Heavy Matters: The Relationship Between Just Noticeable Differences in Perceptions of Facial Adiposity and Facial Attractiveness

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Abstract

People can reliably infer various traits, states, and group memberships from minimal cues. Despite impressive demonstrations of the breadth of social perception, however, few studies have critically examined the sensitivity and limits of social perception in specific quantitative terms. Here, we investigated the just noticeable difference for perceptions of a facial trait with profound consequences for social behavior, that is, facial attractiveness. Building on research examining facial adiposity, we determined the changes in body mass index needed to meaningfully alter perceivers' judgments of weight and attractiveness. Although perceivers recognized differences as small as 1.33 kg/m^2, changes of roughly twice that size (2.38 kg/m^2 and 2.59 kg/m^2 for women and men, respectively) were necessary to alter attractiveness. These findings contribute to a greater basic understanding of the precision and limits of social perception and may provide information of value to medical practitioners and individuals seeking to manage changes in weight.

Keywords

weight thresholds, social perception, body mass index, psychophysics, overweight

People make sundry evaluations of each other throughout the course of daily life. Indeed, a growing literature has begun to document many of the phenomena and processes that account for individuals' interpersonal perceptions. One of the landmark traits on this emerging map of social perception is facial attractiveness (Dion, Berscheid, & Walster, 1972). Few characteristics show such blockbuster effects on social behavior as attractiveness (see Perrett, 2010; Zebrowitz, 1997). Although beauty may be in the eye of the beholder, people show high and consistent agreement about whom they deem attractive (Langlois et al., 2000; Rhodes et al., 2001; see also Hönekopp, 2006). More striking, these perceptions are remarkably consequential. Attractive people are not only expected to be more socially capable, popular, and competent when considered abstractly (Dion et al., 1972; Eagly, Ashmore, Makhijani, & Longo, 1991), they also benefit in the real world by earning higher wages (Mobius & Rosenblat, 2006; Toledano, 2013), receiving more favorable outcomes in court (Stewart, 1980), and are even more likely to win political elections (Banducci, Karp, Thrasher, & Rallings, 2008; Berggren, Jordahl, & Poutvaara, 2010; King & Leigh, 2009).

Given that facial attractiveness has broad and substantial effects in everyday society, it is unsurprising that attractiveness is steeped in a wealth of empirical research. To date, the literature's account of facial attractiveness is extensive, and several physical traits have been reported to impact perceptions of attractiveness (see Re & Rule, in press, for review). Perhaps the

greatest of these is the relationship between facial attractiveness and health (see Kalick, Zebrowitz, Langlois, & Johnson, 1998; Re & Rule, in press; Shackelford & Larsen, 1999; Thornhill & Gangestad, 1999). Indeed, one of the most recently discovered components of facial attractiveness that has also been demonstrated to be one of its most important determinants is facial adiposity or the perception of weight in the face (Coetzee, Perrett, & Stephen, 2009). Facial adiposity is an accurate indicator of body mass index (BMI) and a robust cue to both perceptions and real indices of one's health (Coetzee, Chen, Perrett, & Stephen, 2010). Indeed, recent studies have demonstrated that facial adiposity correlates negatively with individuals' immunological competence, cardiovascular function, frequency of respiratory infections, and ultimate mortality (Coetzee et al., 2009; Rantala et al., 2013; Reither, Hauser, & Swallen, 2009). Judgments of weight from the face have also been associated with individuals' mental health, as people with heavier looking faces report more stress, anxiety, and depression (Tinlin et al., 2013). Facial adiposity even affects more

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distant social traits, such as perceived leadership ability (Re et al., 2012; Re & Perrett, 2014).

Considering both its connection to health and the rampant negative stigma associated with being overweight (e.g., Crandall, 1994), it is almost trite that adiposity would affect perceptions of facial attractiveness. Indeed, facial adiposity shows a curvilinear relationship with attractiveness (Coetzee et al., 2009), such that the faces of both underweight and overweight people are judged as less attractive than the faces of people in the healthy weight range (defined by the World Health Organization, 2006, as 18.5–25.0 kg/m^2). Most people report preferences for adiposity levels that correspond to BMIs in the lower end of the healthy range, an effect that remains even when accounting for the perceiver's own BMI (Coetzee, Re, Perrett, Tiddeman, & Xiao, 2011; Fisher et al., 2014; Re, Coetzee, et al., 2011; Re & Perrett, 2014). Moreover, facial adiposity has strong effects on attractiveness across multiple cultures and outside of the first-world populations traditionally studied in social psychology (Coetzee et al., 2012). The effect of facial adiposity on attractiveness is therefore robust and extensive.

