

GETTING THE MESSAGE ACROSS: TEN PRINCIPLES FOR WEB ANIMATION

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Abstract

The growing use of animation in Web pages testifies to the increasing ease with which such multimedia components can be created. This trend indicates a commitment to animation that is often unmatched by the skill of the implementers. The present paper details a set of ten commandments for web animation, intending to sensitise budding animators to key aspects that may impair the communicational effectiveness of their animation. These guidelines are drawn from an extensive literature survey coloured by personal experience of using Web animation packages. Our ten principles are further elucidated by a Web-based on-line tutorial.

Key Words

Educational Multimedia, animation, design principles, Web and Internet Tools and Applications.

1. Introduction

In the contexts of Web applications, television advertising and educational multimedia, computer-based animation is increasingly making its mark as a basis for effective information delivery. The availability of user-friendly and accessible animation packages, such as Flash™ and Director™ from Macromedia (cf. www.macromedia.com), means that growing numbers of would-be animators are turning their ambitions to the creation of engaging and entertaining moving images.

This growth of animation in Web pages echoes the take up of HTML. As Web page implementation became easier, more people composed their own pages and greater was the proportion of poorly considered and badly constructed Web sites. This growth is reflected in the emergence of compendia that record links to 'bad web sites'. Similarly, we should expect the take-up of Web-based animation to reflect equal commitment with corresponding lack of skill. This presumption is supported

by experience of emerging usage of Web-based animation and is the motivation for the work described in this paper.

As with HTML, so with animation packages, technical mastery of the implementation facility carries no warrant of effective or appealing end results. With respect to Web page layout and design, there is no shortage of recommendations and guidelines on good design (e.g., [1], [2], [3], [4]). There is considerably less co-ordinated insight available on animation.

While there are diverse uses for animation, principally, entertainment, advertising and education, our concern is solely with the latter. The Web is a convenient vehicle for delivering information and, in this context, animation promises to be a potent adjunct. Of course, the mere fact that animation is used in a Web presentation carries no assurance of effective communication (cf. [5]). Indeed, some research suggests that animation may be no more effective than static graphics and text [6, 7].

Although this appears to downgrade animation as a vehicle for communication, Hansen et al [8] show that disappointing results from earlier studies lay not with animation as a technique, but with the manner in which animations were employed. With careful selection of technique and form of expression, animation could be more effective in message delivery than traditional teaching methods. This insight reinforces our view that potential animators require guidance in order to optimise message delivery.

Considering the most effective means of assisting would-be animators, we were led to survey potential sources of guidance that might yield useful practical knowledge. This survey resulted in two measures. Firstly, we synthesised the collective insights to produce a set of ten commandments for animators. Secondly, we implemented a Web-based tutorial on these principles of animation. The tutorial (Animate Great) provides an interactive on-line guide, with illustrations and examples to demonstrate the adherence and violation of the animation principles.

(The *Animate Great* tutorial on these principles of animation is accessible on-line at www.cis.strath.ac.uk/~gw/sheeps). In the following, we describe these ten principles for animation and stress the importance of following such advice as a condition for successful message delivery.

2. Principles for Animation

Our selection of animation principles reflects the emphasis that we have detected in the relevant literature coloured by our subjective impressions of common failings. These ‘commandments’ are advisory but we suppose that they are generally applicable wherever animation is intended to ‘convey a message’. The ordering of the principles is not of major significance but reflects our view of their generality. For ease of reference, we provide a list of all ten principles before elucidating them further.

1. Do not distract attention from salient information
2. Avoid clutter
3. Allow appropriate exposure duration
4. Manage the positioning and organisation of objects
5. Adhere to colour conventions
6. Support animations with textual and auditory information
7. Appreciate the insight of semiotics
8. Comply with the Co-operative Maxims
9. Learn from Disney
10. Avoid design myopia

Table 1: Ten Principles of Animation

2.1 Do not distract attention from salient information

People are rarely the passive recipients of sensory information and instinctively turn head and eyes toward any interesting stimuli. Attention plays a crucial role in gluing together the elements of our perceptual experience as evidenced by the fact that we can better perceive when paying attention. Attention must be drawn to the essential features of an animation, so that users focus on the relevant aspect of the animation [9].

Creating a simple, uncluttered animation where the information is directly mapped to the visual information can facilitate users in selecting the essential information from an animated display [10]. A recurring problem with animation is that it frequently provides interesting stimuli, being more sensory attractive than simple text or graphics, and thereby distracts the user’s attention from potentially key information. This can result in users misreading the intended message through influence from ‘strong distracters’ [5].

