Entertaining Evolution: Understanding Science from Animations

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Abstract: At a natural history museum in Chicago, a series of animations puts a humourous spin on important concepts of evolution. These short films demonstrate the tensions between design goals that include both entertainment and education, and raise important questions about the use of animation for teaching complex processes such as evolution. This study reports the findings from clinical interviews with museum visitors and students on their understanding of evolution from watching these animations.

Study Background and Research Questions

Most people today are well-versed in the language of film and television. They see one scene cut abruptly to another, and understand that a gap in time or space has just occurred. They see characters or landscapes change within seconds in real time, and recognize this as short hand for the passage of years. These, among others, are techniques commonly used by animators to compress stories into convenient showing periods (Mascelli, 1998), a necessary design strategy when taking museum visitor attention span into consideration (Falk & Dierking, 1992). In each case, the viewer is trusted to fill in the necessary details to form a cohesive narrative. But what are the effects of such techniques on viewers' understanding when the topic is one already so widely misunderstood (Alters & Nelson, 2002)? What implicit narratives do viewers assume when the knowledge from which they can draw is incomplete or incorrect (Bishop and Anderson, 1990)?

At a permanent exhibit on evolution at a natural history museum in Chicago, a series of animations on display puts a humourous spin on important concepts in evolution, such as natural selection, biogeography, and co-evolution. Across this series, the visual and narrative techniques create an entertaining show, but use of these short hands may be at the expense of viewers' understanding the animation's content. Cutting, wiping, time lapse, and cross-fading, techniques used to economically transition between scenes, may not give a proper sense of change through generations of organisms across geologic time. Anthropomorphization of non-human organisms, such as plants and sperm, may convey a false sense of agency and an active role in the mechanism of natural selection. The animations demonstrate the tensions between designing for entertainment versus designing for education (Allen, 2004), and raise questions over the effectiveness of animations for teaching complex systems (e.g., Morrison, Tversky, & Betrancourt, 2000). This poster reports the findings from interviews with museum visitors and with undergraduate students who viewed the animations and subsequently explained their understanding of evolution based on what they saw.

Method

In the museum component of this study, adult visitors of a natural history museum in Chicago were approached as they neared screens within an evolution exhibit and asked to participate in an interview in exchange for a university brand mug. Those who agreed completed a multiple-choice assessment of their understanding of natural selection, and then viewed one of two animations: *Biogeography* or *Pollen and Seeds*. Subsequent individual interviews lasted 15-20 minutes. Subjects completed a demographic survey detailing their background education in science, their religious beliefs, and their prior visits to the museum. In the laboratory component, undergraduate students underwent the same procedures in a laboratory setting, but in exchange for course credit.

Interview questions included: "Describe how the animation showed how plants came to reproduce through seeds." "Suppose certain individuals in a population possess claws, an advantageous trait for reaching high-growing fruit. Predict what would happen to that trait over time." "Did anything in the animation help you answer that question?" All interviews were audio-recorded, coded, and qualitatively analyzed.

Summary of Findings

A few subjects noted the humour and straightforwardness of the story as factors in the appeal and comprehensibility of the animation, but subsequently went on to express misunderstandings of the concepts depicted. Generally, the language used by subjects mirrored the animation's own visual and verbal languages in a variety of ways. For example, one particular animation depicted a sperm scratching its head in thought just before being struck by the idea – complete with the flash of a light bulb above – to "hitch a ride" on a pollen grain to the female part of a plant (Figure 1). When asked what would happen to land plants if the climate were to suddenly become cold, one subject hypothesized that "they might realize, you know, how to change for their environment, and find another way to reproduce." When asked to interpret the phrase of the narration: "To keep

the embryo moist – and fed – so that it can grow into a new plant, land plants hit on another evolutionary innovation: the seed," another subject said "that part of plants evolving is that they knew that in order for plants to survive they had to develop something. So the seed gradually developed to protect the embryo… they had to learn to work with the environment that they were in."

Generally, many of the subjects with little to no background in science expressed beliefs in need-based evolutionary change that can be intentionally initiated by an individual within its lifetime (e.g., Lawson & Weser, 1990). In the words of one subject, an advantageous trait is "a skill that you need (…) you stop using it, of course you're going to lose it. But if you practice and you keep using it, if anything, it would probably strengthen it." The simplification of complex information such as of inheritance, and the anthropomorphization of characters such as plants and sperm, may have reinforced subjects' already simple and often misconstrued understandings of population change and of the limits of individual agency in biological change (e.g., Bishop and Anderson, 1990).

Undergraduate students and museum visitors with greater prior science knowledge generally showed less influence on their conceptual understanding. However, they used more teleological language after viewing the animations than before viewing them. It may be that they adopted the language of the narration simply out of convenience, but a few subjects expressed change in their understanding from viewing the animation. Specifically, they believed that a trait that had lost its survival function would persist if there were no pressures selecting against it; but after seeing *Biogeography*, in which an animal's trait is shown to fade due to a lack of evolutionary pressures for maintaining it, these subjects revised their prior beliefs. In theory, both the persistence and the loss of a trait in the absence of selective pressures are plausible possibilities. Thus, the effects of the animation on these subjects' responses underscore the power of animations from museums to convince, and highlight their responsibilities as trusted sources of information.

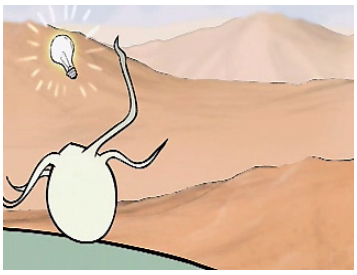

Figure 1. A scene from the animation *Pollen and Seeds*.

Significance to the Learning Sciences

This study considers broad issues of learning in informal settings, and more specific questions of the role of visual representations in understanding science. It raises questions over how concepts can be conveyed through animations given the misconceptions people already hold. Do the illusions of rapid or sudden passages of time – techniques often used to transition between scenes – hinder people's understanding of geologic time? Does literacy in the visual language of film transfer to an understanding of evolution conveyed in that medium? This study also considers the interplay of words and images on people's understanding of evolution from representations. Would the addition of a time scale on screen, for example, better communicate the scale of geologic time? To what degree can teleological language be used in the narration before it becomes misleading? Findings will contribute answers to cognitive questions of learning from representations, and will also be useful to practitioners who must consider the design and presentation of animations within a museum context.

References

Allen, S. (2004). Designs for learning: Studying science museum exhibits that do more than entertain. *Science Education*, *88*(Suppl. 1), S17-S33.

Alters, B. J., & Nelson, C.E. (2002). Perspective: Teaching evolution in higher education. *International Journal of Organic Evolution*, *56*(10), 1891-1901.

Bishop, B. A., & Anderson, C. W. (1990). Student conceptions of natural selection and its role in evolution. *Journal of Research in Science Teaching*, *27*(5), 415-427.

Falk, J. H., & Dierking, L. D. (1992). *The Museum Experience*. Washington, DC: Howells House.

Lawson, A. E., & Weser, J. (1990). The rejection of nonscientific beliefs about life: Effects of instruction and reasoning skills. *Journal of Research in Science Teaching*, *27*(6), 589-606.

Mascelli, J. V. (1998). *The Five C's of Cinematography: Motion Picture Filming Techniques*. Los Angeles, CA: Silman-James Press.

Morrison, J. B., Tversky, B., & Betrancourt, M. (2000). Animation: Does it facilitate learning? *AAAI Spring Symposium on Smart Graphics*, 53-59.