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Judging female figures: A new methodological approach to male attractiveness judgments of female waist-to-hip ratio

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Abstract

The procedure in previous research on attractiveness judgments of female waist-to-hip ratio (WHR) presumably supported an elaborate, effortful and deliberate decision process. In contrast, motivated by evolutionary psychological considerations about the psychological mechanism underlying attractiveness judgments of female WHR, the present study differed from previous research inasmuch as: (a) the participants were uninformed in advance about the various female figures; (b) the exposure time of the female figures was very brief; (c) trials were presented in rapid succession; (d) the participants were instructed to judge spontaneously; (e) forced-choice preference judgments and their underlying judgment times were registered. The results confirmed previous research that men prefer a normal weight figure with a .7 WHR. Additionally, judgments in favor of this figure were made most rapidly. Finally, attractiveness judgments and judgment times were found to be more closely related to those for health than for fecundity or pregnancy judgments.

Keywords: Waist-to-hip ratio; Attractiveness judgments; Evolutionary psychology; Evolved psychological mechanism

Male judgments of female physical attractiveness are influenced by a variety of morphological traits such as face (e.g., Buss, 2004; Hassebrauck, 1998), body weight (e.g., Singh, 1994a; Singh and Young, 1995), height (e.g., Pawlowski and Koziel, 2002), body mass index (e.g., Tovée and Cornelissen, 2001a,b), breasts (Singh, 1995) and waist-to-hip ratio (WHR).

The critical role of WHR for judgments of female attractiveness has been proposed by Singh (1993a). This proposal has inspired a considerable body of research (e.g., Furnham et al., 1997; Henss, 1995, 2000; Marlowe and Wetsman, 2001; Singh, 1993a,b, 1994a,b,c,d, 1995; Singh and Luis, 1995; Singh and Young, 1995; Streeter and McBurney, 2003; Tassinary and Hansen, 1998; Rozmus-Wrzesinska and Pawlowski, 2005; Wetsman and Marlowe, 1999). In these studies, a WHR near .7 was frequently found to be the most attractive in Western societies. This preference for a .7 WHR almost exclusively derives from a single experimental methodology: Participants were presented line drawings or photos of female figures varying in WHR and weight which had to be rank ordered or rated for attractiveness. Additionally, the participants typically could take their time to inspect and compare all stimuli simultaneously in making their judgments. Thus, the participants knew the entire set of stimuli and were aware of the differences between the female figures when making their judgments. Additionally, the exposure time of the stimuli was unrestricted and—as a consequence—presumably varied considerably between participants. Moreover, these studies counted on subjective evaluations (rank orders or ratings) as the sole dependent variable.

As a consequence of the reliance on a single methodology, the obtained empirical findings might be restricted to this methodology and might not emerge when alternative presentation modes and response formats are used. This possible limitation takes on even greater weight when one considers the possibility that this methodology might induce elaborate, effortful and deliberate decision strategies. However, in everyday life, attractiveness judgments are presumably—at least in the typical case—made rather rapidly and automatically. That is, the usual attractiveness

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judgments most likely rely on decision strategies that are quite dissimilar to the ones examined in the previous WHR studies.

These considerations about the nature of the processes involved in typical attractiveness judgments of female WHR derive from the assumption that the underlying psychological mechanism evolved in our ancestral past because it importantly contributed to successful mate selection. Considered an evolved psychological mechanism (e.g., Buss, 1995, 2004; McDougall, 1960; Cosmides and Tooby, 1994), it is assumed to be a domain-specific and content-dependent information-processing device that reliably detects and preferentially as well as rapidly processes relevant input. As a consequence, the evolved attractiveness judgment mechanism should be able to make reliable and rapid judgments even when the stimuli are presented only briefly and in the absence of prior information as to their range (for applications of this assumption on research on the jealousy mechanism, see Schützwohl, 2004, 2005; Schützwohl and Koch, 2004).