Web animators often deploy attention grabbing animation and even small animations may lead to chaotic, disturbing and incoherent attempts at communication. A classic example is the spinning company logo. Such animations frequently appear in the periphery of the user’s vision, apparently harmless and out of the way. However, movements in the periphery of vision are known to attract increased level of attention (thought to arise from our evolutionary development which associates this type of movement with danger). Visual surprise always attracts the greatest level of attention. As such, this type of movement can become distracting to the degree that users lose sight of crucial company information. Many competing sequences of animation or concurrent animations also make it less likely that a user’s attention will remain focused on key information.

The principle recommends avoiding the use of animation that distracts attention from critical areas, but has a corresponding positive message, viz., animation can be used effectively to attract attention and help direct a user’s visual focus and perception. Thereby, ‘pointers’ which attract attention and emphasise relevant information are desirable uses for animation.

2.2 Avoid clutter

Visual clutter is known to suppress the brain’s responsiveness such that interpretative ambiguity may result. According to Woodruff et al [11] ‘multiple studies have shown that clutter in visual representations of data can have negative effects ranging from decreased user performance to diminished visual appeal.’ The human information processor has adequate but limited visual processing capacity so that multiple representations of static and moving objects in the visual field competing for this capacity frequently result in ambiguity. Users may attempt to ignore some components in their perceptual field when faced with a cluttered display and this is often detrimental to message delivery.

Clutter usually occurs in two contexts: too many ingredients and irrelevant ingredients. Both situations are detrimental to conveying a message by animation and can create ambiguity. Irrelevant ingredients should be removed from a busy scene to simplify the setting. The presence of too many relevant ingredients suggests that the animation requires reworking to achieve a more concise expression.

The principle of avoiding clutter also suggests the positive message that brevity and succinctness are desirable in animation.

2.3 Allow appropriate exposure duration

Exposure duration to an animation can have dramatic effect on a user’s ability to interpret and understand the animation. Too short an exposure time to graphical

animation (or textual information) can leave the viewer confused or unable to take any relevant information from the display. Where animation is presented in a very short burst it is unlikely that the user can properly process the information before it disappears. The human eye takes time to process change and rapid exposures simply divide the brain's attention between the previous image and the current one [12]. The brain is tricked into believing that two things have to be processed at once (cf. [13]). A related problem may occur where a user is given more time than is necessary. Additional time is likely to cause boredom and the onset of fatigue will impair the viewer's concentration and comprehension.

Precise guidance on suitable exposure duration is problematic since it depends largely on the environment and the context of the particular animation. However it should be noted that for information exposure, 'too much is generally better than too little'.

2.4 Manage the positioning and organisation of objects

The proper positioning and organisation of objects in an animation plays a crucial role in aiding user understanding and removing ambiguity. These aspects should be influenced by Gestalt theory which suggests methods for planning screen presentations in terms of precedence and proximity [14]. The Gestalt law of proximity advises that related items should be located closer together than non-related items. Things which are close together in space or time tend to be perceived as grouped, if you want two aspects to be perceived as associated, present them in close proximity. According to this law when things are placed closely together, the individual's perception recalls the members of the group more accurately. Similarly, things which are similar are likely to form groups. If you want users to perceive the elements in an animation as belonging together you should try to give them the same shape or present them as forming part of one shape, as suggested by the Gestalt principle of similarity. In terms of motion, objects that move simultaneously may be 'grouped' by the viewer.

Information should also be organised in terms of precedence. Objects of greater importance must appear in positions of greater importance on the screen from the user's perspective [15].

2.5 Adhere to colour conventions

Colours should always be used with a specific plan or purpose. The influence of colour is greater than a mere cosmetic effect. and where used wisely they can aid the animator in conveying a message and removing possible ambiguity. Colour has many known principle applications and can be used effectively to convey emotion and meaning, change apparent size, show similarities and

differences, separate fields, attract attention, create emphasis or create aesthetic and emotional impact [10].

There are standards for the association of meaning to colours from organisations such as the Occupational Safety and Health Administration (www.osha.gov). They have standardized: red with danger, orange with warning, yellow with caution, blue with notice and green with safety. Other conventions associate red with heat (or blood), green with nature and black with death. Animators should be aware of the potential influence of preconceived ideas of colour association and utilise them constructively to help remove ambiguity or sharpen the message from the animation

Colour may also affect a user's perception of space and depth. Orange and red appear close whereas green and blue appear distant. An animator can use this insight to help differentiate between foreground and background or add a 3D appearance to a 2D animation. Similarly, colours should not be combined in a manner that may unintentionally confuse foreground and background or produce an undesired 3D effect. Colour can also be used to affect the appearance of size and division whilst highlighting similarities and differences.

