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The development of the Body Morph Assessment version 2.0 (BMA 2.0): Tests of reliability and validity

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Abstract

This study tested the psychometric characteristics of the Body Morph Assessment version 2.0 (BMA 2.0). A sample of 563 adults composed of four groups classified by gender and ethnicity (Caucasian men and women and African-American men and women) were studied. Support for the internal consistency and test–retest reliability of the BMA 2.0 was found for both men and women. A study of convergent validity was conducted. The BMA 2.0 was found to have adequate reliability and validity. Norms were established for the BMA 2.0 estimates of current body size (CBS), ideal body size (IBS), and acceptable body size (ABS) for Caucasian and African-American men and women. In summary, the BMA 2.0 is a reliable and valid computerized measure of CBS, IBS, ABS, the CBS–IBS discrepancy (body dissatisfaction), and provides an estimate of over/underestimation of body size as compared to individuals of the same sex and body mass index.

Keywords

Body image; Eating disorders; Obesity; Morph; Body image assessment

Introduction

Body image is a multifaceted construct with many dimensions that may be objectively studied (Thompson, 2004). This study tested the reliability and validity of a new computerized measure of body image called the Body Morph Assessment version 2.0 (BMA 2.0). The BMA 2.0 measures current body size estimates (CBS), ideal body size estimates (IBS), acceptable body size estimates (ABS), body image/size dissatisfaction (CBS–IBS discrepancy) (Williamson, Gleaves, Watkins, & Schlundt, 1993) and provides an estimate of body size over/underestimation as compared to individuals of the same sex and body mass index. For the purpose of the present study, body distortion/body size overestimation was defined as, “the degree to which an individual misperceives current body size” (Stewart & Williamson, 2004, p. 498). Body image/size dissatisfaction was defined as, “the discrepancy between an individual’s perceived current body size and perceived ideal body size” (Stewart & Williamson, 2004, p. 498), which has been established as valid measure of body dissatisfaction (Williamson et al., 1993).

Researchers generally agree that body image is multidimensional phenomenon (Prunzinsky & Cash, 2002). There are three main dimensions that have been identified in the classification of assessment measures: (a) attitudinal measures, which examine the attitudinal, cognitive, and affective components of body image; (b) perceptual measures, which examine the size perception aspect of body image, e.g., over or underestimation of body size; and (c) behavioral

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measures, which assess behaviors related to body image including body checking and/or avoidance behaviors. Some figural stimuli measures, e.g., the Body Image Assessment (BIA; Williamson, Davis, Bennett, Goreczny, & Gleaves, 1989), Body Image Assessment for Obesity (BIA-O; Williamson et al., 2000), the Body Morph Assessment (BMA; Stewart, Williamson, Smeets, & Greenway, 2001) estimate both size estimation as well as measure body size dissatisfaction.

Over the years, many weaknesses of figural stimuli measures have been noted: Such weaknesses include: (a) coarse response scales, (b) method of presentation, (c) scales of measurement, and (d) content validity problems (Gardner, Friedman, & Jackson, 1998; Russell & Bobko, 1992; Russell, Pinto, & Bobko, 1991). For example, with the use of silhouettes, individuals are typically asked to select one choice from a limited number of choices for a continuous variable (body size) which has been shown to alter their responses (Russell & Bobko, 1992; Russell et al., 1991). Silhouette measures are often presented in a fashion where all cards are on the table at once and some measures even place cards in ascending order from smallest to largest body size. This method allows the individual to use other cards as a point of reference for their choices and allows for very high test–retest reliability. Most silhouette measures do not increase in size in equal intervals from one to the other which presents statistical problems (Gardner et al., 1998). Further, silhouette measures have questionable content validity as they are typically animated type drawings or grossly unrealistic sketches of human figures and it is difficult for individuals to relate to in reference to their own body. Few of these measures have been validated on obese populations, men, and different ethnic groups. Despite their weaknesses, figural stimuli measures are often selected for use because they provide a quick, unobtrusive measure of body image dissatisfaction for clinicians and researchers.

The BMA 2.0 addresses many of the difficulties associated with traditional figural stimuli measures of body image. The BMA 2.0 employs a continuous response scale in that it has 100 figures from the thin endpoint to the obese endpoint that increase in size equally throughout the measurement tool. In the method of presentation, the individual only sees one figure at a time in the form of a movie, so it appears to them that they are seeing one body that “grows” on a fine gradient. Therefore, they have no reference points by which to make choices for their given instruction, e.g., current body size, as they would if all the figures were presented to them at once. Finally, the figures are created from high quality graphic animation software that aimed to more closely represent human figures compared to existing figural stimuli methods. The figures are also matched for gender and race to the participant.