It is thus clear that facial adiposity has great effects on person perception, including the ever-important trait of facial attractiveness. Despite the considerable understanding of facial adiposity's perceptual impact, however, knowledge about the point at which attractiveness meaningfully shifts based on changes in facial adiposity is absent. Digital face processing software can alter facial adiposity to simulate precise changes in BMI (see Coetzee et al., 2011; Re & Perrett, 2014). It is therefore intriguing to wonder how much change in BMI is required to alter facial attractiveness. The face provides a proportionately greater contribution to evaluations of overall attractiveness than other parts of the body (Currie & Little, 2009; Peters, Rhodes, & Simmons, 2007). Thus, even minor changes in facial adiposity may have a great impact on perceived attractiveness. Indeed, the effect sizes from studies documenting facial adiposity's influence on attractiveness are typically large and independent of other elements of attractiveness (Coetzee et al., 2012; Re & Perrett, 2014). Small changes in facial adiposity could therefore produce sizable shifts in facial attractiveness.

Here, we determined the minimum change, or just noticeable difference, in facial adiposity required to alter perceptions of weight and attractiveness. Doing so allowed us to estimate the precision with which people can detect changes in adiposity that affect social perception. Previous research has reported that remarkably small changes in skin redness and yellowness (coloration associated with aerobic health and immunological capacity, respectively) can significantly affect facial attractiveness (Re, Whitehead, Xiao, & Perrett, 2011; Whitehead, Re, Xiao, Ozakinci, & Perrett, 2012). It is conceivable that comparably small changes in facial adiposity may have similar effects. Establishing perceptible thresholds in facial adiposity would not only help to inform practical understanding of the effects of adiposity on judgments of attractiveness (e.g., Dion et al., 1972), it would also allow for a robust test of the capacity of

the social perceptual system to detect and act upon small visual differences in appearance (see Zebrowitz & Collins, 1997). Determining the weight change thresholds for altering attractiveness judgments would therefore reveal how sensitive humans are to facial adiposity in assessing attractiveness. Thus, we investigated the perceptual threshold needed for changes in facial adiposity in Study 1, established the optimal BMI values for attractiveness in Study 2A, and, finally, determined the threshold at which BMI changes modify perceptions of attractiveness in Study 2B.

Study 1

We began by establishing the just noticeable difference for changes in facial adiposity by employing an experimental psychophysics paradigm that allowed us to simulate the effects of weight change on facial appearance. This step was necessary for creating tests to determine the BMI change thresholds that affect perceptions of attractiveness. We therefore examined the minimum threshold at which weight change impacts perceptions of facial appearance.

Method

Stimuli

We used images from a publicly available database of male and female faces (www.3d.sk). All chosen images were taken under standardized lighting in which the faces were photographed from a 0° angle with neutral expressions, hair pulled back, and without facial adornments, and we digitally standardized the interpupillary distance to control for the size of the face image. Height, weight, and age information for each target were included in the database.

We digitally averaged triads of same-sex faces from the database to create 20 composite faces (10 male and 10 female). We calculated the BMI and age of each composite identity by averaging the BMI and age of the three contributing faces. The composite identities spanned a range of BMIs and ages (female composites: $M_{BMI} = 20.04$ kg/m^2, $SD = 2.06$; $M_{age} = 23.00$ years, $SD = 1.84$; male composites: $M_{BMI} = 23.76$ kg/m^2, $SD = 2.51$; $M_{age} = 24.17$ years, $SD = 1.94$). Using composites, rather than individual faces, reduces the likelihood of possible facial anomalies that may confound experimental testing (see Rowland & Perrett, 1995).

In addition to the 20 composite faces, we created a total of four high- and low-BMI male and female prototype faces by averaging 10 faces of individuals with high or low BMIs from the original database that differed from those used for constructing the composite faces above (see Tiddeman, Burt, & Perrett, 2001). The low-BMI female prototype had a BMI of 17.85 kg/m^2 ($SD = 0.79$), and the high-BMI female prototype had a BMI of 24.06 kg/m^2 ($SD = 6.37$). The low-BMI male prototype had a BMI of 22.19 kg/m^2 ($SD = 2.52$), and the high-BMI male prototype had a BMI of 26.47 kg/m^2 ($SD = 3.27$). As earlier, the BMI for the prototype faces comprised the average BMI of the 10 parent faces contributing to each prototype.

Using the prototypes, we transformed the 20 composite faces to produce simulated changes in BMI for each identity. Specifically, the prototypes served as anchors in a 31-step BMI continuum with 1.5 kg/m^2 increments for each of the 20 different composite face identities. To perform this transformation, we digitally morphed each of the 20 composite faces with the high- and low-BMI prototype faces that matched the composite's sex and progressively transitioned the amount of contribution from the anchor prototype as it continued toward the midpoint of the continuum (the 16th face), which was the original composite face image not receiving a contribution from either of the high- or low-BMI prototypes. We held the interpupillary distance constant across the transforms along the continuum and between the different face identities to ensure that the faces did not simply grow larger overall as facial adiposity changed with the transformation. We only transformed the shape of the composite faces, retaining skin color and texture to preserve the identity of the faces. Similar methods have been used in previous studies to successfully alter facial adiposity (Re & Perrett, 2014).

