thing. If you are even slightly off in your placement, the lids and even the eyes themselves could do some very odd things when you rotate the eye joints, like intersect, or the eyes could pop out of the socket.

Figure 11.1

Placing the head and neck joints

Duplicate the head end joint, whatever it may be called, and rename the duplicate LEye_Joint. Constrain LEye_Joint positionally to the left eyeball, and then, in the Hypergraph, delete the constraint node that was just created; it'll be directly below LEye_Joint. Duplicate the joint twice and rename one duplicate LUprLid_Joint and the other LLwrLid_Joint. Figure 11.2 shows the left eye joint placed.

MAKING THE RIGHT-SIDE EYE JOINTS

It's possible to use Maya's Mirror Joint tool to create the right side joints, but I recommend *against* it, and that's just to ensure easier hookup and behavior of the eye rig that is described a little later in this chapter. It's better to create the right side eye and lid joints manually, as I did. To create the right side manually, select all of the left side joints, then duplicate them and move the copies to the right side where they will correspond to the right eye. To rename them, just change *L* to *R* and get rid of the 1 suffix they got when you duplicated them. It's as easy as that! Figure 11.3 has the whole skeleton in place.

Figure 11.2
The left eye joint placed
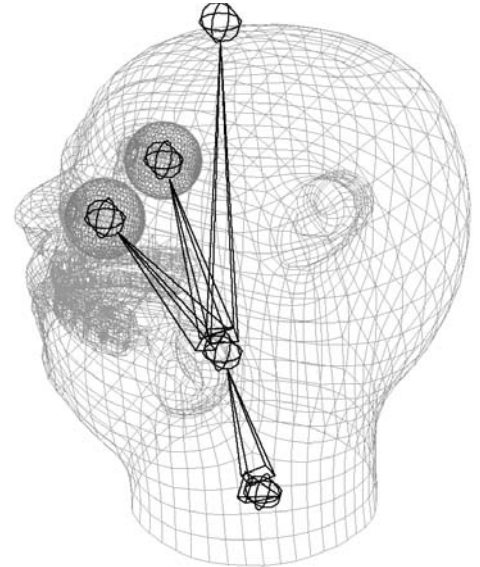
Figure 11.3
The head, neck, and eye and lid joints placed

Placing the Jaw

Now, in this book I talk about using shapes for the jaw and not joints. That said, sometimes binding to a jaw joint is helpful in the process of sculpting face shapes. The jaw is an easy joint to place. If you were to be ultrarealistic about it (and I've done this before with mixed results), you would put the jaw joint up where it really hinges, forward of the ears at about the same height. The motion would actually be a rotation and a translation, but we'll take the easier road, which works just as well, and place it in basically the corner of the jaw, as in Figure 11.4. The weighting should spread like Figure 11.5. Again, if you are not doing this for shape sculpting help, you *shouldn't* add it to your skeleton.

CONNECTING THE EYEBALL GEOMETRY TO THE SKELETON

There isn't really a best or worst way here so much as a list of options. You can parent the eyeballs under the eye joints, or you can bind them to the skeleton and then weight them only to the eye joints, just as you would the rest of the head. *Or*, if your transformations match up *exactly* between the eye geometry and eye joints, you could even constrain the eyes to the eye joints. Any which way you like should work just fine to get the desired results. I personally parent them to the eye joints unless I am doing a squash-and-stretch setup.
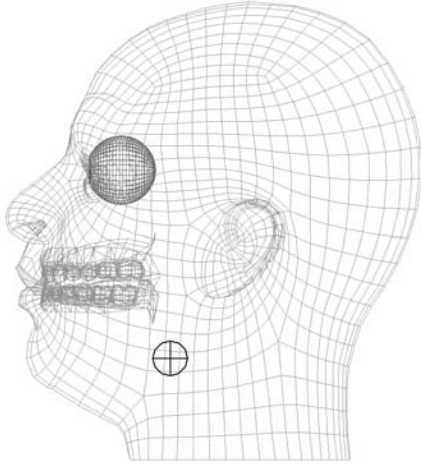
Figure 11.4

Where you would place a jaw to help you build shapes
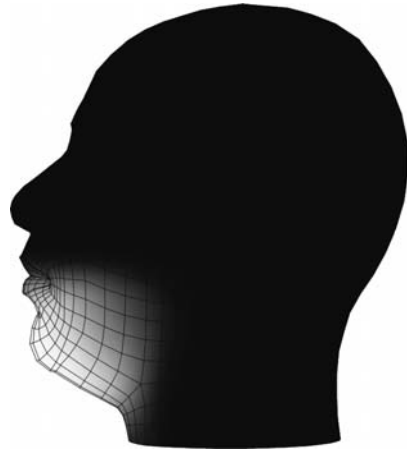
Figure 11.5

The jaw's effect should look approximately thus.

Binding the Head

Binding is what they call sticking points to joints in Maya. Other programs may call it *skinning* and/or *weighting*. In Maya, the process is that once you've got your skeleton set up and selected, you also select the objects you want weighted and then choose Skin → Bind Skin → Smooth Bind. The program will try to calculate for you which points should follow which joints, but since we have so many joints on top of each other, it doesn't usually guess what to do with the eye area very well.

Weighting Order

To adjust the skin weights, choose Skin → Edit Smooth Skin→ Paint Skin Weights Tool ❏. Change the settings so that Opacity is set to 1, the paint operation is Replace, and the value is 1. The very first thing I do when weighting is overwrite any and all of the existing weighting by flooding (clicking the Flood button) all verts on the head model to the top node, which I've named MasterSkel. This assigns all weights to that joint, nullifying any other weighting. From there, I proceed to move down in the hierarchy, dealing with each stage of the weighting, by selecting an area of vertices and flooding. By going from top to bottom hierarchically (bottom to top visually) and being very broad in the weighting, you can ensure that no point gets left behind—even if one does, it will be moving relative to the joint hierarchically above the one it should, meaning that its motion will be close to correct, and you won't have points hanging in space as you move your character through a scene. From there, I just use the Smooth function to make the transition between areas less harsh. Figure 11.6 shows my weighting of the master skeletal, neck, and head joints, respectively.
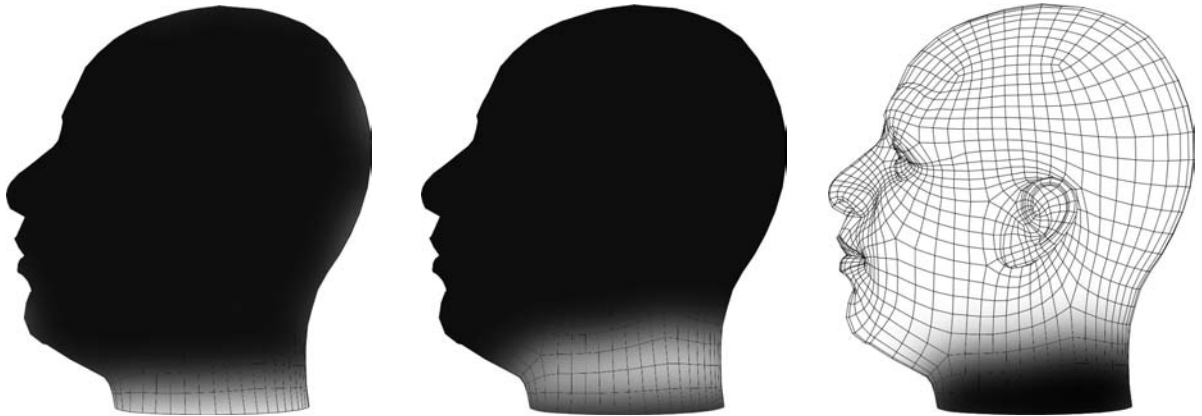
Checking Poses

Instead of weighting blindly on a head in its default position, I pose my head and then tweak the weighting; by doing so, you can actually see the points move into different alignments, and it makes the tweaking of weights actually mean something visual. For the head and neck, the best test is to twist the head. Figure 11.7 shows the main pose I worked on.

Weighting the Eyelids

I'll tell you an evil fact about this skeleton setup. Since the eyelid and eye bones are all on top of each other, there's no easy mirroring of weights—it doesn't work. We need to be sneaky, and even then, it's only about 70 percent successful. Before we weight too much with the lids, select each one and open up the Attribute Editor. For a few versions of Maya there has been a joint attribute called joint labeling. The real reason for this attribute is outside the scope of this book, but we can put it to use. On the left side, set the joint label to be Left and Root on the eye, Left and Hip on the upper lid, and then Left and Knee for the lower lid. On the right side, set the same, but Right, so Right and Root for the eye, Right and Hip for the upper lid, and Right and Knee for the lower. It's a funny thing to set the eyelids as hips and knees, but don't you worry just yet.

The best way to weight the lids is the same as the best way to weight everything else: rotate the joint into a pose, and start changing the values on mesh points until the pose looks right. I usually start with the left upper lid and rotate it down about 30 to 40 degrees. Then I weight the whole leading edge of the lid 100 percent to the lid joint, causing it to move.
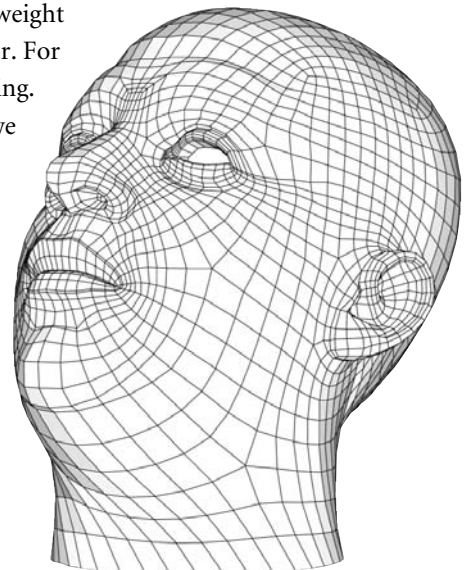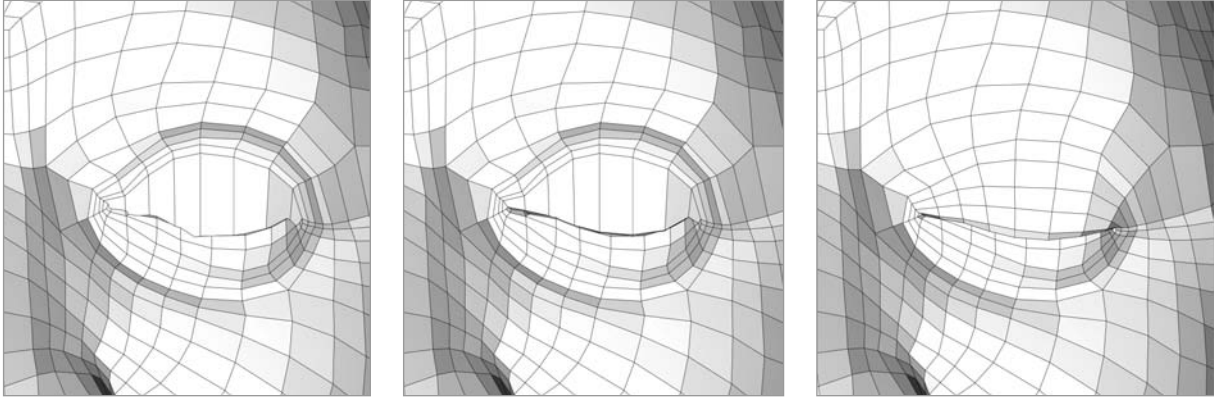
Three stages in the weighting of the eyelid; the first rows, the refinement of those, and then the rest of the lid made to follow

Change the rotation of the upper lid joint to rotate as far as is needed for the two lids to meet if you need to. Then weight each area of points on the upper lid to follow the contour of the lower lid, basically creating the meeting of the lids as we will want to see it.

Once you've got the leading edge figured out (some views of this are in Figure 11.8), continue on and include more rows of the lids, tapering the effect as you go.

A nice touch is to weight *much* farther around the eye to the eyelids, but in extremely small amounts. I usually weight all the way up past the brows very slightly, so the whole area moves subtly when the eyes open and close.

After the upper lids are done, repeat the same process for the lower lids. The lower lids are usually easier, as there's no need to test them past the iris. Only rotate the lower lid joints up to about half as far as the upper lids, but otherwise copy the process.

Mirroring the Weights

Figure 11.9

The Mirror Skin Weights tool settings

We're almost done. If you now want to mirror the weights from left to right, choose Skin → Edit Smooth Skin → Mirror Skin Weights ❐. You might be working in any axis, so it's hard to tell you *exactly* every option you'll need to use in this option box, but if you are working Y up Z fwd, then use everything you see in Figure 11.9. The most important thing to note, though, is to set the influence associations to use Label. This is where that hip and knee nonsense will help us out. Maya's mirroring doesn't generally work out so great with joints in the same location, and there is no guarantee it will even use this method, but it helps your odds. If it does work, lucky you; if not, do the same on the right as you did the left and hope it works out better next time. At the end of the day it's only two joints weighting each side.

> **EYELASHES**
>
> Something I don't cover in this book is eyelashes. If you do create lash objects, you'll need to weight them to the lid joints and create blend shapes for any poses in which the shape of the lids change via blend shapes on the face.

The SS2 Eye Rig

Beyond the simple weighting and on to rigging, setting up eyeballs and eyelids can turn into a pretty enormous task. Consider what was needed for even the tiniest bits of what I've called "natural" behavior in Chapters 2, 3, 7, 8, and 9, where the upper eyelid height is an emotional indicator and therefore needs to track relative to the iris and pupil. Also think back to where I told you how the lower lid doesn't really move except to get pushed up by the scrunch and pushed down by the cornea. Add on top of this the notion that with some lateral motion tracking, you can make the entire area surrounding the eye look more fleshlike. As it turns out, there isn't a *super*-easy way to write an expression or node tree for you that will actually do all these things *automatically*, but what I have is close. You'll need to provide *some* input to make it all work; it's only *mostly* automatic.

Since I cannot predict the axis you are working in (Y-up, Z-forward; Z-up, Y-forward; or even Y-up, X-forward), and I don't know exactly the way you built your skeleton (it is more likely to work well if you make it as described earlier), providing a rigging solution that does not rely completely on specific axes or ranges of motion for the eyes and lids requires a slightly more abstract approach.

To understand what I mean by an abstract approach, the first thing I'm going to do is scare you. Open the ss2_eyes window, which is done by clicking "eyes" on the SS2 shelf. (See the installation instructions in the Introduction if you haven't already installed this software from the accompanying CD.) What you are presented with is one pretty nasty interface, shown in Figure 11.10. I promise this thing is simpler than it looks (you may need to expand the window out if it doesn't look like the image).

> The ss2 eyes window may open up slightly differently based on your version of Maya and OS. Just make sure you can see everything, and you should be okay.

As shown in Figure 11.10, the Eyes window has three functional areas. The menus at the top of the window allow you to create new eye networks and manage connections to the core eye rig node. The second major area is the left side eye and lid information, and the third is the right side information.

Figure 11.10

The SS2 Eye window presents you with a menu bar, all the left and right input and outputs, and variables. Whew!

Left inputs   Left outputs   Right inputs   Right outputs

Each section

Left variables   Right variables
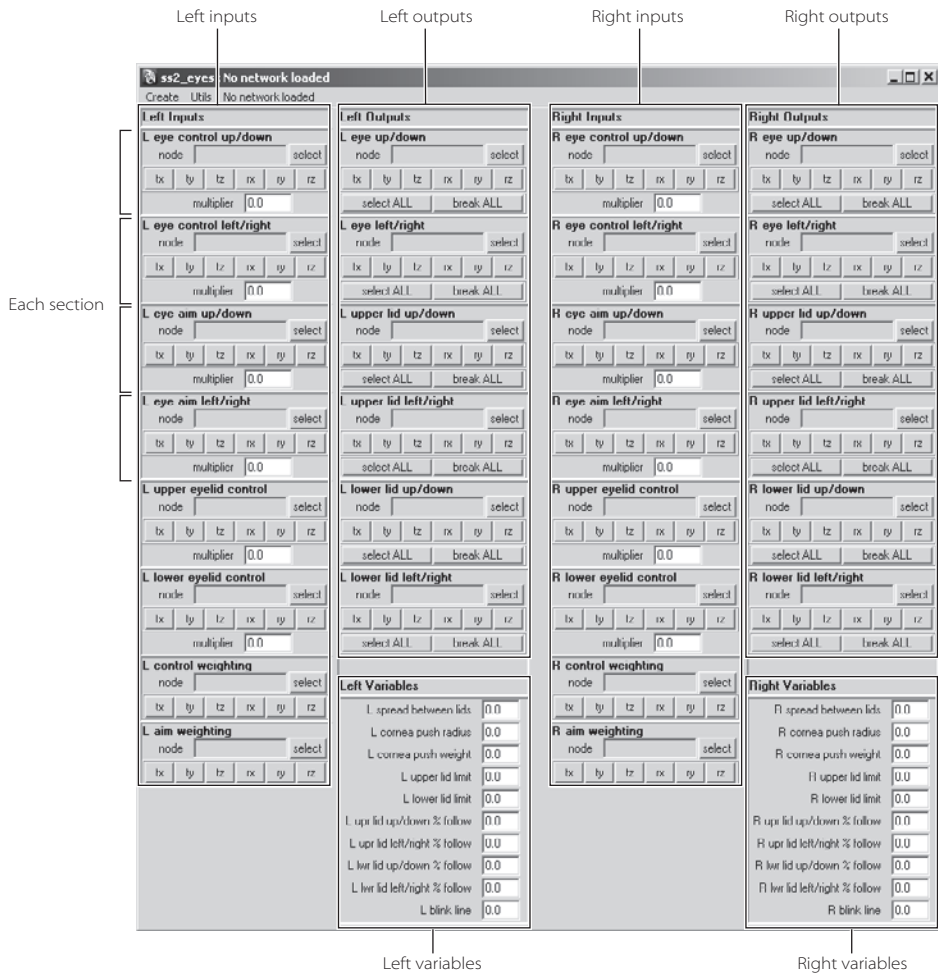
The left and right sides present you with the same information except that one applies to how the left eyes and lids are controlled and the other applies to the right. Within the left and right areas, there are three other "sub" areas, which are each labeled with the titles inputs (Figure 11.11a), outputs (Figure 11.11b), and variables (Figure 11.11c).

This may seem like a lot, but if you peer inside each one of the boxes in the inputs and outputs, you should notice that they are almost the same mini-window repeated over and over, so really all that matters at any given moment to you is something the size of the area shown in Figure 11.12. For a given node on the network, this mini-window helps you select a node to control or be controlled and the attribute you want to use for that control. That's not so bad, is it?

Figure 11.11

The three control areas for each eye: (a) input, (b) output, (c) variables

Now that you have a brief overview of what's what, it's time to take you through all of these interface components in a meaningful process. Load up tutorial_cartoonEyes_ normal.ma, which you can find in the Chapter 11 folder on the CD. If the ss2_eyes window is not already open, click Eyes on the SS2 shelf. The window should read "No network loaded" across the top, and none of the buttons or fields should work when you click them because this tool needs to have an eye network in your scene. In creating networks, you have three major methods exposed to you, and they are all in the Create menu of the ss2_eyes window. The first, Generate Eye Network Only, will do just that; it will create only the basic version of the network, with no user interface. This option is for the more technically inclined who may need to customize this system to a very specific standard. For the rest of us, there is Generate Eye Network And Controls and Generate Eye Network And Controls (Diverge). The first, Generate Eye Network And Controls, will create a setup that gives you independent control of each eye through both aim and control widgets. Generate Eye Network And Controls (Diverge) will create a single directional eye control widget and aim but then also give you the ability to converge and diverge the eyes. (You'll learn more about this optional setup in "Offsets and the Diverge Setup" later in the chapter.) For now, go ahead and choose Generate Eye Network And Controls. What *should* happen is that the window refreshes itself, this time with a little color and a lot of the fields filled out, and there should be a small control scheme in your scene too, as in Figure 11.13.
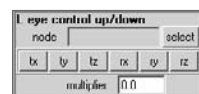
Figure 11.12

Use this window to select an object and attribute to serve as an input or be controlled as an output

Figure 11.13

The first of the two auto-generated eye control rigs
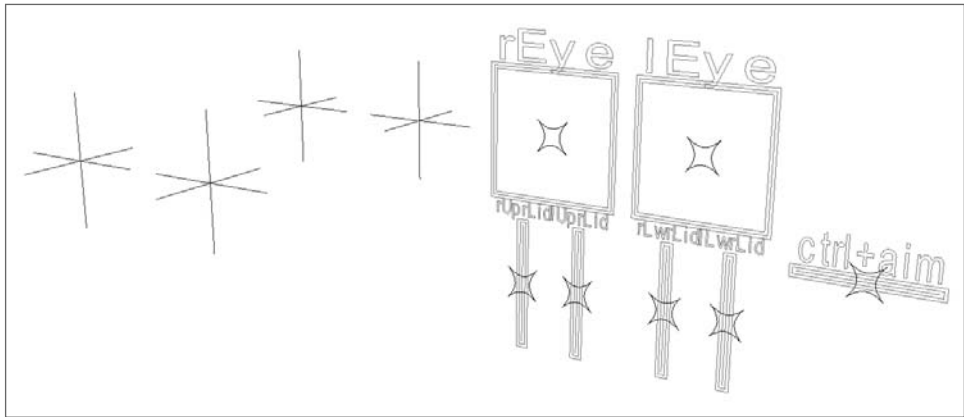
WHEN GENERATING THE NETWORK GIVES ERRORS

With any of the options under the Create menu, there are a few things that will make the system unhappy. For that reason, it's designed to let you know about these problems. Anything that is blocking the creation of the setup and needs fixing should show up in the regular place Maya shows errors and warnings (the bottom right side of the Maya window).

Fix what that tells you to, and you should be off to the races.

Also built into the tool is a safeguard against multiple eye networks being created in the same scene. There is no real technical limitation against rigging two characters in one scene, but it just adds what could be a lot of complication and scene clutter and confusion, so I present a confirmation for you when the situation might be getting tricky.
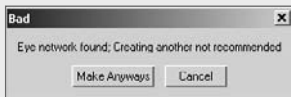
Outputs

To jump straight ahead to hooking things up, select the left eye in the scene you loaded (it's called leftEye), and then in the Left Outputs section of the eye window, click the Select button in the box labeled L eye up/down, which should make leftEye show up in the node field, and then click the RX button underneath that; these two things completed will look like Figure 11.14. You just hooked up that eye to be controlled by the eye rig! To test it, move the control labeled lEye, shown in Figure 11.15, and watch the eye go. Directly below where you hooked to the up/down, there is an area called L eye left/right. With the eye selected, click the Select button in there and then the RY button. Play with the eye control again, and notice that you are now getting two axes of motion out of the control. Moving right along, select the left upper eyelid (named leftUpperLid), click the Select button in the L upper lid up/down area, and again, click the RX button. Repeat the process for its left/right and use the RY button. Now when you move the eye control around, you should also be seeing the eyelid tracking the motion and you can use the l upper lid control in the scene to move the eyelid itself. Repeat these steps for the right side eye and lids, the hookup controls for which, are located on the *right* side of the user interface.

Figure 11.14
This is what the window looks like with a connected node and attribute.

When you are done, the output portions of the user interface should look like Figure 11.16. Double-check all the names in all the fields, and you should be having a fair bit of fun playing with the controls and watching the eyes and lids move around.

Notice that since you can map any translate or rotate attribute you want for a behavior like up/down or left/right, you should be able to connect a rig of any orientation to this control scheme. Once your rig is connected, you may find that the up/down of the input corresponds to your eye's down/up (so that when the control is *down*, the eye is *up* and vice versa). You may need to play with the multipliers and variables to fix that kind of behavior.

Figure 11.15
The lEye control

Multipliers and Variables

Now that you have the interface connected to the eyeballs and lids in your scene, it's time to make use of the multipliers and variables. Multipliers live along with the inputs since that's the easiest place to think about them (a multiplier has a direct effect on the input it is located with), and variables have a more global effect on the overall behavior of the system in more than one way. So, let's say that the up and down range isn't enough for your eyes and you need more. To see this in action, select the eye controls in the scene and drag them both all the way up so that the eyes and lids are pointed up. Now, in the ss2_eyes window, change the multiplier in the l eye control up/down window from -30 to -50, as in Figure 11.17. You should have seen the left

Figure 11.16
The left and right output areas with the lEye control connected

Figure 11.17

Changing an input's multiplier

Figure 11.18

A close-up of the Utils menu

eyeball jump up 20 degrees. If you now drag the eye controls up and down, you should see that the left eye moves more than the right. It's as simple as *that* to modify the setup for specific characters! In the previous paragraph, I mentioned that if the eyes were going the wrong directions, you could fix *that* with multipliers, too. For example, if -50 was a good range, but going in the opposite direction from what you wanted, you would only need to change the number to 50 and it would now travel the same range but the opposite direction.

Almost all the inputs have multipliers. Play with them to get the results you need for your character. To save time, or be lazy, you can use the copy functions located in the Utils menu of the ss2_eyes window (Figure 11.18). If you wanted the right eye values to be the same you just set on the left (changing -30 to -50), you could simply type that in for the right, but you could *also* use Copy Left Multipliers To Right. The rest of the functions in there are similarly self-explanatory. Beware, however, of copying *inputs*; that one is a little different. This *literally* means driving the left and right with the exact same inputs. If you were to run Copy Left Inputs To Right on this scene, the right controls would no longer have any effect at all and the left controls would control *both* sets of eyes and lids. This would be something you might use if you *intended* to have only one eye control for yourself or your animators. (The Diverge setup works this way; more on this shortly.)

Since most of the *multipliers* don't need much explanation, I'll move on to describing what each of the *variables* does.

Spread

This is the number of degrees of separation between the upper and lower lids, how far you'd have to rotate the top lid to reach the bottom one. I actually built the need for you to adjust this one into the tutorial you should hopefully still have open. The fully closed range of the lids would require a 60 for this value in the `tutorial_cartoonEyes_normal.ma` scene.

Cornea Push Radius

This is the "virtual" radius offset of the cornea relative to the zero-point of the eye. As the eye looks down, I have it push the lower lid out of the way; playing with this will change how much and when that push occurs.

Cornea Push Weight

The Cornea Push Weight attribute is simply a multiplier on the cornea push effect. There will be certain rigs that just don't want to behave with the cornea push radius effect, and this is for those rigs. You can set this to 0 for a deactivation of the effect.

Upper Lid Limit

This is the rotation at which the upper eyelid cannot pass. This is just to make sure that while looking up or widening the eye, the lid doesn't collapse into the head.

Lower Lid Limit

In function, much like the upper lid limit, this limits how far down the lower lid can rotate.

Upper Lid Up/Down % Follow

As discussed in previous chapters, it's nice to have the upper lid follow the iris and pupil. A 100 percent copy, though, usually looks mechanical and incorrect. This allows you to tune how much you want the upper lid to follow the eye's up/down motion. In some cases, if your eyes and lids are not oriented the same, you may need to make this, or some of the other follows, actually a negative number.

Upper Lid Left/Right % Follow

This combined with the up/down tracking has a lot to do with providing you with a nice "squishy" surrounding eye area. It can serve to really soften the whole area up in motion. Simply put, this is how much of the eye's left/right motion you want the lid to copy.

Lower Lid Up/Down % Follow

Like the upper lid follows, this is the up/down factor for copying the eye's motion on the lower lid.

Lower Lid Left/Right % Follow

The last of the follows, this is what you would expect; a multiplication amount for how the lower lid follows the eye motion.

Blink Line

Blinks are built into the regular lid behavior at or below the blink line. The *blink line* is the portion of the total spread (spread between lids) after which the upper eyelid will attempt to lock itself to the lower lid and not track the iris and pupil directly. If you have a spread of 60 and the blink line is at 40, the last 20 degrees of motion are treated more like a "percentage of closed" to ensure that when you close the lid, it is closed.

SPREAD CANNOT EQUAL *BLINK LINE*

If the number in the *spread* and *blink line* variables is the same, the rig will behave poorly, and this will cause the upper eyelids to flip with even the slightest change to the eyelid inputs.

Setting Up *Your* Skeleton

So, now that you've run through this with a pair of goofy clamshell eyes, it's time to do it to your model. Unfortunately (or *fortunately*, depending on how you look at it), though, there is nothing for me to tell you to do that isn't exactly the same as what you did with the cartoon eyes example. All I can say is take your character, your skeleton, and run through the same steps, hook the eyelid joints up to the eyelid outputs and your eyes to the eye outputs, and that's it! A reminder for you is that if your axes aren't exactly the same as the ones on the cartoon eyes, don't worry. That's why I gave you options to choose. Just rotate your eyes, identify up/down and left/right, hook those axes up, and then modify the multipliers and variables until you have what you need!

Notes on the Ss2 Eye Rig : For TDs

There is a fair bit going on under the hood with this setup, so this next section is going to go a little deeper into what is really happening. It's addressed to the technical directors out there who will be maintaining or adapting the setup for a production environment.

The inputs can be driven by anything and swapped out just like the outputs can. The only big difference here is that the outputs can actually affect multiple objects, whereas the inputs are unique. This is why there are Select All and Break All buttons in these sections; these options allow you to see or affect everything involved, not just the "feature" object displayed. There is also no rule that an input must use a tx, ty, tz, rx, ry, or rz; I just chose those since they are the most common. The buttons only turn red and make the text caps if there is one of those six attributes doing the controlling. Even so, if an object is connected in to control an input and shows up in the node field but none of the buttons highlight, that's the only difference, a visual one in this user interface.

To connect your own custom rigging, you may want to go beyond the six main attributes, as I do even in the basic setups with the Aim+Ctrl and Diverge controls by slightly modifying the default control network (discussed in Chapter 13). Here's an easy way to access attributes for connection: If you have a valid eye network, the last menu on the menu bar should be Loaded: and the name of your scene network (usually called EyeNetwork), would be Loaded: EyeNetwork. In that menu, choose Open Connection Editor. This will open the Connection Editor with the eye network on both sides, so you can just go ahead and select an object and reload it to whichever side of the Connection Editor you want to use to directly connect to or from.

Before you bother direct connecting, though, it might be handy to know what you're looking at in the attributes. The ss2_eyes window is meant to present the relevant information in a simplified manner with better labeling. To better understand the labeling that is on each individual attribute on the network, read on.