This new version of the BMA 2.0 replaces the original BMA (version 1.0) that was tested in an earlier study and found to be reliable and valid for measuring body image of Caucasian women (Stewart et al., 2001). The BMA 2.0 is designed for use with African-American and Caucasian men and women ranging from a very thin body size to an obese body size. The BMA 2.0 is an efficient (10–15 min to complete) and an unobtrusive (participants do not have to remove clothing or be photographed) measure. It captures the data from the assessment automatically to a spreadsheet format and the instructions for participants’ use is on board the program. Participants who have used it report it as a pleasant assessment experience.

Method

Participants

The study sample included 563 participants recruited from universities, research studies, and the community. Participants who were recruited in the university setting ($n = 358$; 297 female, 162 male), signed up for the study via an online system and were given course credit for participation. Participants who were recruited as part of other research studies were offered the

opportunity to participate in the BMA 2.0 and paid \$10 per assessment to participate ($n = 159$; 88 female, 71 male). Individuals recruited from the community were recruited via flyers and advertisements and were paid a total of \$50 to complete both assessment sessions (for test–retest reliability) of the BMA 2.0 ($n = 46$; 13 female, 33 male).

For inclusion in the study, participants were required to be between the ages of 18 and 65 and have a BMI between 17.5 and 50. Table 1 summarizes the demographic and descriptive data for the sample. Of note is that participants recruited from other research studies were predominantly overweight/obese and accounted for 27% of the overall sample. The other 30% of the overall sample that was overweight/obese came from the university and community samples. Thus, by including the research population in the sample, it skewed the amount of overweight/obese individuals in the overall sample population.

The BMA 2.0: presentation, stimuli and administration

Stimuli and presentation—Pilot tests influenced the stimuli, presentation and administration of the BMA 2.0. First, the BMA 2.0 figures consist of 100 figures with equal increments in between each figure. The figures represent a linear model. There is a 63% difference in size between frame 1 (28,439 pixels) and frame 100 (46,303 pixels), with a .64% difference (180 pixels) increase between each frame. In the creation of this measure, the templates per sex were created and then animated for color. Thus, the same sex stimuli (for Caucasians and African-Americans) are qualitatively the same. However, for men and women (different sex stimuli), the figural stimuli are qualitatively different, thus, data for men and women are reported and interpreted separately. Second, pilot testing of video distortion methods produced cognitive bias, discomfort, and complaints that the body shown to them did not look like them, and/or the task provoked anxiety, therefore, content validity was in question. Thus, it was decided to utilize a generic stimulus with no distinct facial features (blurred) in which people could project their own face on a generic image. This decision essentially made the BMA 2.0 task an ambiguous task with a self-referential feature. In pilot studies, purely self-referential tasks (individuals viewing photos of their own body) are more highly associated with cognitive bias versus neutral tasks (generic stimuli). Finally, researchers utilizing figural stimuli measurements have delivered the stimuli in a variety of ways over time (e.g., randomly spread out, all at once, in sequential order). Through pilot testing, it was observed that when participants utilized silhouette cards, they used the figures as reference points when deciding their answer to instructions given. Thus, for the present study, we chose to test a model that did not present all of the images at once in an effort to reduce an artificially high test–retest reliability.

Overview of the BMA 2.0—The BMA 2.0 utilizes a computer “morph” movie of a human body. The battery consists of several morph movies distinguished between sex and race. The image of the human body that was utilized with each subject was an image that matched the subject’s race and sex. Fig. 1 shows screen captures of the BMA 2.0 including a Caucasian male (selection of CBS), a Caucasian female (selection of ideal body size), and an African-American female (selection of acceptable body size). The morph transforms from an exceptionally thin body into an obese body, or vice versa. There are a total of 100 increments between the two endpoints of the thin and obese bodies. By pressing a button, participants can select the body size picture they believe corresponds with a given instruction. For example, participants can select their perceived current body size (CBS), ideal body size (IBS), as well as an acceptable (able to be maintained over time) body size (ABS).

Administration of the BMA 2.0—The BMA 2.0¹ is a completely self-driven program with instructions on board. Administrators were available to answer questions if participants needed help with the program, though assistance was seldom required. In addition, participants were

asked to imagine their face on the generic stimuli figures as the figures had a blurred face. The BMA 2.0 instructions consist of an orientation/training phase (Phase 1) and a measurement phase (Phase 2). In Phase 1 participants are introduced to the software and guided through practice trials. Phase 2 instructions guide the participant in selecting choices of stimuli frames for their body image estimates including CBS, IBS, and ABS.