Procedure

We used a two forced-choice staircase-method psychophysical task to determine detection thresholds for BMI. The task proceeded as follows: participants ($N = 54$; 27 women, 27 men; $M_{BMI} = 22.58$ kg/m^2, $SD = 4.64$; $M_{age} = 18.54$ years, $SD = 1.88$) viewed two versions of the same composite face in pairs, choosing the one that appeared heavier in weight. The first trial for each composite face identity showed the thinnest and heaviest faces in its continuum (i.e., Faces 1 and 31 of the 31-step continuum, corresponding to ± 1.5 kg/m^2 from the original BMI, a total difference spanning 3 kg/m^2 between the faces). If the participant correctly chose the heavier face, the next trial that drew faces from the continuum for that particular identity would show two versions that differed by half of the BMI difference of the previous trial for that same identity—for example, a correct response on Trial 1 (3 kg/m^2 span between the faces) would result in the presentation of faces that differed by 1.5 kg/m^2 on Trial 2. Notably, the presentation order for the 20 composite face identities was interleaved so that consecutive trials would rarely display the same identity, and choices for one identity would not affect the selection or presentation of faces for any other identity.

This process continued until the participant made an incorrect choice (i.e., chose the lower BMI face in the pair), at which point the BMI difference on the next trial would be double that of the BMI difference of the previous version (e.g., an incorrect choice on Trial 2 would revert back to a BMI difference of 3 kg/m^2 between the faces on Trial 3—the same span implemented on Trial 1). This event constituted a "reversal." The BMI difference between the pairs of faces would then continue to double with each trial until the participant chose the heavier face again (constituting another reversal), at which point the differences would return to halving rather than doubling. Faces would continue to be drawn for each identity until

Figure 1. Example of facial adiposity differences reflecting a body mass index reduction of 1.33 kg/m^2—the average threshold required to produce a reliable change in perceptions of weight in Study 1.

the participant initiated three reversals along that specific continuum. The experiment therefore terminated once the participant had produced three reversals for all 20 identities. We defined the BMI detection thresholds as the average difference of the three reversals for each of the 20 identities. This task design has been used successfully in previous studies (Re, Whitehead, et al., 2011).

Results and Discussion

We calculated the weight change thresholds in terms of BMI rather than simple kilograms or pounds. This made it possible for us to generalize the findings to individuals of all weights and heights. Results showed that the average BMI change needed to noticeably alter facial appearance was 1.33 kg/m^2 ($SD = 0.06$, range = 1.21–1.45 kg/m^2), and this did not differ between male ($M = 1.34$ kg/m^2, $SD = 0.06$) and female ($M = 1.31$ kg/m^2, $SD = 0.07$) faces, $t(18) = 0.72$, $p = .48$, $r_{effect\ size} = .17$.[1]

A weight change of 1.33 kg/m^2 would correspond to a change of 7.8 lbs for a woman of average height (5 ft 4 in.) or 9.3 lbs for a man of average height (5 ft 10 in.). Thus, the average woman and man would need to gain or lose approximately 8 lbs and 9 lbs, respectively, to alter their facial appearance toward looking noticeably lighter or heavier (see Figure 1).

Study 2

Study 1 determined how much weight an individual would need to lose or gain in order to noticeably change his or her appearance. A detectable change in weight does not guarantee an improvement in attractiveness, however. To determine the threshold required to make a person look more attractive, we first needed to determine the BMI levels at which male and female faces are judged most attractive. This would allow us to create BMI ranges that capture the optimally attractive levels of facial adiposity while knowing what direction of BMI change

(increasing or decreasing) would produce more attractive faces for use in testing our primary question about attractiveness thresholds. We therefore determined the most attractive BMI levels in Study 2A by engaging participants in an interactive experiment in which they manipulated faces on a computer to adjust their apparent weight. With these data in hand, we were then able to establish the amount of weight change needed to change attractiveness in Study 2B.

Study 2A

To pinpoint the threshold at which changes in adiposity resulted in notable changes in attractiveness, we first established the weight deemed ideal for judgments of facial attractiveness as a preliminary step.

Method

In addition to the 10 male and 10 female face composites used in Study 1, we created another 10 male and 10 female face composites by drawing new faces from the same database described above. We added these new composites to the faces used in Study 1 for a total of 20 female face composites ($M_{BMI} = 20.52$ kg/m², $SD = 2.42$; $M_{age} = 23.00$ years, $SD = 1.95$) and 20 male face composites ($M_{BMI} = 23.83$ kg/m², $SD = 2.24$; $M_{age} = 24.08$ years, $SD = 1.82$), subjecting them to transformation using the same BMI prototypes employed in Study 1.