The animator should be sensitive to the strong effects of colour and aim to use these to enhance the effectiveness of animation. Colour should be used primarily to discriminate objects or aspects of objects that are relevant. Irrelevant differences in colour can distract and mislead users; colours used should provide additional representational information for a particular animated concept.

2.6 Support animation with textual and auditory information

Textual and auditory information is the primary effective means of conveying information and offers great potential in support of animation. Animation alone is always at risk of ambiguity through differing user interpretations. The use of text, sound and possibly, narration, can provide constraints to the interpretation of any animation.

Although text may also hold ambiguities, when combined with animation the likelihood of an ambiguity is reduced. Where a user's view of an animation is likely to be mistaken the presentation of 'backup' text is likely to eliminate the ambiguity. Despite this, text should be used sparingly. Even if used as support information there are issues of focus, distractibility, and cognitive overload. Too much visual information, presented simultaneously can create an attention overload which has been shown to promote misinterpretation. Text is best used to label unrecognisable or ambiguous objects in an animation or to provide additional detail where the animation itself is wholly ambiguous

To reduce scope that the text harbours ambiguity, it should follow Gestalt principles and should be clearly formed (figure ground principle), spaced (clarity), words and lines should be separated suitably (proximity) and highlighted (similarity). In relation to text, animation, colour change, fonts, flashes, underline, size and highlighting can aid or hinder learning and should be used carefully [16, 17].

Sound is perhaps the overlooked medium and is often neglected within animation. Like colour, sound should only highlight or provide an additional backup to existing objects and their behaviour (e.g. linking a sound to an action). Sound can help to discriminate between different actions within an animation or to provide feedback dependant on a particular result. Sound can also be particularly distracting if used to excess or unnecessarily. The safest measure is to limit the use of audio to contexts where it is vital to the purpose of the animation. Loud, fast background sound can be extremely distracting, while slow, quiet looping music can cause fatigue and attention drift. Inappropriate sounds will simply confuse.

Narration is often favoured in instructional animations on the principle that it facilitates successful learning. This view is supported by Mayer and Anderson [18], who conclude that the 'dual-code theory to learning' (animation accompanied by text or narration) successfully enhanced the learning experience. Narration must occur simultaneously with the relevant animation or learning and recall benefits are significantly diminished. In addition, animation irrelevant to the narration should be avoided.

Given the content of an animation design, further non-graphical communication modes should be used to support the meaning. In other words, the pictorial content should determine the non-graphical features.

2.7 Appreciate the insights of semiotics

Associated with semiotics is a broad range of communication concepts and academic fields, including; Communication Theory, Visualisation, Generalisation and Metaphor. Understanding the insights of Semiotics will allow the potential animator to enhance the level of effective communication whilst reducing ambiguity, and limit animation to its required content. Optimal visualisation implies that the (visual) contents of an image (or animation) are such that the intended meaning is conveyed. In other words, the meaning dictates (at least in part) the pictorial content.

Semiotics 'deals with meanings and messages in all their forms and in all their contexts' [19]; 'the subject matter of semiotics is the exchange of any messages whatsoever – in a word communication' [20]. Acquaintance with this discipline will assist potential animators to determine how meaning is produced and conveyed in animations that are

primarily visual and how users construct their own meanings from visual communication cues. One example of relevant work on semiotics was an investigation of an Apple Macintosh television advertisement. This research sought to determine the meanings of the images in the commercial. This was addressed by a group of viewers who performed a semiotics analysis [21].

Using metaphors in animations is a potent way of removing ambiguity. Animation that uses effective metaphors has been shown to communicate better, facilitate learning and significantly enhance the success of the conveyed message [22]. Animation can be used to exploit familiar processes, or objects that have properties similar to the context of the intended message. For example, using animation to show water flowing through pipes as a metaphor for the flow of electricity can better help students understand the properties of electrical circuits. Conversely, an animation that does not follow a recognised metaphor is more likely to be misconstrued.