The present study links these assumptions to Singh's (1993a) original study and its successors. To achieve this linkage, the line drawing figures introduced by Singh (1993a) were also presented in the present study, thus making it directly comparable to the original study and a number of other studies using the same stimulus set. However, the presentation mode of the line drawing figures differed from its predecessors in several important aspects. These modifications were all motivated by an attempt to encourage the use of those decision strategies that were presumably used in the typical attractiveness judgments. First, the participants were not pre-informed about the various female figures whose attractiveness they had to judge. Second, the exposure time of the female figures was restricted to very short and was constant for all participants throughout the entire experiment. Third, trials were presented in rapid succession to prevent participants' reflecting on the differences between the figures. Fourth, in order to prevent the use of elaborate, effortful and deliberate decision strategies in the production of preference judgments, the participants were instructed to make their judgments spontaneously, that is, without extensive rumination. Finally, two instead of one dependent variables were obtained, namely a preference judgment and—unknown to the participants and thus outside their voluntary control—the time needed for this judgment which helped to serve in establishing the validity of the subjective preference judgment.

In sum, the first aim of the present study was to examine whether the preference for a .7 WHR can be confirmed with a new procedure that encourages decision processes which more closely resemble those processes presumably underlying typical attractiveness judgments of female WHR than those invoked by the original procedure. More specifically, two predictions which can be derived from the assumption that an evolved psychological mechanism underlies attractiveness judgments of female WHR were tested: first, men also prefer a female WHR of .7 as most attractive when the presentation mode of the female figure encourages rapid and automatic rather than elaborate and effortful decision strategies. Second, attractiveness judgments in favor of a female WHR of .7 are made most rapidly.

The second aim was to compare these attractiveness judgments, which by themselves are biologically irrelevant, with more biologically relevant judgments associated with WHR. WHR has been found to be associated with a variety of biologically relevant attributes (e.g., Singh, 1993a; Streeter and McBurney, 2003). For example, the WHR has been proposed as a reliable indicator of a woman's health, her fecundity and the likelihood of her being pregnant. The assumption is that a WHR of .7 signals good health, high fecundity and the absence of pregnancy. A comparison of the preference judgments for health status, fecundity and the likelihood of pregnancy and the pertinent judgment times with those for attractiveness might provide some immediate (i.e., without reference to some external criteria) insight whether attractiveness judgments assess one or more of these biologically relevant attributes.

1. Method

1.1. Participants

The participants were 105 male students of various disciplines at the Universities of Bielefeld and Osnabrück, Germany. Three participants were excluded from the data analyses because they failed to respond in a considerable number of trials. A fourth participant was excluded because he reported having problems in judging female attractiveness as a consequence of his homosexuality. Thus, the analyses of the results are based on 101 men. Their mean age was 24.9 years (S.D. = 6.6). The participants were informed that after the completion of the study, six of them would win € 25 each (about US$ 30) drawn by lot.

1.2. Apparatus

Stimuli were presented on a 19 in. monitor (Samsung Sync Master 959NF) connected to an IBM compatible Pentium computer. All stimuli presentation and data collection was controlled by Experimental Run Time System (ERTS; BeriSoft Corporation) software.

1.3. Stimuli

The stimuli were based on line drawings of female figures used by Singh (1993a). There were three levels of WHR (.5, .7 and .9) and three levels of body weight (underweight [90 lb], normal [129 lb] and overweight [150 lb]). The complete combination of the three levels of WHR and body weight resulted in nine pictures. The figures with a WHR of

