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USE OF 3-DIMENSIONAL BODY SCANS FOR BODY-IMAGE RESEARCH[1]

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Summary.—This preliminary study explored the use of highly realistic 3-dimensional body-scan images as a potential tool, taking advantage of a much more specific and expanded representation of the entire body. Traditionally, body-image research makes use of various contour drawing scales whose 2-dimensional figures increase proportionately and do not match the shape of many women. The study tested whether body-scanned images ($N=85$) could be consistently "matched" to individual figures on a contour drawing scale. Internal consistency and interrater reliability were calculated and high coefficients were observed ($\alpha=.97$, $\kappa=.80$). The potential of utilizing 3-dimensional images either as more realistic somatotypes in contour-rating scales or as a measurement of body-image satisfaction using computer manipulation of a digital image is discussed.

Body image is how people mentally envision their bodies and has both perceptual and attitudinal components (Rudd & Lennon, 2000). The discrepancy between people's approximation of their actual body size and their estimate of their ideal body size has been conceptualized as body-image dissatisfaction (e.g., Fingeret, Gleaves, & Pearson, 2004). Within this framework, people compare their perceived appearance with some imagined ideal; a greater discrepancy or body dissatisfaction may be associated with lower self-esteem and eating disorders (Fallon & Rozin, 1985; Gleaves, Cepeda-Benito, Williams, & Cororve, 2000; Holder & Keates, 2006). Twenty years of body-image research indicates that even though thinness is culturally desirable, objectively what is rated as an ideal body does not guarantee that women will be satisfied with their bodies (e.g., Williamson, Gleaves, Watkins, & Schlundt, 1993; Rudd & Lennon, 2000; Webster & Tiggemann, 2003; Roy, Hunter, & Blaudeau, 2006). Originally thought to be limited to younger women, recent research indicates that body dissatisfaction appears at all ages (Webster & Tiggemann, 2003).

Western cultural ideals of ideal feminine body size are continually reinforced in the media in which the images of women have become gradually thinner (Wiseman, Gray, Mosimann, & Ahrens, 1992; Cameron & Ferraro, 2004; Park, 2005), while women have in fact become physically larger. Byrd-Bredbenner, Murray, and Schlussel (2005) examined the changes in ideal-

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ized female body images in the media over eight decades, noting that Body Mass Index (kg/m2) for idealized women tended to decline significantly over time. Moreover, as the average adult is often said to watch 4 hr. of television per day and is exposed to 40,000 commercials per year, television alone provides many opportunities for women to compare bodies. Such media images do not seem likely to change in the near future. This disconnect between the reality of larger and heavier American women and the media ideal continually confronts women, so dissatisfaction with body image is an important topic for investigation (Voracek & Fisher, 2002; Byrd-Bredbenner, *et al.*, 2005).

Contour Drawings

Contour drawings are one of the most popular methods of perceptual body-image assessment with concurrent validity as high as .71 (Stunkard, Sorenson, & Schulsinger, 1983). The contour drawings generally contain a discrete number of figures or silhouettes which range from underweight to overweight. The contour drawings can be presented on a single sheet in order from thin to obese (Stunkard, *et al.*, 1983; Fallon & Rozin, 1985; Collins, 1991; Rand & Wright, 2000); randomly ordered (Counts & Adams, 1985; Beebe, Holmbeck & Grzeskiewicz, 1999), or figures can be put on individual cards and presented either in ascending order of body weight or in an unordered array (Thompson & Gray, 1995; Gardner, Stark, Jackson, & Friedman, 1999). Participants choose the contour drawing which best represents their current and their ideal body sizes. The difference between the self-selected current and ideal figures represents a given participant's body-image dissatisfaction (Wertheim, Paxton, & Tilgner, 2004).

Over the past ten years, contour drawings have been modified so that there are rating scales resembling male and female, adult, adolescent, and child figures (Thompson & Gray, 1995; Tiggemann & Wilson-Barrett, 1998; Truby & Paxton, 2002; Sherblom & Rust, 2004; Wertheim, *et al.*, 2004). Also, contour rating scales have been developed with and without depiction of facial features, muscular definition, or weight indicators and with differing number of figures on the scale (Stunkard, *et al.*, 1983; Gardner, *et al.*, 1999; Ambrosi-Randic, Pokrajac-Bulian, & Taksic, 2005). Regardless of modifications made to the contour rating scale, a limitation is that the drawings are flat, the 2-dimensional images increase proportionately in size, and they do not accurately represent the body shape of most women. Researchers examining 531 female body scans found nine different somatotypes, such as bottom hour glass, spoon, rectangle, and triangle. Figure classification was based on five independent measurements of circumference, such as the difference between hip and waist measurements (Devarajan & Istook, 2004; Simmons, Istook, & Devarajan, 2004). A visual comparison indicates that

the majority of the nine body shapes are not represented by the contour drawings, such as the spoon or pear-shaped figure identified by thin shoulders and waist with larger hips and thighs.