Similar to Study 1, we then created face continua for the 20 male and 20 female faces in 21 steps, such that the 11th face was the original starting BMI, which then increased or decreased in 10% intervals toward the ends of the continuum (again anchored by the prototype faces), resulting in a range spanning $\pm 100\%$ of the BMI difference between the two prototypes. For example, the BMI difference between the two male prototypes was 6.21 kg/m², and thus a 100% transform in facial adiposity for any composite would result in a BMI increase of 6.21 kg/m².

We then used a custom online experimentation program to present each face starting at a random point along the continuum that allowed participants to scroll horizontally over the image to smoothly rotate through consecutive steps in the continuum, giving them the impression that they were changing the weight of the person as they moved their computer's cursor across the image of the face (see Re & Perrett, 2014). We instructed the participants ($N = 33$; 13 men, 20 women; $M_{BMI} = 26.37$ kg/m², $SD = 5.48$; $M_{age} = 39.55$ years, $SD = 13.69$) to scroll across the face until they had "made it most attractive." Scroll direction was randomized, so that scrolling to the same side of the image would not always make the face appear heavier. Participants completed the task online through Amazon's Mechanical Turk.

Results and Discussion

We aggregated the degree of transformation required to maximize attractiveness (in percentage) across participants for each face (inter-rater agreement Cronbach's α = .98) and converted it to BMI units. Overall, participants transformed the male and female faces to mean BMIs of 23.79 kg/m² ($SD = 2.16$) and 19.11 kg/m² ($SD = 2.34$) to maximize attractiveness, respectively—values very similar to the BMIs found to be most attractive in bodies (Tovée & Cornelissen, 2001). The optimally attractive BMI for female faces was significantly lower than that for male faces: $t(38) = 6.57$, $p < .001$, $r_{effect\ size} = .73$. These values correspond to weights of 111.70 lbs and 165.83 lbs for women and men of average height for their sex, respectively. Obtaining these results primarily served as an intermediary step to isolate the threshold at which individuals appreciably gain in attractiveness. Thus, further research as to whether these optimally attractive BMI values vary by sex, age, or culture may be fruitful.

Study 2B

To isolate the BMI thresholds that would meaningfully change attractiveness, we developed an experimental psychophysics paradigm similar to that used in Study 1 that allowed us to establish "attractiveness thresholds," or the minimal change in BMI required to affect attractiveness. Isolating this threshold allowed us to determine the point at which changes in weight rendered changes in a person's perceived attractiveness.

Method

Having established the most attractive BMIs for women (19.11 kg/m²) and men (23.79 kg/m²), we next created new BMI continua like those constructed for Study 1 that exceeded this weight to assure that the direction of choices would be uniform in a forced-choice task. We therefore created continua of 22–27 kg/m² and 27–32 kg/m² for the female and male faces, respectively, well above the optimal attractiveness values found in Study 2. We divided the continua into 11 steps, creating intervals of 0.45 kg/m² that therefore allowed possible thresholds from 0.45 to 5.0 kg/m². Participants ($N = 56$; 28 men, 28 women; $M_{BMI} = 21.11$ kg/m², $SD = 3.74$; $M_{age} = 19.35$ years, $SD = 3.35$) then engaged in a psychophysics experiment similar to that in Study 1 for the 40 different face identity continua (20 male and 20 female) created in Study 2A. The study proceeded similarly to Study 1 but instead of selecting the heavier face in a pair, we asked participants to "choose the face that looks more attractive," and the continua were reversed so that choosing the lighter of the two faces as more attractive halved the BMI difference on the next trial from that particular continuum and choosing the heavier face doubled the difference on the next trial.

