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Categorical perception of human female physical attractiveness and health

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Abstract

Using realistic three-dimensional female body models, we found evidence for a categorical perception of female physical attractiveness and health in male and female Caucasian observers. In a rating task, we showed that these bodies were rated for attractiveness or health in the same way as real bodies. In a two-alternative forced-choice task, we showed that these bodies were categorized into attractive vs. unattractive or healthy vs. unhealthy nonlinearly, which allowed us to estimate the position of a categorical boundary between attractive and unattractive or healthy and unhealthy bodies. In a delayed match-to-sample task, we measured the sensitivity of discrimination between pairs of bodies. We found significantly better discrimination for pairs that crossed the attractive/unattractive or healthy/unhealthy boundary than pairs that did not, even though the physical changes in both conditions were identical. Thus, categorical perception enhances the perception of physical changes that cross the boundary between discrete perceptual categories of important judgments such as attractiveness or health, which can be a cue for mate selection.

Keywords: Categorical perception; Attractiveness; Female bodies

1. Introduction

One of the most fundamental problems facing individuals is mate selection. Thus, it is important that they have a means to efficiently evaluate the attractiveness of potential partners because the wrong choice will have a negative impact on their reproductive success (Buss, 2006; Zebrowitz & Rhodes, 2002). As attractiveness can be a cue to fitness and reproductive potential, we might expect very strong selective pressures for the development of perceptual mechanisms that effectively evaluate attractiveness. It is generally assumed that body attractiveness judgments are graded along a continuum from attractive to unattractive through a series of intermediate levels (e.g., Fan, Liu, Wu, & Dai, 2004; Swami, Caprario, Tovée, & Furnham, 2006, Swami, Neto, Tovée, & Furnham, 2007; Thornhill & Grammer, 1999; Tovée, Reinhardt, Emery, & Cornelissen, 1998, Tovée, Hancock, Mahmoodi, Singleton, & Cornelissen, 2002). However, it is perceptually demanding to make fine-grain judgments of physical attractiveness. To simplify such judgments so that appropriate responses can be acted upon, a potentially more effective approach would be to initially assign bodies into discrete perceptual categories, such as attractive or unattractive. This kind of categorical perception is well documented for many aspects of perception. For example, facial identity (e.g., Beale & Keil, 1995; Levine & Beale, 2000; Rotshtein, Henson, Treves, Driver, & Dolan, 2005), gender (e.g., Webster, Kaping, Mizokami, & Duhamel, 2004), facial expressions (e.g., Calder, Young, Perrett, Etcoff, & Rowland, 1996; Etcoff & Magee, 1992) and race (e.g., Cosmides, Tooby, & Kurzban, 2003; Levine & Angelone, 2002) all show categorical perception. However, little research has examined categorical perception for evolutionary fitness cues, such as attractiveness.

In the current study, we examined the extent to which observers perceive female physical attractiveness and health categorically and how this categorical perception, if present, affects observers' ability to discriminate body shapes. A key feature of categorical perception is that although an observer will be very sensitive to changes occurring across a boundary between two perceptual categories (such as between attractive and unattractive bodies), observers will be much less sensitive to the *same amount* of physical changes in stimuli if they occur within a perceptual category (such as discriminating among bodies that are all attractive). A well-

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known example of categorical perception is the recognition of human facial expressions. We are very good at distinguishing the changes in facial feature configurations that push a facial expression across a categorical boundary, such as between happy and sad, but we are much less sensitive to the same amount of changes in facial configuration within a category, such as happy (e.g., Calder et al., 1996; de Gelder, Teunisse, & Benson, 1997; Etcoff & Magee, 1992; Young et al., 1997).

Categorical perception would allow a more accurate classification of bodies into attractive vs. unattractive or healthy vs. unhealthy categories but necessarily reduces finer-grain judgments within a perceptual category. However, in reproductive terms, the important strategy is to avoid unattractive partners, who are potentially unhealthy and nonfertile. Discrimination within categories is still possible but less important. If partner choice is from an "attractive pool", all of the potential outcomes should be a reasonably good choice. Indeed, given an individual's limited neural processing resources, it would make sense to sacrifice within-category shape sensitivity to improve across-category shape sensitivity. Thus, categorical perception could enhance the accuracy of health judgments.