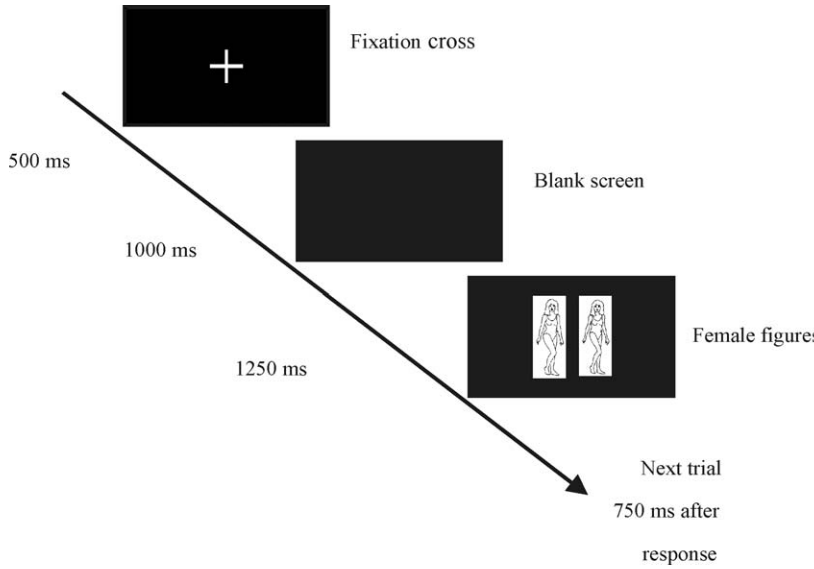

Fig. 1. The sequence of events in a given trial.

.5 which were not originally used by Singh (1993a) (but see Streeter and McBurney, 2003; Tassinary and Hansen, 1998) were generated by modifying the WHR .7 figures using the Jasc Paint Shop Pro drawing program. Within each of these body weight levels, all facial and bodily features were held constant except for WHR sizes. Within each level of body weight, WHRs were manipulated by varying the waist size while keeping the hip size constant.

In each trial, two figures were presented simultaneously side by side to the left and to the right of the center of the screen. Each figure was 14 cm high and 5.8 cm wide. The figures were presented as black line drawings within white 21.5 cm × 9.0 cm rectangles against a black background. The distance between the rectangles was 6 mm. Within each block of trials, 36 pairs of figures resulting from the complete pair-wise combination of the nine figures were presented in random order. An example of a trial along with the sequence of events is shown in Fig. 1.

1.4. Procedure

The participants were tested individually in a dimly lit laboratory room. They were seated approximately .6 m in front of the computer screen. The instructions informed the participants that they were required to provide various judgments of female figures. In each trial, two line drawings of female figures would be presented shortly side by side. They were asked to indicate their preference judgment by pressing the left or the right mouse key, respectively. Judgments should be made spontaneously, that is without extensive rumination. The four requested judgments were introduced as follows: "Which of the two women appears more attractive to you?"; "Which of the two women appears more healthy to you?"; "Which of the two women appears more fecund to you?"; "Which of the two women appears to you less likely as being pregnant?" Within a block of 36 trials, the requested judgment was always constant. The participants were not informed in advance about the kind of judgments to be made. Instead, each required judgment was introduced immediately before the respective block of trials. Within each block, the pairs of female figures were presented in random orders.

The participants started the experiment after the experimenter had left the room. Each trial started with the presentation of a fixation cross for 500 ms at the center of the screen, followed by a blank screen for 1000 ms. Thereafter, the two female figures were presented for 1250 ms. If the participant responded during the presentation of the female figures, the screen remained blank for 750 ms before the fixation cross announced the next trial. If the participant responded after the figures had already disappeared, the fixation cross appeared 750 ms after the response.

1.5. Design

The experiment consisted of a 3 (WHR: .5, .7 and .9) × 3 (weight: underweight, normal and overweight) × 4 (judgment: attractiveness, health, fecundity and pregnancy) design with repeated measures on each factor. The judgments were made block-wise in random orders.

2. Results

Due to an error in the computer program controlling the experiment, the combination of the normal weight .7 WHR figure with the underweight .9 WHR figure was not shown; instead, in each block, the participants saw the pair consisting of the normal weight .7 WHR and underweight .7 figure twice. The data of the second presentation of the same pair within each block were not considered in the following analyses. As a consequence, the results concerning the normal weight .7 WHR figure and the underweight .9 WHR figure are based on seven instead of eight pair-wise comparisons.