Attribute Labeling on the Network Node

All of the attributes on the eye network node are labeled for reasonably easy identification. The main identifier on attributes is the suffix: *In*, *Mult*, *Var*, *Int*, or *Out*. Attributes suffixed with *In* are where inputs come into the system. A suffix of *Mult* denotes a multiplier on an input, which is the main way that different inputs and outputs can be made to relate. Of note with inputs and mults is that you can make *almost* any input valid; the one rule is that the input and output attributes are zero-centric, meaning 0 = default. *Var* on the end of the name means this is a behavioral variable, something that you *will* need to address per character but should only have to touch per character once during initial setup. If you have a character that "morphs" to two sufficiently different shapes, you may need to control these values in some way like using driven keys for the different looks. The suffix *Int* means that the value is merely an intermediate value created from the network and later used by it. (This is a legacy from when I was creating the network. To avoid getting lost, I pulled certain key intermediate values out into their own visible attribute for easier debugging. I've left them in for the more curious of you out there to better understand the workings of the eye rig.) Finally, *Out* is the suffix for attributes you are expected to use to drive your character's eyes and lids. The second way that all of these attributes are separated is by certain attributes I've locked out. Each one serves as a label/divider for the following block of attributes to more easily find them in the Channel Box. If you really intend to untangle the whole network, what I recommend is to build it using Generate Eye Network Only; it won't clutter with inputs/outputs or any conversion nodes.

Offsets and the Diverge Setup

There is one pair of attributes on the network that aren't called out in the ss2_eyes window, and those are the offsets, lOffsetInt and rOffsetInt. These allow a horizontal-only addition to each eye, which the lids and all trickle-down effects will pick up on. You'd use these as an alternative to the setup I've described in most of this chapter. That is, instead of having two completely independent eye controls, you'd have one main eye control, with a divergence control for situations in which you want to control each eye independently. The default system gives you hooks into both eye rig networks independently, but there is nothing stopping you from driving both with the same control or aim constraint. That is, while "under the hood," both eyes are independent; they are practically stuck together, duplicating the rigging in two parallel paths. Most of the time that's what you want, but you may also like the ability to diverge the eyes (or each eye independently) for further control flexibility. Although I didn't include it in the main setup (to keep the text discussion and support tools simpler), that is the purpose of the Generate Eye Network And Controls (Diverge) setup option on the Create menu of the ss2_eyes window. There is no on-network multiplier called out for this effect, but like all else in the network, it's just run by a multiplyDivide node.

Up/Down/Left/Right

I'm not going to force you into assigning a positive or negative value to up and down, nor a particular axis of rotation being up/down versus left/right. What *will* be required for best results, however, is that your eyes and lids all move up/down and left/right the same way.

To "test" how you would tune and tweak another setup that is not at all the cakewalk that the other tutorial proved to be, load up `tutorial_cartoonEyes_weird.ma`. I purposely made that one have inconsistencies, but it too will function just fine once worked through. Keep in mind that the eyes can be "jacked up" but the joints or objects for the eye and lid on each side really should be "jacked up" in the same way; that is, in the same place and have the same parent and same rotation order (rotation order is often the main thing you'll need to concede to make the eyes' lids feel like they are moving correctly in this system, but you'd have that problem with or without my rig). Simply test the up/down left/right of the rotation axes on the lids and eyes and you can get to a working scene in very little time using the ss2_eyes window. Figure 11.19 shows what settings make it work if you guess-and-check yourself in circles.
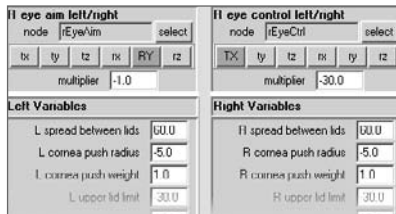
Figure 11.19

The settings and connections for the cartoonEyes test scene

Integrating the Aims

With the automatically generated setups, there are some aim constraints ready to go, each consisting of a pair of nodes, an aimer, and an aim target. You could absolutely create your own aim setup and then just replace the inputs that I've created with your own easily in the user interface. With aims, though, to fully integrate them with your character you'll want to be sure to first group the aimers before parenting them into the head of your character so that they don't initially "pop" into some odd orientation. They need to be hierarchically under the head joint for them to accurately represent an aim to a target. You can do really anything you want with the aim targets—stick them under an icon, leave them as they are, replace them entirely—their only influence on the whole rig is to provide the aimers with something to aim at.

Since the aimers are the ones that provide the direct input, you need not actually use an aim constraint to generate their values. My personal preference is to use an orient constraint, not an aim, to keep eyes in a direction. All I need to do to make that work in this setup is kill the aim constraint on the aimers and instead orient-constrain them to some outside influence. Done and done!

Zipper Lips

Something almost no facial rigging resource can avoid talking about is the "zipper lip" effect. This term simply describes how real-world lips, when opening and closing, tend to stick to each other toward the corners of the mouth.
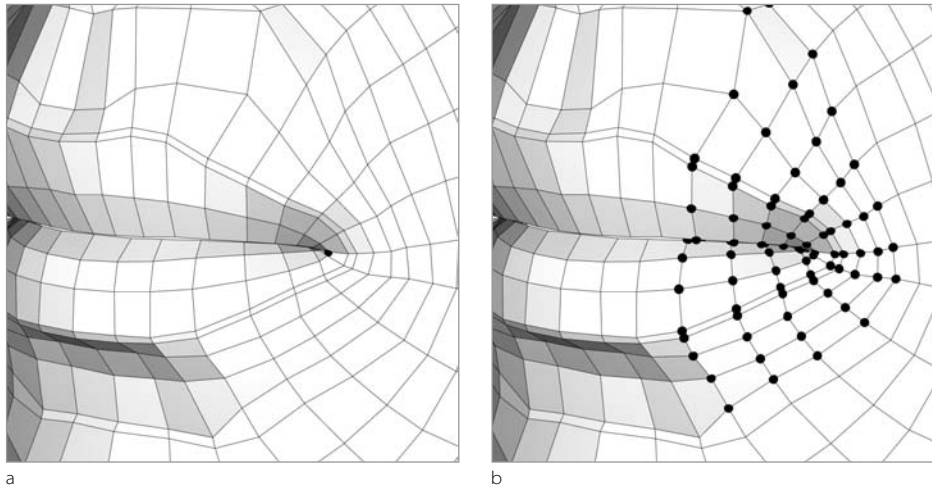
Figure 11.20

The selection we'll use for the Soft Modification tool

There are a lot of different ways to simulate this effect in facial animation, and most of them are pretty crazy complicated. I prefer to create the zipper effect by simply hijacking the Soft Modification tool. It is not as full featured as some other methods, but it's *way* easier than anything I've seen so far.

Figure 11.21

The Soft Modification option box with the settings we'll use

To use the Soft Mod tool for this, select a point right in the corner of the mouth (Figure 11.20a), and then grow your selection a few times (Shift+.) so that it looks like Figure 11.20b. From there, create a soft mod; choose Create Deformers → Soft Modification □. Once in the option box (Figure 11.21), set Falloff Mode to Surface (new to 8.5, so you won't see this in older versions); set Color Feedback, Preserve History, and Mask Unselected all on; set Falloff Around Selection off; and make sure you are doing Falloff based on all X, Y, *and* Z. Apply the soft mod by clicking either Apply or Soft Modification.

SOFT MODIFICATION OVERLAPS

When creating your soft mods for the zipper lip effect, try not to overlap the center area with both the left and right sides. If you do, those center points will double-transform when zippering and will just generally be a headache to deal with.
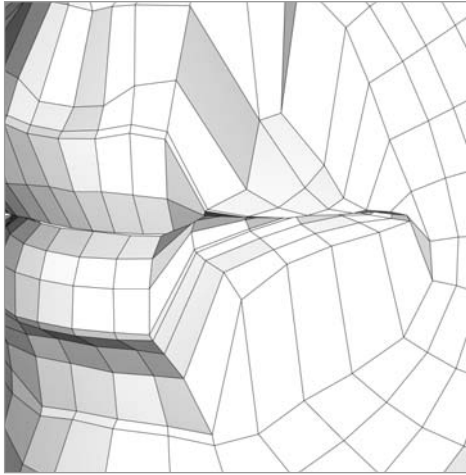
Figure 11.22
Scaling the soft mod handle
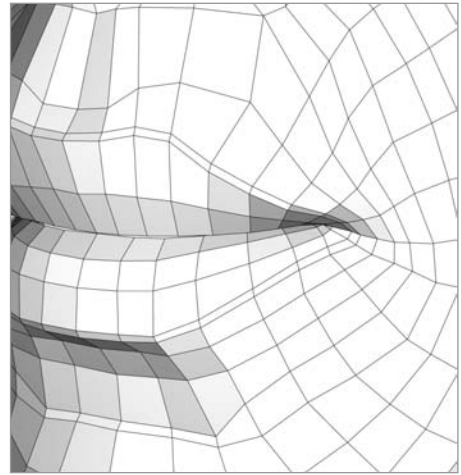
Figure 11.23
The modification smoothed for a more natural effect

Now, you should have the soft mod handle automatically selected. Scale that down so that it "flattens," as in Figure 11.22, which will look pretty weird to begin with. Now select the head and open the Attribute Editor. On the tab for the soft mod, you can play with the numbers for the falloff center. Soft mods have effectively two "centers" and each works differently. The center for any *transformations* you do will be around the softMod Handle object you scaled, but the actual scaling of the soft mod *effect* will be around the falloff center. To see the effect grow and shrink, play with the Falloff Radius attribute.

Now to make the soft modification not quite so harsh: With your head selected, open the Paint Attributes tool by choosing Modify → Paint Attributes Tool ❏. In this option box, the attributes you can affect appear under Paint Attributes. Depending on which kinds of attributes and deformers you have and how many, they could be anything from blend shapes and softmods to clusters. What you want to do, if it is not already there, is click the first button. It should show options for which deformer to pick. Select the soft-Mod you just created; then the button should say softMod1.weights (assuming you didn't rename the softMod, and if you did, *that* name would appear). Now, using the standard paint tools (I heavily favor Smooth), you can paint this so the effect of lip-pinching is appropriate; more like what you see in Figure 11.23.

FOR THE MEL GUYS

It's not part of the generic user interface for the tool, but it's quite easy to manually set the falloff center of the softMod using the `-falloffCenter` flag during creation via MEL.
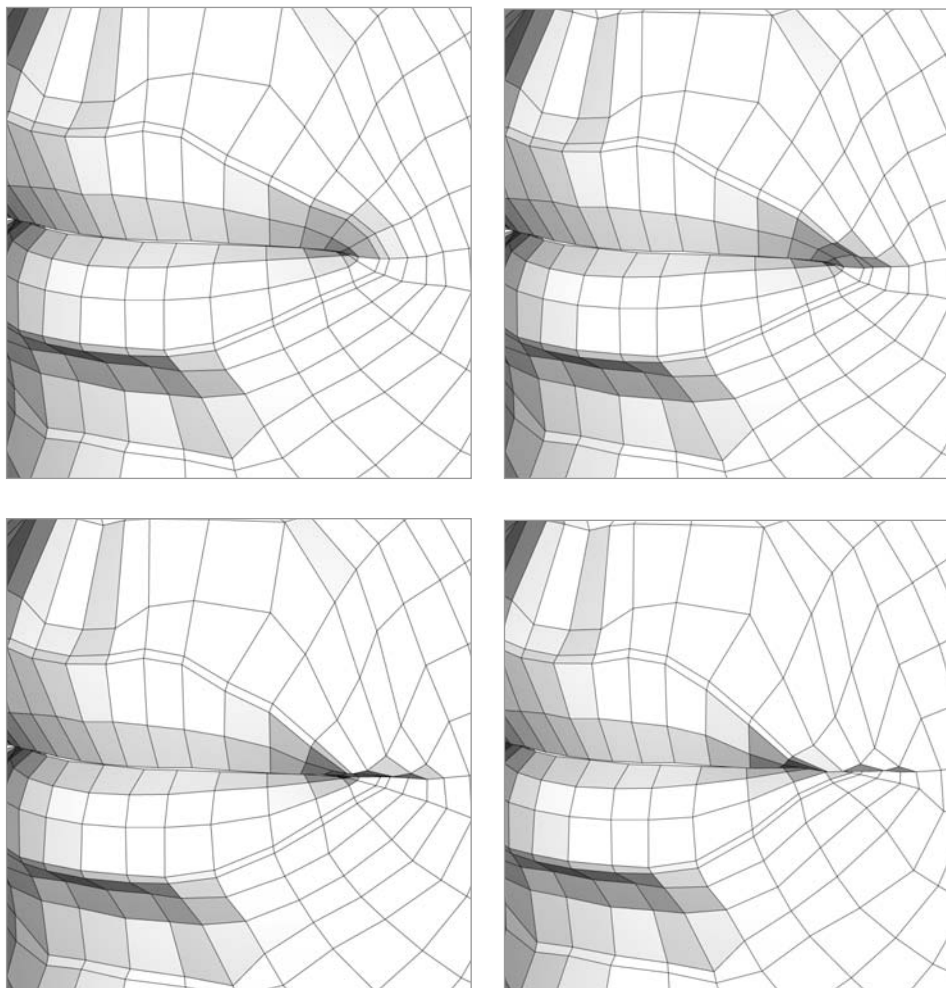
Figure 11.24
The "zipper lips" effect in motion

Now, once you've painted that up, when you play with the radius of the softMod and the scale of the handle, you should be able to generate pretty decent sticky/zippy lips. When you have something you like, repeat on the other side and you've got a whole zippy mouth! Figure 11.24 shows a few frames of the effect "in motion."

SS2_Zip

You probably think that's a lot of work to go through each time, and so do I. Instead, I use a tool I've written that takes care of most of the work and leaves just a little bit to do manually.
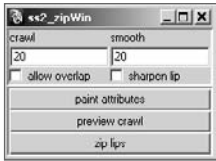
Figure 11.25

You control the SS2 shelf's Zip tool through this window

On the SS2 shelf, find the Zip button and click it. You should be presented with a window like the one shown in Figure 11.25. Here, instead of going through the steps I described for both sides, you just select two vertices, one on each side, where you would like the "center" of pinching to occur on each side. Then you set the crawl, which is the number of times you want to grow the selection, and then the smooth, the number of times you would hit the Smooth button if you were doing it manually. From there, you are pretty much ready to go (to launch the tool, click Zip Lips), but there are some neato features if you care to use them.

The Allow Overlap check box defaults to off, and what it does is actually *limit* the crawl based on your topology. For example, if it would only take 7 crawls (growth selections) before your two selections would overlap and affect the same points. This option will only let you grow the selection six times. This is just to make the calculation of crawl easier; otherwise you do a lot of point counting. Basically, I usually just set it high and leave Allow Overlap off. If you really wanted to have 20 crawls, even if it meant overlap, then you'd check Allow Overlap, but beware that the double-transforms caused can be tricky to control. The Sharpen Lip option is there for those of you who followed the modeling tutorials very closely or are generally just tidy modelers. It will actually refine the way the weights are applied so that it is "tighter" along the shared edge of the verts you picked, *if* they share an edge loop. That said, if the verts you picked do not share an edge loop, nothing more will happen than if you did *not* have this checked. For the head I made for this book, using the Sharpen Lip option saved me about 20 minutes of painting and refining the weights for the zipped lip effect.

The ss2_zip menu also contains a Paint Attributes button, which will open up the Paint Attributes tool for you, just as if you had chosen Modify → Paint Attributes Tool ❐. The Preview Crawl button will actually perform the crawl settings you are using and will print out a warning telling you, based on the current options, how many times it will actually crawl (undo to go back to your pre-crawl selection). Finally, the Zip Lips button takes all the options and does the work. This tool does exactly what the walk-through did, but about 100 times faster. Once that is done, it adds attributes to your head called falloff0 and falloff1. From there, or by connecting those attributes to a control, you can easily manipulate the zippering.

It is important to note that the functions in ss2_zip *will not work* unless the head has blend shapes applied to it. The reason is that, as I described earlier, there are two things that affect the way the soft mod works: the falloff center and the soft mod handle itself. Since, during blends, the corners of the mouth move, you basically need the handle and falloff center of each soft Mod to move to its respective mouth corner every frame, no matter the combination of blends that got it there. Since you cannot easily have a deformer both be affected by a shape *and* modify that same shape at the same time, ss2_zip actually

makes some shapes that mimic the blends; it then makes the new blends copy the old through connections, and those new blends drive the positions of the relevant objects for zippering. This way, your zipper lips can follow all the motions of the face shapes and still provide the right effect you might want at any time without getting into cyclic craziness.

Ss2_zip takes the blends into account, but to do so, it will actually destroy any connections you have to your blend shape (and any objects in the scene named the same as any shapes in your blend shape). For this reason, it is recommended that you get *all* of your blend shapes done first (including Fix, Half, and XYZ shapes), clear your scene out of anything unnecessary, and do this zipper work *before* you generate your network or actually use prep to hook up the Fix, Half, and XYZ shapes. Prep work? Fix, Half, and XYZ shapes? Generate Network? What's all this about? I'm glad you asked, because that's up next.

> Something important to note, when using this method of zipping the lips, is that you need to be *very* aware of the deformation order of the inputs on your head. You'll need to be sure to set the deformation order so that skinClusters come first, softMods come next, and blend-shapes come after that. If you don't do this, expect some major weirdness when you start to pose your character's head and body. To rearrange deformation order, right click over your head mesh, and click Inputs → All Inputs then use the middle mouse button to drag inputs up and down in order.

Interfaces for Your Faces

Since the first edition of *Stop Staring* hit the shelves, to my surprise, the "Osipa" setup, where you use a collection of multidirectional sliders to control facial shapes, has actually become a well-known entity in 3D, and I can spend a whole lot less time explaining that concept again here and more time on the new nifty ways to create, collect, and tweak setups. If you are the impatient type and want to just skip all the talk and slap a control scheme on your face, you can jump all the way to the end of the chapter and find the section called "The 'Just Do This' Part."

- **Using expressions to animate**

- **Interface concepts**

- **Prep work for your own setup**

- **Sharing control schemes**

- **The "just do this" part**

Using Expressions to Animate

To a lot of people, hearing the word *expressions* (as in MEL statements, not facial expressions) is like hearing Boo! All I can say is that expressions can be difficult to understand and use, but they can also be very easy if you don't let yourself get carried away.

First, I have a very simple introduction to what expressions are and what they do. All the setups I give you access to in the book are done with nodes and connections in Maya, but for readers in other software packages, this introduction may help you understand how to re-create the functionality I'll describe.

This is the second edition of *Stop Staring*, and the expressions discussion here has in *most* practical ways been deprecated, but for those of you following along in other software packages or wanting to create control schemes using expressions, it may be valuable to read through this. Included on the CD in this chapter folder is a group of scenes from the first edition of the book; all of the setup in these first edition scenes is done with expressions, so they are working examples of these ideas in action. For those of you who aren't interested in expressions, skip this section; it won't affect the rest of the book's instruction.

What Is an Expression?

Expressions are just a way for you to connect two or more attributes together so that when one changes, one or more others do something automatically.

Let's say you have a ball and a box and you connected the vertical (Y) translation of the ball to the vertical (Y) translation of the box. That expression would look like this:

```
Ball.translateY = Box.translateY
```

The format for reading or writing expressions is, whatever appears on the left of the equal sign is what gets affected, and whatever's on the right of the equal sign does the affecting. The words on the left and right of the equal sign break down as follows: first, the name of the node you want involved, followed by a dot, then the specific attribute you want involved. Reading the preceding expression, you should see how Box and Ball will move up and down together in Y when you move Box. Ball is on the left side of the equal sign, meaning that its attribute is going to be controlled by Box. If you were to try to directly move Ball up and down, it would not move, since its translation in Y is being controlled by the expression.

What Else Can Expressions Do?

Since this is an expression, we can do much more to this relationship than just have Ball do what Box does. We could make Ball move in Y twice as much as Box by multiplying it by two:

```
Ball.translateY = Box.translateY * 2
```

If you wanted to make `Ball.translateY` do the opposite of `Box.translateY`, you'd put a minus sign in front of Box's attribute:

```
Ball.translateY = - Box.translateY
```

And now you should be able to figure out that

```
Ball.translateY = Box.translateY /2
```

means that Ball will follow Box by half, since we're dividing that value by two.

Corralling Our Values: *clamp*

I'll get into how to actually write an expression in just a little bit, but before we can do that there's a little bit more information that you should know. I designed the interfaces on the heads in the Chapter 11 area of the CD to be modular. You can, if you choose, add multiple controls for the same shape, and some of the setups will do just that. You can also mix and match your favorite aspects of each setup if you are so inclined.

The sliders have built-in limitations on several levels so that if you were to use three different sliders to control the smile shape, not only would the sum total of all three be limited to numbers from 0 to 1, but each control's influence would also be limited to between 0 and 1. Since we only usually want values between 0 and 1 for shapes, we'll use something called `clamp`, which says to use only numbers in a certain range. Going back to Box and Ball, if we modified the expression to read

```
Ball.translateY = clamp ( 0, 1, Box.translateY )
```

that would mean that Ball's translateY would follow Box's translateY only when it's between 0 and 1. The `clamp` keyword works with three values in parentheses and separated by commas: the minimum limit, the maximum limit, and the value you want to limit.

Here's another `clamp` example:

```
Ball.translateY = clamp ( -500, 723, Box.translateY )
```

This expression tells Ball's translateY value to follow Box's translateY only *if* that number is greater than –500 and less than 723. If Box's translateY is a number greater than 723, Ball will just hold at 723. Likewise, on the lower end, if `Box.translateY` is less than –500, Ball will just stay at –500.

All this comes back to the shapes. Since we want to control shapes with our controls/sliders, which work best with values between 0 and 1, we're going to be seeing `clamp` all over the expressions in the Chapter 12 SS1 example files.

You Can Do Math Anywhere in an Expression

You can put any basic math anywhere in an expression as long as it plays inside the rules. Since the clamp has three important values separated by commas, if you do math in the right spot in a clamp, you can get fancy:

```
Ball.translateY = clamp (0,1,Box.translateY * 2)
```

says, "Ball, follow *double* Box's translate as long as that's more than 0 and less than 1."

Ball will only move between 0 and 1 because it is clamped between these two numbers. When it is between 0 and 1, Ball will travel in Y at double the amount of Box since its translateY is multiplied by 2.

Building an Example Expression and Control

To make use of this expression knowledge, I think practice is in order. On the CD, you will find a file called `tutorial_expressions1.ma`. It consists of a base head with two blend shapes, a smile and a frown, and a slider to try the next steps out.

Creating a Simple Expression to Start

In the scene, I have created for you a slider called controlCtrl to control the face.

Now, we need to get at the attributes we want to control. If you select FaceShapes (it is the blendShape node), you should see two channels named Smile and Frown. If you right-click the attribute named Smile, you can choose Expressions from the menu that appears.

There are things that the lists of nodes and attributes can help you with when writing expressions, but personally, I just like to write the expressions in the Expression field—the bigger box at the bottom of the editor— myself. In that field, type in the following:

```
faceShapes.smile = controlCtrl.translateY
```

Click the Create button in the bottom-left corner, then close or minimize the Expression Editor. You can load an example scene, called `tutorial_expressions2.ma` at this step from the CD.

As you move controlCtrl up from 0, you'll notice that the smile shape appears, which is good. The problem, though, is that as you move down, the smile is *subtracted* from the default shape and looks mighty ugly, as you'll see shortly in Figure 12.1 (that pic is good for so many reasons).

To see what is happening, take a look in the Blend Shape Editor. You'll notice that Smile is at –1, so it's doing exactly what we're telling it to: –1 from the slider to –1 in the shape value. But that's just not pretty, and we'll need to find a way to tell it not to do that.

Go back into the Expression Editor and select faceShapes and smile so that the old expression appears in the expression window. Wrap the `controlCtrl.translateY` portion with a clamp, limiting the value to be between 0 and 1:

```
faceShapes.smile = clamp ( 0, 1, controlCtrl.translateY
```

Your expression probably looked different when you opened it back up—where `faceShapes.smile` is in the example, you saw something like `faceShapes.weight[0]` or `faceShapes.weight[1]`. Maya automatically replaced the "user" name with the "Maya" name for the shape. It's not broken; that's normal. You can leave it like that and change only what's on the right side of the equal sign. Everything will work exactly as described. If you want to retype the whole expression with `.smile`, that will also work fine…although it will change to its Maya name again after you're done!

Hit the Edit button in the bottom-left corner where the Create button was originally, which will update your expression. Now when you move the slider, it shows the smile in the top half as before, and when you pull the slider below zero, there is now no effect. That's better. There is a scene saved at this step named `tutorial_expressions3.ma`.

This is how many of the sliders will work. But there's not much point to having half a slider. Right now, this slider behaves much like the standard blend shape interface. To make it better, let's put something on the other end of the same slider!

Adding More to the Slider

Now let's add Frown, a second shape, to the same slider, and reason our way through the expression because it's just a little bit brainier. We want to put Frown on the bottom half of the same control, so we essentially need to do the opposite of what we're doing with the smile. As I discussed earlier, putting a negative sign in front of things makes them the opposite, so let's try that. Write a new expression to read

```
faceShapes.frown = clamp (0, 1, - controlCtrl.translateY)
```

This one says "Be the opposite value of `controlCtrl.translateY` and limit the values to between 0 and 1." In this instance, when you pull the slider down, it's at −1. The opposite of −1 is 1, 1 is a number from 0 to 1, and so you've got your frown! It's a little bit complicated, but just look at the effects and think about the expression and it should start to make some sense, even if this is all new to you. A final example scene is on the CD with this section finished called `tutorial_expressions4.ma`.

Expressions Wrap-Up

So there you have it, a simple introduction to expressions. Again, these are not used in the *new* setups included in this book, but they should give you enough information to peel apart the old setups, especially for all you out there who are trying to re-create this in another package!

Interface Concepts

It's going to be important to first review the core concepts before we jump in and start working with them. The core idea the control schemes are built around is to get the most out of the animator's effort, and reduce fix shapes, by putting more shapes on fewer controls. Once that idea reaches its limits, we'll need to learn how to up the quality using tools to make half, fix, and XYZ shapes.

Multidirectional Controls

The setups in Stop Staring involve mapping more than one shape to a slider. In a regular blend shape control, you have one slider that goes from 0 to 1. At 0, the shape associated with the slider has no effect on the base mesh. At 1 the shape has full effect, at 0.5 it has

Figure 12.1

With the standard Blend Shape Editor controls, negative values subtract the shape's effect, as demonstrated here with this reverse of the smile shape.

50 percent effect, so on and so forth. To expand on that idea, we'll be mapping multiple shapes to common controls. Imagine that a slider went from –1 to 1 instead of just from 0 to 1. When you take a shape in Maya's Blend Shape Editor to –1, however, it will *subtract* the shape's effect, making it negative…basically making it look weird (Figure 12.1). Imagine, though, if that shape stopped at 0 and another came in from 0 to –1. Imagine that shape was going from *its* 0 to 1 (so it's not all weird and inside out like a normal –1 would be). That would mean one slider would give you two shapes. If you pictured at the 1 position a smile, and at –1 a frown, this would give you pretty much a "mouth emotion" control. Not only that, but since a smile and frown are two shapes that a face cannot make at the same time, you've also managed shape collisions, *reducing* the need for fix shapes. Now imagine the slider went not just left to right *or* up to down, but both. That means that left to right you have two shapes and up and down you have two shapes; now with one control you are working with four shapes. Two pairs I commonly use like this are an open/closed on the up/down and a narrow/wide on the left/right. If you rewired that thing a little differently, you could have each corner carry its own weight, picking a facial expression by dragging over a big 2D gradient area the way you pick a color in Photoshop by dragging over a color palette, as in Figure 12.2. You'll see examples of my 2D sliders illustrated in Figures 12.20, 12.21, and 12.22 later in the chapter.

Shape Collisions

Using blend taper, you subtract portions of shapes out, a chunk at a time, in a way that *ensures* the eventual remix of those shapes in a way that will look good. Unfortunately, not every shape can be derived from one sculpt. Any time you add shapes that come from

Figure 12.2

The multidirectional sliders in our interface let us blend shapes in a way that's comparable to the way you do in Photoshop's Color Picker.

different source sculpts, you run the risk of the mixture of those two shapes looking bad. The more shapes you add, the more risk of shape collision you run, and once you've got even a medium-sized set of blends, you'll find yourself sculpting a lot of fix shapes, even after mitigating the problem by using tapering techniques. One way to further mitigate the risk of bad mixing is simply by putting shapes that don't play nice on opposite ends of a single control. This way, the simple act of making the face do something like smile can also reduce the frown shape, avoiding collision of those two shapes.

Limits

When *almost* all else fails, you'll need to limit one shape with another. As in the example in the last section, you can put shapes like Smile and Frown on opposite ends of a slider to avoid collisions, but many other shapes that are also incompatible with each other are not as easy to artistically separate. Let's say you want to smile and pucker at the same time. It's not

really humanly possible, but let's say you wanted to set the rig up in a way that permits an animator to do it anyway. Well, you could, but it simply won't look good. By using limiting, or what some call "dominant" shapes, you could set up the smile to be allowed to appear only at a maximum that is the inverse of the pucker. That would mean at full pucker, the smile slider wouldn't work at all. At half pucker, the most smile you could get would be 50 percent, and if there was no pucker at all, the smile could behave however it wanted; take a look at Figure 12.3 to see a few images showing the problem and Figure 12.4 for the solution. This technique controls the ugliness in a very effective way, avoids fix shapes, and can be the *fastest* solution for a lot of problems, but it can also get tangled, complicated, and start to impede an animator pretty quickly. An example of the workflow for this is near the end of the chapter after you have some blends set up and ready to try it on.

Figure 12.3
Allowing the mouth to both smile and pucker at the same time creates a bizarre expression.

Figure 12.4
Setting up the pucker to limit the smile corrects the problem.

