

MORE TOYS THA

After a 10-year hiatus, Pixar once again helps Woody rescue his wildly popular toy family from danger

By Barbara Robertson

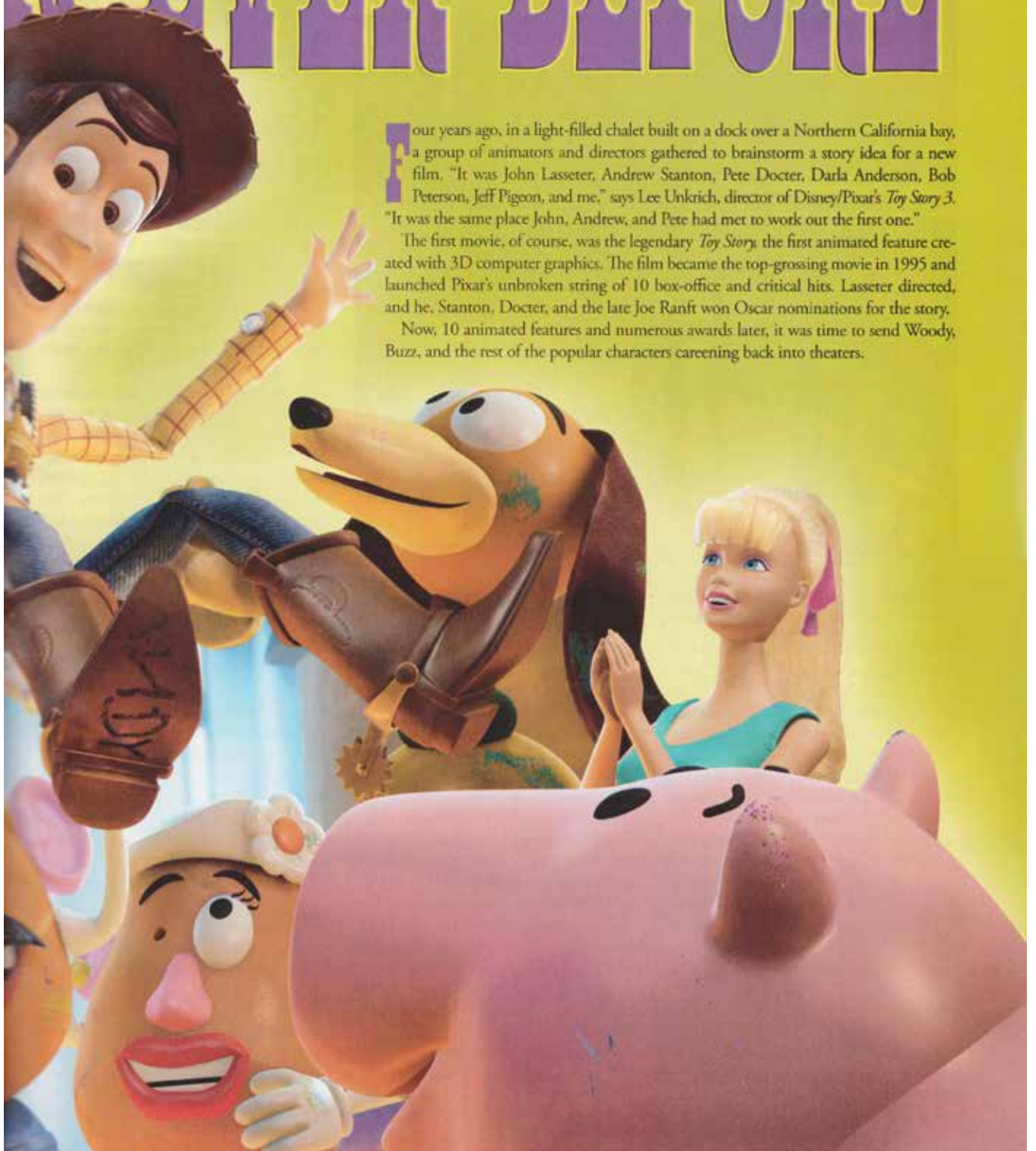


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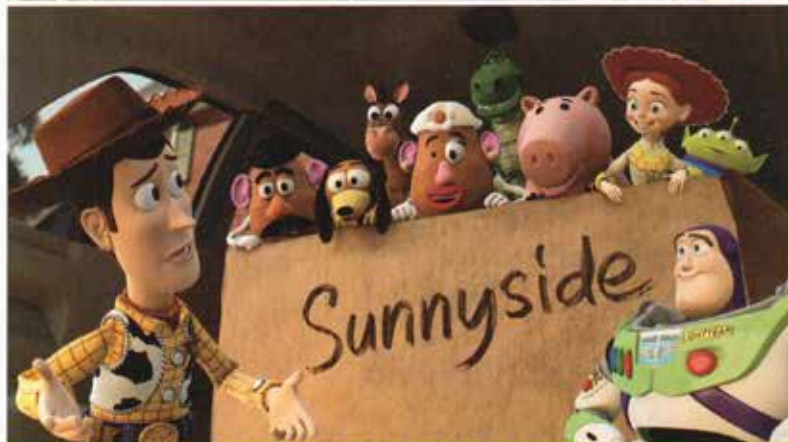
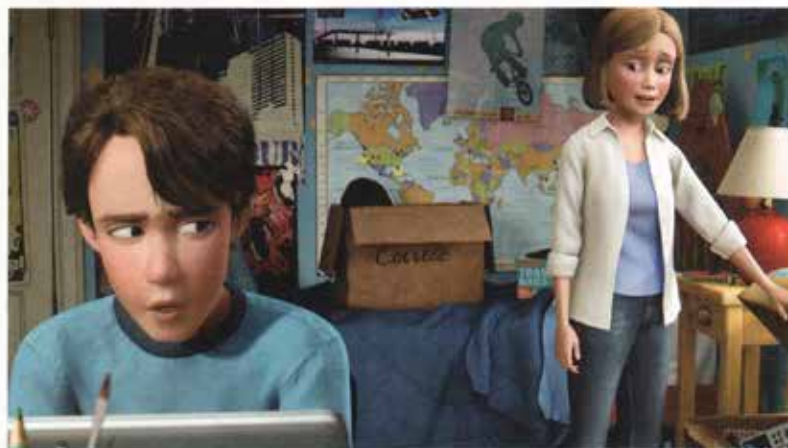
Four years ago, in a light-filled chalet built on a dock over a Northern California bay, a group of animators and directors gathered to brainstorm a story idea for a new film. "It was John Lasseter, Andrew Stanton, Pete Docter, Darla Anderson, Bob Peterson, Jeff Pigeon, and me," says Lee Unkrich, director of Disney/Pixar's *Toy Story 3*. "It was the same place John, Andrew, and Pete had met to work out the first one."

The first movie, of course, was the legendary *Toy Story*, the first animated feature created with 3D computer graphics. The film became the top-grossing movie in 1995 and launched Pixar's unbroken string of 10 box-office and critical hits. Lasseter directed, and he, Stanton, Docter, and the late Joe Ranft won Oscar nominations for the story.

Now, 10 animated features and numerous awards later, it was time to send Woody, Buzz, and the rest of the popular characters careening back into theaters.



■ ■ ■ Animation



At top, Pixar's technical team improved the controls that drive hair parameters to give Andy and his mom hair that looked and moved believably. At bottom, Andy's toys all appeared in *Toy Story* or *Toy Story 2*, but Pixar rebuilt and re-rigged them for *Toy Story 3*.

"I was excited and petrified," says Unkrich, who had co-directed the 1999 hit *Toy Story 2* with Lasseter. "No director wants to be the one who makes the dud. And, this would be a sequel to two of the most beloved and critically acclaimed films."

Adds Anderson, executive producer for *Toy Story 3*, "We have such love for these characters. We all felt the pressure to make a worthy film and honor the past. But, we were also very excited about it." As in real life, the story takes place a decade after *Toy Story 2*. Andy is about to leave for college and the toys are worried: Andy's mom tells him it's time to pack up his toys.