2.1. Preference judgments

For each figure, a preference score was calculated as the percentage with which it was selected in the pair-wise comparisons separately for each judgmental block, thus correcting for the unequal number of pair-wise comparisons mentioned above. The mean percentages a given figure was preferred for each of the four judgments are given in Table 1. Two-way analyses of variance (ANOVAs) of the preference judgments with weight (underweight, normal weight and overweight) and WHR (.5, .7 and .9) as repeated measures factors were conducted separately for the four judgment types. Sphericity problems were controlled by Greenhouse-Geisser corrections. These ANOVAs revealed highly significant main effects for weight and WHR as well as highly significant interactions between the two factors for attractiveness (weight: $F[1.5, 150] = 77.52$; WHR: $F[1.4, 141] = 30.38$; weight × WHR: $F[3.7, 368] = 92.38$), health (weight: $F[1.5, 154] = 78.40$; WHR: $F[1.5, 149] = 40.62$; weight × WHR: $F[3.5, 348] = 73.55$) and fecundity judgments (weight: $F[1.4, 137] = 59.09$; WHR: $F[1.6, 156] = 11.59$; weight × WHR: $F[3.2, 318] = 41.09$; all $p < .001$).

Post hoc tests for repeated measures were computed to reveal the significant differences responsible for the significant main and interaction effects. The main effect of the weight factor on attractiveness and health judgments is attributable to a similar pattern: normal weight women were significantly more frequently chosen as the more attractive and more healthy women than underweight and overweight women, $p < .001$ (see Table 1). However, whereas underweight women were more frequently judged as more attractive than overweight women, $p < .001$, overweight women were more frequently perceived as healthier than underweight women, $p < .05$.

A different pattern of results underlies the main effect of the weight factor on fecundity judgments (see Table 1): underweight women were perceived as less fecund than normal weight and overweight women, $p < .001$. Fecundity judgments for normal weight and overweight women did not significantly differ.

The main effect of the WHR factor on attractiveness, health and fecundity is mainly due to a highly significant preference for the .7 WHR as opposed to the .5 and .9 WHR, $p < .001$ (see Table 1). Additionally, the .9 WHR was conceived of as healthier than the .5 WHR, $p < .01$. In contrast, no significant differences were found between the .5 and .9 WHR with respect to attractiveness and fecundity judgments.

The significant interactions between weight and WHR reflect the following patterns for the attractiveness, health and fecundity judgments. Among the normal weight figures, the .7 WHR was perceived as highly significantly more attractive, healthy and fecund than the .5 and .9 WHR, $p \leq .001$. Among the underweight figures, in contrast, the .5 WHR was the least attractive, $p < .001$, with no significant differences between the .7 and .9 WHR (see Table 1). Finally, among the overweight figures, the .9 WHR was the least preferred with respect to attractiveness, health and fecundity judgments, $p < .001$. Moreover, the .5 WHR was judged as significantly more attractive and fecund than the .7 WHR, $p < .005$, and as marginally significantly more healthy, $p = .05$.

The two-way ANOVA for the pregnancy judgments revealed significant main effects for weight, $F(1.2, 118) = 61.72$, $p < .001$, and WHR, $F(1.6, 161) = 35.80$, $p < .001$. However, the interaction failed to be significant, $F(3.4, 347) = 2.07$, $p < .10$. The two significant main effects reflect that the likelihood of not being pregnant steadily increases with decreasing weight and WHR (see Table 1).

Table 1
Mean percentages a given figure was preferred for each of the four judgments as a function of weight and WHR

	More attractive	Healthier	More fecund	Less pregnant
Weight				
Underweight	51	39	33	67
Normal weight	65	67	57	51
Overweight	34	45	60	32
WHR				
.5	47	41	47	59
.7	61	61	57	50
.9	43	49	47	41
Underweight				
WHR .5	31	18	21	75
WHR .7	63	49	40	68
WHR .9	59	50	38	58
Normal weight				
WHR .5	62	52	49	63
WHR .7	81	84	67	50
WHR .9	54	65	56	40
Overweight				
WHR .5	49	54	71	40
WHR .7	38	50	63	32
WHR .9	17	31	45	25

2.2. Preference judgment times

Judgment times exceeding 10,000 ms were excluded from the following analyses. These long judgment times were very rare (.15%). Additionally, two-way ANOVAs of the judgment times with weight and WHR as factors turned out to be inadequate because a considerable number of participants never chose a given figure within a judgmental block for which accordingly no judgment times were available, thus reducing the available data in the analyses. To base the analyses on the largest possible sample, one-way ANOVAs were separately conducted for the three weight

