Although you can go a long way toward completing a scene simply by animating the character’s body, animating the character’s face adds greatly to the expressiveness of a sequence. At the very least, you’ll want the character to blink its eyes. You can also animate the character to look around and react to its circumstances with various facial expressions. And you can animate its mouth to make it speak in sync with a soundtrack.
Eye Animation

One of the easiest ways to breathe more life into an animation is to make the eyes look in various directions during the sequence.

Look-At Constraint

To control the eyes, you can use a look-at constraint. This forces the eyes to always follow a control object somewhere in front of the head, called the look-at target. Making the eyes look in different directions then becomes a simple matter of moving the look-at target.

To use this tool, you will need to create separate objects for the eyeballs. Usually, you’ll start with spheres, and change their shapes slightly to fit the facial model.

FFD Space Warp

When you use a look-at constraint, the eyes rotate to look at the target. If they aren’t perfectly spherical, the eyes will look strange when they rotate.

To solve this problem, you can use a free form deformation (FFD) tool. This creates a lattice around an object, and you can move the points on the lattice to deform the object. Then, when you use a look-at constraint, the eyes will stay deformed according to the lattice as they rotate to face the look-at target.

There are several FFD tools in 3ds max. For the eyes, you’ll use an FFD space warp. A space warp is similar to a modifier, but it shapes the object using a separate gizmo that can stay put while the object moves or rotates. This means the space warp always applies the same deformation to the object regardless of whether the object is animated.

The FFD space warp will keep the eyeball conformed to the head while the eye rotates to face the look-at target.
TUTORIAL A6

Animating the Eyes

In this tutorial, you’ll shape the eyeballs to fit the head, then add a look-at constraint so you can animate them looking in different directions.

Try out a Look-At Constraint

1. Load the file CharAnimEyes01.max from the Animation/Scenes folder on the CD.

   This scene contains a head similar to the one you created in Chapter 2, and a dummy object placed a short distance from the head. You’ll use this object as the look-at target for the eyes.

   We’ll use this scene because the head has been frozen to prevent you from accidentally selecting it. Also, the eyes were created as separate spheres, then converted to Editable Poly objects, and shaped by scaling vertices at the Vertex sub-object level. The pupils were given a different material ID so the pupils and whites can have different colors.

2. Select the right eye.

3. Choose Animation > Constraints > LookAt Constraint, and click the dummy object in front of the head.

   The eye rolls up into the head. In order for the look-at constraint to work, you must set the appropriate axis for the eye. The eyes were created in the Front viewport, so their local Z axes point straight ahead.

4. In the Motion panel, in the middle of the LookAt Constraint rollout, change the Select Look-At Axis to Z.

5. For the aligned to Upnode Axis option at the bottom of the rollout, choose Z.
This will cause the eye to have the same orientation on its X and Y axes as it had before you added the look-at constraint.

6. Turn off **Viewline Length Absolute**.
   This makes the blue line extend all the way to the look-at target.

7. Select the left eye, and follow the same steps to set up a look-at constraint for the left eye.

8. In the Top viewport, move the dummy object to the left or right.

   When you move the dummy object way over to the left or right, you can see the eyes rotate in the Top viewport. There is a slight problem, though: If you watch the User viewport, you can see the edges of the eyes rotating into or out of the eye sockets at the extremes.

**Create FFD Space Warps**

To prevent the problem of the eyes popping out of their sockets as they rotate, you’ll shape the eyes with an FFD space warp.

1. Load the file *CharAnimEyesFFD01.max*.

   This file contains the same setup, but the eyes haven’t been shaped to fit the head.

2. On the **Create** panel, click ![Space Warps](image). Choose *Geometric/Deformable* from the drop-down menu, and click **FFD (Box)**.

3. Click **Set Number of Points**, and set **Length**, **Width**, and **Height** to 2.

4. In the Top viewport, click and drag to create a space warp around the right eye. Drag again to set the space warp’s height, and click to finish creating it.
The space warp is shaped like a box, with a control point at each corner of the box. You’ll use this box to warp the eye in a later step.

5. Use Align to align the space warp with the right eye.

6. On the Modify panel, name the space warp SWEyeR.

7. Set the space warp’s Length, Width, and Height to 24. This will make the space warp sufficiently large to encompass the eye.