For each set of instructions, i.e., current, ideal, acceptable, participants complete four trials of the BMA 2.0, two in which the figure changed from thin to obese and two in which the figure changes from obese to thin. This method is utilized to control for “anchor effects,” such that when the stimulus starts out thin, the participant may choose a slightly smaller choice than when it starts out large. For each instruction, the forward and reverse responses are averaged, resulting in one mean body size estimate for each instruction, for each participant. Preliminary data analysis showed an anchoring bias. On average, there was a difference of four frames (lower rating when figure started out thin, and higher rating when figure started out heavy) between forward and backward trials. In this case, averaging was the method of choice to determine the official rating per given instruction, versus other methods (e.g., method of constant stimuli).

At the completion of the assessment session, all of the values of the session, including the raw values and the means for the CBS, IBS, and ABS ratings are collected in an export file system of the program. Also collected in this program are the corresponding *T* scores for each rating, i.e., CBS, IBS, ABS, and discrepancy score CBS–IBS as a measure of body size dissatisfaction. This export program collects and organizes the data over time and is easily transferred into other spreadsheet and statistics programs (e.g., Microsoft Excel, SPSS) for organization and analysis of the data.

Tests of content validity: the quality of the stimulus

Content validity is defined as the degree to which a measurement device reflects the specific intended or targeted content or construct of interest (Carmines & Zeller, 1991). Two methods were utilized in order to assess the content validity of the proposed measure. First, rating scales were used to determine if the BMA 2.0 was representative of realistic human figures and the individuals taking the test could relate personally to the stimuli. In a test of content validity, all participants ($N = 563$) rated their ability to personally identify with the stimuli presented in the BMA 2.0. All participants also rated the realism of the stimuli presented to them. Both of these ratings were captured utilizing a 1 (the figures were not realistic at all) to 7 (the figures were extremely realistic) Likert format scale.

Next, a panel of five expert judges with knowledge of the construct of body image and body image assessment procedures was utilized in evaluating the effectiveness of the BMA 2.0 as a method for assessing body image. None of these researchers were at the same institution at the time of the measurement evaluation. Researchers in the areas of body image, eating disorders, and obesity were asked to participate and the measure and rating scales were sent to them if they agreed to participate in rating the measure. No rewards were given for their participation. Judges made ratings on a 7-point Likert scale based on qualities such as; how realistic they perceive the measure to be (1 = not at all, 7 = very realistic); how representative the figures are for obese and thin people (1 = not at all, 7 = very representative); how representative the figures are for race (1 = not at all, 7 = very representative); how representative the figures are for sex (1 = not at all, 7 = very representative); how realistic the shapes are on

¹The Body Morph Assessment (copyright, 2005) is available from the Pennington Biomedical Research Center. Please contact <http://labs.pbrc.edu/healthpsychology/tools.htm> for information.

the continuum (1 = not at all, 7 = very realistic); and the smoothness of the continuum (1 = not at all, 7 = very smooth).

Tests of reliability

The BMA 2.0 was evaluated for internal consistency of the four trials per instruction (i.e., CBS, IBS, ABS). The BMA 2.0 was evaluated for test–retest reliability. Participants completed the BMA 2.0 two times with one to four weeks in between the trials. The average test–retest interval was a period of 11 days.

Test of convergent validity

The BMA 2.0 was evaluated for convergent validity by correlating it with measures that have been shown to measure the same constructs. The primary constructs measured by the BMA 2.0 consist of CBS, IBS, ABS and the discrepancy scores indicative of body size dissatisfaction, CBS–IBS, and CBS–ABS. The measures that were utilized to test convergent validity of the BMA 2.0 are summarized below.

Body Image Assessment–Obesity (BIA-O; Williamson et al., 2000)—The BIA-O is an 18-silhouette measure of body image designed to measure body image dissatisfaction and estimate body size over and/or underestimation in men and women that range in body size from very thin to obese. The BIA-O measures CBS, IBS, and the CBS–IBS discrepancy to determine body dissatisfaction. It also measures reasonable body size (RBS) which is similar to the measure of ABS on the BMA 2.0. The BIA-O was selected as a measure of convergent validity for the BMA 2.0 because the BIA-O measures the same body image constructs as the BMA 2.0. The test–retest reliability for the BIA-O has been found to be adequate (Williamson et al., 2000). It was hypothesized that the ratings of CBS, IBS, and RBS on the BIA-O would be significantly correlated to the ratings of CBS, IBS, and ABS on the BMA 2.0. Likewise, it was hypothesized that the CBS–IBS and CBS–RBS discrepancy scores would be correlated with the CBS–IBS and CBS–ABS discrepancy scores on the BMA 2.0.