"We try to give the toys toy problems, not people problems," Unkrich says. "When toys are played with by kids, they get broken, but they can be fixed. If they are lost, they can be found. But, there's no cure for being outgrown. That's almost unanswerable."

As the story progresses, rather than ending up in the garbage, which almost happens, or stored in the attic, which was supposed to hap-

pen, Mom delivers Woody, Buzz, and the rest of Andy's toys to the Sunnyside day-care center. "That's utopia for a toy," Unkrich says. "But then we pull the rug out from under them."

Why? "Stories are about conflict," Unkrich says. "And, we found a toy way of creating a conflict."

Animating in the 21st Century

Because many of the animators had not worked on either of the first two films—in fact, some were only six years old when the first feature came out—animation supervisors Bobby Podesta and Michael Venturini found ways to bring the past forward. They interviewed Lasseter, Docter, and other animators who worked on the first two films about the returning toys. They also edited clips from the films into a nine-minute, best-of reel.

"We even interviewed Brad Bird, who didn't work on either film," Podesta says. "We did not want the animators to mimic what had been done. We wanted them to know it,

know it, know it, now throw it away."

Also providing continuity were the actors who returned to voice the characters. The pull-string cowboy Woody again speaks with Tom Hanks' voice, and heroic space ranger Buzz Lightyear with Tim Allen's. Other returning characters and actors are cowgirl Jessie (Joan Cusack), piggy bank Hamm (John Ratzenberger), Mr. and Mrs. Potato Head (Don Rickles and Estelle Harris), dinosaur Rex (Wallace Shawn), Barbie (Jodi Benson), and Andy (John Morris).

Joining this ensemble are the day-care residents: Lots-o'-Huggin' Bear aka Lotso (Ned Beatty), a pink, strawberry-scented plush toy; Ken (Michael Keaton), a swinging bachelor with a cool wardrobe; Stretch (Whoopi Goldberg), a purple octopus; Big Baby, a lifelike doll that doesn't talk; along with hundreds of other toys and dozens of children.

What didn't return were the models and rigs. "We used the same models and rigs on *Toy Story 2*," Podesta says, "but we rebuilt them for *Toy Story 3*."

Guido Quaroni, supervising technical director, led the technical team that modeled all the characters and sets, rigged the characters, shaded the models, ran simulations including, often, cloth and hair sims, and lit and rendered the shots. "Everything geeky," he says. "But also artistic. The story and art departments feed us the design and characters. We construct the assets, and give them to animation. And then we take everything to the pixels."

But, at Pixar, this process doesn't move along a straight line. "Initially, designs approved by the art department would move to modeling, then rigging, then animation," Quaroni says. "But we've refined this process over the years. Animators inspire the design; they start giving feedback as soon as character design starts. They understand motion and expression."

Quaroni singles out animator Angus McClane as being particularly instrumental in the toy designs. "He has millions of toys," Quaroni says. "He knew how a manufacturer would build the toy." Ken, for example, moves stiffly because the modelers and riggers gave him rigid plastic joints.

"John Lasseter tells us to be true to the character," Quaroni says. "If a toy is plush, make it feel like a plush toy; if it's plastic, make it rigid. We have these discussions early on, and it saves us a lot of time later."

All told, the crew built nearly 300 animated characters. "Some are made with LEGOs and aren't that complex," Quaroni says. "But, the animators still had to animate them." For modeling, Pixar uses primarily Autodesk's

Maya and then converts the files into Pixar's own Marionette for character rigging, animation, camera, and lighting.

The challenge with the returning characters was to make sure the animators could match key expressions. "Bill Reeves built the articulation in 1993," Quaroni says. "We had to load that software in 2007, and execute the same math, the same computations. Then on top, we built the new rigs and did an A-to-B comparison. There are quality differences, but we kept the feel of the characters—the way Buzz lifts an eyebrow, Woody's special smile. We saw instances where we'd build a model and it would look like a cheap fake. It took three or four months to nail Buzz and Woody especially."

Cloth and Hair

As for challenges on the technical side, Quaroni cites two: hair and cloth. "Lee wanted to see hair and cloth working together before he approved the shots," says Sanjay Patel, character supervisor.