8. In the Deform group, choose the All Vertices option. This will cause the space warp to deform all vertices in the eye, even if they aren’t inside the space warp. Setting this option makes the space warp work even if it’s a little too small for the eye.

9. Make a copy of the space warp, and name it SWEyeL. Align this space warp with the left eye.

**Bind the Eyes to the Space Warps**

In order for a space warp to affect an object, you must bind the object to it.

1. Select the right eye. Make sure the eye itself is selected, not the space warp.

2. On the main toolbar, click Bind to Space Warp.

3. Press the [H] key, and choose SWEyeR from the Select Space Warp dialog. A new modifier, FFD Binding, appears on the stack for the right eye.

4. Select the left eye, and click Bind to Space Warp. Press the [H] key and choose SWEyeL.
Warp the Eyes with the Space Warps

1. Select the space warp on the right eye.

2. On the Modify panel, expand the listing to show the Control Points sub-object, and highlight it.

3. In the Top viewport, move the control points to skew the eye and make it follow the shape of the head, as shown in the picture.

   As you move the control points, you’ll see the eye deforming to follow the shape of the lattice. Check your work in the User viewport to make sure the eye looks good.

4. Turn off Control Points when you have finished.

5. Select the space warp on the left eye. Use the control points on this space warp to skew the left eye in the direction opposite the right. Turn off Control Points when you have finished.

Set up the Look-At Constraint

Now you’re ready to apply the look-at constraint to the eyes.

1. Select the right eye.

2. Choose Animation > Constraints > LookAt Constraint, and click the dummy object in front of the head.

3. In the Motion panel, set the Select Look-At Axis and the aligned to Upnode Axis to Z. Turn off Viewline Length Absolute.

4. Select the left eye, and follow the same steps to set up a look-at constraint on the left eye.

5. Move the dummy object to the left or right.

   The eyes follow the look-at target, but they stay deformed to the shape of the head as they turn.

6. Save the scene as CharAnimEyesFFD02.max.
Facial Expressions and Speech

As with body animation, your best tool for facial animation is your own face. That said, your second-best tool is a mirror. Before you animate your character, make the faces yourself, and note how your facial muscles and features respond to each emotion. If you want to animate your character speaking, talk to your mirror and notice how your mouth moves to form each sound.

In this book, you’ll learn to create facial expressions and animate them with the Morpher modifier. You’ll also find out how these techniques can easily be used for speech animation.

Morpher Modifier

A good way to animate facial expressions and speech is to use a Morpher modifier to gradually change one version of an object into a different version.

To use the Morpher modifier with a character’s head, you must first create several copies of the head, and arrange the vertices on each copy into different expressions. The various copies are called morph targets. Then you can apply the Morpher modifier to the head, and use it to animate the head changing to match specific morph targets on different frames.

The Morpher modifier requires that all objects have the same number of vertices. So before you make any copies, you must take the time to set up the head with all the vertices you think you’ll need. For example, if the character will open its mouth, the initial head must have a mouth cavity and sufficient vertices at the lips to form the expressions. If the character is going to blink, you must give it polygons that can act as eyelids.
TUTORIAL A7

Morphing Facial Expressions

In this tutorial, you’ll create several versions of a single head, model different facial expressions, and morph between them with the Morpher modifier. You can use this technique with any model to animate the character’s face.

Load the Head Scene

1. Load CharAnimHead01.max from the Animation/Scenes folder on the CD.
   This scene contains a single head with its mouth and eyes in a neutral pose. The eyes are rigged with FFD space warps to follow the dummy object when it moves.

2. Select Head_Base, the head in the scene.
   The head has TurboSmooth applied to it, because you’ll need to see the results of TurboSmooth at certain times while you work. But you’ll need to work at the Editable Poly level of the object.

3. On the Modify panel, turn off the Show end result on/off toggle if it’s still turned on.

Create a Mouth Cavity

The head needs a mouth cavity so the facial expressions will look more realistic when the character opens its mouth. We’ll assign a material to the polygons before we extrude them, so the mouth will have its own color that’s applied as it’s created. (See Chapter 1 if you need a refresher on creating materials or extruding polygons.)

1. In the Material Editor, select the Head material and set the number of materials to 3.

2. Change the last material to a dark red color, rename it to Mouth Cavity, and close the Material Editor.
3. Go to the Polygon sub-object level for the Editable Poly, and for the two polygons that make up the inside of the mouth, set Material ID to 3.