Body Satisfaction Scale (BSS; Slade, Dewey, Newton, Brodie, & Kiemle, 1990)—The BSS is a self-report questionnaire that is completed by paper and pencil. The BSS is designed to measure satisfaction/dissatisfaction with 16 total body parts and includes the following subscales: general, body, and head. On the BSS, higher scores indicate higher levels of body dissatisfaction. Only the body subscale was used in the present study to serve as convergent validity measure for the BMA 2.0. The BSS was selected as a convergent measure for the BMA 2.0 because as a measure of body dissatisfaction, it was hypothesized that the body subscale would be correlated with the CBS–IBS and CBS–ABS discrepancy scores on the BMA 2.0.

Procedure

The present study was approved by the institutional review board at Louisiana State University and Pennington Biomedical Research Center. Informed consent was obtained from all participants. Height and weight was obtained in the lab for the purpose of determining body mass index (BMI). There were no participants that declined to be weighed and/or measured. BMI was computed for each participant by the BMA 2.0 program via the formula $[BMI = (Weight \text{ in Pounds} / (Height \text{ in inches}) \times (Height \text{ in inches})) \times 703]$.

The BMA 2.0 was then administered to participants. After completing the BMA 2.0, participants completed the BIA-O and the BSS. These measures were counterbalanced in administration. Participants were asked to participate in a second experimental session between one and four weeks later. During the second session, a subset of the study sample (150 women, 137 men) completed the BMA 2.0 again in order to collect test–retest data.

Statistical analysis

Statistical analyses were conducted using the Statistical Analysis Software (SAS version 9.1). Descriptive statistics were calculated for BMA 2.0 data and demographic data. Content validity was evaluated using descriptive statistics.

Pearson Product Moment Correlations were used to test test–retest reliability and convergent validity of BMA 2.0. Multiple *t*-tests were utilized to directly compare ratings of CBS, IBS, and ABS for Caucasian and African-American Women and Caucasian and African-American men. Bonferroni correction was used to correct for multiple comparisons. Next, six general linear statistical models were imputed to compare race differences after controlling for BMI. In each regression model, BMI, race, and the interaction of BMI and race were entered for each dependent variable (CBS, IBS, and ABS) separately for men and women. Finally, derived estimates of intercept, slope, and variance were used to establish norms.

Results

Quality control

On the BMA 2.0, the figures begin at frame 1 (thin nest figure) and end at frame 100 (largest figure). In the trials, there is both forward and backward presentation (thin to obese, and obese to thin). The average of the four trials for each BMA 2.0 instruction, forward (two trials) and backward (two trials) is taken to form the official estimate for the trial. This procedure was established to control for anchoring effects, in which the participant may make choices that were influenced by the default figure (beginning figure of the trial). For example, participants may make a slightly heavier estimate of their current body size when the trial starts out with the heavier figure. In addition, some participants accepted the default figure as their own estimate across some trials. For example, participants selected frame number one (or just a few frames above the base figure) when the figure started out thin, and frame number 100 (or just a few frames below the base figure) when the figure started out large. It is important to note that these cases selected both base figures (fat and thin) as their choices regardless of their own size. These data did not indicate a ceiling effect, but a lack of initiative on the part of participant to complete the program in a valid manner. Given this, the data for the BMA 2.0 were subjected to quality control procedures to ensure quality in such cases. 3.5% of the data was affected by these issues. The following procedures were used to control outlier data.

First, cut-off values were derived in order to eliminate the affected outliers in the data. Cut-off values were derived for each estimate by first calculating the difference score for each participant (e.g., for entries of 42, 48, 50, 48, the difference score would be $50 - 42 = 8$). Then the distribution of difference scores was evaluated and the 99th percentile of this distribution was used as the cut-off value. Any estimate with a difference score greater than or equal to the cut-off values listed above was removed and the average was obtained from the remaining values to form the official mean estimate score for the each instruction. Techniques that were employed to eliminate outliers were based on the work of Tabachnick and Fidell (2001).

