PREFERENCES FOR BODY MASS INDEX AND WAIST-TO-HIP RATIO DO NOT VARY WITH OBSERVER AGE

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Abstract. Several studies have suggested that mate selection strategies alter with age, but the mechanism of this shift in mate strategy is unclear. Two possibilities suggest themselves. The first is that attractiveness preferences themselves alter, compensating for the changing mate value of the observer. Alternatively, the preferences may remain constant with observer age, but an individual may compensate for changes in their own relative attractiveness by consciously targeting different regions of the “attractiveness spectrum” as their own mate value changes. To address this question, we asked 142 Caucasian subjects (aged 18–87 years) to rate 50 photographs of women varying in lower body shape (the waist-hip ratio, or WHR), and overall body mass (body mass index, or BMI). We found no effects of observer age on attractiveness preferences. This suggests that the criteria for attractiveness do not alter with changing observer age, and instead that it is the strategies employed using this information that may change.

Keywords: female physical attractiveness; Body Mass Index; Waist-Hip Ratio; observer age

INTRODUCTION

Several studies have suggested that mate selection strategies alter with age, and there are good reasons to suppose that different attractiveness preferences might be exhibited by observers of different age groups. For example, several studies based on lonely-hearts adverts have suggested that mate selection strategies alter with age (e.g. Waynforth and Dunbar 1995; Bereczkei et al. 1997; Buston and Emlen...
Both men and women grow physically less attractive, and so less desirable as a partner, as they grow older, although there may be sex differences in the magnitude of the aging effect (e.g. Kurzban and Weeden 2005). The change in the personal attractiveness of someone seeking a partner seems to impact on their mate selection strategies (e.g. Waynforth and Dunbar 1995; Bereczkei et al. 1997; Buston and Emlen 2003), although the mechanism of this shift in mate selection strategy is less clear. Two possibilities suggest themselves. The first is that attractiveness preferences alter. So, for example, an observer who is 25 years old might prefer a female body with a BMI of 20kg/m² and a WHR of 0.7, but an observer who is 45 years old might prefer a BMI of 25kg/m² and a WHR of 0.8. Alternatively, the preferences may remain constant with observer age, but an individual may compensate for changes in their own relative attractiveness by consciously targeting different regions of the “attractiveness spectrum” as their mate choice strategy changes.

To test the possibility that attractiveness preferences show an age-related change in a UK population we asked equal numbers of male and female observers, ranging in age from 18 to 87 years, to rate a set of photographs of women for attractiveness, and then determined whether these preferences change with observer age. These images systematically varied in two physical dimensions which are believed to predict human female physical attractiveness. These are lower body shape (measured as the ratio of the circumference of the waist to the circumference of the hips; WHR) and overall body mass, commonly measured using the body mass index, or BMI (kg/m²) (Bray 1998).

METHOD

In 2003, 142 participants were recruited (71 women and 71 men), ranging in age from 18 to 87 years (female mean age 42.2 years, s.d. 20.3; male mean age 42.8 years, s.d. 19.7). As the study relied on having the widest age range as possible, participants were recruited from a variety of sources. Younger participants consisted primarily of students from the University of Newcastle. Older subjects were recruited from residential homes in and around York and opportunistically by acquaintance. The remainder of subjects consisted of people recruited in Newcastle, York, and London city centres. All subjects were Caucasian.

Participants in each group were asked to rate digital photographs of 50 real women in front view. To generate the images, consenting women were photographed standing in a set pose at a standard distance, wearing tight grey leotards and leggings in front view. Images were then frame-grabbed and stored as 24-bit images (see Tovée et al. 2002, for an example). The heads of the women in the images were blurred so that they could not be identified, and also so that facial attractiveness would not be a factor in participants’ ratings. Although previous studies have manipulated the relative ranges of BMI and WHR to explore the relative con-
tributions of these features to attractiveness judgements (e.g., Tovée et al. 1999, 2002), in this study the ranges of BMI and WHR used were not constrained, and represented the widest range available in our image library. The ranges are consistent with population data reported by epidemiological studies, such as the Health Survey for England 2003 (UK Health Department, 2003).