Table 2
Mean judgment times (in milliseconds) and standard deviations (in parentheses) for the four judgments as a function of weight and WHR

	More attractive	Healthier	More fecund	Less pregnant
Underweight				
WHR .5	1624 (800)	1736 (1178)	1636 (769)	1398 (559)
WHR .7	1372 (498)	1473 (892)	1435 (547)	1555 (738)
WHR .9	1531 (812)	1546 (732)	1571 (717)	1553 (740)
Normal weight				
WHR .5	1482 (655)	1480 (556)	1491 (656)	1498 (714)
WHR .7	1293 (383)	1364 (466)	1363 (493)	1545 (717)
WHR .9	1433 (485)	1403 (497)	1424 (544)	1709 (737)
Overweight				
WHR .5	1509 (607)	1437 (506)	1504 (654)	1680 (686)
WHR .7	1531 (657)	1589 (723)	1416 (588)	1618 (762)
WHR .9	1572 (737)	1615 (777)	1572 (829)	1902 (1195)

groups with WHR as the within-subjects factor, which allows a testing of the hypothesis that within each weight group, judgments in favor of the .7 WHR are made most rapidly. The mean judgment times for the four judgments as a function of weight and WHR are shown in Table 2.

The ANOVAs for attractiveness judgment times yielded significant effects for the underweight and the normal weight figures, $F(1.7, 125) = 5.15$, $p < .01$, and $F(1.8, 182) = 12.62$, $p < .001$, respectively. As predicted, attractiveness judgment times were significantly shorter for the .7 WHR than the .5 or .9 WHR in the underweight group, $p < .05$, and in the normal weight group, $p < .001$. Judgment times for the .5 and .9 WHR figures did not significantly differ. In contrast, attractiveness judgment times in favor of overweight women were not differentially influenced by the WHR, $F < 1$ (see also Table 2).

The ANOVAs for health judgment times resulted in significant main effects of the WHR factor in each of the weight groups, $F > 3.85$, $p < .05$. In the normal weight group, judgments for the .5 WHR figures were made significantly slower than for the .7 WHR, $p < .001$, and the .9 WHR figure, $p < .05$. Similarly, in the underweight group, judgments for the .5 WHR were significantly slower than for the .7 WHR and marginally significantly slower than for the .9 WHR, $p < .10$. In contrast, health judgments in favor of the overweight .5 WHR figure were made significantly faster than for the .7 and .9 WHR figures, $p < .02$ (see also Table 2). There were no significant differences between the judgment times for 7. and .9 WHR figures in any of the weight groups.

The effect of the WHR on the judgment times for fecundity was significant for underweight and normal weight figures, $F > 3.50$, $p < .05$, and marginally significant for the overweight figures, $F(1.9, 167) = 3.01$, $p < .06$. A closer inspection of these effects showed that in each of the three weight groups, judgment times for .5 and .9 WHR figures did not significantly differ. Moreover, as can be seen from Table 2, in each weight group, judgment times for .7 WHR figures were significantly faster than for either .5 or .9 WHR figures, $p < .05$, with the exception of the marginally significant difference between the normal weight .7 and .9 figures, $p < .10$, and the insignificant difference between the .5 and .7 overweight figures.

Finally, judgment time differences were also obtained for each weight group with respect to the likelihood of being pregnant, $F > 4.20$, $p < .02$. For decisions with respect to underweight figures, those in favor of the .5 WHR figure were made significantly faster than those for either the .7 or the .9 WHR figure, $p \leq .001$. For normal weight and overweight figures, judgments for .5 and .7 WHR figures required similar times. However, decisions for the .9 WHR were the slowest in the normal weight group, $p \leq .005$, and the overweight group, $p \leq .06$.

Table 3
Correlations between the four judgments

	Less pregnant	More fecund	Healthier
More attractive	.38	.35	.82***
Healthier	−.20	.75**	
More fecund	−.64*		

* $p < .10$.
** $p < .05$.
*** $p < .01$.