Fix Shapes

When all else truly does fail, you'll need to create corrective, or "fix," shapes. These serve the sole purpose of eliminating bad mixes the brute-force way: sculpting what you would rather see. Ladies and gentlemen, *this* is why movie characters get such large shape counts. I've made some friends in the past years who worked on Gollum, and the rough math I've done with him and a few other characters of note puts the highest-quality rigs up in the hundreds of shapes at approximately 80 to 90 percent of those being corrective shapes. This really is where most of the talent and work comes in when you want to make something that is going to win you an Oscar. To make it pretty, it's not pretty. There have been a few comments on Amazon.com about this book and its 40-odd blend systems and how much work that is. If you're feeling the same thing, that 40 or so shapes is too much to get a decent result, keep in mind that in the larger picture, it's not even scratching the surface in shape count.

FILM SHAPE COUNTS

To be perfectly on the up-and-up about the shape counts in film, a large number aren't strictly *fixes* as described here. There are also a large number of shapes for when a character speaks out of the side of their mouth that are really more *contextual* blends than corrective ones, but I still lump them in as fixes because, if a straight-up blend to one side or the other plus the regular shapes *worked*, you wouldn't need to create those other shapes.

XYZ Shapes and Half Shapes

A common complaint about blend shapes is how linear they look. Since a blend is only a translation from one position to another per vertex, it's easy for that to look linear. The *simplest* way to avoid linearity in your blend shape animation is to author your shapes in a way that looks like mass moving over bone—and not just being translated—which can absolutely be sculpted in by you, the artist; you don't strictly require a more advanced system to get that effect. The second, though, is to try to animate faces so as not to hit too many keyframes on the exact same frame and allow a more fluid combination and change of poses by simply spreading a pose across a few frames. When all of that fails however, I recommend using half shapes and XYZ shapes. Half shapes, as I refer to them, are shapes controlled by another shape via driven keys. This control guarantees a sloped transition into and out of the shape, which is much smoother looking than the linear in-and-out you get from Maya's in-between flag for blend shapes. Since this is a driven key relationship, you can also modify the curve to do whatever you like, such as, for example, peaking at some point other than the precise middle.

An XYZ blend is another technique I've integrated where you separate out the X, Y and Z components of a shape into their own shapes and control them individually so that even the points in a blend going from A to B are not necessarily doing so on a linear arc. A tutorial on this comes a little later.

SEEING THE EFFECTS

Since so many of these principles are only truly demonstrable in motion, stills won't serve to illustrate as well as scenes. In the Chapter 12 folder on the CD, you'll find several Maya scenes whose names are prefixed with *demo* showing each concept in motion.

Control Schemes: Shapes

Instead of focusing on predetermined moulds to fit into, I am going to instead aim at enabling you to create your own setups in any way you like. There are plug-and-play setups that I talk about near the end of the chapter, but that is not where my effort will be spent between then and now.

The system of setup I'll discuss here focuses on two main groups of tasks. The first is that any blend shape for which you intend to create a control scheme must be "prepped." Then, once a blend shape is prepped, you can create a control scheme for it.

Prep Work for Your Own Setup

Phew! With all those concepts to deal with, there's going to be a lot of tools to learn here, so let's get into them. The techniques you'll become familiar are creating fix shapes, half shapes, and XYZ shapes, prepping your blend, and generating the control network.

Naming Conventions

To deliver as many blend tools as possible, I had to narrow down some naming conventions to eliminate a lot of problems. To get any of the Fix, Half, and XYZ tools to work, you cannot use blend shape target names with underscores in them. (I'll use the underscore instead as a flag that a shape requires special attention and what kind of attention that is.) Instead of naming a shape Brows_Up, use browsUp or BrowsUp. Instead of goofy_smile, use goofysmile. If you intend on using my stuff, intend on getting underscores out of shape names you name yourself unless you mean for them to be excluded or treated as fixes or halves or XYZ shapes.

Work Flow for Fixes, Halves, and XYZs

To minimize confusion, we need to lock down some work flow; an order of operations. Get *all* fix, half, and XYZ work done before you prep your blend and start putting a control scheme on it. Treat these steps more as part of the shape modeling process than part of the control process because, for these tools to work, no sliders should be animated or controlled in any way and your head should be totally unrigged and not manipulated in any way. In fact, these tools will destroy and regenerate your blend targets and blend shapes at several points; any influence could accidentally "bake" deformations you didn't intend to have into the mix. Again, work on fixes, halves, and XYZs on a *completely* "virgin" blendShape node and head or expect a lot of strangeness. The easiest way to verify that your head is as clean as can be is to look at the history for it. The only thing you should see in there is a blendShape and a tweak (Figure 12.5).
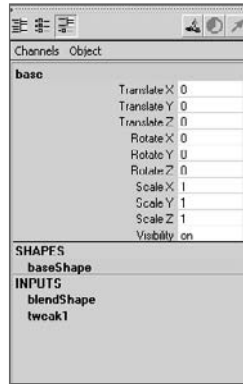
Figure 12.5

Nothing but the blendShape and a tweak node in the history says this shape is clean enough to do fixes, halves, and XYZ blends.

There is a scene for you to load and follow along in the Chapter 12 folder called `tutorial_prep1.ma`.

Fix Shapes

In my implementation, a fix shape is not an entirely new shape that replaces the mix of two other shapes; it is simply the corrective elements and is added on top, working in the same way a pose-space-deformer works. To get started with this, in an *un*rigged, *un*prepped scene, play with your blendShape until you find two or more shapes that mix poorly. Set those sliders to 1 and all others to 0; the tool might think you mean to include a shape if it is not at 0. Select the head, then on the SS2 shelf, click fixOut to start the process of creating a fix shape.

Three new shapes will appear. If they don't, make sure the scene is unprepped and unrigged. The first shape is a copy of the base shape with a *new* blend shape applied to it. The second and third new shapes are both copies of the mixed shape, the one with the problematic mix. The copy of the base shape will be named FIX_*shapeName_shapeName* where *shapeName* is the name of the shapes that were set to 1; the more shapes involved, the longer the name, an underscore between each. Of the other two models that appeared, one is named SculptMe_FIX_*shapeName_shapeName* and another called SubtractMe_FIX_ *shapeName_shapeName*. Sculpt the SculptMe shape until it is the shape you desire. The shape that will be used to correct the mix is the copy of the base, and it should be getting updated instantly as you manipulate SculptMe. When you are happy with your fixed sculpt, select it, the one that starts with *FIX*, and the original base shape you selected when you clicked fixOut and then click fixIn on the SS2 shelf.

FIX SHAPE TOOL INFORMATION

When you use the tool to start fix shapes (fixOut), it picks the shapes you are trying to correct for by finding sliders with any value over 0.9. To make sure you are getting only the fix shape components you want, keep all sliders at 0 except for the shapes you intend to fix, which you should set at 1. Keep in mind that when you reconnect the fix shape, its activation will rely on the values of the other shapes it is correcting. For this reason, it is always better to try your best to create corrective blends that rely on as few input shapes as possible. Using two shapes to activate a fix shape is better than using three, which in turn is better than using four. If you find yourself frequently generating fix shapes for combinations of three or more shapes, you probably need to stop trying to correct things this way and go back to take a closer look at your original shapes.

This should incorporate the new fix shape back into the original blend. Keep in mind that the automatic activation of the fix shape is not yet hooked up; that happens later when you prep your blend's control network. If you want to see and test the effect immediately, prep your blend as soon as you are done. Once it is hooked up, whenever you use the original problem blends normally, the fix shape should activate itself when appropriate.

To try all this, in `tutorial_prep1.ma`, set the open and frown shapes to 1 and all others to 0. As in the steps described earlier, set the open and frown to 1 and press fixOut. Three heads appear, as in Figure 12.6. Sculpt the one called sculptMe_FIX_open_frown. Then select FIX_open_frown and the head named base and press fixIn. You should end up with a new shape incorporated in your blend called FIX_open_frown. (The existing blends you had will have been freshly created and appear on the origin on top of your head. Hide them to return things to normal.)

Half Shapes

The process for creating a half shape is very similar to the process for creating a fix shape. In a scene with an *un*rigged, *un*prepped blendShape node, play with each blend until you feel you find a shape that requires a half shape, meaning that, as you move the slider from 0 to 1, it feels that there needs to be more happening along the way. A good example of where you would use a half shape is a lips-rolling-in shape like uprLipDn or lwrLipUp. Sometimes, no matter how hard you try to avoid it, around the 0.5 mark of a shape it loses volume or looks weird.
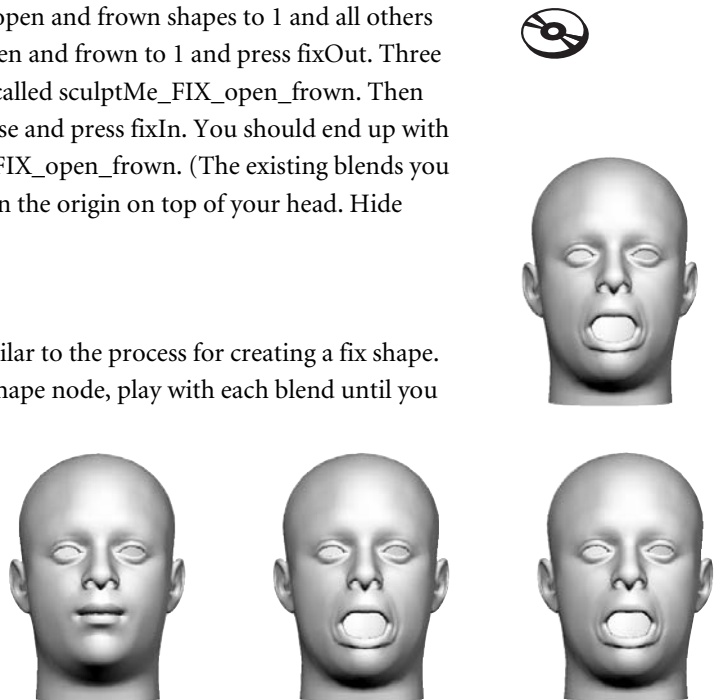
Figure 12.6
A view of the heads you get when processing a fix shape

To get a half shape going, set all blends to 0 except for the one shape you want to build a half shape for, and set that one to anything above 0.1.

On the SS2 shelf, click halfOut, starting the process of creating a half shape.

You will get three new shapes that appear. Familiar, huh? The first is a copy of the base shape with a new blendShape applied to it. The second and third are both copies of the half shape (the shape set to 0.5 exactly). The copy of the base shape will be named HALF_*shapeName* where *shapeName* is the name of the first shape that was set to something besides 0. Of the other two shapes, one is named SculptMe_*shapeName* and another is called SubtractMe_*shapeName*. Sculpt the SculptMe shape until it is the shape you desire. The shape that needs to be used as the half shape is HALF_*shapeName*, which should be getting updated as you work on SculptMe. When you are done, select HALF_*shapeName* and the *original* base shape; then click halfIn on the SS2 shelf.

This should incorporate the new half shape back into the original blend shape.

To try all this, in `tutorial_prep1.ma` (and you can do this in the same scene in which you worked on your fix shape if you are feeling like seeing all of the features in one scene), set the lwrLipUp shape to 1 and all others to 0 and then click halfOut. You should see three new shapes, one called HALF_lwrLipUp, the next called subtractMe_HALF_lwr LipUp, and the last called sculptMe_HALF_lwrLipUp. Sculpt sculptMe_HALF_lwrLipUp until you are happy with the look of it as the halfway point of your blend (Figure 12.7). Select sculptMe_HALF_lwrLipUp and base and then press halfIn. After this, you should end up with a new shape incorporated in your blend called HALF_lwrLipUp.

XYZ Shapes

XYZ shapes are a pretty simple concept. They offer a way to take one shape and turn it into three; each containing the X, Y, or Z aspects of the shape as illustrated (left to right) in Figure 12.8. By having access to the different axes of the component positions in a shape, you can create an arc of motion to and from the end shape. This is an artistically limited way to do so, however, because the effect works across the entire surface the same way. Ideally, you would want to create an arc tailored per vertex, but that approach is not practical. Instead, having the relative arc of each vertex tied to that of every other vertex is what makes my approach (implemented via the xyz button) fast and easy. To create XYZ shapes, set any number of sliders on your blendShape to 1, then click the xyz button on the SS2 shelf.

The process may take a few moments, but what should happen when it's done is that the blendShape node should come back with three more shapes for every shape you had set and modified versions of all the originals. The new shapes should have names that are familiar, but

Figure 12.7

A view of the heads you get when processing a half shape.

Figure 12.8

The X, Y, and Z portions, respectively, of the smile

with the prefix of X_, Y_, or Z_. There are still shapes of the original names of those XYZed, but they now actually perform *no change* when used. That original shape slider exists only to drive the X, Y, and Z component shapes with driven keys while still allowing control schemes authored against the single shape to plug in.

To try all this, in `tutorial_prep1.ma` (or your own version of that same scene where you worked on your fix and half shapes), set the smile shape to 1 and all others to 0. Follow all the steps described earlier and you should end up with three new shapes incorporated in your blend called X_smile, Y_smile, and Z_smile, as in Figure 12.9.

If you carried all these three ideas through, you should now have a blend with fix, half, and XYZ shapes, which can follow through to the next section where we prep a blend.
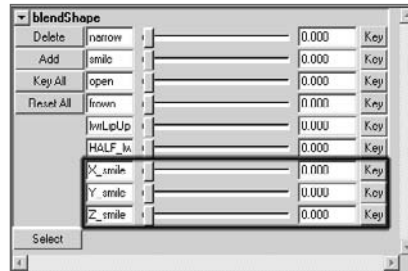
Figure 12.9

The blend shape window with the X, Y, and Z shapes added, the only real change you'll see after clicking the XYZ button

---

HALF SHAPE TOOL INFORMATION

When you use the tool for half shapes, you can work on only one half shape at a time. If multiple shapes have the same value, the *first* shape is picked.

Prepping Your Blends

In the new system, before you can put a control scheme on a blend shape you need to "prep" your blend. At this stage you have the SS2 shelf scripts make connections between the nodes in the specialty shapes (fix shapes, half shapes, and XYZ shapes) you've just created and generate a control network. Prepping a blend involves four different items, so

when you click Prep on the SS2 shelf, you should see a small window that lets you select each or all of them, shown in Figure 12.10. In prepping a blend, you prep the different

types of shapes and generate a control network. Let's follow that order since it's the order in which you should probably do things for predictable results. With the window open, select a

blend you want to prep, select the check boxes for the things you mean to prep, and then click the Prepare Blend button.

You can follow along with the scene you made in previous sections, or open `tutorial_prep2.ma`.

Prepping Fixes

Assuming you have created some fix shapes, either using fixIn and fixOut as described earlier or by making them your own way, prepping a fix relies on only one thing besides a blendShape node: names. When you prep for fixes, any shape that has a name that starts with *FIX_* will be processed and attached so that it's controlled by the other shapes in the name if they exist on the blend shape. For example, if you have a blend shape with shapes

named A, B, and FIX_A_B, running a prep on fixes will connect things up so that when A and B have values, FIX_A_B will automatically be animated. Notice the syntax required: If

you had a shape named A_B_FIX, nothing would happen, A_FIX_B wouldn't work, and fix_A_B won't work either. It has to be all uppercase in *FIX*, then an underscore, then the names of the shapes that would drive the fix. This is why the names of shapes themselves can't have underscores in them; it would confuse this logic. If you run a prep with the fix option checked, as shown in Figure 12.11, any correctly named fixes should now be connected. In `tutorial_prep2.ma`, or your own version of the same, FIX_open_frown should be automatically animated whenever both the open and frown are used.

Prepping Halves

Any way you have authored them, once you have half shapes in your blend shape and are ready to prep them, simply run the prep and make sure that Half is checked, as in Figure 12.12. When you prep halves, any shape that has a name that starts with *HALF_* will be processed and attached so that it's controlled by whatever shape is in the name *after*

*HALF_*. All this does is create driven keys (or, as most people to refer to them, which is a huge pet peeve of mine, set driven keys) wherein the "whole" shape controls the half shape as

many times as that exists in the shapes. If you have a shape named Shape and a shape named HALF_ Shape, then a driven key will be created making Shape control HALF_
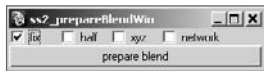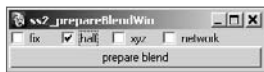
Shape. The default relationship will be that at 50 percent of Shape, you'll have 100 percent of HALF_ Shape, and at 0 or 100 percent of Shape, you'll have 0 percent of HALF_ Shape, but you can modify that any way you want by changing the driven key. If you are following along with `tutorial_prep2.ma` or have carried your scene all the way through from `tutorial_prep1.ma`, as you use the lwrLipUp shape, you should see HALF_lwrLipUp's value rise and fall at the halfway point, creating more of a curl type motion than before.

Prepping XYZs

XYZ shapes are a little different in that, with fixes or halves, you have a pretty solid idea of the behavior you want before you run the prep, but with XYZs, you probably want to play around a little bit before you get something you like. What happens when you run a prep on the XYZs in your blend is that the shape named for what was split up, which should do nothing, gets driven keys slaved off of it that control its X, Y, and Z shapes. A shape named Shape will end up controlling X_ Shape, Y_ Shape, and Z_ Shape if they exist. The relationship created will be one in which it looks like a direct connection. It will all behave like one shape until you modify the driven keys, so all you can expect to happen immediately after prepping XYZs is that you have connections controlling your XYZs.

In `tutorial_prep2.ma`, or your own version of the same, a now well-used `tutorial_prep1.ma`, set the checkboxes just as in Figure 12.13, and then click Prepare Blend. Now that you have a place to start, play with the smile slider in the Blend Shape Editor. You'll notice that it drives X_smile, Y_smile, and Z_smile in a pretty boring way. Now, with the blendShape selected, open up the Graph Editor. Modify the curves for X_smile, Y_smile, and Z_smile to look like the curves in Figure 12.14. Now when you manipulate the smile slider on the blendShape, you should get a nice nonlinear-looking blend.
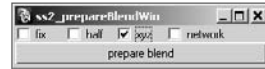
Figure 12.13

Prepping XYZ shapes

Generating a Control Network

Once you have all the rest of it preprepped, the last thing to do before trying to attach a control scheme is to prep your blend network. Instead of connecting controls directly to the blendShape, what I've designed is a system that creates a node network with a lot of places to attach your controls as you like. For every shape in your blend, you'll get a small network like that seen in Figure 12.15. With two shape sliders in your blend, it looks like Figure 12.16—the same thing, only more intermediate nodes. What is being created is a number of nodes that all have the shape attributes (except those whose names have underscores in them) that your blend shape does. Each of these nodes has a job in making it easier to create robust control schemes. The main nodes created are the limited, the unlimited, the direct, and the buffer.
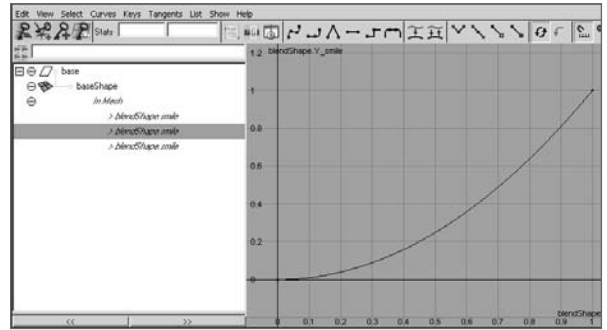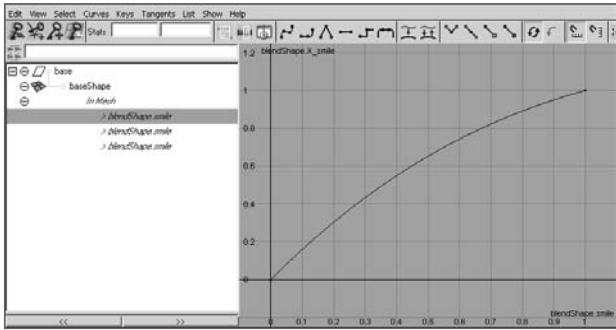
Figure 12.14

In the Graph Editor, modify the X_Smile, Y_Smile, and Z_Smile curves as shown here.
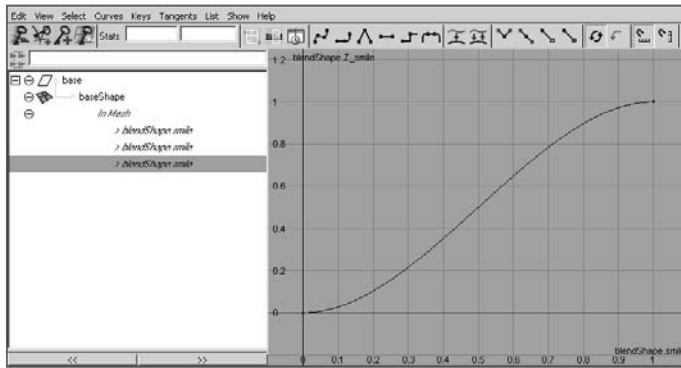
Figure 12.15

The node network for the blendShape
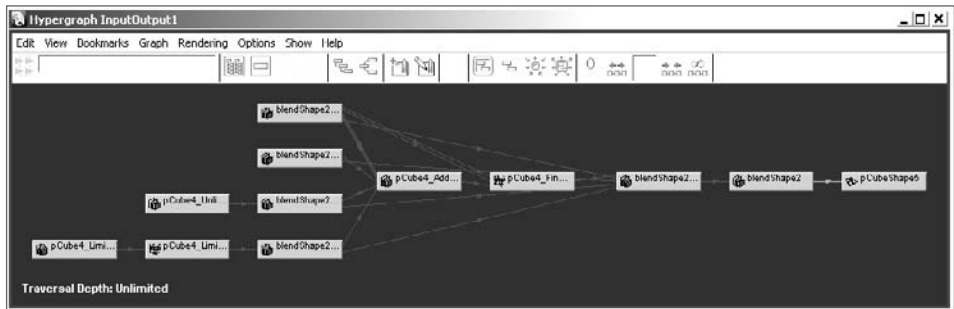
Figure 12.16

A node network for two blend shapes adds intermediate nodes.
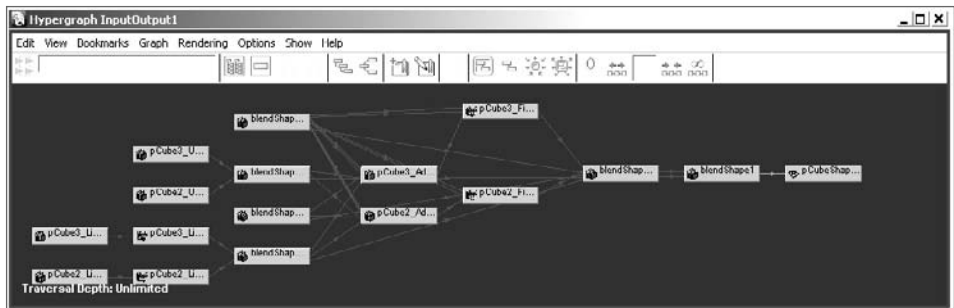
LIMITED

The limited node exists to provide a place to link controls to shapes where the behavior of all controls combined cannot exceed 1 or go below 0. Let's say you want five controls all to have an effect on the smile but for that smile value to never exceed 1; the inputs to this node is where that functionality plugs in.

UNLIMITED

By hooking controls into the unlimited node, while each control can only itself send a value between 0 and 1 per shape (unless you connect it twice), the sum of all controls *can indeed* exceed 1. Five controls affecting the smile plugged in here will have a smile × 5. Probably yucky, but there are a few situations when combined values over 1 are the desired effect.

DIRECT

The direct node exists for an animator to control a value more directly, to affect each weight on the blendShape with total disregard for any other limits or controls, almost as if there was nothing special done to the original blend. For the animator who wants to deal with it all hands-on, no help, no ease of control scheme, this is the thing that lets you distribute the same rig to your whole crew and keep all preferences accounted for. Personally, I use mostly control-scheme-based animation, and then for the final touches, I'll come into the direct node and animate bits here and there.

BUFFER

The buffer is the node that serves as a proxy to all controls for the blendShape node; its purpose is to allow for easier swapping of controls. For the most part, this is invisible to you, except when you want to try to connect an existing control scheme to a blend shape manually (as opposed to loading one into your scene using the tools provided). Since we hook controls to a network upstream of the buffer node, it ends up making whole complicated networks easy to swap because the blend is just a series of one-to-one connections off of this.

Controlling Your Blends

To get going on starting your own control schemes, make sure that you have first prepped your blend. This means, if you need fixes, halves or XYZs, get all that done first, and then run prep with everything checked. I won't be covering how to move back and forth between partially set-up controlled schemes, back to fix/half/XYZ land, and then back again; it's just too complicated to cover here.

Making Controls

Figure 12.17

The SS2 shelf's tool for generating controls

Once all of the prepping is understood and done, on the SS2 shelf, there is a script labeled Ctrls. Click that button and you are presented with the window you see in

Figure 12.17. This tool is how you generate new controls. You create a new control by naming it, picking a type, and deciding whether to generate the generic network that comes along with the control. When you've done that, click the Make Control button and you should see a slider appear on the origin, facing forward in Z, up in Y.

> **NAMING YOUR CONTROLS**
>
> Controls you create through this user interface cannot have a short name that collides with anything else in the Maya scene. That is, even though Maya allows you to have two objects named controlName if they have different parents, the control creation won't allow that. All control names need to be totally unique in the scene.

Control Types

Where you see the choice between A, B, C, D, E, and F type sliders, it might help you to see and understand what each represents. There is more than one way to *use* each one, but the type you choose limits or enables the way you'll want to work with it.

TYPE A

These sliders (Figure 12.18) are simple ones. Their limits are 0 and 0 for X and −1 to 1 for Y. They usually control two shapes. The 0, or default, position is in the center. If you pull the slider one way, you get one shape; pull it the other way, you get another. There is no shape displayed in the default/center position.

TYPE B

Slider type B (Figure 12.19) functions exactly the same as type A except that the available range is from −1 to 1 in X and 0 to 0 in Y—effectively the same as type A, only on its side.

TYPE C

Clearly my favorite; I use them everywhere. A type C slider (Figure 12.20) can function in many different ways. The effective range is from −1 to 1 in both X and Y—a box. Most commonly I'll use this to run four shapes, two asymmetrical pairs. If you pull the slider straight up, it's a 100/100 mix of the two shapes you'll see if you go to either top corner; moving to each corner, however, will show only one shape. The same is true for along the bottom.

This slider can also be used as if it was a pair of sliders, just like A and B on one control.

Figure 12.18

A type A slider
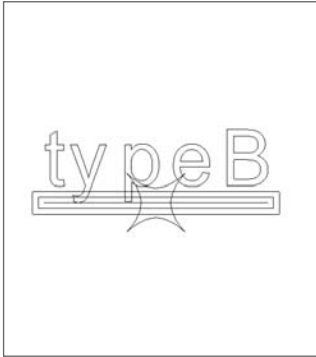
Figure 12.19
A type B slider
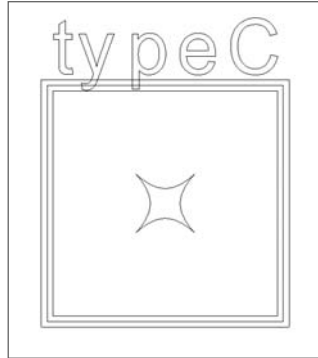
Figure 12.20
A type C slider
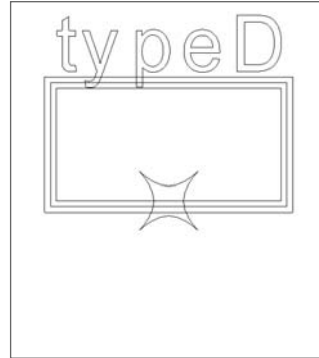
Figure 12.21
A type D slider

A third way you could use this control is to use all of the available slots, meaning that there is a vertical/horizontal range as well as four corners. I've never actually done this, but I'm sure one of you out there will dream something clever up; that's half the fun!

TYPE D

This is much like a type C slider but with the lower half cut off (Figure 12.21); the effective range is from –1 to 1 in X and 0 to 1 in Y. It's good for when you have a desire for an effect that doesn't have an equal and opposite effect to balance it, like a sneer. With Smile and Frown, there is nice asymmetry that also has a counterpart; for that a C makes sense, but there isn't really something you'd see as the *opposite* of a sneer. That's a D for you.

TYPE E

This one's easy. It's a box, just like C and D, but its effective range is only from 0 to 1 in both X and Y; it's like having only the top-right corner of type C (Figure 12.22). This is used when there are really only two shapes that need to interact with each other and it's faster to work with than having two sliders. The default position is in the bottom-left corner.

TYPE F

Very similar to type A and B, this slider only moves in Y, and it only goes negative. I don't use this one very much, but it allows for good general control over large groups of controls by modifying their general values (Figure 12.23).
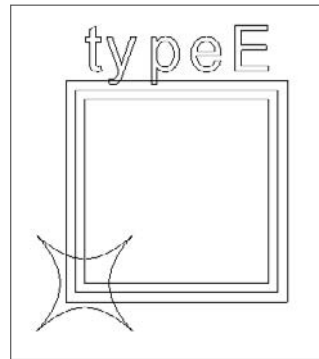
Figure 12.22
A type E slider
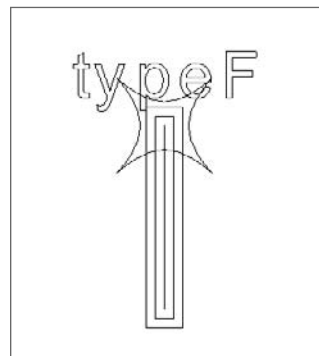
Figure 12.23
A type F slider

A NOTE FOR THE CURIOUS AND TECHNICALLY INCLINED

The different slider types all create the exact same network of nodes. Since representing all uses of the C slider in one network and then masking out portions of the control's translation covers all cases, you can offer the functionality of any of the six options while under the hood maintaining and understanding only *one* kind of construct.

Connecting Sliders

Once you have sliders and blendShape nodes in your scene, it's time to start connecting things up. Here we go—the good stuff. The way this works is that you select the control curve (the star-shaped thing) on a control and an object with a blend shape on it, and then inside the ss2_controls window, you click the Open Slider Connect button, or on the shelf, the button labeled Cnct. They both open the slider connect window. Exactly what you see here will depend on the control and blend shape you have, but on the left will be a column with a list of target weights available on one blend shape. On the right should be an iconic representation of the slots on a control. If it's a type C, you're looking at eight spots; if the control is a type A, you're looking at only two.

