

The 12 Principles of Character Animation Applied to 3D Computer Animation

Summary of presentation by Isaac Kerlow, TWDC,
at the Forum international des technologies de l'animation
Angoulême, France, 2002

The 12 principles were created in the early 1930s, by animators at the Walt Disney Studios to lay the ground rules of animation for more focused discussions during production, and to train young animators better and faster.

The 12 principles transformed the craft of animation from a novelty into an art form, and were applied to the now classic early animated feature films: *Snow White* (1937), *Pinocchio* (1940), *Fantasia* (1940), *Dumbo* (1941), and *Bambi* (1942).

These principles are relevant because they help us to create more believable characters and situations. They also help to better define the genre of our animation, whether it is comedy, drama, or action-oriented.

1. **Squash and Stretch:** Exaggerate the amount of non-rigid body deformations for a more comedic effect. (Exagérer le déformations de corps non rigides pour un effet plus comédique.)
2. **Anticipation:** Guide the audience's eyes to where the action is about to occur, "announce the surprise." (Diriger les yeux de l'auditoire à où l'action est sur le point d'arriver, "annoncer la surprise.")
3. **Staging:** Translate the mood and intention of your scene into positions and actions of the characters. Key poses in scene define nature of the action. (Traduire l'humeur et l'intention de votre scène en position et actions des personnages. Les poses les plus importantes dans une scène définissent la nature de l'action.)
4. **Straight-Ahead Action or Pose-to-Pose:** Two different techniques: working through the action one step at a time until the action is finished, or breaking down the motion into a series of key poses. (Progresser dans l'action étape pour étape jusqu'à ce que l'action finie, ou diviser le mouvement dans une suite de poses principales.)
5. **Follow-Through and Overlapping Action:** The reaction after an action tell us how the character feels about it. Multiple motions influence, blend, and overlap the character position. (La réaction après une action nous dit comment les personnages la ressent. Les mouvements multiples influencent la position de personnage, la modifient, et la complexifient.)

6. **Slow-in and Slow-out:** A snappy effect is achieved by speeding up the middle of an action, while slowing down its beginning and end. (Un effet "snappy" est atteint en accélérant le milieu d'une action, en ralentissant son commencement et sa fin.)
7. **Arcs:** The movements of characters follow circular paths, never a perfectly straight line. (Les mouvements de personnages suivent des trajectoires circulaires, jamais une ligne parfaitement droite.)
8. **Secondary Action:** The smaller motions that complement the dominant motions that define the action. (Les plus petits mouvements qui complètent les mouvements principaux qui définissent l'action.)
9. **Timing:** The precise moment and the amount of time that a character spends on an action add emotion and intention to the performance. (Le moment précis et la quantité de temps qu'un personnage passe sur une action ajoutent l'émotion et l'intention à l'exécution.)
10. **Exaggeration:** Usually helps to deliver the essence of an action by a cartoon character. (D'habitude les aides pour exprimer l'essence d'une action par un personnage cartoon.)
11. **Solid Drawing:** Weight, depth and balance in the drawing of the characters helps them to come alive. (Le poids, la profondeur et l'équilibre dans le dessin des personnages les aident à s'animer.)
12. **Characters' Appeal:** In order to connect with the audience, characters must be well developed and have an interesting personality. (Pour toucher l'auditoire, les personnages doivent être bien développés et avoir une personnalité intéressante.)

Are the 12 Principles Still Relevant in 2002?

Yes, they continue to be a useful set of guidelines or "recipes." Animators continue to find different personal interpretations of these principles for a wide range of projects: Hollywood productions and independent work, feature-length and short movies, 3D CG and hand-drawn, videogames, Anime, etc.

But animation techniques and styles, and scope of productions, have changed tremendously since the 1930s. We could use revisions and expansions, and also new additional principles to address some of the new 3D computer animation techniques and styles.

How to Implement the 12 Principles in 3D Computer Animation?