2.3. Correlations between preference judgments and preference judgment times

Three types of correlations were computed which are given in Tables 3–5. Table 3 shows the correlations between the mean percentages the nine figures were chosen as the more attractive, healthy, fecund and the less likely pregnant. Attractiveness judgments for the nine figures were found to be highly correlated only with health judgments. Additionally, health and fecundity judgments were found to be positively correlated, whereas there was a marginally significant negative correlation between fecundity and pregnancy judgments indicating that with increased perceived fecundity, the likelihood of not being pregnant tends to decrease.

The mean judgment times for the figures' attractiveness, health and fecundity turned out to be highly correlated (see Table 4). In contrast, the judgment times with respect to the likelihood of not being pregnant obviously did not correspond with the other three judgment times. Finally, as can be seen from Table 5, for each judgment type, the correlations are highest with the pertinent judgment times.

Table 4
Correlations between judgment times

	Less pregnant	More fecund	Healthier
More attractive	.08	.85***	.85***
Healthier	−.14	.78**	
More fecund	−.06		

** $p = .01$.
*** $p < .005$.

Table 5
Correlations between judgments and judgment times

Judgments	Judgment times			
	More attractive	Healthier	More fecund	Less pregnant
More attractive	−.85***	−.79**	−.64*	−.44
Healthier	−.86***	−.92***	−.86***	.03
More fecund	−.48	−.72**	−.73**	.38
Less pregnant	−.07	.16	.26	−.88***

* $p < .10$.
** $p < .05$.
*** $p < .005$.

The highly negative correlations suggest that the more frequently a given figure was chosen, the shorter the time needed for the respective choice.

3. Discussion

Despite the drastic differences between Singh's (1993a) original study and the present study in the presentation mode of the stimuli and the response format, the results are strikingly similar. As in the Singh study, men overall preferred a female WHR of .7 with the normal weight .7 WHR figure being judged as the most attractive of all figures. Thus, the empirical support for Singh's hypothesis that judgments of female attractiveness are influenced by the WHR is robust and not restricted to the original methodology which presumably induces elaborate, effortful and deliberate information-processing strategies. Rather, the same results emerged from the new methodology introduced in the present study favoring less elaborate or 'quick and dirty' (LeDoux, 1996) decision processes which more closely resemble those processes presumably underlying attractiveness judgments of female WHR as they are typically made in everyday life.

Another important feature of the present findings pertains to the interaction between WHR and weight and its relevance for the contribution of the body mass index (BMI; e.g., Tovée and Cornelissen, 2001b) to attractiveness judgments. Whereas among the underweight figures, the WHR .5 figure was considered the least attractive, the same WHR was judged as the most attractive among the overweight figures. Thus, a small BMI was clearly preferred over a large BMI within the overweight group. In contrast, within the underweight group, a large BMI was clearly preferred over a small BMI. These findings suggest that BMI is not such a strong factor influencing attractiveness judgments as Tovée and co-workers (e.g., Tovée and Cornelissen, 2001b) claim.

Also in agreement with the prediction and expanding previous research, attractiveness judgments in favor of a female WHR of .7 were made most rapidly for underweight and normal weight figures with judgments for the latter being most rapid. Moreover, there was a very close correspondence between the preferences for the figures and the pertinent judgment times indicating that the more often a given figure was chosen,the shorter was the pertinent judgment time. This correspondence was true for each of the required judgments albeit it was somewhat less pronounced for fecundity judgments. A potential explanation for this correspondence might be that the less processing was required for the judgments the closer did the selected figure resemble the prototype for the respective judgment (e.g., Fehr et al., 1982; Rosch, 1973). From an evolutionary perspective, this prototype might combine the features that the attractiveness judgment mechanism has evolved to preferentially detect and process. Unfortunately, the present study does not allow determining whether the rapid decisions in favor of the normal weight .7 WHR figure (the potential prototype) are attributable to the detection of this figure or to the ensuing processes or to a combination of the two. Further studies are necessary which disentangle the different process stages that might contribute to the rapid decisions.

With respect to the relation between the four preference judgments and the underlying judgment times, preference judgments and the judgment times for attractiveness corresponded most closely to those for health suggesting that attractiveness judgments of female WHR most likely assess a woman's health status (Singh, 1993a). This finding contributes to the more general assumption that attractiveness of morphological traits is closely related to the individual health status. For example, asymmetrical faces are judged less attractive than symmetrical faces and deviations from symmetry are attributed to health impairments (e.g., Gangestad et al., 1994; Shackelford and Larson, 1997).

