

Creating Realistic 3D Stimuli for Behavioral Studies

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Introduction

Forming coherent mental representations of visual objects is a critical precursor to interacting with and reasoning about the world (Peissig & Tarr, 2007). Research on visual memory, visual object classification, symmetry perception, and face recognition is all linked to the central issue of object representation. One technical problem blocking the progress of this line of research is the difficulty of developing ecologically valid and well-controlled realistic three-dimensional stimuli. A majority of visual perception and cognition studies have relied on two-dimensional line drawings or relatively simple three-dimensional object pictures. Because these stimuli are highly similar to each other, they limit the possibilities to develop a wide range of experimental

manipulations. In this abstract, we present a new method of creating realistic 3D stimuli feasible for behavioral studies and outline our on-going study using these new stimuli (Figure. 1).

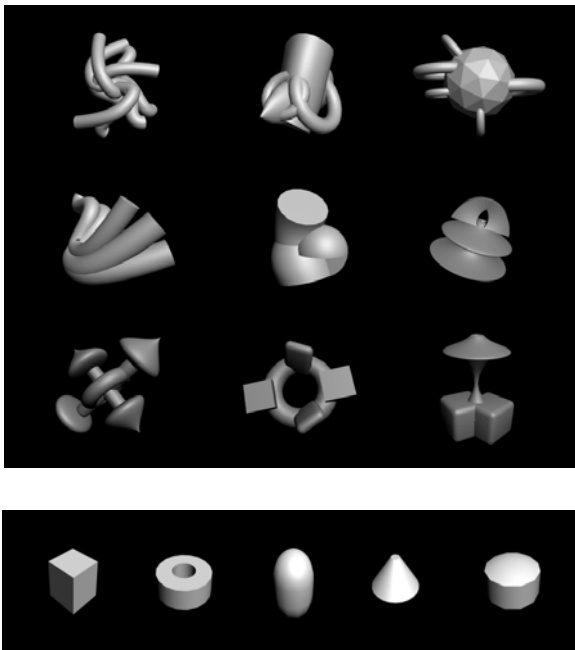


Figure 1: Sample stimuli produced by 3ds Max (the upper panel). These stimuli were created by combining a small number of geometric primitives (the lower panel).

Creating Realistic 3D Stimuli with 3ds Max

3ds Max studio has been used widely by game developers, visualization design professionals, and visual effects artists. This software helps create a variety of three-dimensional stimuli relatively easily. Manipulating the size, color, orientation, and/or texture of the objects is also straightforward.

The interface of 3ds Max consists of the main toolbar, the view port, and the command panel (Figure 2). The toolbar provides quick access to tools and dialog boxes for many of the regular tasks such as selection, transformation — move, rotation, and scale — undo/redo and rendering.

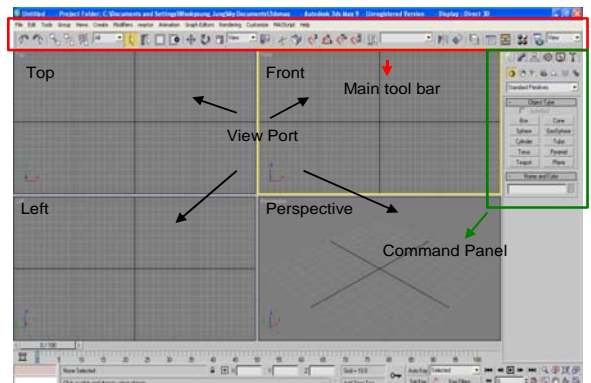


Figure 2: The interface of 3ds Max. The view port gives three different views together with a perspective view. The command panel is the control center for nearly every operation in 3ds Max. All of the creation and modification tools are found in the command panel.

3ds Max offers a large list of default geometric primitives (Figure 1). By combining 5 primitive components randomly from a set of 10

primitives, for example, more than 100,000 novel objects can be created easily. To combine these primitives, 3ds Max provides 3 basic “Boolean operations” – Union, Intersection, and Subtraction (Figure 3). In Union, the volume of both original primitives is produced. In Intersection, only the portion common to both original objects is created. In Subtraction, the volume of one original object with the intersection volume subtracted from it.

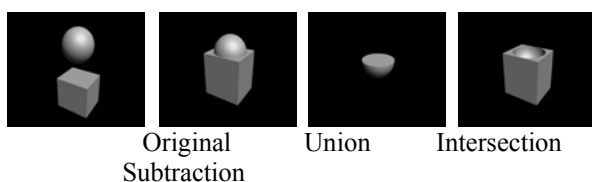


Figure 3: Examples of Boolean operations

Specific studies that can be extended with 3ds Max

The 3D stimuli created by 3ds Max are useful for a wide variety of behavioral studies including visual memory, symmetry perception, and object recognition. Here, we briefly describe our on-going studies addressing the controversy of face recognition. The issue of whether the mechanisms underlying face recognition are domain specific or domain general has stirred much debate. McKone and colleagues advocate a domain specific approach: the neural mechanism engaged in face perception is distinct from those for object perception (McKone, Kanwisher, & Duchaine, 2006). In contrast, Tarr and colleagues (Gauthier, Bukach, Carey, Diamond, Tanaka, et al) have found evidence for the expertise hypothesis (Gauthier, 1997, 2000, 2007; Tanaka & Curran, 2001).

The experiments addressing the mechanism of face recognition are often confounded with the nature of stimuli. “Greebles” used by Tarr and colleagues elicit face-like behavioral and neural patterns in experts because they ‘look like faces.’ At the same time, a typical face recognition experiment requires participants to identify concrete names of facial stimuli; thus, not face recognition per se, but the specificity of judgment guides different mechanisms seemingly underlying face recognition. To avoid these potential

confounds, novel 3D stimuli similar to those shown in Figure 1 are advantageous. Our studies have shown that our novel 3D stimuli have the potential to open a new venue of object recognition research.

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