Anchoring effects were evaluated, and on average, participants selected BMA 2.0 estimates four increments smaller in the forward (thin to obese) trials compared to the reverse (obese to thin) trials. For cases in which there were no valid forward or no valid reverse values, the derived average was increased by two (when there were no reverse trial values) and decreased by two (when there were no forward trial values). For the rare cases for which there were less than two valid values for a given BMA 2.0 estimate, the last observation was carried forward and used to impute the official mean estimate score.

Content validity: quality of the stimulus

The means for the content validity ratings of the realism of the stimulus and how well participants could identify with the stimulus were computed. For women, the means for the identification question were 5.7 ($SD = 1.20$) and 5.4 ($SD = 1.63$) for the realism question. For the men, ratings for the identification question were 5.3 ($SD = 1.41$) and realism question were 5.4 ($SD = 1.19$).

The means for the content validity ratings for the panel of experts were computed. There were five expert raters on the panel. The means for the expert ratings were as follows: realism of the morph, 6.2 ($SD = 0.84$); representative of a thin person, 6.2 ($SD = 0.45$); representative of an obese person, 6.2 ($SD = 0.045$); representative of race, 5.8 ($SD = 1.30$); representative of sex, 6.8 ($SD = 0.45$); realism of shapes on continuum, 6.2 ($SD = 0.74$); and smooth transition on the continuum, 7.0 ($SD = 0.0$).

Reliability

Internal consistency—The four estimates for each instruction (2 forward and 2 reverse) were evaluated for internal consistency using coefficient alphas. The coefficient alphas were high for estimates of each instruction with range of .91–.98.

Test–retest reliability—Table 2 summarizes the overall test–retest reliability coefficients (Pearson product–moment correlations) for Caucasian women ($n = 76$), Caucasian men ($n = 90$), African-American women ($n = 74$) and African-American men ($n = 47$) for CBS, IBS, and ABS, and their discrepancy scores across times one and two. Test–retest correlations were found to be greater than .60 ($p < .0001$) for all BMA 2.0 variables for men and women. Test–retest reliability coefficients were similar across subgroups: Caucasian and African-American men and women. The mean comparisons of Time 1 and 2 tests were nonsignificant for all instructions with the exception of female CBS and female CBS–ABS with 1 frame larger at baseline in both cases.

Correlations of BMA 2.0 with BMI

Alpha was set at .05 for all analyses. The degrees of freedom were 297 for women and 266 for men. As shown in Table 3, for women, there was positive correlation between the selection of CBS, ABS, and IBS and BMI ($r = .86$, .42, and .45, respectively). Similar findings were found for men, $r = .79$ for CBS, $r = .29$ for IBS, and $r = .46$ for ABS. In both genders, CBS–IBS and CBS–ABS were highly correlated with BMI (r ranges from .68 to .79).

Intercorrelations among the BMA 2.0 variables

The rating of CBS for female participants was found to be positively correlated with the CBS–IBS and CBS–ABS ($r = .88$ and .86, respectively). IBS was not correlated with the CBS–IBS ($r = .03$). ABS was positively correlated with the CBS–ABS, but at a low degree ($r = .13$). The rating of CBS for male participants was found to be positively correlated with CBS–IBS and CBS–ABS ($r = .91$ and .82, respectively). IBS was not correlated with CBS–IBS ($r = -.07$), nor was ABS correlated with the CBS–ABS ($r = .07$). This pattern of correlations suggests that changes in CBS determine the magnitudes of the discrepancy scores. For example, for both men and women, the larger their chosen estimate for CBS, the larger the discrepancy was between CBS and IBS and CBS and ABS.

The BMA 2.0 as a measure of body dissatisfaction and body size over/underestimation

Table 3 also shows the correlations of the BMA 2.0 discrepancy scores with the two measures selected to test convergent validity of the BMA 2.0.

Convergent validity: the BMA 2.0 and the BIA-O—The ratings of CBS, IBS, ABS, CBS–IBS, and CBS–ABS were found to be significantly positively correlated with their equivalents from the BIA-O in both women and men samples. These correlation values are summarized in Table 3.

Convergent validity: the BMA 2.0 discrepancy scores and the BSS—As shown in Table 3, the discrepancy scores of CBS–IBS and CBS–ABS were significantly and positively correlated with the BSS in women. The discrepancy scores of CBS–IBS and CBS–ABS were not significantly correlated with the BSS in men, although there was a positive trend. Given this, absolute values of BMA 2.0 discrepancy scores were correlated with BSS for men. As a result, the correlation between BSS and absolute value of CBS–IBS increased from .12 to .34 (p value < .0001) for men.

