Video Article

# Computer-Generated Animal Model Stimuli

Kevin L. Woo[1]

[1]Center for the Integrative Study of Animal Behaviour, Macquarie University

Correspondence to: Kevin L. Woo at kwoo@galliform.bhs.mq.edu.au

URL: http://www.jove.com/video/243
DOI: doi:10.3791/243

Keywords: Neuroscience, Issue 6, behavior, lizard, simulation, animation

Date Published: 7/29/2007

Citation: Woo, K.L. Computer-Generated Animal Model Stimuli. *J. Vis. Exp.* (6), e243, doi:10.3791/243 (2007).

## Abstract

Communication between animals is diverse and complex. Animals may communicate using auditory, seismic, chemosensory, electrical, or visual signals. In particular, understanding the constraints on visual signal design for communication has been of great interest. Traditional methods for investigating animal interactions have used basic observational techniques, staged encounters, or physical manipulation of morphology. Less intrusive methods have tried to simulate conspecifics using crude playback tools, such as mirrors, still images, or models. As technology has become more advanced, video playback has emerged as another tool in which to examine visual communication (Rosenthal, 2000). However, to move one step further, the application of computer-animation now allows researchers to specifically isolate critical components necessary to elicit social responses from conspecifics, and manipulate these features to control interactions. Here, I provide detail on how to create an animation using the Jacky dragon as a model, but this process may be adaptable for other species. In building the animation, I elected to use Lightwave 3D to alter object morphology, add texture, install bones, and provide comparable weight shading that prevents exaggerated movement. The animation is then matched to select motor patterns to replicate critical movement features. Finally, the sequence must rendered into an individual clip for presentation. Although there are other adaptable techniques, this particular method had been demonstrated to be effective in eliciting both conspicuous and social responses in staged interactions.

## Video Link

The video component of this article can be found at http://www.jove.com/video/243/

## Protocol

### Animation Design

### Object Scan

Acquire taxidermic lizard. Scan the model with a Konica Minolta VI-9i. It produces a 3D object (*.lwo and *.obj files) in a single polygon mesh of 50,000 polygons. Lightwave® v8.3 has two programs used for 3D animation: Modeller and Layout. Lightwave® Modeller designs and manipulates the object. Lightwave® Layout program creates animation scenes. Lightwave® Modeller and Layout have three dimensions of positioning, orientation, and rotation: heading (Y), pitch (X), and bank (Z).

### Texture Acquisition

Photograph a live lizard using an 12.8 megapixel Canon EOS 5D digital camera from two angles (frontal and orthogonal), three positions (frontal, orthogonal, ventral, and dorsal), and three body regions parts (head, body, tail, and limbs) over a white sheet of paper to be white balanced for standardized colour. Fuse photographs together in Adobe® Photoshop® Elements 3.0.

Create an Atlas UV map in Lightwave® Modeller. The UV map breaks the object into strings of connecting polygons. Capture JPEG image of Atlas UV map with Grab V1.2 to create a separate JPEG image. Imbed as the background layer into Adobe® Photoshop® Elements 3.0.

In the Lightwave® Modeller, highlight polygons on the Atlas UV map to identify specific areas on the lizard. Crop area and superimpose onto the background Atlas UV map JPEG. When all photographic fragments are layered onto the Atlas UV map JPEG, remove the background and create a single TIFF file. Import the TIFF file into Lightwave® Modeller and assign UV coordinates.

### Implanting Skelegons and Bones

In Lightwave® Modeller, skelegons were designed and imbedded. Skelegons acted as placeholders for bones. Create 61 bones. Create skelegons to mimic the number of vertebrae in a Jacky dragon, with one large skelegon used to simulate the head. Create a virtual spinal column

 

from the neck down to the end of the tail. Fuse the forelimbs, which consist of fours skelegons each, to spinal column. When all skelegons are created, send the entire object to Lightwave® Layout, where the skelegons are to be transformed into bones.