Results and Discussion

We calculated weight change thresholds in BMI units, as in Study 1. The average decrease in BMI required to make a face more attractive was 2.38 kg/m² ($SD = 0.14$, range = 2.13–2.25 kg/m²) for women's faces and 2.59 kg/m² ($SD = 0.20$, range = 2.25–3.01 kg/m²) for men's faces (see Figure 2). These values correspond to weight changes of 13.85 lbs and 18.07 lbs for women and men of average height, respectively. The thresholds
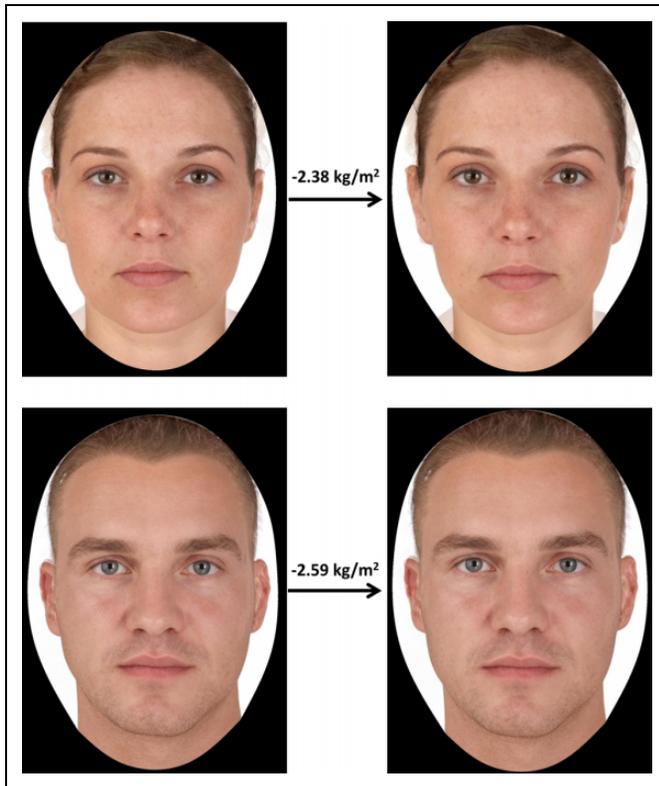
Figure 2. Example of facial adiposity differences reflecting BMI reductions of 2.38 kg/m^2 (top row) and 2.59 kg/m^2 (bottom row)—the average thresholds required to produce a reliable change in perceptions of attractiveness for women's and men's faces, respectively, in Study 2B.

for male faces were higher than those for female faces, $t(38) = 3.84$, $p < .001$, $r_{\text{effect size}} = .53$, suggesting that women's facial attractiveness may be more sensitive to changes in weight, although it is important to note that the starting BMI range was higher for men's faces than for women's faces in the task. Moreover, the thresholds needed to generate noticeable changes in facial attractiveness were significantly greater than those required to perceive changes in weight in Study 1: $B = 1.16$, $SE = .04$, $t(29.97) = 26.76$, $p < .001$, 95% CI [1.07, 1.25]. Thus, although smaller changes in BMI may be enough to make a person appear lighter or heavier, greater changes are needed to modify one's attractiveness.

General Discussion

Across three studies, we documented the sensitivity with which people detect changes in weight and attractiveness in others' faces. The results of Study 1 revealed that people could reliably perceive weight alterations as small as 1.33 kg/m^2 in men's and women's faces. Despite this precision, we found that changes of nearly double that size were needed to meaningfully shift perceptions of attractiveness in Study 2. These data help to inform general understanding of how perceivers evaluate weight and attractiveness from small changes in facial cues.

Notably, the attractiveness thresholds were nearly double those required to notice a difference in weight. These findings suggest that the effect of facial adiposity on attractiveness goes beyond simply looking thinner or heavier. Research on skin coloration has demonstrated that changing attractiveness requires a larger change in skin redness than what is needed to simply perceive a general change in coloration (Re, Whitehead, et al., 2011). Perceptions of attractiveness are therefore not equivalent to the just noticeable differences in coloration but require a greater magnitude of change. We found similar results here. Facial adiposity has strong effects on judgments of attractiveness (Coetzee et al., 2009; Re & Rule, in press), and the present data suggest that the weight changes needed to enhance perceived attractiveness exceed those needed to simply notice a difference in weight.

It is possible that the discrepancy in thresholds for attractiveness and weight could arise from difference in the complexity of the two judgments. Judging weight is a relatively straightforward decision that is likely less malleable to variations in individual preferences than simply recognizing one's weight. Indeed, we observed greater variance in the judgments of attractiveness than we did for judgments of weight in the current work. Thus, the relatively complex and subjective nature of perceived beauty may reduce consensus among perceivers in their judgments of attractiveness, thereby requiring greater differences to accumulate before changes meaningful for the collective group may be reliably observed (i.e., more signal must accrue because of the increased noise).

On an applied level, the present findings may help to promote solutions to treating weight problems. Over 70% of American adults are overweight (Flegal, Carroll, Kit, & Ogden, 2012; Ogden & Carroll, 2010), and weight-related problems account for approximately US$90 billion in national medical expenditures annually in the United States (Finkelstein, Fiebelkorn, & Wang, 2003); similar figures apply to the populations of most first-world nations (WHO, 2015). Unfortunately, a large literature in psychology, health, and medicine has shown that most people's attempts at weight change fail (Garner & Wooley, 1991; Mann et al., 2007), and the rising tide of obesity may soon begin to produce declines in the overall life expectancy of Americans (Olshansky et al., 2005). Appealing to a person's desire for attractiveness is one of the few methods that does seem to be effective for motivating lifestyle changes that improve health (Jones & Leary, 1994; Mahler, Kulik, Gibbons, Gerrard, & Harrell, 2003). Pinpointing the thresholds needed to alter attractiveness may similarly offer concrete weight-change goals to help motivate members of the growing overweight population to improve their health. Indeed, people respond better and adhere more when their goals are concrete versus abstract (Locke, Shaw, Saari, & Latham, 1981). The loss of approximately 15–20 lbs—similar to the attractiveness thresholds for people of average height in the present work—would save an estimated US$3,336–US$4,093 in lifetime medical expenditures for a person with an initial BMI of 27.5 kg/m^2 (similar to the average BMI of many developed nations; WHO 2005), and would increase longevity as much as 15 years (Oster, Thompson, Edelsberg, Bird, & Colditz, 1999).[2] Identifying tangible objectives, such as those provided by the present data, may therefore help to facilitate people's weight-change efforts to