Animators must also appreciate the need to use appropriate levels of abstraction. Animations should not contain objects or actions which are so detailed that they cause information overload. Equally, animations should not contain objects or actions that are so abstract that they cannot be associated with the real life experiences of the viewer. Implicit generalisation will create ambiguity where the generalisation is such that no exact meaning can be inferred. Intermediate levels of generalisation are desirable, with an appropriate degree of proportion, size and speed, as befits the subject matter.

2.8 Comply with the Cooperative Maxims

Grice's Cooperative Principle [23] notes that in ordinary conversation both parties to the interaction share a co-operative principle which serves to promote understanding and comprehension. Grice analyses interaction as involving four maxims related to quantity, quality, relation, and manner, viz.:

1. *quality*: speaker tells the truth or provable by adequate evidence
2. *quantity*: speaker is as informative as required
3. *relation*: response is relevant to topic of discussion
4. *manner*: speaker's avoids ambiguity or obscurity, is direct and straightforward

Although Grice conceived these principles in the context of spoken language they are easily adapted and well suited to the promotion of successful animation. Rewritten for the context of animation, the maxims might read:

1. *quality*: animator tells and portrays the truth not showing what is false

2. *quantity*: the content expressed is adequately conveys the required message but avoids excess animation
3. *relation*: the animation flows and is organised in a meaningful order
4. *manner*: animate clearly, avoid generalisation, obscurity, ambiguity, disorder, and be natural

If we apply these derivatives from Grice to animation, this should aid in promoting comprehension and successful interaction.

2.9 Learn from Disney

Many traditional features of animation were developed in the 1930's at the Walt Disney studios, where the emphasis lay in making animation realistic and entertaining [24]. Many of these insights are still pertinent as means of enhancing or optimising our Web-based animations. The main insights are listed briefly below. Expanded illustration is available from the *Animate Great* tutorial.

1. *Squash and Stretch* - define the rigidity and mass of an object by distorting its shape during an action
2. *Timing and Motion* - space actions to characterise weight and size of objects and the personality of characters
3. *Anticipation* - prepare for an action
4. *Staging* - present an idea so that it is unmistakably clear
5. *Follow Through and Overlapping Action* - terminate an action and establish its relationship to the next action
6. *Straight Ahead Action and Pose-to-Pose Action* - two contrasting approaches to creation of movement
7. *Slow In and Out* - the space in-between frames to achieve subtlety of timing and movement
8. *Arcs* - design the path of action for natural movement
9. *Exaggeration* - accentuate the essence of an idea by the design and the action
10. *Secondary Action* – consider actions of an object that result from another action
11. *Appeal* - create a design or an action that the audience enjoys watching

Although each Disney factor is of relevance to the Web animator, the ‘Squash and Stretch’ and ‘Timing and Motion’ aspects are particularly useful insights that can assist in removing ambiguity from animation. Animated objects should always follow inherently natural motions which are not as simple as a balloon rising or an apple falling but more about finding an engaging natural motion. Finding this natural motion may involve analysing inherent static dynamism, architectonics and common patterns of perception. Usually to avoid monotony in motion and linearity, objects are accelerated and decelerated, take curved paths and experience colour and texture change. Similarly, the shape of an object is

generally affected by its motion. When an object is set in motion, it is natural to expect that parts of its contour will displace relative to each other and when this is neglected the resulting animation may seem solid and flat.

These Disney lessons, intended to secure greater realism in animation, will have a direct effect in reducing ambiguity. This will also tend to make the conveyed message more apparent by removing potentially unreal aspects of object behaviour.

2.10 Avoid design myopia

When animation aims to express a specific message, there is always a risk of ‘design myopia’ [5]. This condition is characterised by short-sightedness on the part of the designer. Having set out with an intended end in view, animators may produce a solution that appears to them ideal. When they view their solution it appears to fit the requirements perfectly. Sadly, the designer’s view of a system is coloured by their familiarity with the aims and objectives that motivated the design. With the designer’s expert insight, the design may appear suitable, even ideal. Yet, to the naïve viewer the system may seem obscure and unobvious.

Our local experience of animation design exposed several instances where an individual responsible for expressing the objectives, produced animation designs that they considered ideal but which proved problematic when viewed by other eyes. This insight led to a strategy that aimed to minimise such myopia. The essence of this approach is the use of ‘fresh eyes’ on the proposed design as a means of flushing out potential problems in interpretation. This approach acknowledges that identification of potential ambiguities is best achieved through inspection of the intended animation. This reflects techniques often adopted for interface analysis and evaluation. In this latter context, the design of a ‘meaningful’ and usable interface is often determined by user testing. One reason for this approach is the avowed difficulty of anticipating all the possible misunderstandings that may arise when an interactive system is used in earnest. This insight is equally valid for the messages expressed by animations.