## Adding Weight Shading

Independent weight maps have a value range from –100% to +100% to evenly distribute motion. Designated the limbs, tail, and head with positive (+) weight map values. Give the body a negative (-) weight map value.

## Stimulus Capture from Archival Video

Archival lizard footage was shown using Sony MiniDV digital video recorder PAL player on a Sony Trinitron monitor to a live lizard held in its enclosure (for initial video acquisition, see Ord and Evans, 2002; Ord, Peters, Evans, & Taylor, 2002; Van Dyk and Evans, 2007). Responses of lizards were recorded using a Canon (MV650i) digital camcorder placed approximately on meter from the enclosure. Lizard size was scaled to the representative size of the perch on the display monitor. Export as individual sequential JPEG images in Apple Quicktime™ v7.0.

## Rotoscoping for Stimulus Replication

'Rotoscoping' is a technique where the object animation is superimposed frame-by-frame in the foreground of the background sequence (Gatsey, Middleton, Jenkins, & Shubin, 1999). Send the animation to Lightwave® Layout, where the light, camera, object, and background characteristics can be controlled for the scene. Select motor patterns from archival digital video and export as an image sequence (JPEG) using Apple QuickTime™ Player 7.0. The object must be in camera view. Import the first JPEG in the image sequence into the background. Manipulate the object using the bones and superimpose into the current position that reflects the background image. Each frame is to be 'keyframed', such that the position of the object is saved. Replace the background image with the next consecutive image and manipulate the object into the new position. Repeat the process until the sequence is finished.

## Rendering the Sequence for Completion

Large sequence clips or batch processing are rendered using Render Farm Commander v2.9. Render Farm Commander (RFC) links up computers to produce a series of processors to aid in faster rendering. Four Apple Mac G5 dual-processors (eight threads) were used to distribute the rendering, thus reducing the time to four hours. All sequences were maintained at PAL-DV standard (720 ¥ 576 pixel resolution; 5:1 compression; horizontal resolution 575 lines; 25 frames s-1).

# Discussion

Computer-generated animations are increasingly becoming a popular tool in which to investigate questions regarding communication in animal behaviour. By using animation techniques, researchers can focus on specific aspects of signal design, and manipulate features that previously were unable to be investigated due to limited technology. Although conventional staged animal encounters still demonstrate theoretical principles, animation techniques now provide a sophisticated tool for examining more detailed interactions.

# Disclosures

Funding was supported by the CISAB and Department of Psychology Postgraduate Award of Macquarie University, and the Australian Research Council. Research was conducted in accordance to the ethical guidelines of the Macquarie University Animal Ethics Committee (2003/014) and the New South Wales National Parks and Wildlife Services (S11024).

# Acknowledgements

I would like to thank Daniel Van Dyk from the Centre for the Integrative Study of Animal Behavour (CISAB) for much help in model design and access to archival video. Christopher Evans (CISAB) provided technical support, Daniel Warner (University of Sydney) provided the taxidermic model, and Richard Peters (Australian National University) provided early design features.

# References

1. Gatesy, S.M., Middleton, K.M., Jenkins, F.A., Shubin, N.H. Three-dimensional preservation of foot movements in Triassic theropod dinosaurs. Nature, 399, 141-144 (1999).

2. Newtek, Inc. Lightwave [8] Reference Manual. San Antonio, Texas: Newtek, Inc. (2004).

3. Ord, T.J., Evans, C.S. Interactive video playback and opponent assessment in lizards. Behav. Process. 59, 55-65 (2002).

4. Ord, T.J., Peters, R.A., Evans, C.S., Taylor, A. J. Digital video playback and visual communication in lizards. Anim. Behav. 63, 879-890 (2002).

5. Rosenthal, G. G. Design considerations and techniques for constructing video stimuli. Acta Ethol. 3, 49-54 (2000).

 

6. Van Dyk, D.A., Evans, C.S. Familiar-unfamiliar discrimination based on visual cues in the Jacky dragon, Amphibolurus muricatus. Anim. Behav, 74, 33-44 (2007).

 