improve their health and, in congregate, offer relief to the over-burdened medical economy.

Although the current research could help to provide additional incentives and useful goals for those looking to change their weight, these effects may not apply to the entire population. For example, the stimuli used here did not cover the obesity range (BMI $\geq$ 35; WHO, 2006) or the underweight range (BMI < 18.5; WHO, 2006). People with BMIs at these levels may also improve their health by changing their weight. Moreover, attractiveness thresholds may differ for these people compared to the majority of the population, which was the target range in this investigation. Specifically, underweight or severely overweight people may require a smaller change in BMI to noticeably increase their attractiveness, as further distance from the most attractive BMI values (as found in Study 2A) may mean that smaller changes are more noticeable (see Ekman, 1959). Furthermore, people with high muscle mass have nonaverage body compositions (Ode, Pivarnik, Reeves, & Knous, 2007), such that they do not follow the same trends in facial adiposity as less athletic people with the same BMI; thus, future work may need to extend the present tests before the results may be generalized to highly athletic populations.

Moreover, we only tested North American participants. Other studies have found that BMI preferences vary between cultures (Tovée, Swami, Furnham, & Mangalparsad, 2006), though preferences for facial adiposity levels in the below-average BMI range are retained from one culture to the next (Coetzee et al., 2012). The faces used here were also all averages of adults 20–40 years old, and the most attractive BMI levels could differ by target age, as facial fat distribution changes slightly across adulthood (Donofrio, 2000). Nevertheless, the current results apply to a range of younger and middle-aged adults, incorporating the majority of the adult population of the first-world countries in which weight concerns show the greatest health and economic impacts (Central Intelligence Agency, 2007).

Thus, the current studies provide weight change thresholds for altering attractiveness that apply to a broad array of people. Facial attractiveness has great and pervasive impacts on daily life (Dion et al., 1972; Perrett, 2010), and facial adiposity has recently been revealed as a major component of facial attractiveness (Coetzee et al., 2012; Coetzee et al., 2009). The present findings therefore help to clarify the perceptual resolution of individuals' visual- and social-inferential capacities. Additionally, they provide concrete weight change goals that may add motivational incentive for individuals seeking to change their BMI. Establishing the thresholds at which perceptions of facial adiposity and facial attractiveness meaningfully change may therefore contribute to better understanding the sensitivity, precision, and limits of the social perceptual system, offering new knowledge about one of the most powerful characteristics affecting how people perceive and evaluate one another.

Declaration of Conflicting Interests

Funding

Notes

1. Participants' own BMI showed no association with any of the results reported in the studies described here, similar to other work (e.g., Fisher et al., 2014).
2. Adjusted for inflation in the value of the U.S. dollar since 1996.

References

Banducci, S. A., Karp, J. A., Thrasher, M., & Rallings, C. (2008). Ballot photographs as cues in low-information elections. *Political Psychology*, *29*, 903–917.

Berggren, N., Jordahl, H., & Poutvaara, P. (2010). The looks of a winner: Beauty and electoral success. *Journal of Public Economics*, *94*, 8–15.

Central Intelligence Agency. (2007). *The world factbook*. Washington, DC: Government Printing Office.

Coetzee, V., Chen, J., Perrett, D. I., & Stephen, I. D. (2010). Deciphering faces: Quantifiable visual cues to weight. *Perception*, *39*, 51–61.

Coetzee, V., Faerber, S. J., Greeff, J. M., Lefevre, C. E., Re, D. E., & Perrett, D. I. (2012). African perceptions of female attractiveness. *PLoS One*, *7*, e48116.

Coetzee, V., Perrett, D. I., & Stephen, I. D. (2009). Facial adiposity: A cue to health? *Perception*, *38*, 1700–1711.

Coetzee, V., Re, D., Perrett, D. I., Tiddeman, B. P., & Xiao, D. (2011). Judging the health and attractiveness of female faces: Is the most attractive level of facial adiposity also considered the healthiest? *Body Image*, *8*, 190–193.

Crandall, C. S. (1994). Prejudice against fat people: Ideology and self-interest. *Journal of Personality and Social Psychology*, *66*, 882–894.