Direct comparisons of ratings of CBS, IBS, and ABS

In women, the ratings of CBS were significantly different from both IBS and ABS ($t(296) = 19.01$; and $t(296) = 12.89$, $p < .001$, respectively). IBS was also significantly different from ABS ($t(296) = -14.92$, $p < .001$). For men, the ratings of CBS were also significantly different from both IBS and ABS ($t(265) = 6.86$; and $t = 3.99$, $p < .001$, respectively) and IBS also differed from ABS ($t(265) = -6.40$, $p < .001$).

Comparison of body image estimates of Caucasian and African-American participants

The scatter plots between perceived CBS, IBS, ABS, and BMI were generated and linear relationships were detected. Six general linear statistical models were conducted to compare Caucasian and African-American men and women rating on body image variables (CBS, IBS, and ABS) after controlling for BMI. In each regression model, BMI, race, and the interaction of BMI and race were entered for each dependent variable (CBS, IBS, and ABS). For men and women, the interaction of BMI by race was not significant. In all six analyses, the linear relationship between the body image variables and BMI were significant. The effect sizes were imputed for race differences using Hedges's g , and medium effect sizes were found for female IBS (.40), male CBS (.26), and male IBS (.29). Effect sizes were .11 for female CBS and less than .05 for ABS of both genders.

For women, as can be seen in Fig. 2, there is an upward trend in the BMA 2.0 selection of CBS, ABS, and IBS as BMI 2.0 increases for both African-American and Caucasian women. The figure shows that as BMI increases, CBS increases (slope = 1.323 for Caucasian and 1.388 for African-American). The slopes for IBS and ABS were, albeit low, also significantly correlated with BMI (slope ranges from .28 to .37). In the figure, the CBS and IBS lines cross at a BMI of approximately 18 for Caucasian and 20 for African-American, suggesting that body dissatisfaction begins at a low BMI. Thus, from the point at which these two lines cross forward, the discrepancy between CBS and IBS increases.

For men, similar findings were found for the same upward trend in the BMA 2.0 selection of CBS, ABS, and IBS as BMI increases (slope = 2.1, 0.30 and 0.66, respectively). As shown in Fig. 3, the CBS and IBS cross at a BMI of approximately 24 for Caucasian and 26 for African-American. Therefore, as BMI levels increase above that, the discrepancy between CBS and IBS increases.

Establishment of norms

Norms are useful in interpreting scores of individuals who are assessed by the BMA 2.0. T scores were developed for CBS, IBS and ABS for Caucasian and African-American women and men. By converting BMA 2.0 estimates to T scores, it can be determined if an individual is overestimating or underestimating body size compared to individuals of the same sex and

BMI. Once the data are collected from the participant, the BMA 2.0 converts the scores into *T* scores using a formula. Based upon the results of these analyses, the BMA 2.0 can be interpreted in the context of BMI, gender, and race. The equations and regression coefficients utilized for the calculation of the *T* scores in each group can be found in Appendix A.

Discussion

The BMA 2.0 was found to be a reliable and valid measure of body image in Caucasian women and men and African-American women and men. The BMA 2.0 represents a technological improvement to existing figural stimuli measures as it utilizes a wider range of stimuli (100 stimuli in range), it accommodates both sexes and different ethnic groups (i.e., African-American and Caucasian), it utilizes a fine grained assessment that allows for greater precision in measurement than previous measures of its kind.

Content validity of the BMA 2.0 stimuli was found to be satisfactory. An expert panel also found the stimuli to be satisfactory with slightly lower ratings for representation of race. The BMA 2.0 cannot account for diverse body shapes, only body size (it is not possible to adjust the figure by areas or body parts—the figure “grows” or “shrinks” as an overall size). This could account for content validity ratings from the expert panel, as well as the participants, that were below 7 on the Likert scale. At the time of its development, technology was not available to incorporate features in order for body areas or parts to “grow” independently of the entire figure size. However, present technology allows for this development. Thus, a measure currently in development will incorporate this and other advanced features. It is important to note that other investigators have attempted similar technology with video distortion methods (Aleong, Duschesne, & Paus, 2007; Harari, Furst, Kiryati, Caspi, & Davidson, 2001; Hennighausen & Renschmidt, 1999; Sands, Maschette, & Armatas, 2004).

The results of the present study are comparable to other psychometric studies of measures of its kind that have been found to have good psychometric properties, e.g., BIA-O, BMA 1.0. Internal consistency was found to be good. The test–retest values for the BMA 2.0 ranged from 0.63 to 0.91. The test–retest values were comparable to those of the BIA-O (Williamson et al., 2000) and the BMA 1.0 (Stewart et al., 2001), with slightly lower values for men for IBS and ABS. We believe this further speaks to the need for tailored measures of body image for men, however, CBS values were very high indicating good test–retest for CBS. Traditionally, ABS values are lower than CBS and IBS. We believe this may be due to more subjectively interpreted instructions than for CBS and IBS.