For this experiment, the photographs of the women were printed on sheets of A4 paper, so that each image covered the entire page. The participants rated the photographs for attractiveness on a Likert scale (1 = Not at all physically attractive, 9 = Very physically attractive). Participant age and sex were recorded by the experimenters. All participants were tested individually. Within the image set, individual images were presented in a randomised order.

RESULTS

Sex Differences

To explore whether there were sex differences in our observer groups, we carried out a Spearman Rank correlation. We found high correlations between the male and female observers in each group, suggesting they were ranking the images in the same way (r = 0.979, p > 0.001). This result is consistent with the correlations between attractiveness ratings by male and female observers found in previous studies (e.g., Tovée and Cornélissen 2001; Tovée et al. 2002). We therefore pooled our male and female observer groups and then tested intra-class variation using Winer’s intra-class reliability for k means (Winer 1970). The value of 0.93 shows a very high degree of agreement between the individual observers’ ratings. This suggests that the reliability was very high and consistent across both sexes. This is consistent with previous studies which have shown similar high levels of intra-class reliability (e.g. Tovée et al. 2002; Swami and Tovée, 2005; Swami et al. 2006a,b).

Multiple Regression Results

A multiple polynomial regression was used to model the contributions of BMI and WHR to the attractiveness ratings. Figure 1 shows plots of the attractiveness ratings as a function of BMI (Figure 1a) and WHR (Figure 1b). In the case of the plot of attractiveness against BMI, we have fitted a 3rd-order polynomial to the data. We accept that there are limits in using a polynomial fit to this data, especially in respect to BMI values above 37. However, this represents the simplest way of capturing an inverted and skewed u-shaped data function, and we have no good, a priori reason for using a more complex equation, and it does prove a good fit to the data for BMIs between 10 and 35, where the vast majority of the data points fall.
Figure 1. a) The average attractiveness ratings made by all the observers for each image plotted against the BMI of the images. b) The relationship between the average attractiveness ratings made by all the observers for each image plotted against the WHR of the images.
As in previous studies (e.g. TOVÉE et al. 1998, 1999; TOVÉE and CORNELISSEN 2001), we modelled the data using a multiple regression model (see ALTMAN 1991), to estimate the variance of attractiveness ratings explained by BMI and WHR. The model was:

\[ y = a + b_1x_1 + b_2x_2 + b_3x_3 + b_4x_4 + e \]

where \( y \) is the attractiveness rating, \( a \) is the intercept, \( x_1 \) is the WHR, \( x_2 \) is the BMI, \( x_3 \) is the BMI\(^2\), \( x_4 \) is the BMI\(^3\) and \( e \) is random error.

When both variables are modelled (as above), BMI is able to explain 72% of the variance (\( p > 0.0001 \)) whereas WHR is not a significant explanatory variable. This is consistent with previous studies using this image set (e.g. TOVÉE et al. 1999; SWAMI et al. 2006; TOVÉE et al. 2006a, b).

Observer Age

To determine the statistical significance of possible age-related differences in preference for BMI, we first fitted a third-order polynomial to each attractiveness versus BMI function for each observer, allowing the BMI at peak attractiveness to be calculated for each participant. These peaks (the ideal BMI) are plotted against each observer’s age in Figure 2(a). There was no significant correlation between the ideal BMI and observer age (Pearson correlation \( r = –0.014, p > 0.05 \)). Although there is no difference in the position of the peaks, it is possible that there might be differences in the width of the attractiveness vs BMI function. The “tightness” of the tuning for attractiveness may decrease as the observer grows older, so that the attractiveness of images at higher and lower BMIs may rise relative to the most attractive BMI values in the centre of the range, reflecting the fact that as an observer’s own attractiveness declines their own selectivity or “choosiness” for the attractiveness of potential partners may also have to lessen. To test this hypothesis, we measured the width of the attractiveness function at half its height. There was no significant correlation of this width with observer age (\( r = 0.054, p > 0.05 \)), suggesting that the selectivity for BMI does not alter with age.

To determine whether there were significant differences in WHR preferences, we calculated the gradient for the attractiveness versus WHR function for each observer. These are plotted in Figure 2b as a function of observer age. There was no significant correlation between the slopes and age of the observer (\( r = –0.039, p > 0.05 \)).