Currie, T. E., & Little, A. C. (2009). The relative importance of the face and body in judgments of human physical attractiveness. *Evolution and Human Behaviour*, *30*, 409–416.

Dion, K., Berscheid, E., & Walster, E. (1972). What is beautiful is good. *Journal of Personality and Social Psychology*, *24*, 285–290.

Donofrio, L. M. (2000). Fat distribution: A morphologic study of the aging face. *Dermatologic Surgery*, *26*, 1107–1112.

Eagly, A. H., Ashmore, R. D., Makhijani, M. G., & Longo, L. C. (1991). What is beautiful is good, but . . . : A meta-analytic review of research on the physical attractiveness stereotype. *Psychological Bulletin*, *110*, 109–128.

Ekman, G. (1959). Weber's law and related functions. *The Journal of Psychology*, *47*, 343–352.

Finkelstein, E. A., Fiebelkorn, I. C., & Wang, G. (2003). National medical spending attributable to overweight and obesity: How much, and who's paying? *Health Affairs*, *22*, W3–219–26.

Fisher, C. I., Fincher, C. L., Hahn, A. C., Little, A. C., DeBruine, L. M., & Jones, B. C. (2014). Do assortative preferences contribute to assortative mating for adiposity? *British Journal of Psychology*, *105*, 474–485.

Flegal, K. M., Carroll, M. D., Kit, B. K., & Ogden, C. L. (2012). Prevalence of obesity and trends in the distribution of Body Mass Index among US adults, 1999-2010. *Journal of the American Medical Association*, *307*, 491–497.

Garner, D. M., & Wooley, S. C. (1991). Confronting the failure of behavioral and dietary treatments for obesity. *Clinical Psychology Review*, *11*, 729–780.

Hönekopp, J. (2006). Once more: Is beauty in the eye of the beholder? Relative contributions of private and shared taste to judgments of facial attractiveness. *Journal of Experimental Psychology: Human Perception and Performance*, *32*, 199–209.

Jones, J. L., & Leary, M. R. (1994). Effects of appearance-based admonitions against sun exposure on tanning intentions in young adults. *Health Psychology*, *13*, 86–90.

Kalick, S. M., Zebrowitz, L. A., Langlois, J. H., & Johnson, R. M. (1998). Does human facial attractiveness honestly advertise health? Longitudinal data on an evolutionary question. *Psychological Science*, *9*, 8–13.

King, A., & Leigh, A. (2009). Beautiful politicians. *Kyklos*, *62*, 579–593.

Langlois, J. H., Kalakanis, L., Rubenstein, A. J., Larson, A., Hallam, M., & Smoot, M. (2000). Maxims or myths of beauty? A meta-analytic and theoretical review. *Psychological Bulletin*, *126*, 390–423.

Locke, E. A., Shaw, K. N., Saari, L. M., & Latham, G. P. (1981). Goal setting and task performance: 1969-1980. *Psychological Bulletin*, *90*, 125–152.

Mahler, H. I., Kulik, J. A., Gibbons, F. X., Gerrard, M., & Harrell, J. (2003). Effects of appearance-based intervention on sun protection intentions and self-reported behaviors. *Health Psychology*, *22*, 199–209.

Mann, T., Tomiyama, A. J., Westling, E., Lew, A. M., Samuels, B., & Chatman, J. (2007). Medicare's search for effective obesity treatments: Diets are not the answer. *The American Journal of Psychology*, *62*, 220–233.

Mobius, M. M., & Rosenblat, T. S. (2006). Why beauty matters. *American Economic Review*, *96*, 222–235.

Ode, J. J., Pivarnik, J. M., Reeves, M. J., & Knous, J. L. (2007). Body mass index as a predictor of percent fat in college athletes and non-athletes. *Medicine & Science in Sports & Exercise*, *39*, 403–409.

Ogden, C. L., & Carroll, M. D. (2010). Prevalence of overweight, obesity, and extreme obesity among adults: United States, trends 1960–1962 through 2007–2008. *National Center for Health Statistics*, *6*, 1–6.

Olshansky, S. J., Passaro, D. J., Hershow, R. C., Layden, J., Carnes, B. A., Brody, J., . . . Ludwig, D. S. (2005). A potential decline in life expectancy in the United States in the 21st century. *New England Journal of Medicine*, *352*, 1138–1145.

Oster, G., Thompson, D., Edelsberg, J., Bird, A. P., & Colditz, G. A. (1999). Lifetime health and economic benefits of weight loss among obese persons. *American Journal of Public Health*, *89*, 1536–1542.

Perrett, D. I. (2010). *In your face: The new science of human attraction*. London, England: Palgrave Macmillan.

Peters, M., Rhodes, G., & Simmons, L. W. (2007). Contributions of the face and body to overall attractiveness. *Animal Behaviour*, *73*, 937–942.