To investigate how observers perceive female physical attractiveness and health, we systematically manipulated realistic female body models to alter their level of fatness from underweight to obese. Previous studies have suggested that altering apparent body fat will alter the attractiveness and perceived health level of the female bodies (e.g., Smith, Cornelissen, & Tovée, 2007; Tovée Reinhardt, Emery, & Cornelissen, 1998, Tovée, Furnham, & Swami, 2007). Following Calder et al.'s (1996) paradigm, male and female observers were asked to perform various perceptual tasks: a rating task, a two-alternative forced-choice task and a delayed match-to-sample (DMS) task. The rating task allowed us to compare the pattern of attractiveness or health ratings with previous studies to confirm that the body models were rated in the same way as real bodies. The forced-choice task forced observers to either categorize bodies as attractive vs. unattractive or healthy vs. unhealthy, which allowed us to estimate the position of the putative categorical boundary. The DMS task allowed us to test whether there was an improved perceptual performance in discriminating between female bodies across this categorical boundary, which has been shown to exist in categorical studies using faces (e.g., Calder et al., 1996).

2. Experiment 1: judgments of female attractiveness

2.1. Methods

2.1.1. Participants

We recruited 40 male and 40 female observers (mean age 23.1 years, S.D. 3.2 years) who all completed the DMS task. We then randomly assigned them into two groups. The first group of 20 male and 20 female observers carried out the rating task. Due to a technical error, the data for one male and one female was lost. The second group of 20 males and 20 females carried out the forced-choice task.

2.1.2. Apparatus and materials

Figs. 1A and 1B show the three-dimensional (3D) body models used as stimuli. The use of realistic body models allows much greater control over the differences in physical characteristics between bodies. Features such as skin colour and texture and overall proportions (such as the relative length of the torso to the legs) do not change, which they would if we used images of real bodies. The models were created using Poser 6 (Smith Micro Graphics, http://graphics.smithmicro.com/go/poser). The two female models used as templates were Victoria 4.0 and Emma, both produced by Daz3D (http://www.daz3d.com). Victoria appeared to be a conventional nonmuscular body, whereas Emma had a more toned and muscular body. The use of two body sets allowed us to test whether the preferences generalised across body types. The bodies were dressed in the conforming two-piece swimming costume from the Victoria 4.0 Basic Wear clothing package. Body shape was altered using the Victoria 4.0 shape morphs. For both bodies, we produced two prototypes, altering the body sizes along the fatness morph available in Poser to produce underweight and obese bodies.

To produce a continuum of body sizes between the two prototypes, for each body model, we morphed the 3D geometry of its prototypes in 3D Studio Max (Autodesk, http://usa.autodesk.com). The original underweight body was designated as body size 0 (0%), and the original obese body was designated as body size 10 (100%). Nine bodies were generated at 10% steps along the morphed continuum between them, making a total of 11 bodies in each continuum. An obvious concern is that these bodies will not change shape and size in an anthropometrically valid way. However, the shape and volume of the models can be measured and compared against corresponding anthropometric measures from real bodies. Such an analysis suggested that morphing between prototype body models resulted in shape and size changes that are very similar to the shape and size changes seen in real bodies for different body mass indices (Appendix A).

All body models were rendered from a full frontal (0°) viewpoint as 24-bit colour JPEGs and were 480 pixels in width by 680 pixels in height (Figs. 1A and 1B). We also rendered all models from four additional viewpoints by rotating the virtual camera −10°, −30°, +10° and +30°, about the full frontal viewpoint. The same lighting and camera settings were used for all renderings.

All three tasks were run in Matlab version 7.1 (Mathworks Inc., www.mathworks.com) using the Psychtoolbox extension (Brainard, 1997; Pelli, 1997). The observers viewed the images on a flat-panel, 19-in. monitor. Half the participants completed the tasks with the Victoria body set and the other half with the Emma set.