When you extrude the selected polygons into the head, the new polygons will also have this material ID and material.

4. While watching the Left viewport, extrude the selected polygons into the character’s head.

5. In the Edit Geometry rollout, click Make Planar.

This straightens out the selected polygons, making them all lie in the same plane. This will make it easier to adjust the vertices in the steps that follow.

6. Turn on the Show end result on/off toggle.

7. Go to the Vertex sub-object level for the Editable Poly, select the vertices at the end of the mouth cavity, and scale them to make the inside of the cavity larger.

   Be sure to check your work in both the Front and Left viewports.

8. When you’ve finished, turn off the Show end result on/off toggle and turn off the Vertex sub-object level.

Create Copies of the Head

The Morpher modifier works only with objects that have the same number of vertices. The easiest way to create these objects is to make several copies of the base object, and move vertices on each one.

1. In the Front viewport, create four copies of the head to the right of the original.

   The head copies won’t have any eyes. You’ll use the Morpher modifier without affecting the eyes, so you don’t need a set of eyes for each head.

2. Name the copies Head_CloseMouth, Head_Smile, Head_Ooo, and Head_Blink.
3. In the Top viewport, move each copy forward individually so you can see each one’s profile in the Left viewport.

4. Save the scene as CharAnimHead02.max.

Create the First Facial Expression

1. In the Front viewport, zoom in on Head_CloseMouth.

2. Go to the Vertex sub-object level for the Editable Poly, and turn on Ignore Backfacing in the Selection rollout.

3. Move vertices around the mouth area to close the mouth in a neutral expression.

4. Check your work in both the Left and Front viewports, and turn on the Show end result on/off toggle as necessary to see how the facial expression looks with smoothing.

5. Turn off the Vertex sub-object level when you’re done so you can select the next head.

Create the Remaining Facial Expressions

For each facial expression, zoom in on the head in the Front viewport, turn on Ignore Backfacing, and work at the Vertex sub-object level. You might also find it useful to work in Smooth + Highlights mode with Edged Faces turned on. You can also use soft selection when working with sets of vertices to move entire regions of the face.

1. For Head_Smile, pose the mouth vertices into a smile. When you smile, the corners of your mouth not only move away from the center of your face, but they move slightly toward the back of your head. In addition, your lips flatten out to some degree.

   To make the smiling expression, move not just the vertices at the mouth, but also those on the nose, cheekbones, and eyes just a little bit. You can also move and rotate the vertices at the corners of the eyes to make the smile “reach” the eyes. This will make this expression look more natural during animation.

   ▶ TIP ◀

If you prefer to have a set of eyes present when you model each facial expression, you can copy the eyes to each head. If you do so, be sure to copy the entire eye setup, including the FFD space warps and the look-at target.
2. For Head_Ooo, pose the lips in a pucker, as if the character were saying, “Ooo.” Push the bottom of the nose upward a little, and squint the eyes slightly.

3. For Head_Blink, move the eyelids close together to close the eyes.

   This can be the trickiest expression to create. There are sets of vertices near the edges of the eyes specifically for closing the eyelids. You’ll have to carefully select these vertices and move them up or down to close the eyes. Use Wireframe display, Arc Rotate, or any means necessary to find and select these vertices.

   You only have to adjust the eyelid vertices for this expression. When you use this expression with the Morpher modifier, you will use only the selection of vertices used to close the eyes, so you can combine this expression with others.

   Be sure to check your work with TurboSmooth, as the eyelids won’t close as much when TurboSmooth is turned on.

4. On Head_Blink, select the vertices you moved to close the eyelids, and in the Named Selection Sets entry area, enter the name Eyelids.

   This creates a selection set that you will be able to access only when you are at the Vertex sub-object level. By creating this selection set, you ensure you’ll be able to select the vertices again if you lose the selection by accident.

5. Turn off the Vertex sub-object level for Head_Blink.

6. Save the scene as CharAnimHead03.max.

Apply the Morpher Modifier

You’ll apply the Morpher modifier to Head_Base below its Turbo-Smooth modifier. The system will respond faster if it’s morphing unsmoothed meshes, because they have fewer vertices.

1. Hide the space warps and dummy object to make it easier to see Head_Base.
2. Remove the **TurboSmooth** modifier from all the heads except **Head_Base**.