To use this UI, select a shape weight from the blendShape on the left area with the shape names, and then on the right, click a button that represents the location on the control that you want to control it. If you have the Limited box checked, the shape will be affected in a "maximum of 1" manner by this connection you are creating (to the limited node discussed earlier). If you add it with the limited box unchecked, then the control you are adding can and will (if there are other influences) take the shape being affected past a value of 1.

What you have now is all the basic information you need to control your characters' faces. To follow along, load up `tutorial_prep3.ma`, or if you've been bringing your blend all the way through since the beginning, just make sure you have run prep with *all* checks on (`tutorial_prep3.ma` has this already done and does not need it done again). Open the ss2_controls window (ctrls), type the name **sync** into the Control Name field, make it type C, and create the control, which will appear on the origin. Now select your new control then your blend shaped head, and open the slider connect (Cnct on the shelf, or Open Slider Connect in the control window).

Select the shape named narrow from the left column, then click the button that is center left on the right side, circled in Figure 12.24. Play with the sync slider and notice how now your face animates to the narrow shape as you move the slider left. Now, back in the slider connect window, select Open and then click the center-bottom button on the right side of the window, circled in Figure 12.25. Now, as you move the sync slider around, it also opens the mouth when it moves down.
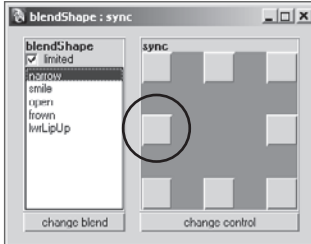
Figure 12.24

The button for the Narrow sync slider
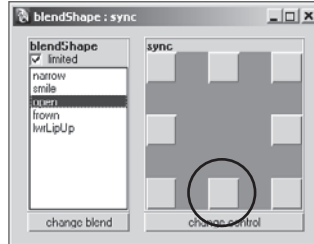
Figure 12.25

The button for the Open sync slider

Figure 12.26

The message displayed when you connect a single shape to more than one control
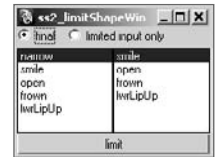
Figure 12.27

The SS2 Limit Shape window

From here, play with different sliders and locations to get the desired effect. As you do this, remember that Undo is your friend. The easiest way to go back on a slip of the finger or some wacky behavior is just to keep hitting undo.

Connecting to Shapes That Are Already Connected

The tools for connecting shapes to controls assume that you will, at some point, need to connect a single shape to more than one control. The tools allow for that, but I wrote them so that they ask for confirmation if there is any chance you might be wandering into trouble. If any shape is already controlled by a limited or unlimited control, it asks you to confirm whether your newest addition to that control is intended; see Figure 12.26. This is mostly to avoid double-connecting the same input or any accidental connection to shapes you already connected. So the prompt asks you whether to *replace* the existing control or *add* this new control to it.

Limiting Shapes

Once you have a control scheme working, all your controls set up, your fixes and half and XYZ shapes all good to go, you may run into shape combinations in which you simply want one shape to limit another. When you find yourself in this situation, with a blend shape selected, you can click the Open Shape Limit button inside the ss2_controls window, or on the SS2 shelf you can click the Limit button. What appears is a window with two columns, as Figure 12.27.

On the left is a full list of the blend shape weights, and on the right, a list of the blend shape weights *except* whichever one you have selected on the left (you can't limit a shape with itself!). Once you have a shape to limit *with* and shape to *be* limited, click the Limit button and it should be done. You have a choice of limiting to the sum total of all inputs or only limiting its already limited inputs. In general, it is easier to work with limit type set to the default, Final. Just as with connecting shapes, if you start to try to incorporate several shapes as limits to one shape, you will be prompted for how to do so, by either adding or replacing existing connections.

Sharing Control Schemes

Figure 12.28

The prompt displayed when you load a scene with more than one buffer node

The last thing to understand after you know how to construct a control scheme of your own is how you might share that scheme with another character, how to use one of the setups provided on the accompanying CD, or how to use one you find online or one that's given you by a friend or coworker. There is a tool on the shelf labeled Save. With a head (or preferably, its blendShape) selected, this finds the control scheme attached to it and prompts you to choose a name and save it out as a scene that contains nothing but your control scheme. There is a big caveat here, and that is that Save will detach and save setups properly only if you haven't gone in and done extra rigging that connects blend shapes to *each other*. You are welcome to connect blend shape buffer nodes (the ones created by prepping) to each other, but if you start to connect blendShape nodes directly to each other, then all bets using my save and load scripts are off, and I can't promise you this toolset will work as expected.

The Load button on the shelf does much what you would expect. With a head (or preferably, its blendShape) selected, click the button and you will see a file browser like any other in Maya, and once you pick a control scene, it loads and attaches the control scheme from that scene. If you try to load and attach more than one buffer node in the scene, you will be prompted to pick a buffer node and a blendShape node to pair. Figure 12.28 shows what this looks like.

The Atch button will attempt to attach a control scheme based on selection, but again, if there is more than one possibility for viable connections, a window will prompt you to pick the specific pair you want to attach. Just as you can attach, there is also a detach. Since all that an attach does is take the buffer node (described near the beginning of the chapter) and, attribute by attribute, connect the blendShape to it, all the detach (labeled Dtch) does is sever those same connections.

In addition to saving and loading, attaching and detaching, you can delete a control scheme by using the button on the SS2 shelf labeled Del. Deleting a control scheme is good practice when you are still working on prep steps before getting a real control scheme set up since it'll clean the network out in a more complete way. If you have started creating your own kinds of connections and extra work outside the generic toolset, again, the deletion may not work completely.

A NOTE ON SAVING SETUPS

Saving out a setup amounts to a File → Export Selection, with the setup selected. This means that if you really want to export your setup cleanly for sharing, you want to be sure to unparent the controls from anything in the main hierarchy of your character. Otherwise, that whole character will probably be saved out as well.

The "Just Do This" Part

So let's say you've read this far or skipped ahead from the start of the chapter and what you really want now is to just take the shapes you made in Chapters 6 and 9 and hook them up to a control scheme or two to take them for a spin. Well, you're in luck, because as described in the preceding section "Sharing Control Schemes," all you need to do is load a control scheme up! In a scene with a blend shape carrying shapes named for the ones you built in Chapters 6 and 9, select the head with the blendShape and click the Load button on the SS2 shelf. Using the file browser, go to the Chapter 12 folder on the CD or to wherever you copied the setups to your hard drive (if you did), *or* surf to a setup you've made or found by other means. Once you select a control scheme scene, the scene will import and connect itself to your blendShape, or if there is more than one of blendShape and buffer node, you should be prompted to pick the pairs you want connected. That's it! If this doesn't work as expected, be sure to read the error and warning messages that pop up in the window that appears and/or look for errors in the Script Editor. Any problems are likely to be something simple. If you do encounter errors, though, the first thing to do is to read through this chapter again.

Shapes

The lists of shapes needed to work with the CD setups are found in Chapters 6 and 9. There are two main sets of shapes, a simple one and a complex one. The names needed for each to work are included in the following lists.

Simple Face Shapes	Simple Teeth Shapes	Complex Face Shapes	
open	teethOpen	open	lLwrLipUp
smile	tongueOut	lJaw	rLwrLipUplLwrLipDn
narrow	tongueUp	rJaw	rLwrLipDn
frown		jawFwd	lMouth
sneer	**Complex Teeth Shapes**	lSmile	rMouth
uprLipUp	teethOpen	rSmile	lSquint
lwrLipDn	lTeeth	lNarrow	rSquint
squint	rTeeth	rNarrow	browsMidUp
browsMidUp	teethFwd	lFrown	browsMidDn
browsMidDn	tongueOut	rFrown	lBrowOutUp
browsOutUp	tongueUp	lSneer	rBrowOutUp
browsOutDn	tongueTipUp	rSneer	lBrowOutDn
browsSqueeze	lTongue	lUprLipUp	rBrowOutDn
	rTongue	rUprLipUp	browsSqueeze
		lUprLipDn	
		rUprLipDn	

Control Schemes: Eyes and Lids

The setups have one last thing that I dare not automate. I learned my lesson last time. To have the eyes and the eyelids interact properly with a control, you'll need to hook that up manually yourself because the eye setup also comes with its own set of controls. If you want to move or incorporate the connections from another control to the eye network, you'll need to do a fair bit of digging through the networks on either end. I recommend just using the eye setup that comes along with the network described in Chapter 11: Skeletal Setup, Weighting and Rigging. That's the easy path to take.

Squash and Stretch and Squoosh

All the animation we've done so far, whether it has a photorealistic or a toon-style "look" to it, has been bound for the most part by the physical limits of what real human bodies can do. But this is animation, people. We can make characters turn themselves into parachutes (like Elastigirl in *The Incredibles*) if we want to. Animation where character deformations are bound only by the imagination is known as squash and stretch, and that's what we'll cover here, using my character Squoosh.

Fair warning: this chapter is more for the TDs than the animators. I've simplified the Squash and Stretch the best I can, but some of it is just a few too many steps into TD land to pull back out. That said, there are only two major areas to look at in squash and stretch rigging: deformations done in a *local* sense and those done in a *global* sense. Locally, you can create a type of rig that will allow your face to do certain specific squashy-stretchy things. Globally, you can prepare your character to be affected by *any* deformation you choose at any time. Local setup is a very open-ended concept, so I will take you through only the things *I* do to make a character's face more fluid and deformable. Global setup, however, is the much larger concept, and it's the "secret" to easy squash and stretch. To get that going, you only need to be aware of a few rules about plugging *all* deformations that come into the final renderable meshes parallel and as blend shapes.

Rigs plugged in as blend shapes. That's it. That's the secret, or at least *one* of the methods for doing squash and stretch. Pretty anticlimactic, wouldn't you say?

Now that the "secret" is out, let's make some sense of it.

- **Local rigs**
- **Global rigs**
- **No rigs**
- **Rigging without wraps**
- **Tutorial: Rigging Squoosh**
- **Gotchas**

Local Rigs

The local rig I'll describe is one made for a character of mine called Squoosh (Figure 13.1), and you can load his head in `squoosh_unrigged.ma`. Squoosh has big 'ol eyes, a big 'ol mouth, and big 'ol ears and tends to make all kinds of wacky faces. The components of his core blend shape set is pretty much exactly what you'd see on a more realistic character, but the execution of those shapes is much broader. Same shapes on a functional level, very different on an artistic one. That said, when it gets to the rigging work, there are so many different ways you could do the local work on a squash and stretch character, none of them right or wrong, so remember as you read on through my local rig that this is just *one* possible example.

Joints

After setting up a more standard set of bones, one of the things you can do to your rigs to make them feel less like a realistic head is to put joints in places that you wouldn't usually.

Besides using very broad blend shapes, I keep Squoosh looking so bouncy by placing two joint chains through his head. The first chain is laid out from approximately between his ears up and to the top of his head, seen in Figure 13.2; all of that is a child of normal head joint. This joint chain location is usually the domain of the skull, something you can't really mess with in reality, but in the spirit of putting joints in odd places to get a new look, this is something that will keep the top of the head fluid enough to be able to bend slightly to accent any pose on the face, or the body in general.

Figure 13.1

Squoosh: undignified
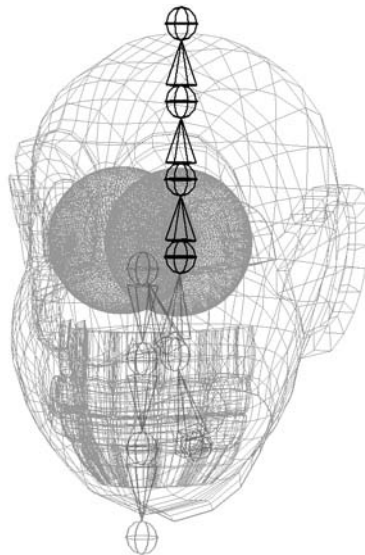
Figure 13.2

The joint chain that will control deformations of Squoosh's skull
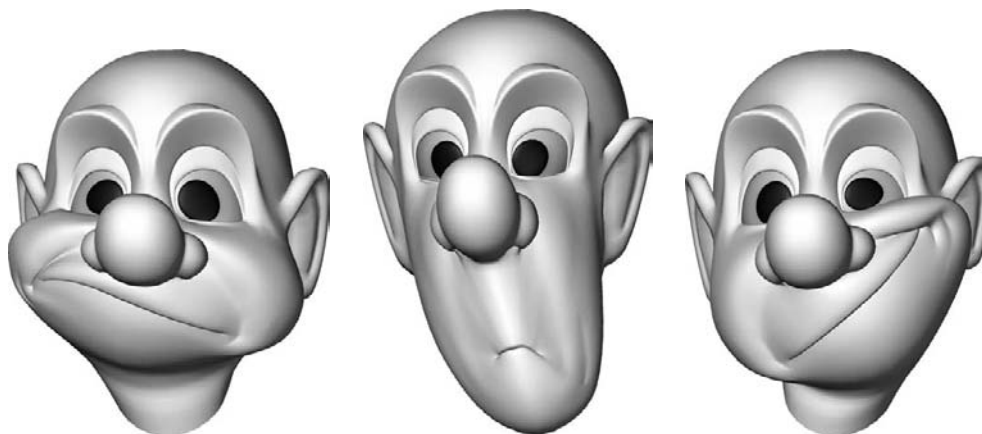
**Squash and stretch
facial expressions**

Watching lots of cartoons and trying to emulate what I saw, it seemed that for sync and
general expression, a common theme was to see a sort of "muzzle" on characters that was
itself a spherical shape that would squash and stretch and bend, as in Figure 13.3. To set
up a rig to accommodate this—again, as a child of the regular head—add another joint
chain that moves down through the cheeks and mouth, right through the lower half of the
face, shown in Figure 13.4.

This is the only unique joint work *I've* done on the local rig to get Squoosh's head to
feel squishier, but the sky's the limit. Put bones in to get the effects you want, but while
you do, try to focus on the head itself. Don't worry about the eyes and teeth just yet. They
need special attention that I'll cover later this chapter in "Separating
out the 'Special' Objects."

Figure 13.4
**The joint chain
through the lower
half of the head
controls the facial
deformations.**

Eye and Eyelid Joints

When working with a squash and stretch head, I've found it's a toss-
up, about a 50/50, whether I can use joints for the eyelids or if that
will cause more trouble than it's worth—trying to get the eyelids to
close *and* follow the rest of the skeleton. I often need to replace the
eyelid functionality by creating blend shapes for lids. More often than
not, blend shape lids will need to have half shapes to avoid blinks that
look too linear (the bigger the eye, the more likely to need to go with
half shapes). That's the case with Squoosh, who has blend shape
blinks with a half shape for each. Figure 13.5 shows this transition in
3D and Figure 13.6 shows the corresponding Graph Editor.

Separate the Big Blends

In Chapter 6, I introduced my *blend taper* tool (`ss2_blend_taper.mel`, the Tap button on the SS2 shelf) and talked about using it to separate left shapes from right shapes and, in a more advanced method, using blend taper to extract several blends from a few core sculpts. There is yet another reason you might use blend taper, and that is to separate out the portions of certain shapes that *do* and *do not* affect sync.

> See the Introduction if you haven't already installed the SS2 shelf.

For squash and stretch characters like Squoosh, there are a few shapes that are much broader in their execution than those you would have for a more realistic character. This creates a new need for further tapering, splitting major mass displacement from functional sync stuff to avoid "popping" motion in the cheeks during speech. Let's say that you have a smile that looks like Figure 13.7. Once you pull that shape apart into two shapes, a left and a right shape as in Figure 13.8, you have enough shapes to work with for your smiles as described in earlier chapters. The problem now, with this character, is that when you

start to put one of these smile shapes into lip sync in time right next to something like the Narrow shape (Figure 13.9), there is potential for a *major* unattractive syllable-to-syllable mass motion on the face. Opposing these two shapes on a control scheme isn't completely *necessary*, but usually you would want to because you can't really do both at the same time anyway, even on a more realistic face. On a shape set like this, these two shapes might just mean you're in real trouble.

For this reason, I recommend using *blend taper* even further than you would use it on a regular head. What I recommend, and what you will see on Squoosh, is to break the lips from the larger mass movement of the Smile, shown in Figure 13.10. You would also do this on the Frown (Figure 13.11) and any other shape you feel would have too big a mass movement on the cheeks that might negatively impact the sync if it were to have to pop on and off very quickly. When you split shapes this way, you end up with more shapes to handle, and frankly, the shapes themselves won't look like much. Just as with XYZ, fix and half shapes, you end up with multiple shapes representing one whole effect.

Figure 13.7
Why is this man smiling?

Figure 13.8
The left and right sides of the smile

Figure 13.9
His lips are sealed.

Figure 13.10
Using blend taper to isolate the lips from the whole-face movements of the smile

Figure 13.11
Using blend taper to isolate the lips from the whole-face movements of the frown

NAMING FOR EXCLUSION

When creating shapes that may need really funky custom control networks and shapes that work together in pairs, such as those you might want for a smile without the lips or a smile without the cheeks, a smart move is to include an underscore in the name of the objects that will be blends. This ensures that once included in the blendShape, the names for the blend-Shape weight attributes that they generate get skipped over by the general control network generation tools covered in Chapter 12. Anytime you start to balance a *portion* of Smile but limit it with a *portion* of something else, or any other custom shape relationship, you pretty much need to wing it, and my automatic setup stuff is only going to complicate that, not make it easier, so name things with underscores to skip them over.

Unlike with XYZ, fix, and half shapes, however, I cannot provide you with an easy hook-it-up tool for when you start breaking certain parts of shapes out for good behavior; *these* tapers of shapes don't always (if ever) have a standard way of being controlled. For instance, you may want the cheeks portion of the smile to be aligned completely with the mouth portion, except when the Narrow shape comes across, and then the smiling on the cheeks to *not* be reduced. You may want that to happen completely; you may want to reduce the cheeks portion by 20 percent, maybe 50 percent. The point is, that's all custom rigging.

Global Rigs

Now that you have an idea of one way you might address some local rigging concepts for *this* squash/stretch character, it's time to move our attention to things you'll need to think about on *any* squash/stretch character. You'll learn how to identify which objects require special attention for a squash and stretch rig, cramming those into lattices and wrap deformers, and then how you'll need several versions of your character's face that all get plugged in together.

Separating out the "Special" Objects

The eyes and teeth are special cases that we'll focus on here, but they serve as examples for other parts of the head and face area that might have motion separate from the gross facial deformation, like a moustache or the tongue. Every character is different. An easy way for you to identify *for yourself* which objects need special consideration is this: If something needs to move in a way that is somehow *different* from the greater head mass but is still affected by it, you may need to create a lattice and do a little work managing the hierarchy to accommodate that difference. Figures 13.12 and 13.13 show a little of this deduction. The eyeballs and teeth are just easy examples and the ones I'll focus on. For the most part,

we'll put these special objects into lattices and wrap-deform those lattices to the main head, but that in itself creates some new problems to solve. The teeth, if put in a lattice, will expand to match the shape of the mouth. This means that for them to behave like teeth and simply occupy a similar space as the mouth moves around, they will actually need to *retract* and *expand* in a way that would otherwise not be necessary or even *desired* in a non-squishy head. The eyes have a different problem; they will need to rotate around in the socket, but the points immediately *surrounding* them won't be doing that rotation. The eyes and head surfaces need to remain in tight contact, even if deformed out of a spherical shape.

To get the eyes and teeth to behave nicely, we need to have all of their unique motion occur in a version of the "universe" that has already been warped by main facial contortion so that anything the eyes and teeth do is moving within the face's constraints.

The best way to achieve this is to put the eyes and teeth in lattices and organize the scene and deformations in a way that makes the eye and teeth geometry the *last* thing in the plug-the-rig-in order to be affected. Before we get too far into the way that they have to fit into the big picture, let's understand how we would get the eyes and teeth into lattices so that they *can* follow the rest of the head around.

Figure 13.12

When you move the top of the head and see things like this, you'll see that you'll need to treat the eyeballs differently.
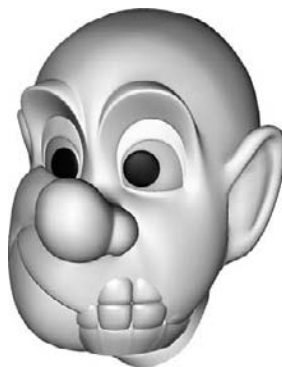
Figure 13.13

When the teeth fall out of the head like this, they are "special" and need more attention.

PROPS

Before we go too far, I must give props where props are due. This technique for getting eyes and teeth to follow a deforming head using lattices was one I picked up many years ago from a colleague named Michael Ferraro. Many people have come to that idea since, but that was a true original at the time.

Lattices

Creating a lattice is quite simple. You first select all the object(s) you want to be affected by the lattice and then select the object you want them affected *by* last. Once you have your selection, in the Animation menu set, choose Create Deformers → Lattice ❏. Anything selected at the time of creation will be affected by the lattice. There aren't right and wrong settings in the Lattice options window since the shape and size of your character will change the needs dramatically, but I can tell you that the Local Divisions setting should be as high as, or *higher* than, the global divisions or your resulting effect will look kind of choppy or jaggy. For the teeth and eyes I did, I went with the options you see in Figure 13.14, most importantly, 7×7×7 in both local and global divisions. I did each eye separately and did the teeth together. In *general*, if you're not getting what you want, make the numbers higher instead of lower as you guess and check.

The lattices will allow us to create a deformation space for the object inside. This means that teeth will be able to bend and flex along with the mouth (gross!) and so will the eyes, allowing us much more freedom on the face in general.

Figure 13.14

My lattice options settings for the teeth and eyes

EYEBALL MOTION CAN BE DONE WITH UVS

The ideas outlined in this chapter are merely one prescribed solution to a well-defined problem. The truth is that there are a *number* of ways to overcome each problem, and for the eyeballs specifically, an alternative I actually recommend as highly as the approach presented here is to handle the eye motion with textures instead of multilevel deformations. You can make the eyes look like they are turning by controlling their UVs with projections so that the true eyeball motion has nothing at all to do with geometry for rotation but instead revolves around (quite literally) projection maps *or* moving UVs directly.
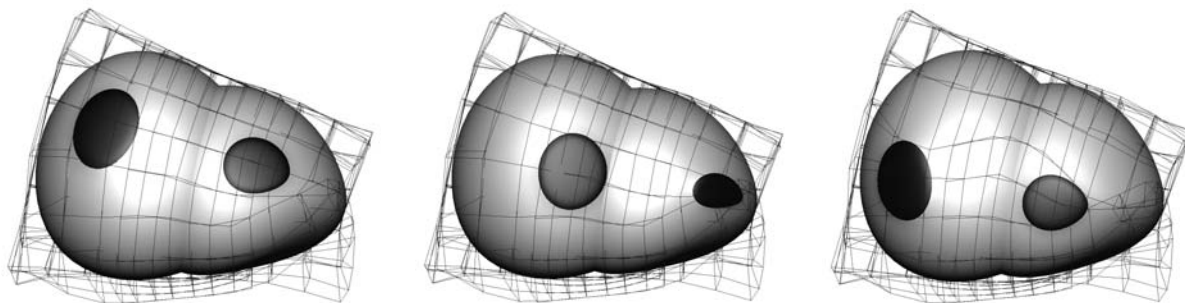
Wrapped eyes rotating in their wrap-defined universe

Wraps

So if we have the eyes and teeth in lattices, how do we ensure that the shape changing is what we *want*—to keep the special objects well planted in the head? The brute-force way is to create blend shapes, each corresponding to the shapes on the head. Ultimately, that gives you the most control, but it isn't always necessary, and even if it is, there is a way to "cheat" and get a lot of that sculpting done for free. In the case of the eyes and teeth, that cheat (and sometimes the full solution) is a simple wrap deformer, which will "stick" the lattices to the deforming head. The effect is usually just what you want, and if it is *not* perfect, the wrap can provide a great starting point to generate blend shape targets. To create a wrap deformer for a lattice, select the lattice and then the head, and then click Create Deformers ➔ Wrap. Repeat as necessary for any lattice that needs it (which is probably all of them). Anything in the lattice should now be affected by anything you do to the head, yet it will still have its own ability to move *inside* the lattice. Figure 13.15 shows how the eyes rotating will remain appropriately deformed.

MULTIWRAPPING

You can connect multiple wraps to a head by this method. Select any or all of the lattices and then the head; then choose Create Deformers ➔ Wrap.

Plugging B, C, D… into A

Once you've identified which objects need special attention, you are ready to really get to the heart of the notion of a global rig as it exists in this chapter. The first thing you'd need to do would be to break out the hierarchy of objects so that in the first hierarchy you'd have the head mesh, in the second you'd have all of your lattices, and in the third you'd have your eyes and teeth, and any other objects that would be in lattices. This type of setup is

your global rig. That's it. If you wanted to do any specific rigging, like the local rig I describe above, you'd duplicate the head mesh and then make that new duplicate a blend shape for the original head mesh. If you set that blend shape slider to 1, everything you do to the duplicate head would always show up on the main head as well, updating in real time, which in turn updates the lattices through wraps and then updates the eyes and teeth. This is really the trick. If you were to have *two* duplicate heads, you'd plug them both in (at the same time, so the blend shape had two sliders—this might mean you would have to delete the existing blend), you'd set both those sliders to 1, and then you'd have the effect of both rigs on your model at once. That is really all there is to it. Affect the visible mesh that in turn affects the lattices that in turn affect the other visible meshes and you've set up a rig that can take a practically infinite number of rigs plugged in together. A view of the Hypergraph showing how you can force all of this through one blend shape is shown in Figure 13.16.

Figure 13.16

You can't read the nodes, but you can see where everything in multiple rigs can come down to one place, a blend shape.
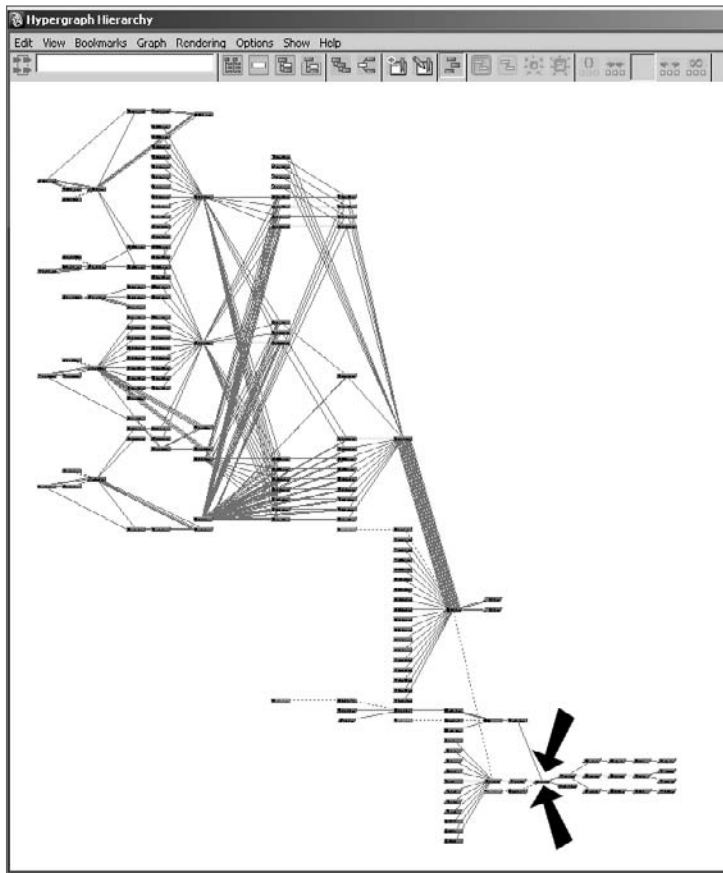
The Elastigirl Parachute

As with any other blend shape, the real limiting factor in a global rig like this is that the shapes you are trying to put together must be blend-shape compatible in their vertex count and vertex order. This means you can rig any one of your heads any way you want, but you can *also* change the shape. You could reshape your character into say, oh, I don't know, a parachute with a face, and then you could rig that parachute portion so that it had all the controls you'd need to manipulate that shape appropriately, as a parachute. Basically, you'd just be creating a new local rig. Then you could simply plug that into your global rig as a blend shape. As you turned that slider up, you'd have a parachute rig for your model with a full set of controls that you can bounce into and out of with a single control. Neat, huh?

The "Real" Character Has *No* Rig!

So, if every single deformation is going to come into the visible character as a blend shape, what does the final rig *really* look like? It can't just be the head, then lattices, then eyeballs and teeth in three hierarchies, can it? Well, it doesn't look like much, but yes, that really is what your global rig looks like. Anything more would come in as local rigs. If you wanted to have the ability to be really quite standard with your character, and also quite squashy-stretchy, but also, say, do something big like have your character turn into a parachute, you would actually need three local rigs, and they'd each affect a different copy of the head. You'd do your weighting and rigging for "basic" motion on rig and head one, you'd do your large distortion/cartoony-type rigging on rig and head two, and you'd do the rig that lets your character turn into a parachute on rig and head three. Then all of those are plugged into the "final" rig, which, as you know, doesn't look too impressive. You may have three different rigs there, but at the end, they all plug into something that is *just a pile a meshes.* The final rig really is nothing. No joints, no nothings. The one thing it may have is lattices to keep the eyes, tongue, and teeth in, but that's it; no real rigging at all.

Anytime You Rig Something, It's Just a Plug

Let me reiterate this point, as it's so simple it can seem easy to miss. Create any rig you want, but rig a *copy* of the head, not the head itself. Then select all the duplicate heads followed by the real head and create a blend shape. Set some or all of the sliders to 1, and you're working with more than one rig at once—and that is where you can really create the squash-stretch feel.