To illustrate further potential differences in the pattern of attractiveness preferences with BMI and WHR, we split the observers into five groups based on age; group 1 are those observers below age 30 years, group 2 are those aged 30 to 45 years, group 3 are those aged 45 to 60 years, group 4 are aged 60 to 75 years, and group 5 are those aged over 75 years (see Table 1). The opportunistic nature of the observer sampling means that there are unequal numbers of observer in the five
Figure 2. a) The ideal BMI for each observer plotted against the observer’s age. b) The gradient of the attractiveness versus WHR function for each observer plotted against the observer’s age.

The BMI and WHR preferences for these five groups are shown in Figure 3. The ideal BMI values of the five groups were very similar and are not significantly different [one-way ANOVA, F(4, 137) = 1.014, p > 0.05]. The width of the attractiveness vs BMI function is also not significantly different between the different groups [one-way ANOVA, F(4, 137) = 0.581, p > 0.05], suggesting that the se-
Figure 3. A) The average attractiveness ratings made by group 1 (black squares and a black line), group 2 (red circles and a red line), group 3 (green stars and a green line), group 4 (blue inverted triangles and a blue line) and group 5 (orange diamonds and an orange line) for each image plotted against the BMI of the images. B) The average attractiveness ratings made by group 1 (black squares and a black line), group 2 (red circles and a red line), group 3 (green stars and a green line), group 4 (blue inverted triangles and a blue line) and group 5 (orange diamonds and an orange line) for each image plotted against the WHR of the images.
Table 1. Summary of results for the five “age” observer groups

<table>
<thead>
<tr>
<th>Age Groups</th>
<th>Age Range of Observers (years)</th>
<th>Mean Age of Observers (years)</th>
<th>Number of Observers</th>
<th>Mean Ideal BMI (Kg/m²)</th>
<th>Attractive-WHR Gradient</th>
</tr>
</thead>
<tbody>
<tr>
<td>Group 1</td>
<td>&lt;30</td>
<td>21.2 s.d. 2.2</td>
<td>39</td>
<td>20.5 s.d. 1.0</td>
<td>-8.6 s.d. 6.6</td>
</tr>
<tr>
<td>Group 2</td>
<td>30–45</td>
<td>38.0 s.d. 3.5</td>
<td>23</td>
<td>20.7 s.d. 1.7</td>
<td>-7.3 s.d. 5.9</td>
</tr>
<tr>
<td>Group 3</td>
<td>45–60</td>
<td>52.6 s.d. 3.6</td>
<td>46</td>
<td>21.0 s.d. 2.5</td>
<td>-6.2 s.d. 5.2</td>
</tr>
<tr>
<td>Group 4</td>
<td>60–75</td>
<td>66.2 s.d. 4.8</td>
<td>22</td>
<td>20.6 s.d. 1.3</td>
<td>-6.7 s.d. 5.0</td>
</tr>
<tr>
<td>Group 5</td>
<td>&gt;75</td>
<td>79.8 s.d. 4.0</td>
<td>12</td>
<td>20.0 s.d. 1.4</td>
<td>-12.4 s.d. 8.8</td>
</tr>
</tbody>
</table>

Selectivity for BMI does not differ between the five groups. The WHR gradients of the five groups were also very similar and are not significantly different [one-way ANOVA, F(4, 137) = 2.920, p > 0.05].

However, it is possible that there are more subtle differences, such as the accumulation of small personal preferences which could accrue over time and lead to increasing the degree of variability in observer ratings in the older observer groups. We, therefore, tested for increased variability with increasing age using Winer’s intra-class reliability for k means in the five age groups (Winer 1970). The degree of consistency in the ratings was high, but showed a trend towards decreasing with increasing observer age (see Table 1).