When you ask the Morpher modifier to load morph targets, it will only find those that have the same number of vertices as **Head_Base** before TurboSmooth is applied. Therefore, you have to remove TurboSmooth from all the other heads before you can use them as morph targets.

3. Select **Head_Base**.

4. Select the **Editable Poly** level for **Head_Base**, and apply the **Morpher** modifier.

   Make sure the **Morpher** modifier appears below **TurboSmooth** on the stack.

5. In the Channels List rollout, click **Load Multiple Targets**. Select all the heads that appear on the list.

6. Save the scene as **CharAnimHead04.max**.

---

**Morph the Facial Expressions**

The Morpher modifier works with *channels*. In the Channel List rollout, each morph target appears in its own channel, only one per channel. You morph to different targets by animating the channel percentage. When a morph target’s percentage is set to 100, the face takes on 100 percent of that facial expression.

1. Turn on **Auto Key**.

2. Go to frame 20, and set the percentage for **Head_CloseMouth** to 100.

   This morphs the head to match this morph target.

3. Go to frame 25, and set the percentage for **Head_CloseMouth** to 0.

4. On frame 25, set the percentage for **Head_Smile** to 100.
Keys for each percentage are stored separately, so the **Head_Smile** percentage will go from 0 to 100 over frames 0 to 25. To keep the character from smiling until frame 20, you’ll have to set a key for this channel at frame 20.

5. Go back to frame 20, and change the percentage for **Head_Smile** to 0.

Now you’ll animate the eyes blinking around frame 25. You can tell the Morpher modifier to use only the last vertices selected to form the morph target for this channel.

6. Click **Head_Blink** in the Channel List rollout to select that channel. In the Channel Parameters rollout, turn on **Use Vertex Selection**.

7. Go to frame 25, and set the **Head_Blink** percentage to 100.

The eyes close, but the smile expression doesn’t change, because the channel is morphing only the selected vertices on the eyelids.

8. On frames 22 and 27, and set the **Head_Blink** percentage to 0.

This creates a blink with three frames to close the eyes, and two frames to open them. If you play the animation, you’ll see the character close its mouth, then smile and blink.

9. Save the scene as **CharAnimHead05.max**.

**Finish the Animation**

Now you’ll set up the remaining keys in preparation for using this head animation with a body animation sequence you created earlier.

1. Use **Time Configuration** to set the total number of frames to 120.

2. On frame 55, set **Head_CloseMouth** to 100 and **Head_Smile** to 0.

▶ **TIP**

If your system is running too slowly, make sure the TurboSmooth modifier is turned off.
3. Go back to frame 50, and set Head_CloseMouth to 0 to keep the mouth closed until that frame. Set Head_Smile to 100.

4. Set the remaining keys in the following order:

<table>
<thead>
<tr>
<th>Frame</th>
<th>Expression</th>
<th>Percentage</th>
</tr>
</thead>
<tbody>
<tr>
<td>50</td>
<td>Head_Blink</td>
<td>100</td>
</tr>
<tr>
<td>47</td>
<td>Head_Blink</td>
<td>0</td>
</tr>
<tr>
<td>52</td>
<td>Head_Blink</td>
<td>0</td>
</tr>
<tr>
<td>85</td>
<td>Head_CloseMouth</td>
<td>0</td>
</tr>
<tr>
<td>85</td>
<td>Head_Ooo</td>
<td>100</td>
</tr>
<tr>
<td>80</td>
<td>Head_CloseMouth</td>
<td>100</td>
</tr>
<tr>
<td>80</td>
<td>Head_Ooo</td>
<td>0</td>
</tr>
<tr>
<td>80</td>
<td>Head_Blink</td>
<td>100</td>
</tr>
<tr>
<td>77</td>
<td>Head_Blink</td>
<td>0</td>
</tr>
<tr>
<td>82</td>
<td>Head_Blink</td>
<td>0</td>
</tr>
<tr>
<td>102</td>
<td>Head_CloseMouth</td>
<td>100</td>
</tr>
<tr>
<td>102</td>
<td>Head_Ooo</td>
<td>0</td>
</tr>
<tr>
<td>102</td>
<td>Head_Blink</td>
<td>100</td>
</tr>
<tr>
<td>100</td>
<td>Head_CloseMouth</td>
<td>0</td>
</tr>
<tr>
<td>100</td>
<td>Head_Ooo</td>
<td>100</td>
</tr>
<tr>
<td>100</td>
<td>Head_Blink</td>
<td>0</td>
</tr>
</tbody>
</table>

The animation should end with the character’s eyes and mouth closed. If you like, you can play the animation to see what it looks like. If you don’t want to set all these keys, you can load CharAnimHead06.max from the Animation/Scenes folder on the CD to see the final sequence.