Not Using Wraps Changes a Few Things

Sometimes, as I mentioned earlier, you may need to create blend shapes for your lattices instead of just having them follow the head with wrap deformers. If this is the case, you'd just sculpt the lattice to match each shape with the head but then plug them all in as blends

to the real lattice. If you do this, you actually have two issues to overcome. The first is reasonably simple, and it is that you'll need to use the Connection Editor to connect the blend shapes on the lattice to those on the head so they trigger at the same time (this is exactly the same as having a separate brow object get connected, which I went over in Chapter 9). The other problem is bigger: you need to shuffle the hierarchies around. You'd need to move the lattice into the hierarchy with the head, and anytime you bound that head to a joint, or do anything else to it, you'd need to do it to the lattice as well. This is so that when you plug more than one rig in as a blend, you absolutely *must* be creating all your motion on the point level.

Point-Level Rigging

Point-level rigging is a huge gotcha if you aren't using wraps to keep the lattices in place. Because everything needs to be funneled through at the end of the line as a blend shape, all point *motion* must be through point *deformation*, meaning it happens to the shape node and not the transform. Remember in Chapter 6 where I talked a lot about how shapes are additive and everything really is simply added together on the vertex level? What I'm saying now about point-level rigging is completely derivative of that discussion. If two points are in a certain position but are getting there through different local spaces, that means the addition per point is not the same, and when you plug those two points into a blend shape, they stay together as they move. But really, what the heck am I talking about? Parenting.

No Parenting to Joints

In most rigs, even mine discussed in other chapters, you are usually told to parent things that can be parented. It runs a little faster interactively in the scene, and well, if you can just parent some geometry to some joints, why not? The problem is, if you parent something like the eyes to eye joints in rig one and then bend and twist them to be squishy in rig two, the eyes will basically "fall out" of any blend that has both rigs plugged in at once, and that is annoying and confusing.

Tutorial: Rigging Squoosh

That was a lot of information to parse all at once, so let's go through a series of decisions and steps that churn out a global rig and a local rig. I'm then including a problem and solution you'll run into regarding the teeth. After all this, we'll make a silly second local rig and plug it into the global rig alongside the first local rig, and after all that, you should be pretty informed on how to do this on your own characters whenever and however you want. To start, open `tutorial_1.ma`, which should look just like Figure 13.17.
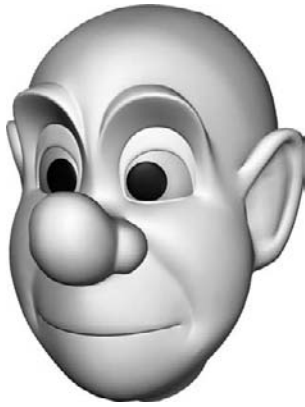
Figure 13.17

Squoosh as he appears in `tutorial_1.ma`
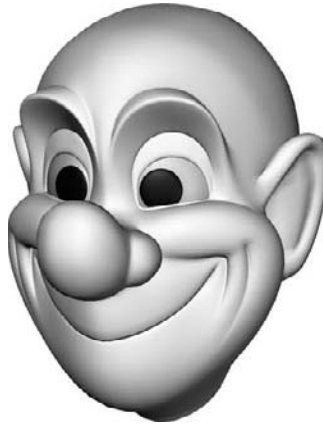
Figure 13.18

Squoosh's big smile will require the use of blend taper to avoid sync problems.

Taper Big Shapes

If you play in the Blend Shape Editor, you may notice that there is a shape that is really "big" in its execution, the Smile, shown in Figure 13.18. As I mentioned earlier, these are the kind of shapes that you'll need to use with blend taper to separate out the portions that will and will not affect sync. To do this, you'll need to "bake" *all* the shapes out so you can work with them. Take each blend shape slider in turn and set it to 1, with all others set to 0. Duplicate the head only, base, and then rename the duplicate for the shape you have set to 1. This should give you a head called smile, a head called browsDn, a head called open, and a head called narrow. Another way to accomplish this baking is to hit the Bake button on the SS2 shelf.

On a regular head, you'd have more than this many shapes, but this is just a tutorial. Now, with all blend shape sliders set to 0, duplicate base one more time; this new duplicate is the head you will use to taper with. If you space the heads out, you should have what looks something like Figure 13.19. The newest head is the one on which you will paint the lips and cheeks apart from each other; name it blender.
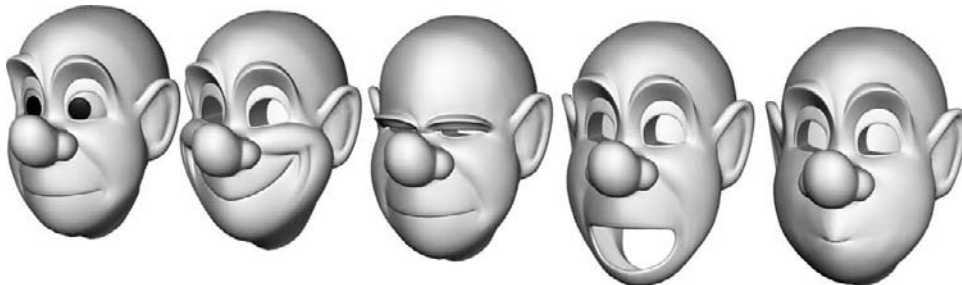
Figure 13.19

All Squoosh's example shapes baked out
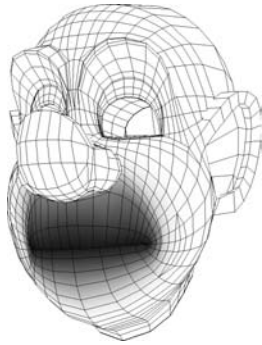
Figure 13.20
The lip area painted with the Paint Blend Shape Weights tool
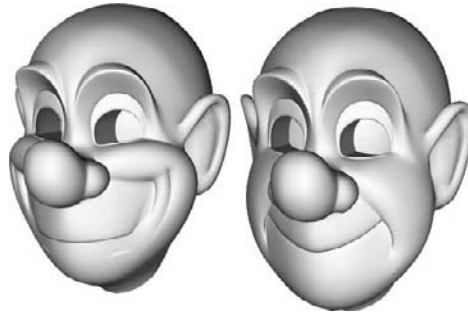
Figure 13.21
Two new shapes, smileNoCheeks and smileNoLips

Make *only* the new smile a blend shape for blender; you only need to paint the lip effect out from the big shapes, and each big head may or may not require its own painting. Now, in the Paint Blend Shape Weights tool, paint out the lip area as shown in Figure 13.20. Be sure you get the *inside* of the lips too. As you play in the Blend Shape Editor, with the slider for smile on blender, you should see just the cheeks move. Once you're happy with the effect, press Taper on the SS2 shelf and you should now have two new shapes, one with the lips, one with the cheeks. Rename them smileNoCheeks and smileNoLips; your scene should look like Figure 13.21.

To compare what you've done to a scene with this work completed to the end of this step, see tutorial_2.ma. After you've verified that what you have done matches up with the example scene, you can delete blender if you like; we're done with it.

You are pretty much ready to roll here as far as blends go and get one of your local rigs done. Duplicate your head mesh base (make sure all the blends are set to 0 again), and name the new object mainRig. Make the narrow, open, smileNoCheeks, smileNoLips and browsDn blend shapes for mainRig. You can delete those objects and base, now. You're done with them; they're stored as needed on mainRig.

USING ADD INSTEAD OF BAKING SHAPES OUT AND RE-CREATING THE BLEND

It is *sometimes* possible to simply duplicate the taper shapes like the smile, do the taper work, then add them back into the head using the blend shape add functionality (Edit Deformers → Blend Shape → Add), but in my experience, that is an unpredictable path, and a better practice is just to go with what works 100 percent of the time, the full re-creation of the blends.
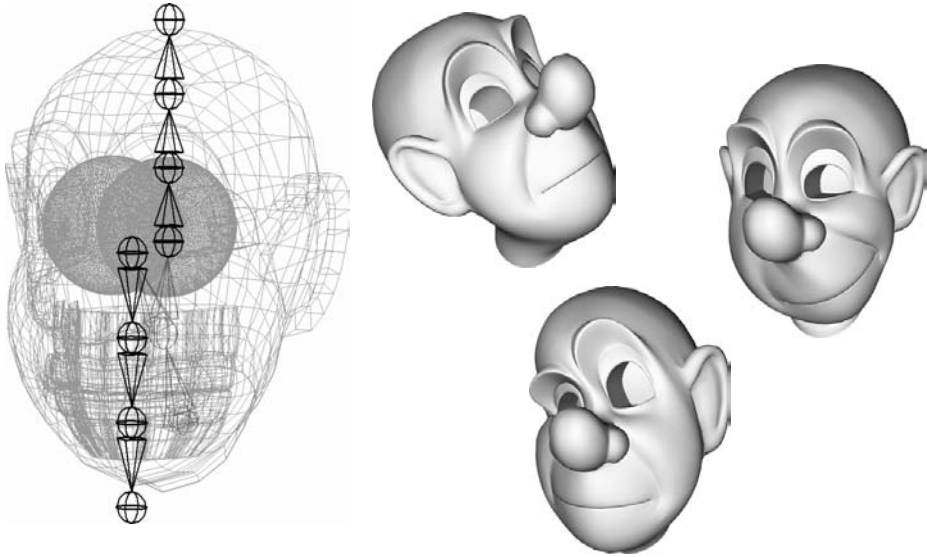
Make a Skeleton

At this point, build Squoosh a skeleton as I described earlier in this chapter in "Local Rigs." Create a root, then a neck and a head, then two chains, one each up and down through the head. Figure 13.22 shows what my skeleton looks like and some poses with the weighting done. Weight only mainRig to the skeleton, just that one model of the head.

Identify "Specials"

Save your scene. If you care to confirm yours against mine at this step, `tutorial_3.ma` is what your scene *should* look like after the previous work. After you check your scene, reload it or just continue with mine. Now that we have cleared the way on our big shapes, the next thing to do is to identify the objects that will need to move independently from the major head motion. By translating, rotating, and scaling things and playing with the blend shapes, it should become apparent that the special objects are the teeth and the eyes, named topTeeth, botTeeth, leftEye and rightEye, all high-lighted in Figure 13.23.

leftEye

rightEye

topTeeth

botTeeth
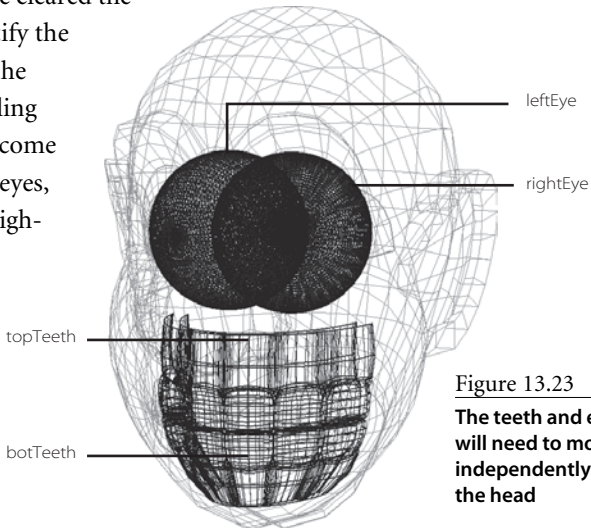
Figure 13.23

The teeth and eyes will need to move independently of the head

Create Lattices

Once the work of identification is done, time to begin *doing* something about the special objects—cramming them into lattices. Select the leftEye and create a lattice that is 7×7×7 and 7×7×7. Do the same on the rightEye, then do the same to the teeth (do the top and bottom teeth together). When done, your scene should look like `tutorial_4.ma`. Confirm that the lattices are working by "noodling" with them; just pull lattice points around and watch the objects inside deform, just as in Figure 13.24. Either undo to get rid of those manipulations, or with each lattice selected, reset them by pressing Edit Deformers → Lattice → Reset.Lattice.

Make Wraps

Duplicate your head mesh, base (make sure all the blends are set to 0 again), and name the new object finalHead. finalHead will be the final destination for all the deformations we'll do from blends, lattices, and skeletons.

Now that we have the special objects in lattices, we need a way to ensure that those lattices will follow the new head, finalHead. Select all the lattices, then finalHead, and create a wrap deformer. This action should "stick" the eye and teeth lattices to finalHead, and this in turn effectively "sticks" the eye and teeth geometry to the head as well. As you might expect, scaling, rotating, or translating finalHead should now also move the lattices and in turn the eyes and teeth.

If you play with the blend shape sliders for smile, browsDn, and so on, you should see that those blend shapes and the skeleton are *not* causing finalHead to change shape. They are causing mainRig to move, meaning that the lattices are not keeping aligned with finalHead, as you can see in Figure 13.25. That is

Figure 13.24

Yanking lattice bits to confirm they work can be fun.

expected, and it is because the facial expression blend shapes and skeleton are part of a *local* rig, mainRig, and in this step, we are prepping our *global* rig. To fix this, select mainRig and then finalHead, create a blendShape, and then hide mainRig. In the Blend Shape Editor window, the new blendShape should have only one slider called mainRig; set it to 1. This time, when you move the blend shape sliders for the face poses, you should see finalHead deform. *Also* this time, along with finalHead's changes, you should, as in Figure 13.26, see the eyes and teeth do their thing too. Play with the blend shape sliders until you get a pose with the mouth open; the specifics of the pose besides "open" don't matter

much. Select the teeth objects, topTeeth and botTeeth, and notice that if you scale them in Y (a few scales are shown in Figure 13.27), it creates the effect of the teeth clenching and unclenching. Feel free to select the eyeballs leftEye and rightEye and see how you can rotate them regardless of the pose the face blends are in (Figure 13.28). This effect is precisely *why* these objects are in lattices. Get the teeth back to scale of 1, 1, 1 and the eyes back to rotations of 0, 0, 0 before moving to the next step.

Figure 13.25
Lattices not following along

Figure 13.26
The eye and teeth lattices following with the rest of the head

Figure 13.27
When the tooth objects are scaled, they can occupy more or less of the mouth.
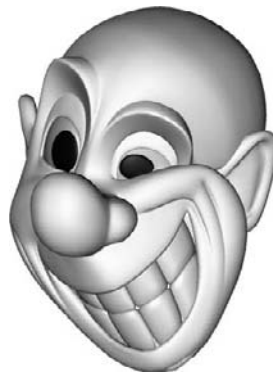
Figure 13.28
When rotating, the eye objects stay in the head

Hierarchies

Now to take the different things happening and separate out the general functionality into hierarchies to more easily manage our deformations. The objects finalHead and mainRig should be left all by themselves. Then you should group all the lattices together and name that hierarchy lattices. Next, group the eye and teeth geometry and call that group renderables. For all intents and purposes, you are finished in creating your global rig, and you already have one local rig plugged in; that is base. A scene to compare against is `tutorial_5.ma`.

Making the Teeth Behave

The eyes and teeth in this setup, and usually any of the objects that end up in lattices, probably require some of their own setup. And not all of it should be "canned," meaning some problem solving is required before you can decide how you want it to work. The teeth for this character present an easy solution. We need them not to simply "grow" whenever the mouth opens. That just means we need to set up an animation relationship between them and the open shape. Relationships of this type are easily authored and edited with driven keys.

Open the UI for driven keys, choose Animate → Set Driven Key → Set. Select the teeth objects, botTeeth and topTeeth, and then choose Load Driven in the Set Driven Key window. Now select the blend shape with the face poses. Once you select the names of the objects in this window, their usable attributes show up on the right side of the window. For the teeth to stay a size/shape like teeth, you need to first select the open shape as the driver, and for the two objects being driven, select scaleY. That should make the UI look like Figure 13.29. Press the Key button with the open shape not active and the scales at 1. Now, change the values for the open shape to 1 and scale the teeth to where you think they look good; I chose 0.66 for the lower teeth and 0.75 for the top. Set the open shape to different values and scale the teeth at each pose to be the scale what you want them to be. The scene in `tutorial_6.ma` shows what I did with driven keys, and Figure 13.30 is a snapshot of the animation curves created. Change the value of the open blend shape to see it working dynamically.

Figure 13.29

The Set Driven Key window with faceShape → open set as the driver
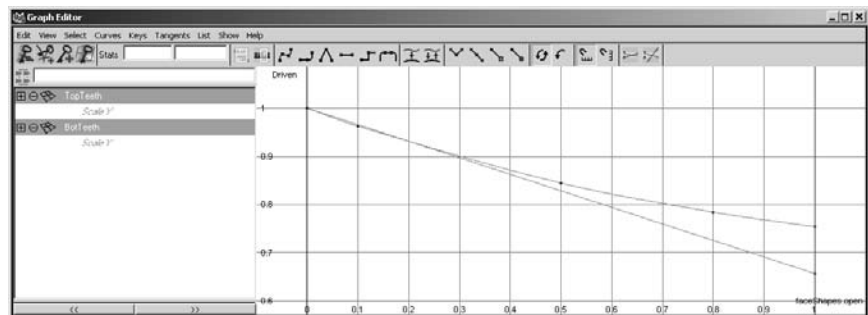
Figure 13.30

The resulting animation curves in the Graph Editor
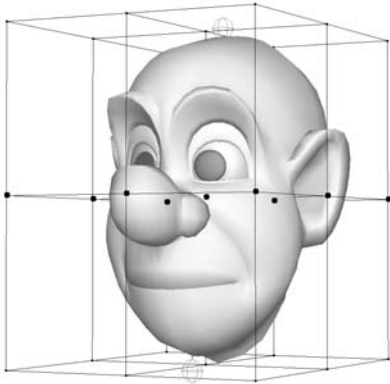
Figure 13.31

Select the "equator" points shown here.
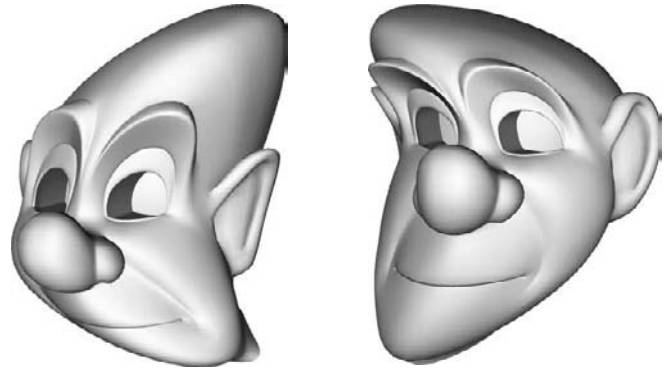
Figure 13.32

The simple lattice rig lets you deform the character in a big way.

Adding More Rigs: The Real Fun

So far, this really only gives us *one* local rig, mainRig, to plug into our global rig, final-Head. You could easily just make the lattice and wrap follow mainRig instead of finalHead and get the exact same result—for this. Remember, though, that mainRig is a local rig and finalHead is a global rig. That means that you can do more to finalHead, where mainRig is pretty much tapped out. Let's create an example to show the ability to do more. With all the blend shape sliders set to 0, duplicate mainRig, unhide the duplicate, and name the new object blah. Create a lattice for blah but make it 3×3×3 and 3×3×3. This creates pretty much a single cross-section per direction in the lattice. Select the "equator" points, seen in Figure 13.31, and then choose Create Deformers → Cluster.

Now when you move the cluster handle, you should be able to get an effect like those seen in Figure 13.32.

Reset all blend shape sliders to 0, and delete the blend shape that pipes mainRig into finalHead (the one that only has one slider named mainRig). Now, select mainRig *and* blah and create a blend shape using those for finalHead. Set both sliders on the new blend shape, named mainRig and finalHead, to 1 so they are both always on.

Hide both blah and mainRig, if you haven't already done so.

Now as you move the cluster, you see the warping effect occur on finalHead. If you *also* mess with the face shapes, and/or the joints for mainRig, you'll see that effect show up *as well*. Some combos are seen in Figure 13.33. A finished version of this can be found in `tutorial_7.ma`.
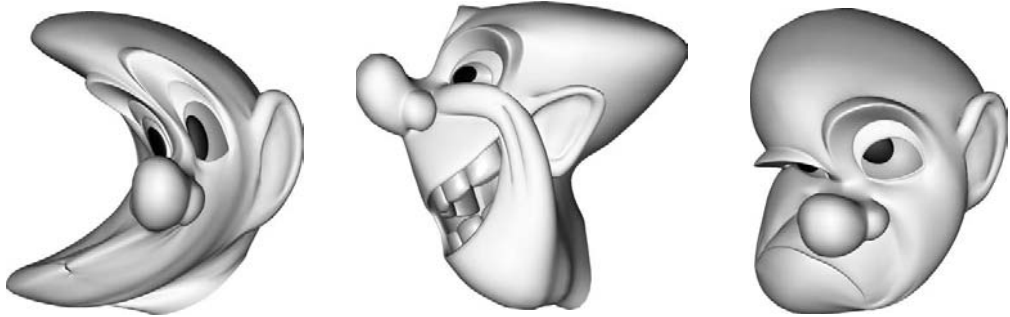
There you go! That's it! You can now create funneled, or compound, blend shapes that let you create any rig or group of rigs for any shot, and you can bounce to and from each with ease! Your Squashy-Stretchy-Squooshy training is complete.

Gotchas

The main object of focus in this section is the teeth. The teeth, with this new concept, are going to follow along with the entire shape of the mouth and face. They will track along in the 3D space the overall motion of everything that surrounds them. This makes the teeth stretch and pull to anything you may do with them, which can be a good thing depending on the scene. This, however, creates the need to scale the teeth, which is weird, but it's what you will need to do to make them look like they are *not* being weird.

Pivot Location

It's a freebie in the tutorial since I gave you models set up this way, but if you intend to set up your own teeth, it is important to note that the pivot location is absolutely critical if you want to scale the teeth to clench them and then keep them the right scale for generic opening and closing of the mouth. The pivot must be, vertically, where you want them to scale down to, so scaling should pull the upper teeth up and the lower teeth down. Figure 13.34 shows the pivots on my models.

Tooth Line and Tooth Scale

You may need driven keys to keep a good scale for the teeth based on the Open shape, but you may also want to have a control for a tooth line (Figure 13.35) and/or a tooth scale (Figure 13.36), so that you can (a) vertically adjust the location where the teeth meet, and (b) adjust the scale or clench on top of the normal behavior. Along with this, any other number of shapes might be something you want to influence the teeth with. Using driven keys as described in the tutorial will work for all of these, even if you use custom controls made using the Ctrls shelf button, covered in Chapter 12 (for this purpose, you should connect to the control widget itself using driven keys and *not* using my control connect window).
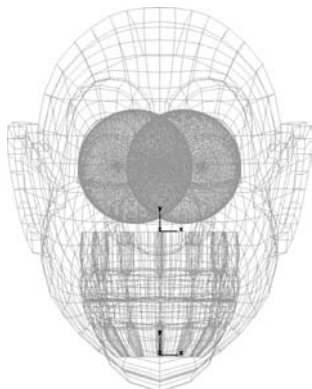
Figure 13.34
Pivots for the top and bottom teeth on Squoosh
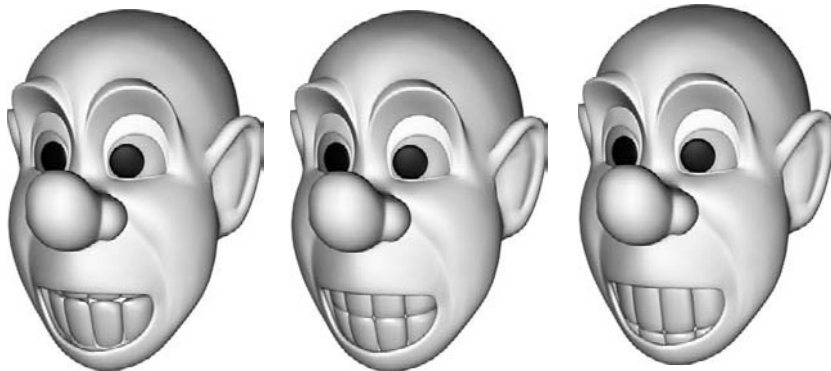
Figure 13.35
A few images of the tooth line moving up and down
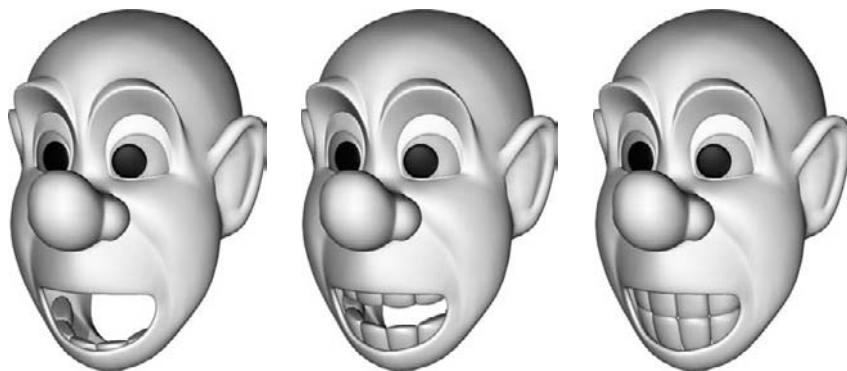
Figure 13.36
This is the effect of the tooth scale

To create driven keys to affect the teeth from more than one source, you will need to set a preference. Otherwise, each new driven key object and attribute relationship will destroy the old one. To set or confirm this preference, go to Window → Settings/Preferences → Preferences. In the Preferences window, select Animation from the left column, and in the lower half of the window, you have an Animation Blending section. Set the radio button to Always Blend with Existing Connections, as shown in Figure 13.37. Now when you create new driven keys, all effects will be compound. Of note, you may want to set that blending option back to one of the other two options for general Maya use after setting up your teeth driven keys. The Always Blend setting can easily break most character rigs; it's a bit of a nuclear setting.

A scene with these teeth driven keys is set up for you to look at in `toothCtrls_drivenKeys.ma`.
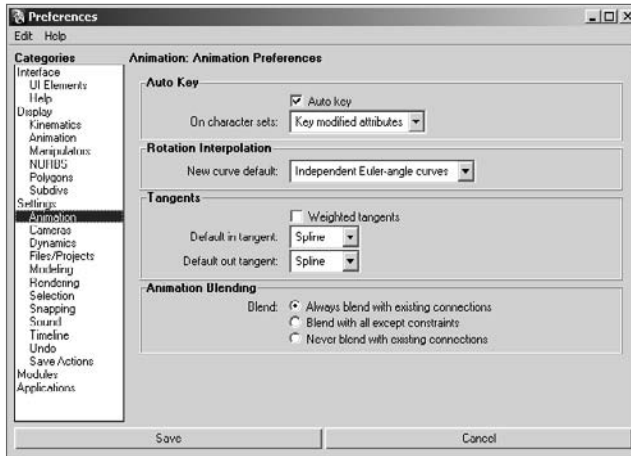
Limiting

The only gotcha left here with all this teeth functionality is finding ways to easily control when numbers go higher or lower than you might want and end up with the teeth colliding or scaling backwards and popping out of the top or bottom of the face. Instead of a lot of detailed instruction here, I'll give you an overview and point you at a tool to do the work.

What you need is two general limiting factors, one that says, "teeth, don't scale negatively," and another that keeps them from overlapping when they want to scale through each other. The first is easy—attribute limits can handle that—but the second is trickier in that you need to pick a dominant scale, that of the upper or lower teeth, and when push literally comes to shove, the dominant teeth push the submissive teeth. The way to do this is to set up an inverse limit, where if one set of teeth is at 1, the other can also be at 1, but if the dominant teeth go to 1.5, the submissive teeth are limited to 0.5. The tool provided to do this is on the SS2 shelf and labeled thLim. To use thLim, select the teeth in order of submissive, dominant, and click the button. Do this *after* you've created all the driven keys you want. Now you should have two sets of teeth happily fighting for space in the mouth. A scene set up and ready for examination can be found in toothCtrls_all.ma

Deformation Order

If you find deformations are looking really compounded and are constantly freaking out, try changing your deformation order. Right-click over your head, and select inputs → all inputs. Once inside the window that appears, you can use the middle mouse button to slide inputs up and down. Generally, when the stuff from this chapter looks wrong, you just need to make sure that your skinCluster occurs *before* your blendShape on any local rigs.

A Shot in Production

Here in the final chapter, I'll take you through five animations using the techniques I've described. Whenever those techniques work particularly well, or need to be ignored, or are amplified, I'll point it out and discuss the how and the why. This chapter is all about the doing, the art, the acting, and the performing. I am by no means God's gift to animation, but I do okay making a talking head look like a living one and not just a set of gums flapping. That *life* factor is going to be most of my focus here; I'm concerned mostly with the character's *head space*, the emotional outlook.

Box Head should be suitable for any and all of these scenes if you want a simpler character to get some performance practice with. The last two scenes are Pete and Sally Ann (toon) bits. They are here to show examples of another style and how the same basic techniques carry through. I have worked with all kinds of humans and animals in all kinds of ranges and styles, and I can comfortably tell you that when it comes to facial performance, it's all different flavors of the same thing; it's just a matter of what the director wants.

- **Scene 1: Bartender**
- **Scene 2: Lack of Dialogue**
- **Scene 3: Dunce Cap**
- **Scene 4: Salty Old Sea Captain**
- **Scene 5: Pink or Blue?**

Scene 1: Bartender

So this floating head walks into a bar, and the bartender says, "Hey, buddy! … You know what? I don't have anything. This is… I really don't. If I had legs, I would leave."
(*Voice performance by Jason Osipa*)

You can load `Bartender.mov` from the Chapter 14 folder on the companion CD to see my take on the animation and `Bartender.wav` for the audio file alone. Figure 14.1 shows a selection of frames from this piece.

With all of the scenes I talk about here, I can't stress enough that you really need to watch the animations on the CD to truly follow the discussion. It's one thing to read about motion and see snapshots of it, but we're dealing with the topic of living sounds and pictures, and for this chapter to have the most value, you've got to watch the movies.

Sync Special Cases

The vast majority of this sync is very much just following the style and techniques I've laid out already. I found the visimes, worked with the syllables, and had a talking character when I was done. There were, however, a few places where it needed some extra love. The R in the word *bar* really looked weird. Going back to the ideas in Chapter 4 ("Visimes and Lip Sync Technique") about R, I decided to add some height, although I left the width mostly narrow. This led me to a slightly weird shape, and I took a stab at widening the mouth a little bit, out to about default width. That worked for me. Figure 14.2 shows a short sequence of images for the word *bar*.