Traditionally, Pixar used a 2D garment pattern system to cut out pieces of cloth and then stitched them together digitally, and the simulation engine expected clothes made in that fashion. For *Up*, the studio moved to the 3D solution, which became especially important for Ken. "His closet looks like a wardrobe department," Patel says. "We matched as many vintage clothes as we could find. We have Animal Loving Ken, Rock Star Ken, Cool Times Ken, and more I can't remember."

The joke is that Ken has more clothes than Barbie. "He changes clothes for every shot," Quaroni says. "He wears maybe 20 garments and has a closet full of more. We needed a faster system, better-quality simulations, and an improved workflow."

So, rather than having people who are expert tailors create Ken's clothes and those for other characters in the film, modelers sculpted 3D clothes and sent them to a new simulation system. "Modelers understand form, and the cool thing was that we could make more garments," Patel says. "With the new system [researcher] David Baraff worked on, cloth generates a quad mesh that we can throw at the simulator."

In addition to the toy Ken, a new human character, a child called Bonnie, wears three outfits. "She has mismatched socks and a cape over her clothes, with a necklace that she made atop that," Patel says.

And one of the toys, the Jolly Chimp (who is not jolly at all), is all-cloth. "We used the cloth system for his body and put fur on top," Patel says. "We also used the fur system to create terry cloth for Ken's clothes."



Toys in Stereo

Stereo supervisor Bob Whitehill likes to call Pixar's stereo style "comfortable, consistent, graceful, yet rewarding."

"We want to reward people for paying extra to see the film in 3D," Whitehill says. "But we don't want to add a distracting sheen."

When Whitehill supervised the conversion of *Toy Story* and *Toy Story 2* to stereo, he did so with some basic themes in mind. For those films, he concentrated on dialing down the stereo when the toys are in their world, and dialing it up when they're in the human world to make it seem more overwhelming. Also, he increased the stereo depth when Woody and Buzz are alienated, and decreased it when they connect (see "Stereo Twice Over," October 2009).

That wasn't so much the case with *Toy Story 3*. "This film is such an ensemble," Whitehill says. "It doesn't have the same character and thematic through lines. I just looked for opportunities to make the 3D pop in individual shots within a sequence." For example, he dialed down the stereo when Ken and Barbie meet, but increased it during the dramatic scenes toward the end.

Whitehill and the other stereo artists create the stereo camera by working in Pixar's proprietary MenV software. In a shot with Woody peeking around a fire hydrant, for example, he starts with the stereo dialed down. Grids representing the possible stereo depth lay one on top of the other at Woody's nose; Whitehill has dialed the stereo down. To increase the depth as Woody stretches forward, he pulls one grid forward to the fingertips of Woody's right hand, and pushes the other grid back to the fingertips of the other hand, which is still holding onto the hydrant.

"I look for the emotional beat, and play a visual accordion," Whitehill says.

Pixar did not design any of the shots for stereo. Unkrich, who had co-directed *Toy Story 2*, which Whitehill successfully converted to stereo 3D, knew that it wouldn't be necessary. Even so, Whitehill did make some subtle changes.

"Lee [Unkrich] likes to use shallow depth of field," Whitehill says. "So, we broadened some shots for stereo and sometimes removed foreground elements to spread the depth. In 3D, an out-of-focus element draws your attention to it, which is not what it's supposed to do. Also, he likes to put the camera down in the grass, so we raised it."

To cope with the problem stereo glasses cause by making the projected images look darker, Pixar color-timed a version of the film specifically for stereo. "It's upsetting to the lighters and colorists," Whitehill says, "because the whites have nowhere to go."

But, Whitehill notes that on home screens, darker images aren't such a problem. "I think people will be pleasantly surprised by the brightness," he says.

Whitehill supervised eight people credited with working on stereoscopy for the feature film and another four who helped, and it's likely many of them will start working on another film soon. "All our films in the future will be in 3D," Whitehill says. —Barbara Robertson

■ ■ ■ Animation

The catalyst for the conflict is Lotso, the plush teddy bear who runs the day-care center like a prison guard. "It was really important to make him believable," Quaroni says. "So we did a lot of work on the controls that drive the hair parameters to achieve the quality we wanted for him and also for the humans."