**DISCUSSION**

The results from this study suggest that, for UK observers, the optimal BMI for attractiveness is around 20 kg/m², and the optimal WHR for attractiveness seems to be around 0.7. This result is consistent with previous studies (e.g. Tovee et al. 1998, 2002). For women in Western Europe and the USA, the optimal fat distribution for fertility is proposed to correspond to a ratio of 0.7 (Zaadstra et al. 1993; Wass et al. 1997), and this is suggested to be the most attractive shape (Singh 1993, 1994; Henss 2000; Furnham et al. 2006). BMI also appears to be a strong predictor of attractiveness (Tovee et al. 1998, 1999, 2002; Thornhill and Grammer 1999; Puhl and Boland 2001; Fan et al. 2004; Smith et al. 2007a, b). There are also advantages to using BMI as a basis for mate selection as BMI provides a reliable cue to female health (Manson et al. 1995; Willet et al. 1995) and reproductive potential (Frisch 1988; Lake et al. 1997; Reid and van Vugt 1987;
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WANG et al. 2000). In Western countries, the balance between the optimal BMI for health and fertility is struck at around a value of 19–20 kg/m², which is also the preferred BMI for attractiveness (TOVÉE et al. 1998, 1999).

Although there are no gross differences in attractiveness preferences for BMI and WHR with age in our sample, it does appear that there are small changes in the variability of rating. These changes may have arisen through for two possible reasons. There may have been increased inaccuracy in performing the rating task with increasing age (especially in the two older groups). Alternatively, these differences may have arisen through the accumulation of small individual preferences, unique to a specific observer based on personal experience. However, these differences are comparatively small and the consistency of rating by observers in all five observer groups remains high.

As in previous studies, the results suggest no sex difference in the ranking of female images (e.g. TOVÉE and CORNELISSEN 2001; FURNHAM et al. 1997; HENSS 1995). Mate selection theory predicts that women will have a very precise and accurate idea of what men find attractive (e.g. BUSS 1992). This allows them to judge their own relative value, with respect to their peer group, and match this value with the value of a prospective mate. Thus, there should be no sex difference in the perception of either female or male beauty, as both sexes should use the same selection criteria for estimating attractiveness in a particular gender.

This study tested the hypothesis that attractiveness preferences will change with changes in observer age. Several studies suggest that attractiveness preferences are a flexible representation, and subject to change. For example, attractiveness preferences change when an observer moves from one environment to another, to take into account differences in the selective pressures found in these two sets of conditions (TOVÉE et al. 2006, 2007). So it is quite possible that an individual’s attractiveness preferences could change with their changing age to incorporate the individuals own altered mate value into their preferences, and thus direct an individual towards the potential partners that they have the best chance of success with.

However, the results show no apparent change in attractiveness judgements as the age of the observer alters. This suggests that the reported changes in mate selection strategy with increasing age are not based on changes in attractiveness preferences. Instead, there seems to be a similar representation of attractiveness across all the observers. It may be advantageous for the observer to have the same general criteria for physical attractiveness as observers of different ages and levels of attractiveness. Then, as the observer’s own mate value varies, he will be able to consciously compensate by targeting potential partners with the appropriate physical attractiveness level. Thus, they would target not what they regard as the most attractive potential partner, but instead the most attractive individuals that they would be likely to successfully court.

The existence of this shared set of attractiveness preferences across all the individuals within a society, irrespective of age, would be consistent with previous studies with observers of a more uniform age range. Although these observers were
all from the same narrow age range, they will have varied in their own attractiveness due to the natural variation in their own physical features, but intra-class correlations show they all rate the images in a very similar way despite this variability in observer attractiveness (e.g. TOVÉE et al. 2002; SMITH et al. 2007a). This also suggests that variation in observer attractiveness does not alter their perception of attractiveness in others, although a number of studies have suggested that differences in personal attractiveness lead to differences in mate strategy (e.g. WAYNFORTH and DUNBAR 1995; BERECKZIEI et al. 1997; BUSTON and EMLEN 2003). Instead, it is possible that based on a common criteria for attractiveness assessment, observers of different attractiveness levels will target potential partners of an appropriate attractiveness level to optimise the chances of a successful courtship.

In conclusion, our results suggest that the reported changes in mate strategy with changing age are not reflected in the attractiveness preferences of observers, and that there is a shared perception of attractiveness across the nearly seventy year age difference across our observers.

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REFERENCES


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