The next spot that was tricky was the quick little "This is… I." Those sounds and shapes are all IHs and EEs, which, like any similar repeated sounds, are never too easy to sync well. This is a case where I polarized what each of the shapes is. That way, all the shapes are Wide and Tall, but they're not all at the same width and height. I emphasized the height quite strongly during IH (taller) from "this," then let the height drop and made the mouth wide for "is." At the start of the "I" (AH-EE), I let the mouth narrow much more than I would in

Figure 14.1
A few frames from "Bartender"
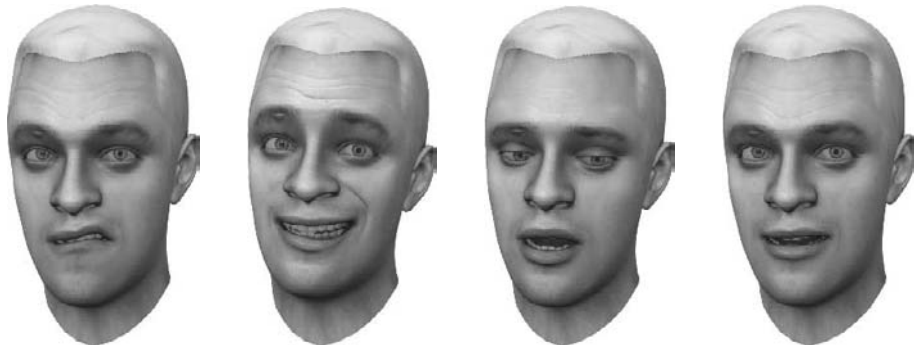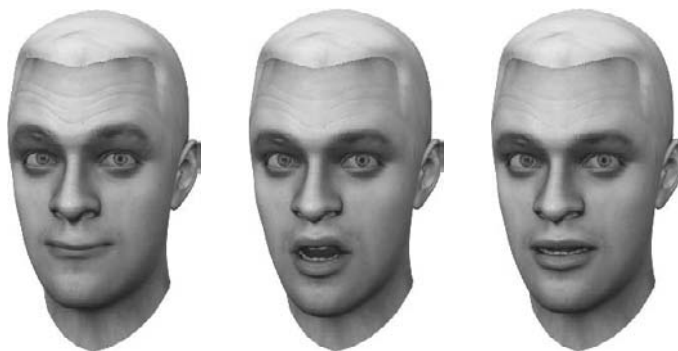
a different context, basically using opposites to strengthen the surrounding shapes. This let me go at the third Wide/Tall shape with strength in both height *and* width. Each of the three shapes ended up different even though they would have all been the same—or much more similar—had I left it with just basic analysis of sound-to-Visime relationships.

Figure 14.3
The breath will benefit from a lead-in shape that is more closed.

I held the mouth closed in the pause after "I really don't." Pauses force you to make a decision: Do I want to lead into the following sound early, or do I want to hold the shape of the preceding sound? You can't really float slowly from one shape to the next—drifts look strange; you need to choose break points, places where the expression changes more quickly. I held his mouth closed until the breath before the last line. That also provided a strong look for the breath instead of the mouth already being open and then just opening more (Figure 14.3).

The last place there was something interesting with sync was on the very, very last sound, the V from *leave*. This sound in the vocal performance trails off here so badly that you almost can't hear the word. I've put this in to demonstrate a point: In real production, things like this actually happen. Actors don't give you exactly what the director or writers imagined in their heads; they emphasize different words, pause unexpectedly, enunciate inconsistently. And no matter how professional or expensive the production, there will always be some point when there's no time left to reshoot or rerecord! (Sometimes actors' interpretations work in your favor; for example, in the "Pink or Blue?" scene later in this chapter, you'll see how an unplanned pause opens up a fantastic animation opportunity.)

So here, the end of the spoken line trails off. Instead of fighting that fact, I filled in the missing sound with animation. The V, although almost inaudible, is brought back to the forefront because I made it look as if it were a loud F; see Figure 14.4.

Figure 14.4
I animated a sound that wasn't there to clarify that it *should* **have been, helping the audience to more clearly hear the line.**

Doing this can help the audience "hear" the sound—help their brains recognize the word—even though they can't literally hear it. You can't and shouldn't do this with all sounds—you want to sync what's really there, not what's *supposed* to be there—but if it's at the end of a phrase, and it helps the audience understand the line, go for it.

Head Tilts

I've got more to talk about in terms of timing than anything else in this subtopic. My own voice, my cadence, is pretty weird. I've never synced to someone who says things quite like me. (Frankly, I'm not totally convinced I'm a very good voice actor. My mom says I am, but still…) With tilting the head through tonal shifts, my performance has an interesting problem. I do a lot of shifting in volume, but not as much in tone. If you strictly follow my advice, you get a string of places in a row that feel like they *should* be where you shift the tilt of the head up and down, but you're not quite sure. What I did (which is just one approach) was to use the first of those "maybe" spots to start a move and then to finish it on the last of them. For example, in the sound "and the bartender says," I say *bar* with a big shift in volume, but it's the same tone as the words before. I then give a little tonal hop upward during *TENder*. This gives me two places in rapid succession that feel like either one could be the place to raise the head. I started to tilt up at the start of *bar* and stopped that move on *ten*.

For "Hey buddy," I again just spoke louder. I didn't really change tone so much, so even though it felt like it might be a place to tilt the head, I only did it very, very slightly. Next, I moved the head down quickly and slightly as the character locks up, loses his train of thought. Moving him down to get into that pause, and then holding the motion very tightly, basically freezing him, emphasizes the feeling of being "stopped in his tracks." Figure 14.5 shows that poor little deer in headlights. The rest of the scene really just followed techniques I've talked about before!

Eyes

Seeing as this had only one major focus or eyeline—the audience—this wasn't too hard a step. I started the eyes down and to (screen) left just because I wanted him to catch your attention during the start of the scene. If he was already looking at you, that might not have happened. This is a case of that whole "If you don't know where it came from, you don't know where it is" thing, landmarking. Figure 14.6 shows the two eyelines.

I darted his eyes around quickly on "and the bartender says" because I chose to create a subtext right off the bat, that this guy doesn't know where he's going with this. I started seeing more of the performance I wanted to create when I did this: He starts just talking, then he gets excited as he thinks he knows what he's going to say (the darting). He's going to focus that back on the audience, and then, when that focus breaks, he's going to keep

Figure 14.5

The man is all out of ideas.

his eyes low, or away from the audience. After his head drops, I then have his eyes point back at the audience at the start of his next line, "You know what." From here until the end of the scene, I don't let him hold a stare with the audience too long.

In the next scene, where there's dialogue instead of just monologue, I'll talk about how characters hand the conversation back and forth. Because I don't let this guy hold the audience in a look, he internalizes what's going on; he's not communicating as clearly or forcefully.

Figure 14.6
The eyeline starts out low so it can move to land on the audience.

Lids

By the time I got to the lids, I really had a strong idea of the ups and downs in emotion I wanted to portray, so I just punctuated those. I kept his lids pretty level for the first part, and then widened them for "and the bartender says" as he gets excited—because, remember, lids, not brows, show that. After that, I just returned the lids to a comfortable level and left them there. My voice performance and the scene didn't provide much more opportunity than that for lots of lids action.

With the squint, I crept it up to create a more eyes-type smile in the first half (Figure 14.7), so when I remove that in the second half, there's an extra little bit of a difference you *feel*, if not consciously register, as a difference.

Figure 14.7
Two levels of squint

Brows

This guy is trying to tell a joke—the operative word being *trying*. I'll talk more about this in the following scene, but we can often use our brows to signify a loose end, something left requiring conclusion. When the brows raise here, he's thinking and talking, but he's not sure where he's going. For a brief moment, when he feels he actually has control of the situation—the shift toward excitement during "and the bartender says"—he drops his brows. Even though he's excited, he's gained some control. To me, the control portion is the more important one; excitement is more of a reaction than an intention, and I lean toward the intentions for my acting choices. So, during the excitement, I dropped the brows to a more comfortable level, which gives the emotion in the scene some variety too.

Later, when the character exhales (usually a smart place to relax the whole face), I actually moved the brows toward a slightly sadder shape (Figure 14.8). I did this at the same time I dropped the brows so it looked like a relaxation, but one that occurred mostly on the outsides of the brows.

Mouth Emotion

It would have been easy to start the scene smiling and keep it there until the shift in the middle, but I think that would have been boring, too homogenous. Again, just as with the eyes, unless you know where you came from, you don't know where you are. By letting the smile increase in little increments toward the portion of the scene where he feels like he's in control, viewers might be coaxed into smiling too. Figure 14.9 shows the places I notched it up.

Just as a laugh can be contagious, so can a smile. By having it grow instead of just immediately exist, you can better lead your audience along with you through the emotions in a scene. (I often get a kick out of watching people watching my animations, contorting their faces along with what the on-screen character is doing!) Making the smile a sideways one, a real smirk, makes this a more playful thought, as opposed to, say, a happy one. When this guy hits that pause where he gets stuck, I kept the smile going. My first instinct was to pop the smile down a bit—create less of a smile in that dead space—but after doing that, and watching it that way, I wasn't sold, and I decided instead to just freeze him in his tracks.

For the rest of the scene I left the mouth just a hair toward frown, but not so much that he looked pouty. The only place I wanted to break him out of that frown was somewhere in the last line, but I hadn't decided exactly where. He's given up, he's finished. When people are in that state they smile a nervous smile. Part of what can make a smile nervous is that it's a smaller smile, and it's crooked, and it also doesn't hang around for long. I decided to smile on the word *legs*, mostly because of the fact that it hangs in the air. I like to express in the dead (quiet) spots, so I just got him into a smile for that moment and then rolled right back out of it as soon as he continued talking.

Figure 14.8

The raised and then dropped brows, the motion where I hid the sad transition, so it looked like a release instead of a flex

Figure 14.9

A few frames where you can see the increases in the smile
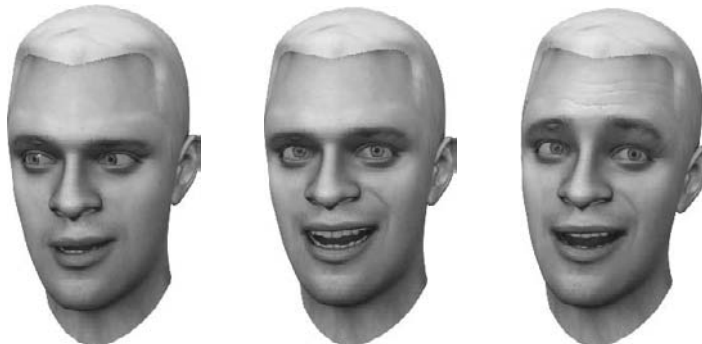
Other Tilts and Finesse

As will be the pattern in this chapter, I actually worked my overall finesse into the initial discussion, which is indicated whenever I say I tried X, then changed it to Y. The last step I want to talk about is the left-to-right twists and tilts of the head. When I say twist, I mean like shaking your head no, and when I say tilts in this last section and the final sections in the scenes to follow, I mean the left-to-right tilts like a metronome.

The first place I made a significant tilt here was in the section where he says, "Hey buddy." There is another scene later on where a character talks as if she was another character ("Scene 5: Pink or Blue?"), sort of like an impression but not really; she's speaking outside of herself. In the Bartender scene, to help draw the line and differentiate that shift, I tilted his head over. Besides the voice, which obviously makes that acting difference identifiable, the tilt in the head just turns this guy askew. There's something different—for this portion of line, he *is* different. For the rest of the scene, as far as left-to-right tilts, he stays pretty central.

With the shaking of the head, here's a situation where I go with a tried-and-true method of my own personal style. If a character is saying something negative, they shake their head. As this guy says, "I don't have anything," he gives that noggin a little shake. This isn't a universal rule or anything, just something I do that seems to work pretty well most of the time.

Scene 2: Lack of Dialogue

One: "So, you hang out here often?"

Two: "Yeah, yeah, I'm not really privy to movement."

One: "Oh, yeah, I, I can see."

Two: "Yeah, it's… you know, that's the way it is sometimes."

One: "Yeah."

Two: <cough>

One: "So, uh, what brings you to the neighborhood?"

Two: "Oo, lack of dialogue."

One: "Oh, oh, so… uh, it's going to be you and me?"

Two: "Yeah."

One: "I guess me and me?"

Two: "Yeah."

One: <laughs> "That's kind of funny."

Two: "No it's not."

(Voice performance by Jason Osipa)

Figure 14.10

A few frames from "Lack of Dialogue"

You can load `Dialogue.mov` from the Chapter 14 folder to see my take on the animation and `Dialogue.wav` for the audio file alone. Figure 14.10 shows a selection of frames from this piece.

Another fine vocal performance just begging for a little animation. This one's a two-character shot, so if you're following along, I recommend doing each character separately and approximating eyelines at first. When you think you're close to done, bring the two together and tidy it all up; get your eyelines worked out and any last final touches that only become apparent as the two characters exist together. With this scene more than any other here, I suggest you animate a version yourself first and then come back and look at what I did, just to see where ideas ran parallel and where they were completely different.

Sync Special Cases

We'll start with Character One, the head on screen left. His first line is "Yeah, yeah, I'm not really privy..." The very first sound a character makes in a scene can often be the hardest to get right in the sync, and here's why: Once a character is talking, it's easier to continue a flow and maintain that illusion, but initiating the sense that the sound is coming

out of the character's mouth can sometimes be hard. My own vocal performance makes this extra difficult because I ease into the first sound with some hesitation. Instead of saying "yeah," I actually say "eeeyeah," making it hard to identify a solid start point.

What I do in this type of situation is go in and key the shape where the sound *is* definite—in this case, near the EE (eey*EE*ah). This starts way too late for the sounds preceding that. What I actually did to overcome that was create another (subtle) EE shape for the very start of the word. To make that have a good effect, I then had to make sure the mouth was keyed a little bit narrower immediately preceding that first EE so that when it widened, you would notice; keep in mind that this is all very subtle. Working out of order like this is perfectly normal. You may not know how you want to *lead into* a word until after you've animated it!

"That's the way it is sometimes…"

This phrase only has major width variation on the W in *way*, so it gets very repetitive visually since it consists mostly of just the jaw flapping with a wide shape. To beat this, I used the technique of opposites and made some mouth shapes narrower between the strongest wide sounds.

The Cough

I like coughs, but I hate coughs. They're great for character, but I find them hard to animate. This one, I think could still use work; Figure 14.11 shows a few frames of it.

The problem with a cough is, there's no shape for which you can say, "That's it exactly!" so whatever one you pick usually looks weird. I find that often the best way to sell a cough is to cover the mouth with the character's hand (that is, if they have hands). As I said, I'm still not sold on this. I just went from a wide(r) shape to a narrower shape, which was decided merely by trial-and-error.

Neighborhood

What an ugly, ugly word and ugly, ugly delivery. It happens; not all sync is simple. *Neighborhood* has a wide-narrow-narrow sequence, making it seemingly easy, but the B gets in the middle and messes it all up by adding a need for contrasty movement in the middle of something otherwise smooth. To analyze it by visime, you'd end up with something like EH-B-OH-OO, but the B makes the word stylistically more contrasty, and so the OH-OO at the end, which to me feels

Figure 14.11

Three frames of a cough
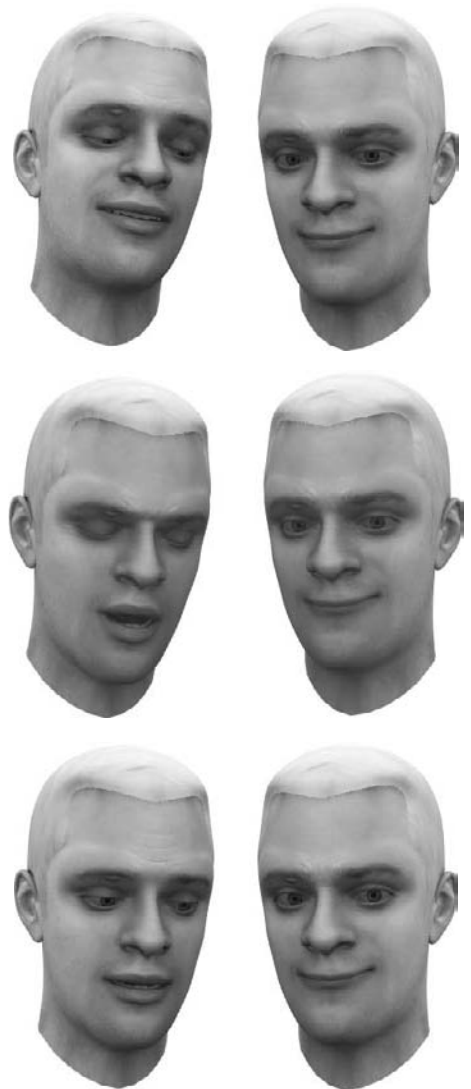
like it should really be a smooth motion, needs to be made choppier to match the look of the B. If we just rolled through the OH-OO, it probably wouldn't look right. What's worse is that trying to widen the mouth on the H, to create more contrast, doesn't work either.

With this I used stepping, very carefully, and held the OH for as long as I could, and then jumped quickly into the OO. I originally had a little widening and opening to emphasize the D, but with the speed of all the speech going on, it just looked like a mistake. So instead, at the end of the word I just eased out, without being *too* floaty in my animation.

Character Two

Nothing too fancy came up with this guy, up until the end of "lack of dialogue."

I really hit the mouth clicking noise at the end of the word "dialogue"—yes, the G sound, the no-visime example sound G. The reason is that even though G isn't a visime, if I didn't do that, the word would just look like *dialoo* or *dialaw*. Widening the mouth at the end would make it look like *dialoee*, so I just snapped the mouth open after the G sound, and that worked.

Other than that, Character Two's sync was simple and by the book! (By *this* book, anyway.)

Head Tilts

In regard to the forward and back movements, what can I say? I animated up and down to the tones in the recording and then amplified and minimized the effect based on what looked good to me. There's not a whole lot of *new* teaching here, just practice on concepts from Chapter 7, "Building Emotion: The Basics of the Eyes." The main thing to notice are the nods and reverse nods. Character Two (screen right) starts off a lot of his nods upward instead of downward, animation that comes from analyzing the tones in the sound, but it also took some how-to-nod decision making.

The upward motion of a nod is the same once a character is *into* a group of nods—you go up, you go down—but the initiating motion of a nod, be it up or down, can paint what the underlying intentions and feelings are. An upward start to nodding generally looks more forced, like you're trying to show that you are in agreement instead of more naturally being in agreement, which would usually lead in with a downward motion. It's subtle, but watch the animation a few times and you should see the difference in how the characters' nods *feel*. Character Two's one-word "yeah" statements at the end show this pretty clearly. This isn't by any stretch of the animation a rule, it's just something I've observed and used before. As a technique to get subtly different emotions, choosing the direction a nod starts behaves very predictably and reliably.

Figure 14.12
The uncomfortable duo

Eyes

This was the fun part for me. These two characters are obviously having a forced "polite" conversation. From a scene analysis perspective, you can take that down to a thought level and say these characters aren't too terribly comfortable. Not very comfortable? Move the eyes a lot. In fact, find any possible opportunity to move the eyes around. Figure 14.12 has a sampling of some of the many awkward moments.

Remember though, when animating eyes darting around, within that movement there are stops, break points, places the characters settle on, even if only for a few frames. For Character One, I had him settle on two points down and to the (screen) right. Whenever Character One stammers, or does any searching for words, I have him break eye contact, and I represent that search physically with his eyes. It really emphasizes the acting in the sound by reflecting that search, or uncertainty. I also broke One's stare to Character Two whenever Two directly addresses him, also making One the shyer of the two.

Character Two

This guy was really, really fun. I honestly didn't have too much a plan for this scene beyond the attitudes I wanted to portray; I wanted Character One to be lacking confidence and Character Two to be a little bit cocky, a little bit of a smart-ass. I basically wanted to amplify some of the subtleties in the sound to that effect, which actually then leads better to the sound's conclusion. To do that, I kept Character Two's stare a lot more focused (Figure 14.13).

He looks around like Character One, but he does it at times when Character One is being more forthcoming/open/vulnerable and then at the end, as Character One is trying to establish more of

Figure 14.13
A hardened gaze gives strength to Character Two.

a relationship and be more comfortable. By picking those moments to break the eyeline, it makes it look like this guy is not interested in or impressed with Character One. One way he does this is by holding a stare throughout some of Character One's loss for words or polite conversation but not nodding until prompted. This makes him look like he's expecting something. Having him look like he's waiting for "the point" definitely creates some attitude and, in turn, the social control of the scene (Figure 14.14).

Concerning amounts and timing of eye contact, it is a very fine line between polite, rude, and uncomfortable. I played this character a little more intensely with the eyelines, but don't have him do as many proper nods; that makes him a little bit snotty.

Lids

People use blinks to "hand off" a conversation. At the end of a section of speech, it's usually a good idea to blink the speaking character's eyes to communicate that they're done and are then handing control over to the listener. I usually like to place this type of blink *before* the absolute end of the line, which makes it look less like a conspicuous system or rule. Talk, blink, talk, blink would get pretty tiring to watch. For blinks in general, I really stuck to a generic timing of one frame longer on the return, meaning, if the blink took two frames to go down, it takes three to return; three to go down, four to return. Most blinks can hover around two or three frames for the down and look natural, but in certain situations, like where Character Two gets crankier in the second half, I slowed the blinks way down. You'll blink slowly if you're tired or making a point to express your discontent, which is exactly what he is doing. I reserved the wider-eyed look for the times when the characters are looking around. Character Two in particular shows a real "edge" during the time when Character One coughs. Character Two looks around, but when the eyes widen during one of those gazes (Figure 14.15), it communicates a focus, or an interest, *away* from Character One.

Figure 14.14
I'm waiting…

Figure 14.15
That black pixel over there is way more interesting than the bumblefool to my right!

At that point Character Two goes from simple avoidance to actually looking like he's *more* interested in his static surroundings than in whatever Character One might have to say. We as an audience read his emotion very well; he's not really looking at anything, but that communicates emotionally. He just does not care about Character One's babblings.

> The reason that blinking slowly looks less impressed is that it hovers longer in that *unimpressed* or *sleepy* area illustrated way back in Chapter 2 ("What the Eyes and Brows Tell Us") by the pupil-and-iris-o-meter. By spending time in that range, it becomes a pose unto itself—an "I don't care" pose, to be precise.

With the squint (lower lids), I was fairly conservative because of the type of scene. I usually use the squint as an intensifier, but since here I'm playing the characters less intensely, leaving the squint mostly uninvolved was good for the feel. Neither of these guys really gets too intense with their delivery, so to add that into the animation would just simply be out of place.

> Don't contradict the voice track of a performance. You can always find interesting ways to act something creatively, but avoid trying to *alter* the voice performance through your animation. It can be done, but in most cases, the conflict just weakens the scene.

I chose only to use the squint to punch some big moments and create some contrast. On Character One I most noticeably did this when he's thinking through "so it's going to be you and me." The squint there helps show there's thought—he's having to think about what he's saying; he's considering something, not just talking. With Character Two I used the squint in several places, but none of them in a very strong way, nothing worth specific mention.

Brows

Something we do with our brows is raise them when there is something *opened up*, like a phrase or an asked question, that needs a conclusion. When I'm waiting for you to finish what you're saying and I don't know where the sentence is going, I'll probably arch my brows until I *do* know, which is when they'll drop again. Figure 14.16 shows one of these moments.

It's facial language for "I'm listening." On Character One, I raised the brows while Character Two initiates the conversation, and then as soon as Character One has absorbed the incoming statement, the brows drop, as he begins to respond, "Yeah, yeah…" When Character Two finished the question is when his brows raise; as he's opened the conversation up, now *he's* waiting for a response. The brows stay raised until that expectation is

Figure 14.16
**Waiting and then
not waiting**
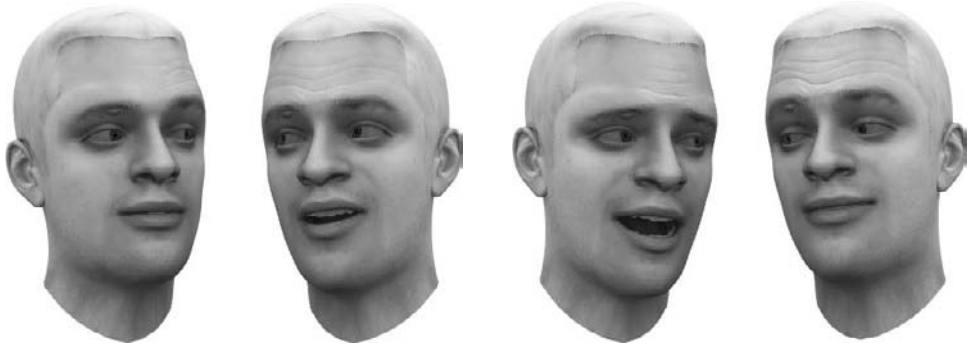
satisfied, which, in this scene, is long *before* Character One is done talking. This also feeds into the feel I'm after of Character Two being a little unimpressed, although this only helps subtly. Character One then raises his brows again as he tosses the conversation back over to Character Two after "privy to movement." This makes him *look* like he's asking for a response, which then prompts Character Two to respond.

The next brow activity of note is on Character Two in the dead space after "lack of dialogue…" By raising the brows and looking down in silence during a nod, you can create a generally apathetic feeling (Figure 14.17).

This movement is well suited for this guy in this scene at this time, and yes, this is an extremely specific usage in a very specific circumstance; you just pile this kind of stuff up after you animate faces for a while.

With the brows, there's something I did during the cough on Character One, which I also did near the end with Character Two. If you tilt your head upward while showing stress on the forehead, (either a brows down or squeeze type shape), there's a sense of not being happy. You're being forced to do something you don't want to do or think about something you don't want to think about. In this case it's Character Two's patience running out with Character One's blabbing (Figure 14.18).

Figure 14.17
Apathy central

Figure 14.18
I'm so bored.

You can see that Character Two is going to be nasty before he even says anything. To catch that *consciously* might take a few viewings, but you should feel it on the first view, then his last comment, which is quite rude, doesn't feel out of place. In the sound alone, or acted differently, that line definitely could seem a little abrupt.

The last brow pose on Character Two is sad in nature. See, this is why I've condensed the set of shapes down to what it is. Even though at the end Character Two looks sad in a still frame, in context he's being rude (Figure 14.19). Sad = rude? Not likely a connection one might make out of context, but it works great if it's what you're got to work with!

Figure 14.19
Sad brows used for jerk-ness

Mouth Emotion

This isn't the case with stylized characters, but you want to be very careful where you layer in smiles and frowns for realistic characters. You shouldn't just leave a full smile over a whole phrase or scene just because a character is happy. One of the main characteristics of a smile is that it is wide. That's not the *only* characteristic, but it's a big one. To make the significance of that more obvious, Wide and Narrow are the main things you should focus on with your sync, so leaving a smile present over large chunks just because a character is happy will impact the look of your sync in a bad way; it'll all look too wide. That's why smiles don't work well when blanketed over scenes.

Frowns are better in that respect, but they also don't look good left too long; it feels like your character gets a lazy lip or something. The way to use mouth emotions best is in the pauses. You smile in the breaks, you smile during the breaths, and you smile over long syllables. If you watch real people, they do have to suppress part of their smile to properly enunciate OOs.

In this scene, you can see very clearly how I used that information. When Character One asks, "So, you hang out here often?" I have a slight amount of smile throughout, but I really turn the smile up in the second syllable of *often*. Having some smile turn into more smile really feels like the smile was there the whole time; I think of it as emotional punctuation. It's at the end of the sentence, but it changes the way we perceive the whole thing! Or perhaps it changes the way we perceive the whole thing?

Moving right along, I do the same thing on Character One at the end of "privy to movement." I smiled him subtly throughout and then made it stronger coming out of the speech. Other than that, things in mouth-emotion-land are pretty predictable up until Character Two's little tilt down after saying, "lack of dialogue." I chose to smile him here (Figure 14.20) to emphasize the apathetic look of "What are you gonna do?" He already had this going; I just wanted to notch it up.

Figure 14.20
More apathy from our friend on screen right

Other Tilts and Finesse

The head tilts via the "music" in the acting were easy, but here is where I went through and layered in some more animatorly touches. For the sake of instruction, I did something here a little more deliberately than I would for production animation. A little head gesture I've picked up on is that people tend to toss the conversation back and forth with their heads. Watch each character as they *finish* their lines. After "hang out here often?" Character Two tilts over to Character One (Figure 14.21). When Character One is done with his response line, he points his head back over to Character Two (Figure 14.22).

It's a very natural movement for conversation that is moving between two characters. Quickly thereafter, I added another aspect but kept the same basic idea going. After Character One's second line about "not really privy to movement," Character Two leans away quickly. Here, he's *catching* this toss of the head, really responding, almost like an imaginary ball was passed to him (Figure 14.23), and he dribbles that ball a little bit before he tosses it back at the end of his line, " I can see."

Figure 14.21
The setup and then the nod
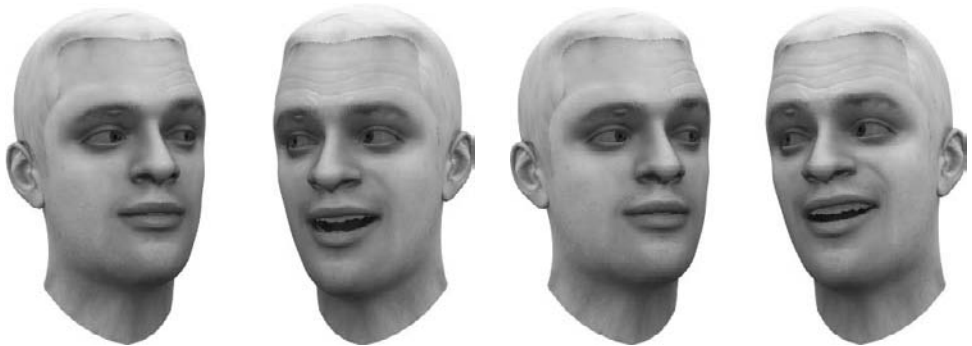
Figure 14.22
Another pass over the net, as the head tilts and tosses the conversation to Character Two

This pattern repeats throughout. Besides those motions, the only other one of this type that might be of interest is where I tilted Character One's head left to right during "That's the way it is sometimes." This paired with his look up really separates him from the statement. It makes it feel as if he's repeating something he's heard, or just not putting too much weight into the statement. The same motion could be used for mocking, but in this context, it just sort of lightens up the phrase and definitely makes this guy look like he's trying to be funny or entertaining. It really helps to make him the goof and Character Two the controlling party.