Bonnie has curly hair, and Barbie has long, straighter hair. "Mattel doesn't do the hairdo we use any more, but we got them to make one for us," Patel says. "We wanted to know what it looks like; how much it bends."

Pixar grooms the hair in Maya with NURBS curves, using parameters, paint tools, and procedural patterns to give it particular characteristics—length, bounciness, curl, color, and so forth. "Every movie for us now is about little steps," Quaroni says, "incremental, evolutionary steps."

Dirty Dozens

The little steps made it possible to simulate hair and fur for the 24 background kids as well as for the main characters. "We had a team with one simulation person, one shader person, one modeler, and one articulation person [rigger] tasked with getting the background kids as good as possible in a limited amount of time," Patel says. "The goal was to have them all look good and not like each other."

The team would show the supervisors all the kids in a group and then work on only the ones that stood out. "One shirt might look too much like another, or the hair on one kid wouldn't look right," Patel says. "It took them two months to do the 24 kids."

When Andy's toys arrive at the day-care center, the kids, the toys in the day-care center, and the toys in Lotso's gang all appear together with Andy's toys in one shot that included most of the 300 animated characters in the film. It was one of the most challenging sequences for the animation team.

"It was like an impending storm," says Podesta. "We had everyone put everything else down and said, 'We'll do this in one giant, two-week party.'" Pixar created a festive atmosphere and even brought in an ice-cream truck. It worked. Two weeks later, they showed the shot to an amazed Unkrich.

Soft Body, Hard Body

The challenge for the effects team centered, as is often the case, on a series of events near the end of the film. The toys find themselves inside a garbage bag, which is inside a garbage truck. The truck dumps the bag onto a conveyor belt that pulls trash, and Andy's toys—Woody, Buzz, Mr. and Mrs. Potato Head, Slinky, Rex, Hamm,



At top, Lotso, a new character and one of 300 animated characters in *Toy Story 3* leads Woody, Buzz, and Andy's other toys into danger. At bottom, in addition to the 24 background kids and the toys the animators turned into characters, modelers created 2500 unique objects for the day-care center.

Jessie, Bullseye her horse, and Barbie, (with newcomer Ken)—toward a huge grinder and an incinerator. And this sequence isn't the only scary moment. The Jolly Chimp is as bad as Sid, the human kid who made mutant toys, in the first film. And, Big Baby is no baby doll, either. "Baby doesn't do anything bad, but we filmed the doll in a creepy way," Unkrich says. "Everyone likes being scared in a safe environment."

And Jason Katz, head of story, adds, "We wanted to take the toys to the endgame. It's intense; it will be a challenging film for a three year old. This family faces a real dilemma. But, when we tried to remove the scene, the film didn't work."

For the effects team, the dilemma with the endgame was in simulating a massive amount of soft and rigid bodies. "The trash has everything from plastic bags to pieces of wood," Quaroni says. "We couldn't know which pieces of trash would go in the garbage truck or wherever, so we needed to make it easy to add parts to the simulation."

Before this film, modelers singled out objects selected for simulation and built them

based on the type of destruction that would occur later. But the climactic sequence had 200 shots of continuous effects. "We said, 'Guys, we need a more flexible system,'" Quaroni says. "Rather than remembering what needed to be set up and building models for a particular moment when they'd be melted or smashed, we assumed all of them would be. That was our mind-set."

It took a year to set up the infrastructure they needed, but at the end, they could crunch, smash, trash, or melt anything they wanted. Glass, cars, computers... it didn't matter. "We built 3000 models that we didn't have to worry about," Quaroni says. That is, the modelers constructed every object to be ready for simulation.