1. Squash and Stretch: Can be implemented in 3D with a variety of techniques: skin and muscle, springs, direct mesh manipulation, morphing, etc. Newer approaches might include weighting for dynamics simulations, and unusual IK systems.
2. Anticipation: Use digital "time-editing" tools such as time sheets, timeline, and curves, to fine-tune more or less anticipation, including motion holds.
3. Staging: Animatics are a great tool for previsualizing staging. Plan process so that staging can be blocked out first, before primary, secondary, and facial animations.
4. Straight-Ahead Action or Pose-to-Pose: Take advantage of "layers" or channels to blend different types of motion, this allows for the intelligent mixing of keyframe and motion capture animations. Use non-linear capabilities of motion curves to edit different parts of body motion.
5. Follow-Through and Overlapping Action: Use layers to blend different types of motion. Use dynamics simulations to animate most follow-through, including cloth and hair.
6. Slow-in and Slow-out: Can be fine-tuned with digital "time-editing" tools: time sheets, timeline, curves. When using mocap, direct performers to do slow-ins and outs.
7. Arcs: Use software constraints to force all or some motion within arcs. Fine-tune mocap performances with arc editors.
8. Secondary Action: Take advantage of "layers" and channels to build-up different aspects of secondary motion.
9. Timing: Refine timing with non-linear time-editing tools to shave-off or add frames. Use tracks for different characters, and sub-tracks for areas of characters.
10. Exaggeration: Use many of the same techniques as "Squash and Stretch." Take advantage of scripts and other procedural techniques.
11. Solid Drawing (Modeling): Optimize models for specific animation. Customize IK skeletons for personality of character. Take advantage of modeling techniques to develop visual style.
12. Characters' Appeal: Two elements that can be greatly increased with 3D CG software: complexity, and consistency.

Revisions and Expansions...

Principle number 11, "Solid Drawing," perhaps could be renamed "Solid Modeling and Motion Rigging." Principle number 3, "Staging," perhaps could be expanded for the benefit of beginner animators and include more details such as: hiding the point of interest, reveals, chain reaction (action-reaction), etc.

Additional Principles? (work in progress...)

Additional principles need to go beyond drawing cartoon characters, acting and directing the performance, and interpreting real world physics. New principles could address the following topics:

13. Visual Styling: Develop a visual look that is technically feasible to produce throughout the entire process. More than ever before, visual development decisions can have a huge impact on animation style and production complexity.
14. Cinematography: Unlike "non-3D CG" animation productions 3D computer animation gives us absolute control over camera movement, and this has a huge impact on animation layout and the overall production process. Lighting work needs to be addressed upfront because of its huge impact on visual look and rendering.
15. Blending Cartoon with Real World: The gap has narrowed between effects animation and visual effects for live action movies. Learning how to integrate motion capture, must add intention to the motion so that it becomes a performance. Figure out how to blend hybrid styles: live action and cartoon animation, rotoscoping and mocap, hyperrealistic rendering of cartoon animation, etc.
16. Facial Animation: Determine what level of facial control, technique and styling works for the character since this has huge production implications. Must build facial morph targets and/or lookup tables for reference and production.
17. Significant Technical Complexity: Being able to managing the production pipeline has a huge impact on whether creative goals can be achieved.

Appendix: A Few Milestones in the Style Evolution of 3D Animated Characters

- 1985 Return of Sherlock Holmes. First 3D animated character in live action.
- 1989 The Abyss. First realistic 3D animated character.
- 1991 Terminator II. First complex 3D animated character.
- 1992 The Lawnmower Man. Fantasy 3D and live action combination.
- 1993 Jurassic Park. Multiple complex 3D animated character.

- 1994 The Mask. 3D squash and stretch in live action.
- 1995 Toy Story. First all 3D animated feature movie.
- 1995 Jumanji. Complex 3D realistic motion.
- 1995 Casper. Cartoon 3D and live action combination.
- 1997 Titanic. First large-scale 3D extras.

- 1997 The Lost World. Final proof that 3DCG can look real.
- 1997 Batman and Robin. 3D characters intercut with live action.
- 1997 Mars Attacks. Over-the-top 3D and live action.
- 1997 Hercules. first major 3D character in a Disney movie.
- 1998 A Bug's Life. Huge rendering complexity/cinema.

- 1998 ANTZ. Feature with stylized 3D characters.
- 1998 Mighty Joe Young. Hyper-real 3D with live action.
- 1998 Small Soldiers. Cartoon/realistic 3D and live action.
- 1999 Toy Story 2. First "well-rounded" 3D milestone.
- 1999 Stuart Little. first successful realistic/cartoon 3D characters.

- 1999 The Mummy. Stylized realism, multiple 3D characters.
- 2000 Dinosaur. 3D cartoon, realism and live action.
- 2000 X-Men. Successful 3D stylized hyper-realism.
- 2001 Shrek. Second 3D milestone: comedic realism, and first winner in Animated Feature Oscar category.
- 2001 Monsters, Inc. Third 3D milestone: sweet comedy.

- 2001 Jimmy Neutron. first box-office success low-budget 3D feature.
- 2001 Jurassic Park III. "Invisible FX," hyper-real 3D characters.
- 2001 Final Fantasy. Experiment in sci-fi/mocap/hyper-real.
- 2001 El Bosque Animado. Ultra low-budget production.
- 2001 Cats and Dogs. Cartoon 3D characters, with realistic rendering.

- 2002 Ice Age. Fourth major 3D milestone: economy of style.
- 2002 Spiderman. 3D stylized hyper-realism.
- 2002 Star Wars 2. Massive complex 3D characters, combination of blue screen and high-definition (HD) video.