The convergent validity values for the BMA 2.0 are also comparable to similar studies on like measures of body image, e.g., BIA-O, BMA 1.0. The BMA 2.0 was found to be correlated with measures of body dissatisfaction, i.e., BSS and BIA-O. Of the two measures, the BIA-O is more consistent with the measurement technique and constructs that the BMA 2.0 is designed to measure. First, in both men and women, the ratings for CBS (*T* scores provide estimate of body size over/underestimation), ideal body size preference (IBS), and acceptable body size preference (ABS/RBS) were highly correlated with their equivalents on the BIA-O. In women, the BMA 2.0 discrepancy scores (CBS–IBS, CBS–ABS), which serve as a measure of body dissatisfaction, were significantly correlated with the BSS and the BIA-O discrepancy scores indicating a convergent validity for body dissatisfaction. For men, the BMA 2.0 discrepancy scores were significantly correlated with the BIA-O discrepancy scores indicating convergent validity for body dissatisfaction, however, the BMA 2.0 discrepancy scores were not significantly correlated with the BSS score. This correlation was increased slightly when absolute values were used instead of *T* scores for men. This may be due to some measures of body dissatisfaction (derived for and validated on female populations) failing to adequately measure body dissatisfaction in men. In a recent study, it was reported that a common measure

used for the measurement of body image in women, the Body Shape Questionnaire (BSQ; Cooper, Taylor, Cooper, & Fairburn, 1987) was potentially not addressing body image in the same way for men, as it had traditionally with women (Rzeznikiewicz, Williamson, Stewart, & Martin, 2005). This could be one explanation for why the BSS and BMA 2.0 discrepancies were not as highly correlated in men as in women. These results, along with aforementioned research, points to the need for body image assessments to be tailored to men. Without the ability to evaluate the current-ideal discrepancy in men with things taken into consideration such as muscularity, this measure may be less useful for men than women, when desiring to get at more specific body image concerns. However, given the results of the present study, we believe the BMA 2.0 is still a valid and reliable measure in men, particularly when size is the main issue as in the case of obesity. Further, since correlations between the BSS and the BMA 2.0 in women were weak as well, it may be that the BMA 2.0 and BIA-0 are measuring the same construct and the BSS is actually measuring something different.

CBS was highly correlated with discrepancy scores suggesting that as CBS increased, body dissatisfaction increased. CBS, IBS and ABS were regressed on BMI to gain information about the nature of body image in the study population. In both men and women, as BMI increased, perceived current body size increased proportionately. However, compared to current body size, ideal body size and acceptable body size increased at a much smaller increment as BMI increased. Thus, both figures (for men and women) illustrate a significant discrepancy between current and ideal and current and acceptable body sizes, regardless of race. This may suggest that ideal body size and to some degree, acceptable body size, remain more of a fixed “constant” of body image (no matter what size a person is, they want to be a certain standard of size) than perceived current body size (rises proportionately as actual body size, i.e., BMI, rises).

Limitations of the present study include the study population. The BMA 2.0 has not been tested on populations other than African-American and Caucasian adult individuals. Therefore, generalizability to other populations is unknown. Second, the BMA 2.0 in its current form does not contain the ability to adjust body part size or muscularity. Thus, this measure is most appropriate as a measure of overall body size in women and men (taking into account absolute values of the discrepancy scores to determine what direction the discrepancy goes, e.g., desire a smaller body size, desire a larger body size). Next, 3.5% of the participants in the current study selected the default figures (both fat and thin) when making their selections (CBS, IBS, ABS) on the BMA 2.0. Thus, quality control procedures were employed in the data to overcome this. However, in a revised version of the BMA 2.0, this issue has been corrected. Finally, the BMA 2.0 is not a traditional method of body size distortion. It utilizes normative data to make estimations about body size over/underestimation. This feature is characteristic of other figural stimuli measures (e.g., BIA-O). The fact that the actual body size (e.g., BMI) of the figural stimuli is not known, and/or that the actual body of the participant is not used as the stimuli is a limitation of all figural stimuli measures when assessing body size over/underestimation. However, this may not necessarily be viewed as a limitation if body size over/underestimation is viewed as a cognitive bias as opposed to a perceptual bias (Williamson, 1996).