3. Conclusions

The primary aim of our ten principles is to alert and sensitise animators to potential problems and common foibles. Our directions afford no assurance of securing effective animations, yet we believe that forearmed with these insights and defences, the budding Web animator can avoid common shortcomings and better ensure succinct communication. In the belief that these principles for animation are more easily assimilated by viewing examples of compliance and deviation, we have made the associated tutorial available on-line.

References

- [1] J. Nielsen, & M. Tahir, *Homepage usability: 50 websites deconstructed* (New Riders, 2001).
- [2] M. Friedman, *Effective communication design on the web*, Professional Development Centre, San Jose State University, 2001.
- [3] P.J. Lynch & S. Horton, *Web style guide: basic design principles for creating web sites* (Yale University Press, 2002).
- [4] C. Wodtke, *Information architecture: blueprints for the web* (New Riders, 2002).
- [5] G.R.S. Weir, J.D. Ferguson & J.N. Wilson, Animating complex concepts, *Proceedings of ICHED2003*, Aveiro, Portugal, 2003.
- [6] M. Betrancourt, & B. Tversky, Effect of computer animation on users' performance: a review, *Le travail Humain*, 63(4), 2000, 311-330.
- [7] J.B. Morrison & B. Tversky, *Animation: Does It Facilitate Learning?*, Department of Psychology, Stanford University, 2000.
- [8] S.R. Hansen, N.H. Narayanan & D. Schrimpscher, Helping learners visualize and comprehend algorithms, *Interactive Multimedia Electronic Journal of Computer-Enhanced Learning*, 1999.
- [9] H. Petersen & J. Nielsen, *The eye of the use: the influence of movement on users visual attention*, Department of Informatics, Copenhagen Business School, 2002.
- [10] Y.K. Beak, & B.H. Layne, Colour, graphics, and animation in a computer-assisted learning tutorial lesson, *Journal of Computer-based Instruction*, 15 (4), 1988, 131-135.
- [11] A. Woodruff, J. Landay & M. Stonebraker, Constant information density in zoomable interfaces, *ACM Symposium on User Interface Software and Technology*, ACM Press, 1998, 57-65.
- [12] M.G.H. Coles, A.F. Kramer & G. Logan, *Converging operations in the study of visual selective attention*, American Psychological Association, Washington, 1996.
- [13] H. Shibuya & C. Bundesen, Visual selection from multielement displays: Measuring and modeling effects of exposure duration, *Journal of Experimental Psychology: Human Perception and Performance*, 14, 1988, 591-600
- [14] W. Kohler, *Gestalt psychology: An introduction to new concepts in modern psychology* (New York; New American Library, 1966).
- [15] W. Kohler, *The task of gestalt psychology* (New Jersey; Princeton University Press, 1969).
- [16] M.G. Gillingham, Text in computer-based instruction: What research says, *Journal of Computer-Based Instruction*, 15(1), 1988, 1-6.
- [17] W.S. Longstreet, Human factors in educational computing: Toward software efficiency for education. In U. Schneider & M. Schratz (Eds.), *Permanent Education Between New Illiteracy and High Power Technology*: New Orleans: University of New Orleans, 1988, 19-33.
- [18] R.E. Mayer & R.B. Anderson, Animations need narrations: An experimental test of a dual-coding hypothesis, *Journal of Educational Psychology*, 83(4), 1991, 484-490.
- [19] R.E. Innis, (ed.) *Semiotics: An Introductory Anthology* (Bloomington: Indiana University Press, 1985).
- [20] T.A. Sebeok, *Signs: An introduction to semiotics* (Toronto: University of Toronto Press, 1994).
- [21] S. Moriarty, *Visual semiotics and the production of meaning in advertising*, AEJMC (Visual Communication Division), Washington: 1995.
- [22] G. Sherson, *The relevance of semiotics to the Internet: How web designers use metaphors in web development* (Victoria: University of Wellington, 1999).
- [23] H.P. Grice, Logic and conversation, reprinted in P. Cole and J. L. Morgan (eds.). *Syntax and Semantics, vol 3. Speech acts*; Academic Press, New York, 1975, 41-58.
- [24] F. Thomas & O. Johnston, *The illusion of life: Disney animation*, Hyperion, 1995.