"We made sure every object in the pipeline could be fully simulated as a rigid or soft body," Quaroni says. "You can take a building and make it Jell-O. Or make Jell-O into a piece of steel. The shading system knows not to swim the textures. And, before, when you wanted a special object like that to interact with a model, we needed to make a special model, a



At top, an upgraded cloth-simulation engine moved 3D models of Ken and Barbie's clothes. At bottom, Lotso's gang plays poker in a sickly yellow light, a color cue that this group of toys is bad.

collider. For *Toy Story 3*, we pretend every object can interact with every other object. We can select 1000 objects, push a button, and they're live and active in the simulation process."

Lights

The lighting department also worked with more flexible tools for this film. The goal was to do more multithreaded, interactive rendering, rather than pushing rendering off to a renderfarm, and that meant lighters could work more interactively. "We have eight-core machines on our desktop now, and we'll soon have 12 cores," Quaroni says. "So this movie helped us develop the interactive technology. And, we're using Lumiere in RenderMan now."

Lumiere, explains Kim White, director of photography for lighting, allows the artists to change lights and see rough, quick renders. "It's a tool we had a while ago, but it got lost in software changes," she says. "It caches shading and animation so it only recalculates the lighting. It helps the lighters make faster iterations."

White, who was a lighting supervisor on *Ratatouille*, decided to incorporate some of the tools developed for saturation and contrast control on that film (see "Most Delicious,"

July 2007). "We pushed some of the tools further to get more detail in the darks, more value down at that end," she explains. "We didn't use exactly the same color space as *Ratatouille*, but we wanted that richness."

In addition to *Ratatouille*, for reference and inspiration White cites the live-action films *Amelie* and *Searching for Bobby Fisher*. You can see some beautiful things done with color in *Amelie*, she says, "where a lot of the frame is one color, like green, and the character wears another color that pops out, like red. Or, a lot of the frame is yellow. So we looked at that. When Lotso was the center of his little girl's world, we had one color for a lot of the frame, and let him be the only pink thing. And then when the girl gets a new Lotso, [the abandoned Lotso], who looks at them through the window, is still pink, but no longer a vibrant pink. The new Lotso is a pinker thing."

Bobby Fisher inspired a scene in which Woody and the toys are in a cardboard box in the back of a car. "A shaft of light falls on Jessie," White explains, "but rather than have it fall on her face, we let the bounce light come up on her face."

At the beginning of production, White

worked with art director Daisuke "Dice" Tsutsumi and Unkrich, providing feedback as Tsutsumi developed the color script. Then, Tsutsumi created color keys, two or three key paintings for each sequence that showed colors, values, and mood. White gave those keys to the master lighters on her team of approximately 37.

"That's when we did the broad strokes for entire sequences," White says. "We'd have the lights for the sets and characters—sunlight streaming from a window, bounce light from a floor—the broad strokes." Individual shot lighters would then add, remove, and move lights to compose the frames for each shot. The goal was to set the mood, support the story with emotion, and direct the viewer's eye.

For example, at one point in the film, Buzz locks up Andy's toys because he doesn't know who his friends are. He puts them in prison. "During that sequence, we desaturate the lighting so it feels bleak and hopeless," White explains. "We pull a little saturation out of the saturated *Toy Story* world over the course of the shot. You don't know it; you feel it."

By contrast, dappled light gives viewers the feeling that Bonnie provides a safe place for her toys. But, when Woody falls out a window, the lighting is harsh and contrasty. "That's why I'm in lighting," White says. "I love how we can make a viewer feel the story."

Color also helps provide subtext. In this film, blue means safe. Andy's room, and his car are blue. The characters hide in a blue bin. Red and sickly yellow, on the other hand, are bad.

"When the toys get caught by Lotso [who is pink] as they're trying to escape, they're under yellowy street lights," White says. "We do a little of that through the film."

The End?

The first *Toy Story* opens with a scene of Woody riding on Andy's back. He does so again in this film, but this time, it's a bittersweet moment. "I wanted to end the toys' relationship with Andy," Unkrich says.

But, although Andy might disappear, Buzz and Woody could live to infinity and beyond. Pixar's relationship with the characters won't end, at least not yet.

"We've announced that we're doing a short," Unkrich says. "People love these characters."

Especially the people at Pixar.

"We just want to entertain ourselves," Katz says. ■ ♡ ☺

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