5. If you removed the TurboSmooth modifier from Head_Base, turn it back on now.

6. Save the scene as CharAnimHead06.max.
**Animating Speech**

You can use the same morphing techniques to make your character talk. Simply create a series of morph targets that represent 8–12 vowel and consonant sounds, and morph between them. Synchronize the morphs with a recorded soundtrack to make the character appear to talk.

These sounds, and the facial positions that represent them, are called *phonemes*. You don’t need a phoneme for every letter of the alphabet, because the mouth position is the same for many sounds. For example, your mouth looks nearly the same when you pronounce the letter *B* as it does for *P*.

If you wish to pursue this type of animation, consult a reference that covers this topic in detail. Some of these references are listed in the “Resources” section at the back of this book.

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**TUTORIAL A8**

**Merging Head and Body**

Now you can merge the heads into a scene with an existing character rig, and use the facial expressions in conjunction with body animation.

**Prepare the Head for Merging**

To prepare the head for use in a scene, you’ll link all the objects to a single object. Then you only have to link that one object to the character rig’s head bone.

1. Load the file *CharAnimHead06.max* from the CD or continue from the previous exercise.
2. Hide all the heads except *Head_Base*.
3. Unhide the space warps and dummy object.
4. Create a dummy object about half the size of the head. Name the dummy object *DummyHeadAll*. 

---

*Tip*

You can find a list of phonemes and their corresponding facial positions in any comprehensive book on character animation. The phonemes are the same for both traditional and computer animation.
5. Move the dummy object so it sits just on top of the head.

6. Select all the objects in the scene except DummyHeadAll (the head, eyes, space warps, and look-at dummy), and link them to DummyHeadAll.

7. Test the linkage by moving DummyHeadAll. The head, eyes, space warps, and look-at dummy should move along with it.

8. Save the scene as CharAnimHead07.max.

**Merge the Head into the Action Scene**

1. Load the scene CharAnimCatch03.max, either your own version or the one from the Animation/Scenes folder on the CD.

2. Play the animation.

   This is a version of the scene you animated earlier, with the character waving his arms, getting hit by a ball, and falling down.

3. Unhide Skater_Mesh_Head, and delete it.

   This is the existing head in the scene. You’ll be replacing this head with your morphed head, so you can get rid of it.

4. Choose File > Merge, and choose CharAnimHead07.max. Select all the objects in the scene, including the morph targets.

   Because you hid the morph targets before saving the scene, they come into the current scene already hidden.

**Place the Head**

1. Unhide the body and hair mesh objects.

2. On frame 0, move DummyHeadAll so the head sits on the head bone, BoneHead. If necessary, rotate it to match the rotation of BoneHead.

3. Unfreeze all the objects in the scene.

4. Link DummyHeadAll to BoneHead.

5. Link the hair mesh to BoneHead.
6. Hide all the bones and control objects.

7. If the neck protrudes into the mouth cavity, go to the Vertex sub-object level of the body mesh's Editable Poly, and move the topmost neck vertices down to make the neck nub shorter.

You can also improve the scene by changing the character's facial or body skin colors so they match.

8. Play or render the animation.

The character smiles, blinks, and says “Ooo!” when he's about to catch the ball. When the ball hits him, he closes his eyes, and they remain closed for the duration of the animation.

To get the facial timing for this animation, I looked for times when the character made a strong move, and changed his facial expression at those times. The blinks also coincide with strong motions.

9. Save the scene as CharAnimCatch04.max.

You can find a version of this scene that includes lights and materials in the file CharAnimCatch05.max in the Animation/Scenes folder on the CD. There's also a rendered version called CharAnimCatch05.avi in the Animation/AVI folder.

If you like, you can also animate the look-at dummy to make the character look in different directions over the course of the action.

**Congratulations!**

Now that you've gone through this book, you have all the tools you need to model, rig, and animate with 3ds max 7. Try out the techniques on your own characters, and use what you've learned to bring them to life.

I also encourage you to explore some of the resources listed at the back of this book to further your education in character animation. Good luck!