Rantala, M. J., Coetzee, V., Moore, F. R., Skrinda, I., Kecko, S., Krama, T., . . . Krams, I. (2013). Adiposity, compared with masculinity, serves as a more valid cue to immunocompetence in human mate choice. *Proceedings of the Royal Society B: Biological Sciences*, *280*, 1471–2954.

Re, D. E., Coetzee, V., Xiao, D., Buls, D., Tiddeman, B. P., Boothroyd, L. G., & Perrett, D. I. (2011). Viewing heavy bodies enhances preferences for facial adiposity. *Journal of Evolutionary Psychology*, *9*, 295–308.

Re, D. E., Dzhelyova, M., Holzleitner, I. J., Tigue, C. C., Feinberg, D. R., & Perrett, D. I. (2012). Apparent height and body mass index influence perceived leadership ability in three-dimensional faces. *Perception*, *41*, 1477–1485.

Re, D. E., & Perrett, D. I. (2014). The effects of facial adiposity on attractiveness and perceived leadership ability. *Quarterly Journal of Experimental Psychology*, *67*, 1–11.

Re, D. E., & Rule, N. O. (in press). Appearance and physiognomy. In D. Matsumoto, H. Hwang, & M. Frank (Eds.), *APA handbook of nonverbal communication*. Washington, DC: American Psychological Association.

Re, D. E., Whitehead, R. D., Xiao, D. K., & Perrett, D. I. (2011). Oxygenated-blood colour change thresholds for perceived facial redness, health, and attractiveness. *PLoS One*, *6*, e17859.

Reither, E. N., Hauser, R. M., & Swallen, K. C. (2009). Predicting adult health and mortality from adolescent facial characteristics in yearbook photographs. *Demography*, *46*, 27–41.

Rhodes, G., Zebrowitz, L. A., Clark, A., Kalick, S. M., Hightower, A., & McKay, R. (2001). Do facial averageness and symmetry signal health? *Evolution and Human Behavior*, *22*, 31–46.

Rowland, D. A., & Perrett, D. I. (1995). Manipulating facial appearance through shape and color. *Institute of Electrical and Electronics Engineers*, *15*, 70–76.

Shackelford, T. K., & Larsen, R. J. (1999). Facial attractiveness and physical health. *Evolution and Human Behavior*, *20*, 71–76.

Stewart, J. E. (1980). Defendant's attractiveness as a factor in the outcome of criminal trials: An observational study. *Journal of Applied Social Psychology*, *10*, 348–361.

Thornhill, R., & Gangestad, S. W. (1999). Facial attractiveness. *Trends in Cognitive Sciences*, *3*, 452–460.

Tiddeman, B., Burt, M., & Perrett, D. I. (2001). Prototyping and transforming facial textures for perception research. *Institute of Electrical and Electronics Engineers*, *21*, 42–50.

Tinlin, R. M., Watkins, C. D., Welling, L. L., DeBruine, L. M., Al-Dujaili, E. A., & Jones, B. C. (2013). Perceived facial adiposity conveys information about women's health. *British Journal of Psychology*, *104*, 235–248.

Toledano, E. (2013). The looking-glass ceiling: Appearance-based discrimination in the workplace. *Cardozo Journal of Law & Gender*, *19*, 683–714.

Tovée, M. J., & Cornelissen, P. L. (2001). Female and male perceptions of female physical attractiveness in front-view and profile. *The British Journal of Psychology*, *92*, 391–402.

Tovée, M. J., Swami, V., Furnham, A., & Mangalparsad, R. (2006). Changing perceptions of attractiveness as observers are exposed to a different culture. *Evolution and Human Behavior*, *27*, 443–456.

Whitehead, R. D., Re, D. E., Xiao, D., Ozakinci, G., & Perrett, D. I. (2012). You are what you eat: Within-subject increases in fruit and vegetable consumption confer beneficial skin-color changes. *PLoS One*, *7*, e32988.

World Health Organization. (2005). *The SuRF Report 2*. Surveillance of chronic disease Risk Factors: Country-level data and comparable estimates. Retrieved from: https://apps.who.int/infobase/Publicfiles/SuRF2.pdf.

World Health Organization. (2006). *BMI classification*. Global database on body mass index. Retrieved from http://apps.who.int/bmi/index.jsp?introPage=intro_3.html.

World Health Organization. (2015). *Obesity and overweight*. Retrieved from http://www.who.int/mediacentre/factsheets/fs311/en/.

Zebrowitz, L. A. (1997). *Reading faces: Window to the soul?* Boulder, CO: Westview Press.

Zebrowitz, L. A., & Collins, M. A. (1997). Accurate social perception at zero acquaintance: The affordances of a Gibsonian approach. *Personality and Social Psychology Review*, *1*, 204–223.

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