Based on these results, it may be concluded that the BMA 2.0 can be used in studies of body image related to persons ranging in body weight from very thin to obese and in studies of body shape perceptions and preferences. The BMA 2.0 can be used as a body image assessment tool in cross-sectional and longitudinal studies involving body image, eating disorders, and obesity. Future development and research in this area includes the enhancement of the current measure in order to address the association of BMI and the stimuli figures, the selection of diverse body shapes, three dimensional viewing, and a wider range of ethnic origins, as well as tests of reliability and validity in diverse populations, including aspects relevant to men.

Appendix

Appendix A

Equation and regression coefficients used to calculate BMA 2.0 *T* scores

$$T = 50 + 10 \left[\frac{\text{BMA} - (b_1 \text{BMI} + b_0)}{\text{SEM}} \right]$$

Regression coefficients for prediction of CBS, IBS, and ABS

	Predicted	<i>b</i> (BMI)	Constant	SEM
Caucasian female	CBS	1.323	26.157	6.054
African-American female	CBS	1.388	23.033	5.648
Caucasian female	IBS	0.321	41.777	5.122
African-American female	IBS	0.280	45.182	4.638
Caucasian female	ABS	0.332	46.667	5.367
African-American female	ABS	0.369	45.479	5.211
Caucasian male	CBS	2.054	4.411	9.198
African-American male	CBS	1.956	3.137	9.306
Caucasian male	IBS	0.263	46.224	6.116
African-American male	IBS	0.359	45.341	5.693
Caucasian male	ABS	0.590	40.726	8.138
African-American male	ABS	0.770	36.169	7.069

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Fig. 1.
Stimuli examples of the BMA 2.0; Caucasian male (CBS), Caucasian female (IBS), African-American female (ABS).

Fig. 2.
Current, Ideal, and Acceptable body size scores regressed on BMI: women.

Fig. 3.
Current, Ideal, and Acceptable body size scores regressed on BMI: Men.

Table 1

Demographic and descriptive data for the study sample.

		<i>n</i>	Mean	Range
Caucasian Women	Age	161	36.7	18–75
	BMI		28.0	17.8–48.0
African-American Women	Age	136	26.9	18–72
	BMI		28.6	18.0–48.0
Caucasian Men	Age	175	35.5	18–75
	BMI		27.9	17.6–43.1
African-American Men	Age	91	23.2	18–68
	BMI		27.6	18.6–47.2

Table 2

Test-retest correlations.

BMA estimates	Women	Men	Caucasian women	Caucasian men	African-American women	African-American men
CBS	.91*	.91*	.88*	.90*	.91*	.92*
IBS	.82*	.66*	.79*	.58*	.80*	.76*
ABS	.69*	.63*	.73*	.66*	.65*	.57*
Discrepancy scores						
CBS-IBS	.79*	.86*	.69*	.86*	.82*	.86*
CBS-ABS	.63*	.65*	.67*	.65*	.59*	.64*

n = 150 for women, 76 Caucasian and 74 African-American; *n* = 137 for men, 90 Caucasian and 47 African-American.

* *p* < .0001 level.

Table 3
Intercorrelations of BMA measures, BMI, and measures of body dissatisfaction.

	CBS	IBS	ABS	CBS-IBS	CBS-ABS	BMI	BIA-O	BSS
CBS ^a								
IBS ^a	.50***		.63***	.91***	.82***	.79***	.71***	
ABS ^a	.61***	.65***	.47***	-.07	.09	.29***	.38***	
CBS-IBS ^a	.88***	.03	.35***	.46***	.07	.46***	.37***	
CBS-ABS ^a	.86***	.22**	.13*	.88***	.83***	.71***	.68***	.12
BMI ^a	.86***	.42***	.45***	.76***	.79***	.68***	.44***	.12
BIA-O ^b	.81***	.60***	.53***	.67***	.56***			
BSS ^b				.41***	.30***			

The correlations of BSS scores with CBS, IBS, and ABS are not reported since the BSS was tested as a convergent measure of body dissatisfaction, which theoretically is measured by CBS-IBS and CBS-ABS.

The correlations for the BMA and BIA-O are as follows: CBS/CBS, IBS/IBS, ABS/RBS, CBS-IBS/CBS-IBS, CBS-ABS/CBS-RBS.

* $P < .05$ level.

** $P < .001$ level.

*** $P < .0001$ level.

Female measure: Not italic; Male measure, italic.

^a $n = 297$ for female; $n = 266$ for male.

^b $n = 185$ for female; $n = 192$ for male.