3-dimensional Body Scanning

Body scanners are a relatively recent technology whose main function is to measure the surface topography of the human body, producing a 3-dimensional image of the person as well as an extensive list of body measurements. A Human Solutions VITUS/smart 3D body scanner was used in the present research study. The body scanner has eight cameras and four laser light sources which collect approximately 300,000 digital data points from each scanned subject within 12 sec. For accuracy, the participant must be minimally clothed in form-fitting garments such as undergarments, aerobic shorts and sports bra, or swimsuit. Unlike contour drawings, body-scan images are highly realistic and allow the participant a global view and an accurate representation of the body in three dimensions. Importantly, the image can provide a great deal more information about the body than the frontal views represented by contour figures. The image can be rotated on the computer screen so all aspects of the body can be viewed. In many cases, it is the first time participants get a clear and realistic picture of their bodies' posterior view. As a 3-dimensional image provides a much more complete representation, it may be useful in creating a more valid and accurate representation of body image than contour drawings. The 3-dimensional images may be depicted anteriorly or posteriorly for ordering, with selection of a more appropriate body configuration for a given set of subjects whose perceptions are being evaluated.

The objective of this preliminary study was to evaluate whether women could use 3-dimensional body scans as they used the older 2-dimensional contour drawings. This is the first step toward developing a new measure of body image based on 3-dimensional images. It was hypothesized that body scanned images could be consistently "matched" to the figures on a contour drawing scale by a panel of expert raters, thereby providing a test of validity with contour rating scales as the criterion. Three-dimensional body scanning could provide participants with a 360° image of their bodies.

Method

Participants

Women ($N=85$) from selected general education courses at a rural midwestern university, ages 18 years or older participated. The mean age of participants was 19.5 yr. ($SD=1.4$). By self-reported height and weight, Body Mass Index ranged from 16 to 38 ($M=23.4$, $SD=3.6$). The majority of participants (94.5%) were Euro-American.

Procedure

Participants were informed of proper attire for scanning, namely, clothes which fit close to the body. Height and weight measurements were obtained, and Body Mass Index was calculated. Next, the body scanner and overall procedure was explained to the participants who were informed that they would be given the opportunity to view their 3-dimensional scan. Later, all such images were printed on 5- × 8-in. index cards, and images of heads erased to preserve the participants' anonymity. Although printing changes the scan from a 3-dimensional to a 2-dimensional format, the image is highly realistic and preserves a sense of depth that is lacking in simple contour line drawings.

Five persons volunteered to be trained as raters to match these individual index cards with one of the nine contour line drawings from Thompson and Gray's Contour Rating Scale (1995). The Contour Rating Scale depicts sequentially increasing body girth from 1: Underweight to 9: Obese. The raters were instructed to match each index card to a contour silhouette based on comparability of the total body shape. Each of the 85 3-dimensional scans were then matched to a single contour line drawing from the nine available choices ranging from thin to obese by the five raters.

Results

Raters' matching of a 3-dimensional image to a numbered contour silhouette were entered into SPSS Version 14.0 for Windows. The results were then analyzed for internal consistency to ascertain the homogeneity of ratings by the five panelists for the 85 datapoints. Regression analysis indicated that age of the participant was not related to the ratings of the panelists. Cronbach alpha and Fleiss kappa were calculated and gave coefficients of $\alpha = .97$ and $\kappa = .80$. The high intraclass consistency supports the validity of the 3-dimensional reproductions of body scans as a viable alternative to contour line drawings.

Discussion

Three-dimensional body images have the potential to be applied either as a contour rating scale or as a measurement of body-image satisfaction using computer manipulation of a digital image. To illustrate how a 3-dimensional image could be utilized in a contour drawing format, a series of female figures which vary in size are shown in Fig. 1. To represent a more contemporary figure, the authors chose a spoon-shaped figure on which to construct the rating scale. The image was selected based on Simmons, *et al.*'s (2004) five anthropometric measurements which defined a spoon-shaped figure and was described as having a waist tapered from the bust and a "shelf" at the hips. Using Adobe Photoshop, the original figure was decreased and

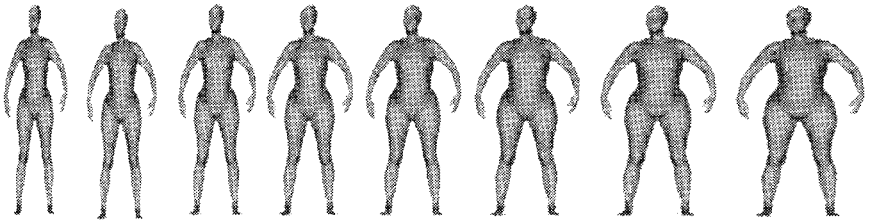

FIG. 1. A contour rating scale derived from a 3-dimensional body image

increased in 10% increments to create the sample rating scale. Additional contour scales could be developed for each of nine different somatotypes; subjects presented a contour scale which best represented their figures based on self-reported anthropometric measurements such as hip, waist, and chest. Alternatively, the 3-dimensional images, which can be exported in a number of different file formats, could be used in computer-manipulation programs like those reported by Sands and Armatas (2004) or Gardner and Boice (2004). The advantage of current digital methods is the 360° view afforded by body-image scans.

Given the newness of body-scanning technology and limited application in body-image research, findings are limited to simple evidence of validity against line drawings. Perhaps women might more reasonably compare themselves with more realistic images, like those generated through body scanning, which would better represent the shapes of the women. Whether a series of realistic body shapes can be generated to replace those of the contour drawings must be examined.

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