As far as twisting motions, as if saying no, I threw in very quick ones anytime a character had anything negative to say (as I always do). Not negative as in mean or nasty, but negative as in *not* affirmative. When Character One says, "I can't," I threw one quick one in, and then I did again during "I'm not really…" It may be very formulaic, but it does a good job of matching the vocal performance.

Figure 14.23
Head catch

Scene 3: Dunce Cap

Heh, heh, heh—that guy's got a dunce cap! Ain't he stupid? Look at it, look at it, stupid head… Oh. Yeah. OK. I guess I've learned my lesson. (VOICE PERFORMANCE BY JASON OSIPA. ANIMATION BY JASON HOPKINS.)

You can load `Dunce.mov` from the Chapter 14 folder to see the animation and `Dunce.wav` for the audio file alone.

This scene is a special little treat for me. I really wanted to get at least one section in here to talk about other animators' styles for both sync and facial acting, and this is it. Jason Hopkins is an outstanding character animator I had the pleasure to work with at Mainframe Entertainment in Vancouver, Canada— "Hollywood North," as it's been called. Hopkins has been a senior and supervising animator on a whole big bunch of great episodic television and direct-to-video CGI projects.

Instead of going through this scene like the others, I posed some questions about the things that stood out to me and have recorded his responses. Figure 14.24 shows some of the more interesting frames from this animation.

Figure 14.24

Some frames from "Dunce Cap"

What Order to Do Things?

You've all been exposed to my approach, but Hopkins's is a little bit different. In an over-all sense, what I teach and what he does are very similar, but it's easy to see that there are a few swaps in the order of some steps.

Jaw first (Open/Closed) Hopkins animates the jaw first until the point where it looks like it could pass as is—you know, everything is *readable* even if it's only the jaw.

All heights and widths (visimes) By phrase or chunks, he works in sections, not individual sounds or words. Once he's done with the whole thing he goes back and look at it as a whole. For this one he broke it into two chunks. With long scenes, he says, you've got to work in pieces so you don't get too lost.

Brows Hopkins says that this has always been the hardest for him. They're not easy. There's so much emotion in them that it's hard to move on to other things. To get good brows, he experiments by looking for "moments" that work. Sometimes you get things you didn't expect. It always depends on what the director wants. With rare things like this, just dialogue, he doesn't see definite rules for what to do. Undirected dialogue can be turned into anything; it's just a matter of knowing which way to steer it.

Head and eyes For him, these two are intertwined. He does them at the same time because they need each other, they work together.

Tweak When he's got a working version of the rest of that stuff in, he tweaks the overall scene—adds little smirks and sneers, all the fun stuff.

Your Process with *This* Scene

After getting his thoughts on order of approach, I then asked Hopkins, "Tell me about your approach to *this* scene."

> **Q:** What was the first thing you thought about?
> **Hopkins:** Eyes. Much of your acting and emotion comes from the eyes, so what I did was start by basic syncing, letting my mind roam on the acting. I used that time, hearing the sound over and over, to figure out what I wanted to do with the shot. You can sync pretty well without knowing the acting, so I don't worry about it too much. Going through it, I was thinking about "A little smirk here would be great" or "Here I'll cock the brow." You just sort of log that stuff away for later.
>
> **Q:** Opening with a laugh is hard; it's one of my weak spots. How did you deal with that?
> **Hopkins:** I wanted the laugh to be hearty; it felt like a real strong "Ha ha ha." I thought if I could pull that off, I would be okay. I wanted to try and get a shoulder shrug across even though there's no body there with shoulders to shrug!
>
> **Q:** Were there any acting techniques you had in mind for this scene?
> **Hopkins:** Well, since there's no body, I wanted to, *had* to, gesture with the head. To really match the voice track, I had the talker gesturing to the other character and the audience.
>
> **Q:** So what were the attitudes you wanted to get across?
> **Hopkins:** The talker was a guy who's, you know, in your posse; like you're walking down the street with him, and you see this dunce cap guy. With *dunce*, I wanted to draw the audience toward his character quickly, to identify with him somehow, so that when the cube shows up on the talker, you're instantly happy. I wanted to steer people toward seeing the talker as a jerk, and the little hero of the scene was the dunce.

Q: What was the hardest part of this scene?

Hopkins: There's just so much in the head. I'm always very worried about the fact that you can wreck everything by animating the head wrong.

Q: I noticed you keep the dunce cap guy pretty subdued throughout….

Hopkins: I toned down that guy's animation quite a bit because I felt like he would act embarrassed; he does have a dunce cap on his head, after all. I didn't want him completely still, but I kept his motions pretty slow. I didn't want him to *steal* your eye, I wanted him to *take* it because he was what was being talked about and he was so calm in comparison.

Q: I really like your brow movement style; describe it for me in your words.

Hopkins: I kind of *throw* the brows with the head. I don't do it intentionally; I guess it's something that just feels like it flows. I worked on shows where the characters had no textures on the face; it was a style. If you weren't careful, it would look like the brows just crawled up and down the forehead. I got in the habit of hiding brow motions in head moves, and I guess it just stuck with me.

Q: Dunce Cap seems like the focus to me, even though he's not talking. Did you do anything to help that?

Hopkins: I hope so. I wanted you to move your eye over to him early and play up how the talker is kind of just noise. I was trying to get a bit of "Hello, there's this guy over here, and I'm being made fun of." You can't help but notice the first guy, but I wanted the second guy to be noticed. I mean, a still head wouldn't have meant anything. I wanted to keep him alive.

Q: I didn't give too much in the way of direction for this. Did anything about that scare you?

Hopkins: Eyes. Eyes are the thing most often wrong. Little shifts, when to lead the head, when to follow the head, when to blink; all those little things mean so much. It's easy to ruin facial animation with bad eye movements.

Q: I noticed a great shift in the acting on the "talker" when the cube shows up. Describe that.

Hopkins: When the cube shows up, I just felt like now he's the focus of all the negative attention he was throwing around. I thought he would start to move a lot more like the other guy, slower and more subdued.

Q: If you were to take another run at this, what would you change?

Hopkins: A lot. I look at it afterward, and that's when I learn from myself, see what I like and don't like. I just watch it like it was someone else's. I don't know, it evolves; I don't hyperanalyze like you. I will say, I kind of liked not having direction. It gave me the chance to play!

Scene 4: Salty Old Sea Captain

I've never seen a more cowardly group! If you want to make it out of this alive—see your pretty wives again—you listen and you listen good. (VOICE PERFORMANCE BY CRAIG ADAMS)

You can load Captain.mov from the Chapter 14 folder to see my take on the animation and Captain.wav for the audio file alone (which I cut the start off of for my scene; you can do the same by changing the offset). Figure 14.25 shows a selection of frames from this piece.

Oh, my goodness, what a blast this was; I love my job. We haven't seen any anger out of characters before now, and what an angry scene to have. Pete's one cranky guy in this clip! In this scene, and this performance, the guy means business.

This scene and the next are examples of different scenarios and characters rather than tutorials because there's a lot in the realm outside of the photo-real style I've focused on so heavily (or at least attempted!). Captain Pete here and Sally Ann in the following scene were not done in Maya; they were built in Animation:Master from Hash. I wanted to show that, indeed, the ways of doing things that I'm describing all carry over across styles and across tools.
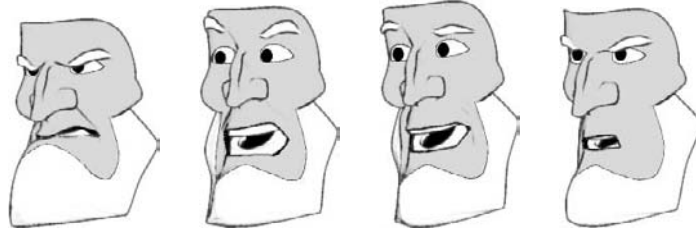
Figure 14.25

Some frames from "Captain"

Sync Special Cases

Seeing as this is the first time we've got an angry performance—a very, *very* focused angry person—there are some new ideas to introduce. You might know the musical term *staccato*. This is how I like to animate most angry characters: I animate them quick and intense. Usually slow motions denote strength, but if a character is yelling at a good rate, speed and motion can add something scary. With the sync here, I went a step deeper than even *I* usually do; I really went frame by frame trying to nail every part of every word (Figure 14.26). To watch the scene over and over, it looks a little "poppy," sort of jumpy. To watch it once through, however, you just see ferocity. My sync approach here was just to overexaggerate and overenunciate everything in the hope that would show both rage *and* focus.
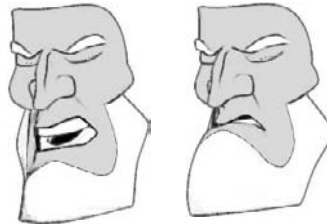
Figure 14.26

These shapes from just one frame to the next are pretty different.

Head Tilts

These proved very tricky. It seemed, after going through this with my usual approach, that almost none of it felt right. The up and down motions felt as if they were out of place. I was almost tempted to do the tilts on gut instinct instead of making it work with the methods I've described. Instead, I started reducing the strength of some nods and completely eliminating others. There's an intensity with this sound file that lots of motion might wreck. At the start of the scene, I reversed the up and down motions. Even though, tonally, the line starts on a very sharp up, I tilted the head down. Forward/Down nods are much, much stronger than upward moves, and this guy seems pretty strong to me. I liked how that looked and found ways to slide the head up slowly so that with almost every big hit in the dialogue, I could tilt the head back down. He spends most of his time looking at you from under that brow (Figure 14.27).

Eyes

This was a huge challenge for me. I am an animator, first and foremost, and that means I like to animate; sometimes that can be a bad thing. I tried darting the eyes in the tiniest pauses. I tried having it look like Pete addressed a larger group, moving his eyes far left and right, almost like he was surrounded by whoever he's talking to. None of it, not one bit of it, worked. It didn't matter what I did; it all weakened the performance.

I realized that this is the exact thing I had been fighting the whole time. Pete's intense, and the more he does, the less intense he becomes. My final decision was to leave the eyes locked on one point for the whole time, and that did so much to strengthen everything else Pete did. He became like a train: he had a path he was on, and nothing was changing that.

Lids

To use this word yet again, my goal was to keep Pete intense. This is the only scene in my examples that can really make great use of the squint, so I poured it on really thick. Using mostly the same criteria I would to widen the eyes, I squinted them. Since the brow poses were so low, the upper lid was mostly invisible, so instead of trying to animate them, even though you wouldn't see them, I just left his upper lids pretty wide for the entirety of the scene, letting you as a viewer figure out how he looked under those angry brows. Especially near the end, where I may have even overdone it, you can see how the raising of the lower lids, the squint, helps strengthen his contempt for whoever he's talking to (Figure 14.28).

Brows

I treated the brows very differently in this scene. I went through and picked some moments, just places where it felt like a certain pose would look right. These, I admit, were terribly unsystematic decisions; it was almost strictly instinctive—it's nice to know I still do that, too! The hardest thing was deciding that I really only wanted his brows in

Figure 14.27

By cutting into the eye silhouette, you can make the brows very strong.

Figure 14.28

That's some squinting, right there.

that lowered angry pose, but leaving them there, along with the stillness in the eyes, almost looked unfinished. I punctuated even the slightest volume shifts (not tone shifts) with raises, but I promptly returned them to that lowered, angry pose. Everything seems to come back to me wanting to hold his focus so as not to betray the great voice-acting intensity.

Mouth Emotion

I can't believe I made it this far without saying it, but here's where you can see why, although we *do* have a Sneer shape, we don't have other shapes that you might expect, like a Cheeks Puff. We have a Sneer because we didn't build a Mad mouth shape. While they are different, sad and mad mouths are very similar. The right amount of a sad shape combined with a sneer looks mighty angry to me. To emphasize anger further, I usually bare a little bit more upper tooth during angry times too; in Pete's case here, it's practically *all* upper tooth *all* the time!

> To close up that *cheeks puff* thing, that kind of shape just isn't necessary. It's a nice touch, but it can be easily added later as a specialty shape. You can get by without it, and everything I'm teaching here, from construction to animation, is about helping draw focus to only what's necessary.

Besides a little tiny hint of a smile during the word *wives*, Pete stays pretty angry in that mouth area. Something I'll talk about briefly here is using the mouth emotion to try to emphasize figure-eight motions. It's not as easy to make work in realistic stuff, but as soon as you're into less-restrictive styles, a good motion to drive for in the mouth is figure eights, circles, just something better than ups and downs. In Pete's case here, the word *alive* is the best example (Figure 14.29), but I do it to a lesser extent in several other places.

Other Tilts and Finesse

I had put so much effort into focusing Pete up until now that I felt I had my bases covered and actually let up a little bit; I had a lot of fun with these other head motions. As always, when he says, "I've never seen," which is a negative statement, I shook his head as if he were shaking his head *no*. On the word *group*, I used a sideways tilt almost as another nod (Figure 14.30).

Now he has a standard sharp biting nod followed by a new different one. They both feel similar, but not repetitive. With "If you want to make it out of this…," I wanted to have him turn slightly, almost as if he was trying to hide the rest of his statement (Figure 14.31).

He uses that opening line "If you want to make it out of this alive…" almost as a hook, and then he knows he's got them, so he opens back up on *alive*. He knows they're listening now, so he can turn to them and open up a little (whoever *they* are). I'm really happy with
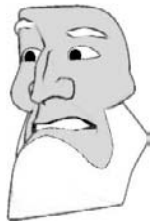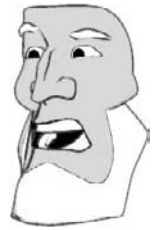
Figure 14.29
Some frames from *alive*, **so you can see how the motion swoops up and around**

Figure 14.30
A sideways tilt to nod, but in a different way
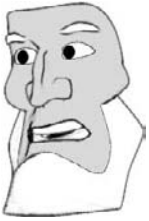
the snappy little move on *see* from "see your pretty wives again." That little twist really *throws* the line out instead of just saying it. He's trying to appeal to his audience, but not in a warm fuzzy way. He's saying, "I know what you want" subtextually, but he's doing it in a very hard way, almost like a slap. This is just a variation on handing the line over.

With the whole last line, "you listen, and you listen good," I shook his head violently back and forth. That kind of motion done quickly just communicates that something negative is being said, but when you prolong it, and amplify it, it turns into something else completely. The motions at the end, to me, seemed almost like a dog tearing through a phone book or a bull snorting and getting ready to charge. Something very animal comes through. That's a very specific style choice in a very specific scene, but, hey, it's what I was thinking!

Scene 5: Pink or Blue?

Pink or blue? Pink or blue? Oh… I just don't know! If I get the pink one, I'm all, "Ooh, look at that little girly-girl in pink!" And if I'm blue, it's like, "Hey, it's a boy-girl. Why don't you go do boy stuff, boy-girl?" Okay, just think it out. If I were a bow on my head, what color would I want to be? (Voice performance by Robin Parks.)

You can load PinkOrBlue.mov from the Chapter 14 folder to see my take on the animation and PinkOrBlue.wav for the audio file alone. Figure 14.32 shows a selection of frames from this piece.

For this, I used my Sally Ann model, which was made and animated in Animation:Master from Hash.

With this scene, the only real intention I had directorially was to pretend Sally Ann was talking into a mirror to herself. I wanted to really emphasize the shifts in character and present *her impression* of these groups of people she's talking about.

Figure 14.32

Frames from "Pink or Blue?"

Sync Special Cases

The first run-through, as always for me, was to do the basic sync but focus a lot on asymmetry to get a less-structured feel.

> This scene was actually done in Hash Animation:Master, which didn't have my specialty interfaces set up. I had symmetrical versions and asymmetrical versions of all shapes, so for this scene I used only asymmetrical sliders, even when constructing mostly symmetrical facial expressions.

By forcing yourself to construct every lips-up or lips-down pose by manipulating each side of the lips individually, you can create, almost accidentally, very character-rich mouth shapes for your scene. They'll all have little asymmetrical quirks just by the nature of how you create the shapes. So Sally Ann's sync in this scene took me a very long time (3 hours), partly because of the scene length, but mostly because of the slower animation approach.

Toon Sync Differences

For toon characters or anthropomorphs (talking animals), the sync guidelines laid out in Chapter 4 get super-amplified. As a result of that style difference, these characters usually end up having a more "stepped" animation curve style too. I find that to make sync look good for stylized characters, I have to get into shapes earlier and hold them for longer, leaving the in-between times shorter.

For example, looking at the movie of this scene, notice the first three words, "Pink or blue?" Watching the animation for Wide/Narrows specifically, you'll notice that *pink* is practically one uniform width for the whole word, as is the width during *blue*. More realistic characters benefit from slightly longer transitions.

Hitting the "Clicks"

Another toon sync style amplification is to punch percussive noises like the T, K, or D at the end of a word (like the end of *pink*). You'd want to do this same thing in all styles, but the farther from human, the more you *can* and should. These sounds do not have a shape (width or height), but popping the jaw open after the sound really makes the sonic *click* have a good visual representation.

Use Smiles and Frowns in Your Sync When You've Got the Time

It's always a good idea to use smiles and frowns to punctuate your sync and create more custom per-sound shapes, but again, with toons, do it even more. I didn't wait until later on during my mouth-emotion pass to use the smile and frown controls. I did wait in reference to the *acting*, but I used those emotion shapes during the sync stage to really match
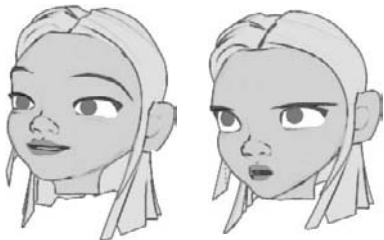
Figure 14.33

A frame each of *pink* **and** *blue***; notice the use of Smile and Frown for sync, not expression.**

Figure 14.34

Hold it, hold it…

Figure 14.35

Two frames, the first an upward swing and then a downward one; these two were paired to look like one long joined motion instead of two separate ones, of course timed so as not to "float."

the actress's performance. For instance, notice that the word *pink* has a smile in the animation and I then dropped the expression to a frown during *blue* (Figure 14.33).

This has next to nothing to do with facial expression and everything to do with saying the words in a mirror and paying close attention to where the *corners* of my mouth were as I said each word. The corners of my mouth raised during *pink* and dropped significantly during *blue*, so I figured I'd copy that little detail onto Sally Ann. I did the same throughout the scene, usually pairing Frowns with Narrows and using Smiles in conjunction with Wides.

Exaggerated Closeds

With most of the B/M/P sounds in this scene, I found I had to hold the lips closed for more than a single frame for them to look good. This has a lot to do with the look and feel of a nonrealistic character and how, as an audience, we've come to expect the way they will behave. Animators exaggerate holds, and most of us have watched cartoons our whole lives, so sometimes the amount you would have to close your mouth with a toon character (Figure 14.34) is much longer than you would with the same dialogue played over a realistic character—it's just what we're used to seeing.

Tilts

This is one of those scenes that briefly makes me reconsider my notion of animating the head musically, but I always come around in the end and remember why I do. Robin Parks, the voice actress, performed this line in a very sing-songy fashion. Not only that, but during the line, she often slides upward tonally instead of how most people slide down in most instances. What this leads to, following my system, is a head constantly doing upward, or *reverse*, nods. These look strange. The whole trick to making these reverse nods work is to turn them into anticipations for downward nods, even if those don't come for a few seconds afterward (Figure 14.35). Sometimes you'll even have to swap an up-sound into a down-move, essentially reversing the rules. In any case, it's always on the big tonal shifts that the big moves should happen for them to look most in tune with the sound.

The opening two cases of "Pink or blue?" are great examples of this timing. Both *pink*s are upward tonal shifts, so I tilted the head up. If I were to just leave it there for eternity or raise it again on the next upward tonal shift, it would not look very good, so I slammed the head all the way back to level (and then a little further down) on each *blue*. On the second *blue*, there's a breath between *pink* and *blue* where I tilted the head even higher. Two upward tilts in a row is not something you'll usually want to do, but if you can get creative with how and when you *reset* the head to level, then the rare occasions they occur can be easily managed.

One place I reversed the rules and nodded the head down on an upward sound shift was at the end of "I just don't know!" Parks (playing Sally Ann) jumped up a few tones at the start of that phrase and then ended it with an even higher note. I initially had Sally Ann's head tilting further up at that point, but it just looked bizarre. I then changed it by using the same timing, but turned the head down instead of up. Later, when I went back and animated the brows, I raised the brows, which pretty much picked up the feeling of the sound.

> If you haven't already noticed, when something fails to work for me, my first follow-up attempt is to do the exact opposite of what I tried initially!

For the section where Sally Ann says, "Ooh, look at that little girly-girl in pink!" it's all very *high* tonally. At first I was trying to find ways to fight that and bring the head back down; with the eyes pointed forward and the head up like that, it's not attractive. Instead of fighting it, I ran with it and decided that when I got to the eyes, I'd animate Sally Ann looking off and up into space, making that portion of the scene an aside. I did eventually have to bring her head back down later in the scene, and to do so, I jumped on the first downward tone shift I could find, which happened to be *in* from "look at that little girly-girl *in* pink!" I shot the head back down quickly because the very next word, *pink*, was going to be another move up. Sally Ann warbles that word, too, which for this stage of animation is something I'm going to pass on (for no other reason than the section already feels very up-and-down to me), but I'm sure I'll find some fun gesture or expression to throw in that spot later, with one of my other animation passes.

The last big thing to do with head tilts that should get some discussion is when Sally Ann talks through "If I were a bow on my head." Instead of climbing the head precisely with each tone, I found a pattern here I liked. Parks performed this line making "If I were a bow…" a tonal pair with "on my head…" When these moments happen in the sound, it's perfect for an animator to pounce. I turned the two halves of that phrase into a pair in the animation, just like they were delivered, by doing a big up and down for each half (Figure 14.36). For this forward and back motion, that's not so exciting, but I've timed it in such a way that later on, when I do the other rotations on the head, Sally Ann will look left then right, one direction per nod. This is a fun head movement that really punctuates a character working through a thought slowly and explicitly.

"If I were a bow…"   "…on my head…"

Figure 14.36

Two neat little arcs in the sound were something I copied in the motion.

Eyes

The eyes in this, as with most scenes, are where I really start to map out the expressions I want the character to move into and out of. With Sally Ann repeating herself at the head of this line with "Pink or blue?" twice, I didn't want to have her weigh this decision of hers completely in outer space. I wanted to start her in the here and now. For the first "Pink or blue?" I held her gaze dead ahead at the imaginary mirror in front of her (Figure 14.37 left). For the second "Pink or blue?" I made sure she looked in two different places, as if the pink and the blue bows were in two different places (Figure 14.37 center and right). I actually had a blink in between these moves originally, but I didn't like it. What I settled on instead was to have her roll her eyes over and then down, which actually becomes a sort of anticipation to where the head drops.

Figure 14.37
The first time through "Pink or blue?" I kept her eyes forward; I gave "pink" and "blue" each their own pose the second time.

With the *Oh*, I went for a look as if she wasn't really focusing on anything, so I centered her eyes. On "I just don't know," she returns to her home eye position, the mirror, so that it looks like she makes the remark to herself, not just to nobody or nothing.

During "If I get the pink one, I'm all," I shot her eyes down and to screen right. This could have been up down left or right, it didn't matter; I just wanted to make that line feel more internal, more an aside, a ramp-up to the impression of a "girly-girl" she does next. Since I push her eyes up during the "girly-girl" phrase (looking at the awkward high angle of the head from earlier steps as an inspiration instead of as a hindrance; see Figure 14.38), I chose to drop her eyes previous to that, just so there would be some contrast.

Figure 14.38
What was once a weird tilt up is now a cute little "girly-girl" moment.

"And if I'm blue…" felt obvious after getting the other two previous eyelines sorted out. I went down and screen left for no fancy reason other than it mirrors nicely with the aside before *girly-girl*. With "Hey, it's a boy-girl, why don't you go do," I chose to contrast the weakness in *girly-girl*, the avoiding or airy-fairy nature, with a very direct eyeline, one that holds more strength and teams up nicely with Parks's delivery (where she lowers her voice a few notes) to give what Sally Ann thinks is how boys act (Figure 14.39).

The end of this section, "….boy stuff, boy-girl!" starts with a pause where it seems like Sally Ann has to search for the words. No direction from me ever got to Parks to do that on purpose; it's just how she did the voice acting. The nice part is I *love pauses*! Thanks, Robin! I just love them, that's where I play. In this pause, since it sounded to me like Sally Ann couldn't find the words, I made her show that, by darting her eyes back and forth (Figure 14.40).

Figure 14.39
And here's the tough "boy-girl."

She visually and sonically has a moment of searching; the two, I think, work very well together to show a moment of almost frustration.

Sally Ann returns to the dead-on look after she finds the words and holds it there until she has her next internal moment. By turning her eyes away again, I broke her out of that sub-scene quickly and easily. I turn her eyes away and keep them turned away from the mirror but moving at each break in the sound. I have her do a whole lap around the frame before she returns at the end. She goes bottom-left, top-left, top-right, bottom-left, and then center. It just sort of worked out that way with the timing of the voice track and the preexisting tilts of the head. Sometimes these things just work themselves out!

Lids

You may have noticed that I made more use of the squint in this scene. On realistic characters, you have to really pick your moments and wait for good intensity, whereas with a character like Sally Ann, you can throw in or take away squints all over the place (obviously, having a reason makes it look better). I actually threw a slight squint in right on the first word, *pink*, as an anticipation to contrast with *blue* (Figure 14.41).

Her lower lids widening while her head tilts down creates an interesting focus. I've talked about using percussive noises as timing for blinks, and this scene is no exception: I blink on almost every B, M, and P.

Something else I did with the lids early in the scene is on the *oh* near the start. Something that looks really nice is to have different parts of the face trail the overall head movement. For example, I had a blink on the *oh* anyway, but it looked strange that her head crept up slowly while her blink was fast and perky. I slowed the blink down so that the lids didn't raise all the way again until the head was already on its way back down.

Later, I used the squint to be the lead-in to both "girly-girl" and "boy-girl" sub-scenes (Figure 14.42).

Just before each one, I have Sally Ann squint to show the "wheels turning" before she bounces into her characterizations of what girly-girl and boy-girl are like. I also tightened up the squint on the last *boy-girl* to give that part of the line a little bit more venom. I thought Parks's performance had some nice bite there, and I didn't want to lose it in the animation by ignoring it. For lids, the rest of the scene is pretty much paint-by-numbers.

Brows

You know how I recommend to tilt the head to get the effect you'd usually want to put on the brows? Well, in some cases—this being one—I do both, which changes my approach slightly. I actually get the brows to complement the head and eye motions instead of the sounds, if that makes sense; it's almost as if I'm paying more attention to the brows' interaction with the rest of the face than with the sound. I end up with something very similar to mapping the volume of the voice to the brows, but it's subtly different. With "Pink or

Figure 14.40

I moved her eyes into similar spots as before so as not to make her look manic, looking in every direction all the time.

Figure 14.41

Squinty pinky

Figure 14.42

The pose before bursting into the "girly-girl" part of the line

Figure 14.43

I find this flat brow look to be so rich in character. I make sure all my (stylized) characters are capable of it.

blue?" I raised her brows on the up of *pink* and dropped them, just like I did with the head, on *blue* (getting a great flat-brows shape, shown in Figure 14.43, which I personally think is *so* strong and full of character).

On the second "Pink or blue?" I actually started a new pattern of movement. Since her eyes look in different directions for *pink* and *blue*, I decided to have her brows mirror that motion instead of the head's motions. I often raise the brow on the side the character is looking (Figure 14.44); it makes the whole face look much more cohesive as a whole.

Raising the brow on the side of the eyeline is an inquisitive look. If you want to have a character's look to one side be more accusatory, suspicious, or mean, don't raise it; instead, *lower* the brow on the side they are looking.

The *oh* was a perfect place for an expression shift (a long drawn-out sound that's *not* a word almost always is), so over the course of that sound is where I rearranged her brows to be more sad. "I just don't know" felt like I needed to drive her into an even more pathetic-looking expression (Figure 14.45), so I lowered the brows right down to below the tops of her eyes, about as sad and broken as I think she can look. I held them there until *know*, where I reset both the height and the expression.

Figure 14.44

Raising the brow on the side a character is looking adds some nice flair to the eyeline.

Figure 14.45

That's one frustrated little girl.

It's important to do that so that people don't forget what the character really looks like! This isn't a joke, either: If you keep the face in too extreme a position for too long, that expression could stop meaning anything.

The next place the brows really shift is during the "girly-girl" section. This is easily identifiable as mockery, and that—for me, anyway—means raised and saddened brows, as shown in Figure 14.46.

Between the end of *girly-girl* and the beginning of *boy-girl*, I merely reset the brows and held them there. For the "boy-girl" section, I made some decisions that really didn't feel like rules or guidelines at all but instead went purely with my own tastes. Since I went with sad brows for *girly-girl*, I had sort of used it up for now (sad brows, that is). You could easily play this section with the same expression, but I thought it might be boring. I decided instead to swing her brows to the mad side of things and also played them asymmetrically, giving her a little more attitude (Figure 14.47). Both of these sections are mocking perceptions Sally Ann has of others, but acting them on two ends of the sad-mad spectrum pulls out some of the subtext of soft versus hard, prissy versus mean.

"Okay, just think it out" was another place I merely reset the brows to clean the slate for whatever comes next. I pretty much played the whole ending very simply; the only brow movements of note are how

Figure 14.46

Brows up and sad works for the "girly-girl" bit.

Figure 14.47

Angry brows for *boy-girl*

I changed the raised brow to match the side (and height) Sally Ann is look-ing. Instead of having the brows swapping high-and-low all over the place, I just moved one side up and down; this keeps her forehead a little more sane looking.

Mouth Emotion

I love how far down the list this is; all the bases are already covered, and it's just a matter of prettying it all up. By using the smiles and frowns during the sync, a lot of this part of the performance has already come through, leaving mostly just the pauses and long syllables that need some attention.

Figure 14.48

For the mouth, sad through "girly-girl" and smiling through "boy-girl"

The main places I made choices that might need some explanation are during the "girly-girl" and "boy-girl" sections. By now, with all the other layers of animation in there, it's clear that the character separations from one impression to the other are mainly strength and weakness. In pursuit of solidifying that, it helps to know that frowns are weak (with sad brows; a frown is strong with mad brows) and smiles are strong. It might be an obvi-ous statement now, but I took that approach and frowned Sally Ann through the "girly-girl" stuff and smiled her through the "boy-girl" part (Figure 14.48).

Not only did that paint her as strong during the "boy-girl" section, but it actually made her a little bit evil. I like it! Don't worry, this little gal won't get too evil; that eye-dart as she's searching for her words really shows some weakness, which just leaves the evil look-ing more like cute than evil.

Other Tilts

The higher the quality you want to see, the more there is to this stage of the process. First, I dealt with the side-to-side movements of her head, then the twists.

With the "Pink or blue?" section, I would move her head (screen) right for *pink* and left for *blue*. No reason for picking sides, I just chose a side for each and went with it. The next extra head movements were for "I just don't know!" I shook her head as if to say *no*, which I like to do on most any negative statement. I then turned her head to (screen) right for her look down to the right corner, which makes the head look like all parts are behaving together as one. Then, I had some fun during the "girly-girl" section, where I wiggled her head slightly left to right a few times. This movement has so many uses it's hard to describe it in simple terms. For now, I'll just say it works really well for mocking.

Then we come up to the warbly *pink* that I think is just begging for some attention. My first instinct was to simply add another side-to-side wiggle movement like the one I just did, and looking at that, I thought it looked pretty good. But I'm just not a fan of repeti-tion. I wanted something similar, but not exactly the same. A little trick I know that works anywhere in animation, not just for the head, is to key joints—be they heads or arms—at two extremes, like Figure 14.49.
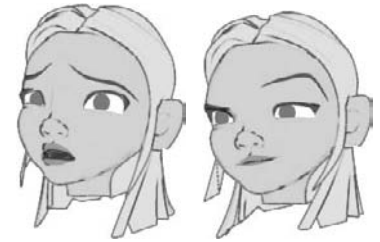
Figure 14.49

Two poses for the head to set up the trick
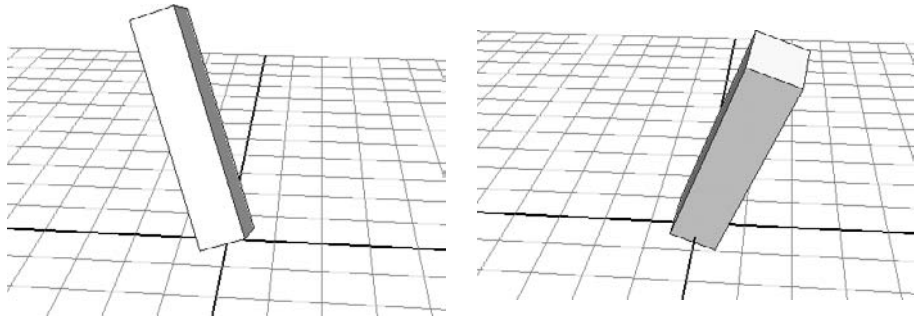
The movement you get is weird, as the joint just moves back and forth on a 45. The *trick* part of it is to take *one* of the two curves involved and slide the keys, as a block, forward or back in time so they do the same motion, just on different frames. This creates circular or ovular motions instead of linear ones (Figure 14.50), and it animates much smoother than if you were to go in and key the head at each point in the circle.

I did this with the twist left to right on Sally Ann's head, so now her tilting left to right actually became like a little fluid jiggle instead of a hard left to right. I liked how that matched the voice's jiggliness right there.

Next, in the aside before the "blue" section, I turned her head to (screen) left to emphasize the eyeline. I added a little twist during the word *why* because it felt as if she was *throwing* the line out. Sometimes on very stinging deliveries, you'll want to make the character look like they're *tossing* the line into the air instead of just speaking (as was the case with Captain Pete). A sharp little twist of the head works very well for that.

Figure 14.50

By offsetting the curves, you can create circular motions.
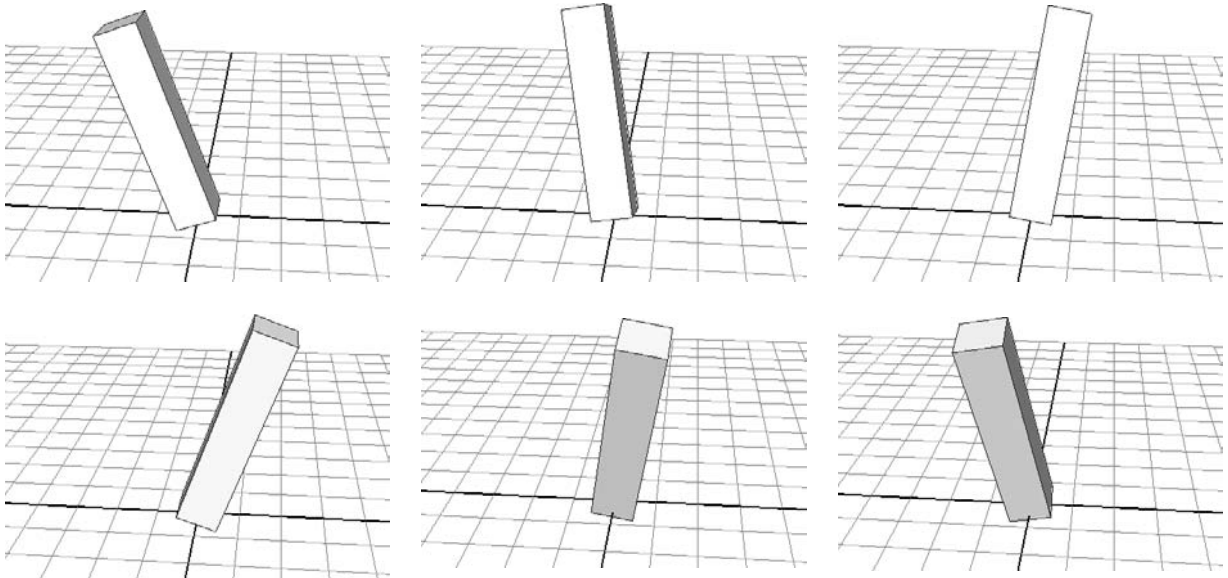
I gave a little tilt to the side on *boy* from the second *boy-girl*. This was simply to break up the linear look of the up-and-down motions there; I had no real acting motivations.

Near the end are some motions I'm quite happy with. Sally Ann tilts her head left and right in the opposite direction from where her eyes go. Doing this opposite motion, instead of going to the same direction as her eyes, makes her look like she's considering things at a deeper level (Figure 14.51). She's taking a step back, you could say— still gazing off to her thoughts, but trying to get a better look at them this time.

Figure 14.51

Two eyelines where the tilt actually goes opposite the direction of the look create a more contemplative look into the heavens.

That's All, Folks!

Well, there you have it. I wish I could just talk animation until the end of time, but unfortunately there are only so many pages and so much one guy can say in one book.

There's an infinite world of animation out there, and you'll find a few bonus examples of it on the book's companion CD. Check out the Extras folder, where I've put a few movie files not mentioned in the book for you to study (with and without sound), plus more sound files you can practice animating to.

I want you to realize something and pat yourself on the back. If you've come this far and covered most or all of this material, you undoubtedly have an edge you didn't have before. Go ahead and push the camera in a little tighter. Don't be afraid to hold that close-up a little longer. Get excited about adding that extra line of dialogue, or just make yourself laugh and animate a big goofy take. You've got the tools; you've got the knowledge; now go make your characters live with thought, intention, complexity, and feeling like never before… and, in the name of all that is good, please, *stop staring!*

Stop Staring in Color

This selection of images—some of characters built and discussed in this book and some from other sources—demonstrates the incredible influence color and lighting can have in really "popping" an expression. It's the same with human or animal, photo-style or toon—animated characters can look perfectly believable if you build the right shapes, create the right textures and move them in a way appropriate to their own style.
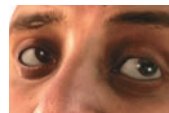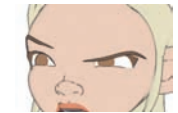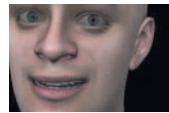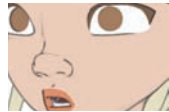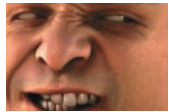
Basic Head

These images show the range of the basic head model developed throughout the book in a way that would not be appropriate for most scenes—but it sure would be a shame not to flex these muscles!

Sally Ann
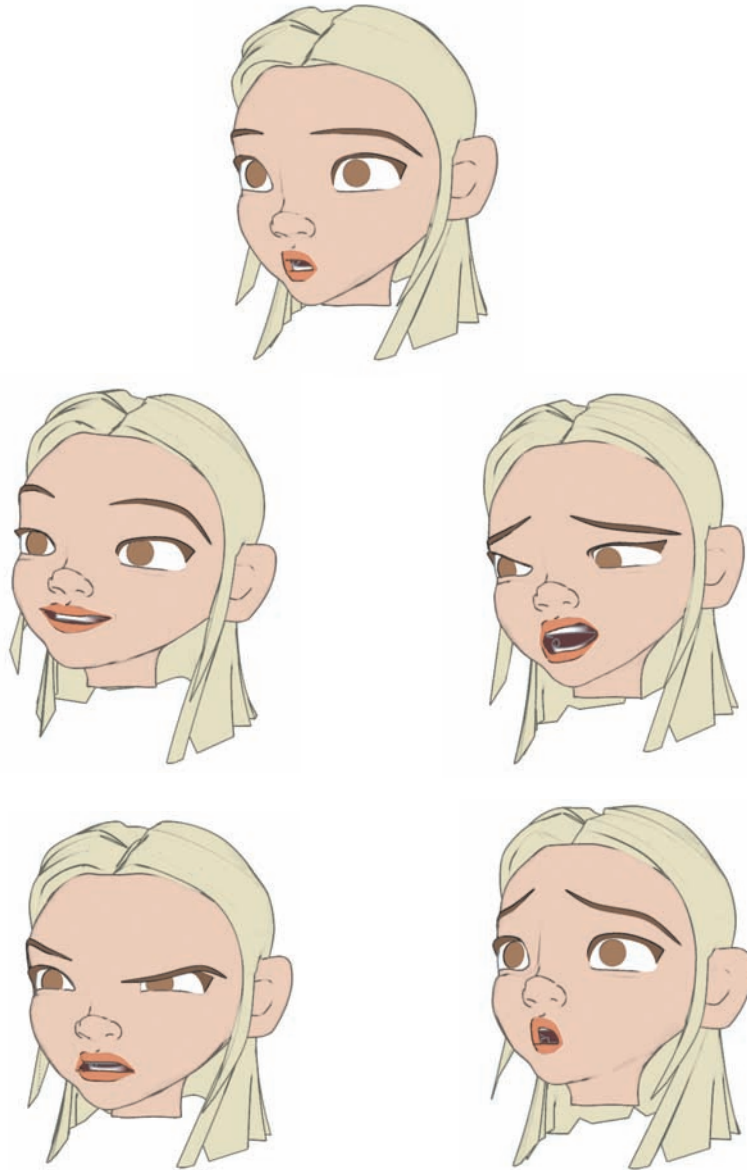
I usually reduce the details around the mouth in toon females, which actually allows me to make some of the mouth shapes a little crazier. Notice the complete and total difference in the shapes Sally Ann can make. If there was creasing going on around that mouth, we wouldn't be able to stretch to half of this range without her looking bizarre. Sally Ann's big brown eyes without pupils make animation a little trickier. The levels of alertness due to lid heights isn't as apparent as it might be with more eye detail. The lids have to raise a lot higher for alert and drop a lot lower for calmness/fatigue. (See Sally Ann in `PinkOrBlue.mov`, in the Chapter 14 folder on the CD.)

Captain Pete

What a cranky, cranky guy. Although I'm sure Pete has a soft side, he's not going to let us see it! Notice that within the anger and focus, though, he has moments where he cracks a little—he uses that feigned softness to lure others in and lower their guard, so *wham,* he can knock them down even harder. (These stills are from a movie called `Captain.mov` in the Chapter 14 folder on the CD.)
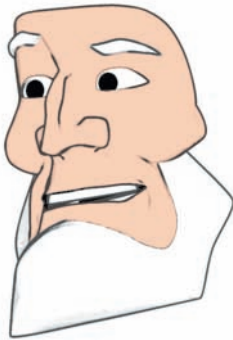
I've used this character for everything from an angry authority to a schmoozing-friendly buddy (some soundless expressing along those lines is shown in `PeteNice.mov`, in the CD Extras folder). The reason he works is because I can overanimate him; with toons, you can get away with pushing their range, but only if you've set them up with natural shapes and lines in the first place.

Miscy the Miscellaneous Man
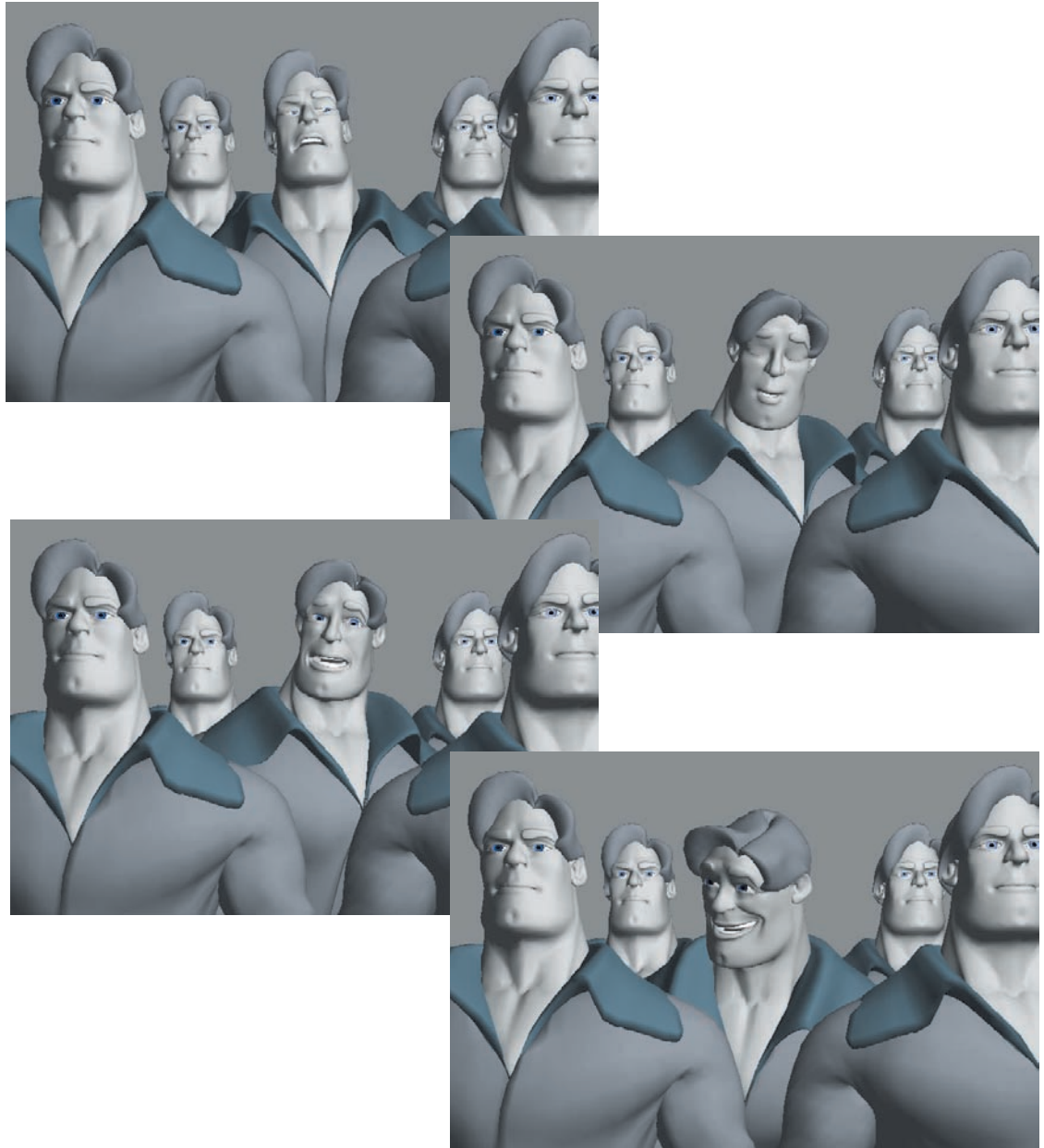
   With Miscy, I gave myself a few short sound bites to test many of my own ideas on facial animation. By putting him in a crowd of immobile, staring versions of himself (`GoodHardLook.mov` in the Extras folder on the companion CD), you can really truly see that the default face is not the face of your character that people see. The Miscy in the middle is clearly the only one who is alive.

Default

Jaw_Open

Jaw_Fwd

Wide

Narrow

UprLip_Up

UprLip_Dn

LwrLip_Up

LSmile

RSmile

LBrowOut_Up

RBrowOut_Up

LBrow_Dn

RBrow_Dn

RSquint

Miscy's key set is slightly different than the ones I teach in this book; his is an older keyset that helped eventually lead to the ones here. Of special note is that he has virtually no range with his brows, yet he still emotes quite well. His brows can only raise and drop. His mouth actually has Wide and Smile as different shapes; this can lead to an overly wide mouth when mixing, but it allows more wide range without getting too expressive, something that's occasionally beneficial. That's one of many variations you can pursue in your shape sets.

Squoosh
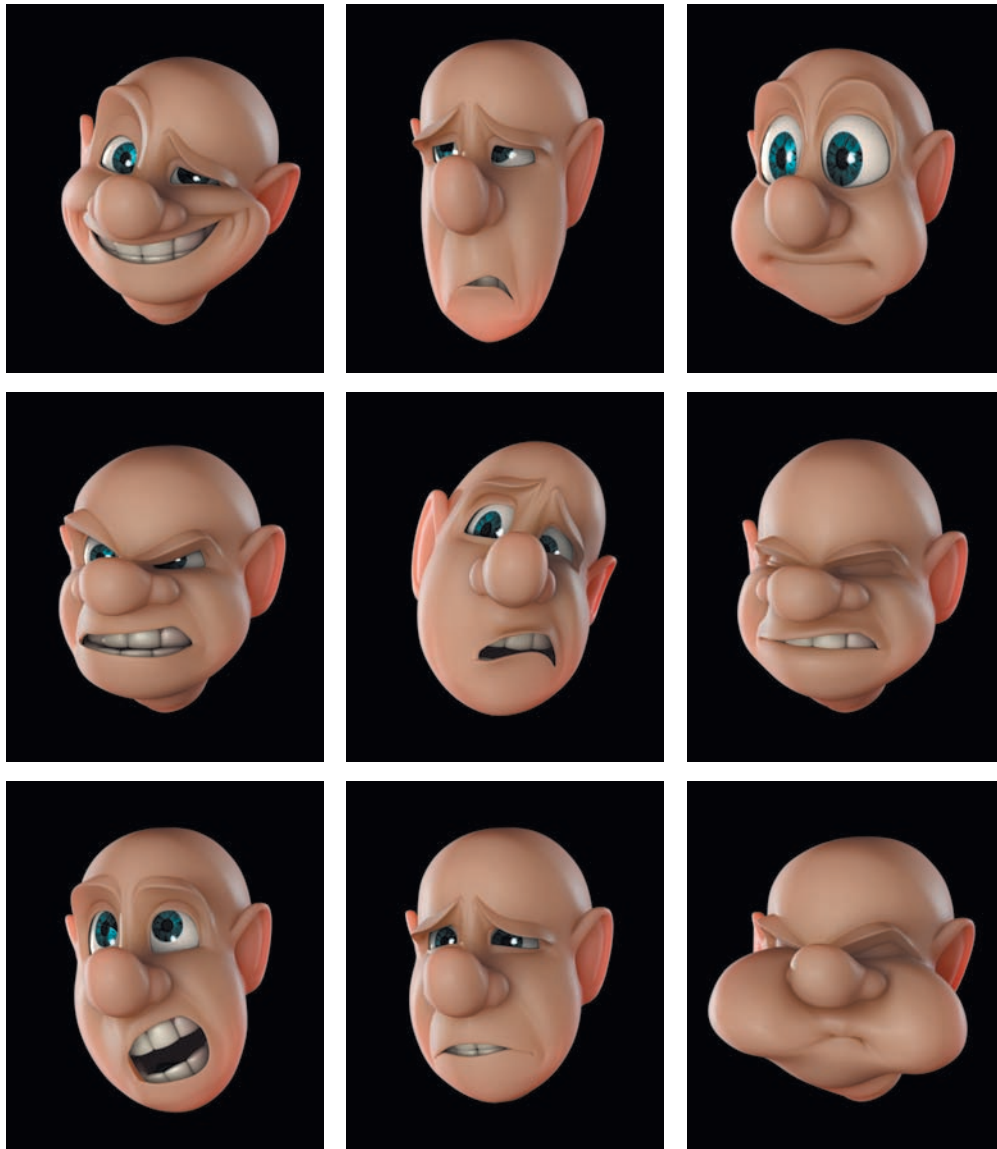
Squoosh, believe it or not, really is fundamentally the same setup and shape set as those I describe throughout the book, with just a few more shapes added, and a squash-and-stretch trick which you can learn all about in Chapter 13. As is always true, the larger range you are seeing here isn't tech as much as it is art. Make a bigger smile shape, you'll see a bigger smile shape; make a sadder brow shape, you'll see a sadder brow shape.

Lack of Dialogue
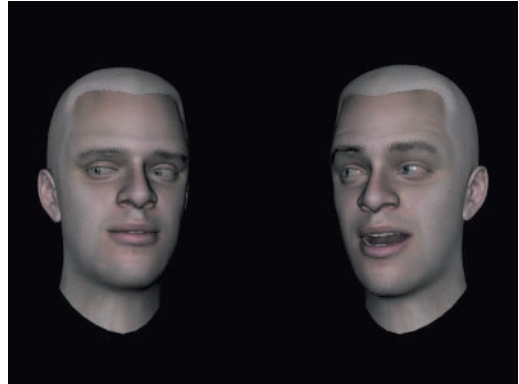
This two-character scene (`Dialogue.mov` from the Chapter 14 folder on the CD-ROM) is a great example of my take on eyelines. Not for one single frame of this are the eyeballs actually pointed where it seems they are, but they look correct, and that's all that matters. There's more on this concept in Chapter 2.

Dunce Cap
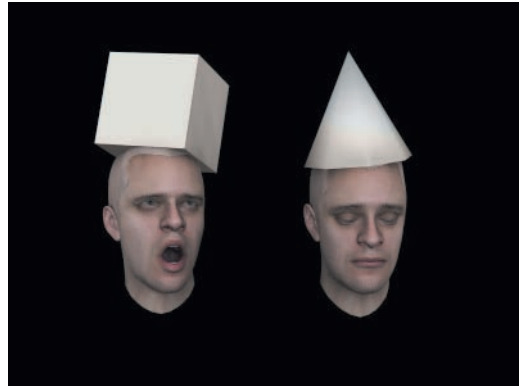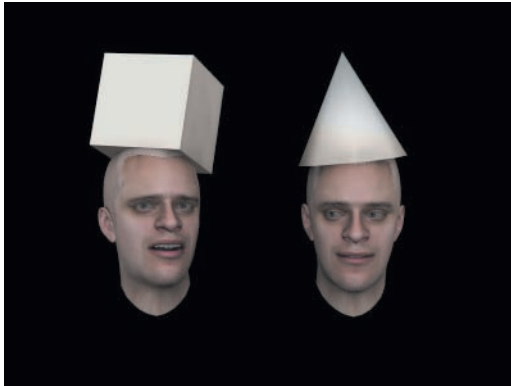
"Dunce Cap" is another two-character scene described in Chapter 14 (`Dunce.mov`); here, the head on our left does all the talking. Jason Hopkins animated this; he says his biggest challenge was doing dialogue without bodies: "Since there's no body, I wanted to, *had* to, gesture with the head. To really match the voice track, I had the talker gesturing to the other character and the audience." He also used subtle movements by the character on the right to keep him "alive" and get him some audience focus.

Bartender
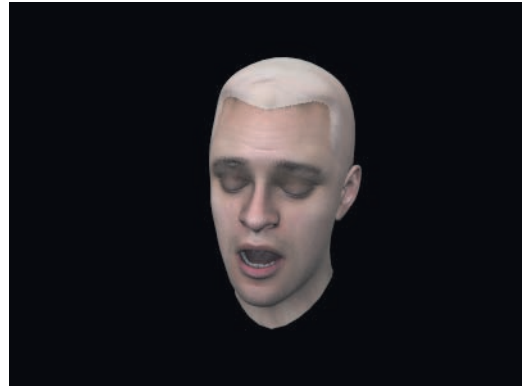
With some of these frames from an animation I talk about in Chapter 14 (`Bartender.mov` on the companion CD), it's easy to see how the varying combinations of smiles, squints, and brow poses can combine to create a wide range of sincerity and different subtext at any given moment.

The Mouse King
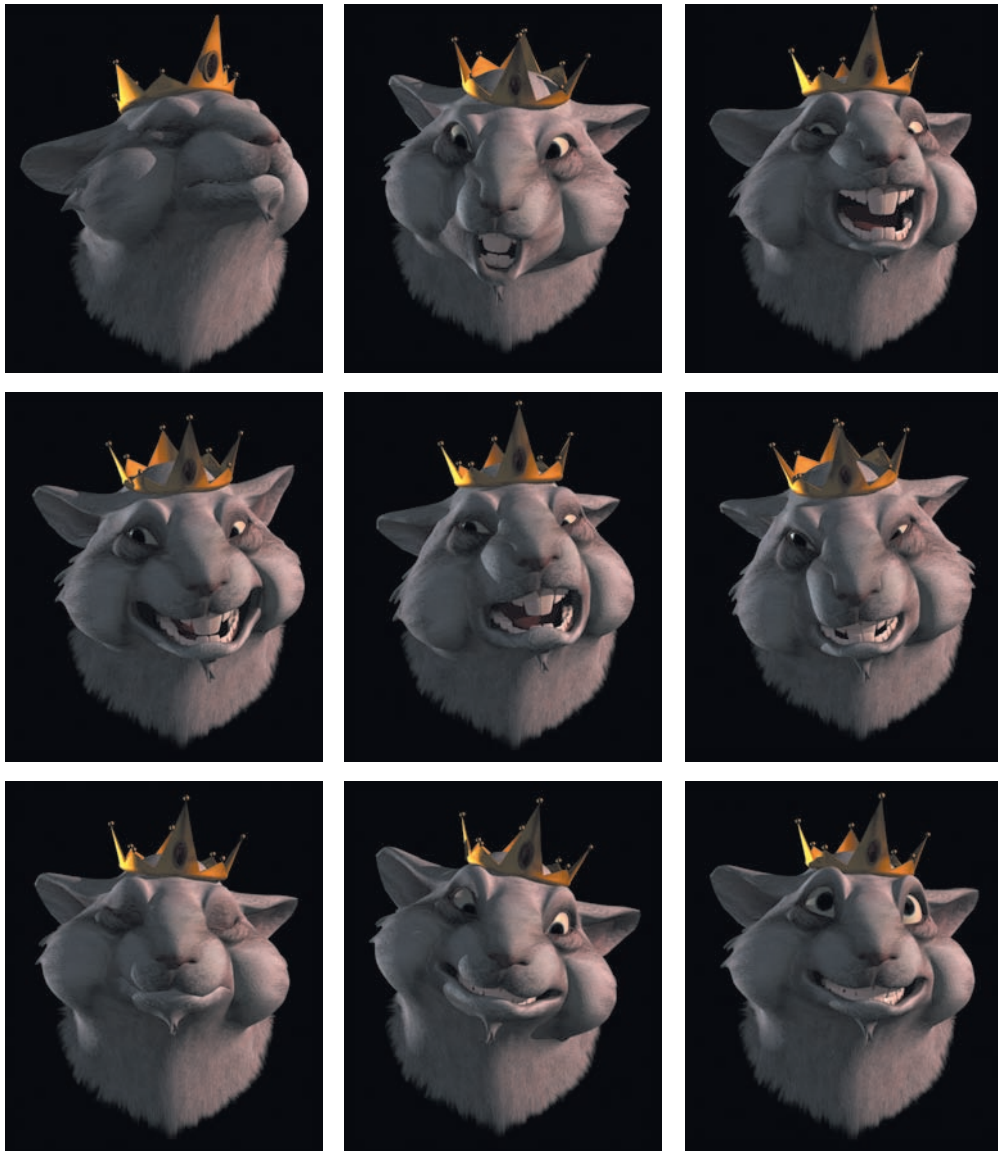
The Mouse King, from Mattel's production of *Barbie in the Nutcracker*, available on DVD and video: The Mouse King (as well as many of the characters from the second Barbie movie, *Barbie as Rapunzel*) presented a unique challenge—characters with a snout—making me re-evaluate some of my systems and key sets for animation, which until then I had based wholly on humans. The Mouse King also has a very distinctive and strong design, which forced me to come up with some creative ways to pose his face while not breaking the look of the character. In the end, after the combined efforts by voice acting, modeling, and animation, he turned out a great performance, with my facial setup being just one of the many pieces that brought him together. Pictured are frames from an animation, from the development stages of *Barbie in the Nutcracker,* where we tested the range and performance styles for the Mouse King, which is in the Extras folder on the companion CD. (Note: The voice track has been removed for legal reasons.)

Creating Complex Expression

Lips Up and In

Smile

Squint

Sneer

Brows Down and Squeeze

All Shapes Together

This series of images shows what it looks like, using the techniques in this book, to build up complex expressions one simple piece at a time. By taking up some of the upper lip to bare teeth, and lower lip up to roll the lower lip in (1), then a little smile (2), then dialing in some squint(3), and pulling the nose up with a sneer (4), then finally pushing the brows down and together (5), it all adds up to one pretty scrunchy face.

Index

Note to the Reader: Throughout this index **boldfaced** page numbers indicate primary discussions of a topic. *Italicized* page numbers indicate illustrations.

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