A shortcoming of the present study that points in the direction of future research arises from the figures used. First, by choosing .5, .7 and .9 WHRs, the figures differed obviously, thus facilitating the task. The reason for using the present figures was that short presentation times were mandatory in pursuing the aim of the study and more minute differences in WHR could have made the task extremely difficult, leading participants to 'give up' during the experiment. Nevertheless, it would be informative to replicate the experiment with more minute differences between the female figures, thus learning more about the sensitivity of the underlying mechanism. Second, to increase the ecological validity of the experiment, the use of pictures of real females instead of line drawings appears to be desirable. Third, based on the findings of Rozmus-Wrzesinska and Pawlowski (2005) who showed that men's judgments of female attractiveness are influenced more by changes in waist size compared to changes in hip size, it might be important to manipulate WHR by varying both hip and waist sizes (instead of varying only waist size as in the present study). This appears especially interesting because waist size is considered as more informative about a woman's health status, whereas hip size indicates pelvic size and fat storage (Rozmus-Wrzesinska and Pawlowski, 2005).

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References

Buss, D.M., 1995. Evolutionary psychology: a new paradigm for psychological science. Psychology Inquiry 6, 1–30.

Buss, D.M., 2004. Evolutionary Psychology: The New Science of the Mind, second ed. Allyn and Bacon, Boston.

Cosmides, L., Tooby, J., 1994. Origins of domain specificity: the evolution of functional organization. In: Hirschfeld, L.A., Gelman, S.A. (Eds.), Mapping the Mind: Domain Specificity in Cognition and Culture. Cambridge University Press, Cambridge, pp. 85–116.

Fehr, B., Russell, J.A., Ward, L.M., 1982. Prototypicality of emotions: a reaction time study. Bulletin of the Psychonomic Society 20, 253–254.

Furnham, A., Tan, T., McManus, C., 1997. WHR and preferences for body shape: a replication and extension. Personality and Individual Differences 22, 539–549.

Gangestad, S.W., Thornhill, R., Yeo, R.A., 1994. Facial attractiveness, developmental stability, and fluctuating asymmetry. Ethology and Sociobiology 15, 73–85.

Hassebrauck, M., 1998. The visual process method: a new method to study physical attractiveness. Evolution and Human Behavior 19, 111–123.

Henss, R., 1995. WHR and attractiveness. Replication and extension. Personality and Individual Differences 19, 479–498.

Henss, R., 2000. WHR and female attractiveness. Evidence from photographic stimuli and methodological considerations. Personality and Individual Differences 28, 501–513.

LeDoux, J., 1996. The Emotional Brain. Simon & Schuster, New York.

Marlowe, F., Wetsman, A., 2001. Preferred wait-to-hip ratio and ecology. Personality and Individual Differences 30, 481–489.

McDougall, W., 1960. An Introduction to Social Psychology, 31st ed. Methuen, London (original work published 1908).

Pawlowski, P., Koziel, S., 2002. The impact of traits offered in personal advertisements on response rates. Evolution and Human Behavior 23, 139–149.

Rosch, E., 1973. On the internal structure of perceptual and semantic categories. In: Moore, T.E. (Ed.), Cognitive Development and the Acquisition of Language. Academic Press, New York, pp. 111–144.

Rozmus-Wrzesinska, M., Pawlowski, B., 2005. Men's ratings of female attractiveness are influenced more by changes in female waist size compared with changes in hip size. Biological Psychology 68, 299–308.

Schützwohl, A., 2004. Which infidelity type makes you more jealous? Decision strategies in a forced-choice between sexual and emotional infidelity. Evolutionary Psychology 2, 121–128.

Schützwohl, A., 2005. Sex differences in jealousy: the processing of cues to infidelity. Evolution and Human Behavior 26, 288–299.

Schützwohl, A., Koch, S., 2004. Sex differences in jealousy: the recall of cues to sexual and emotional infidelity in personally more and less threatening context conditions. Evolution and Human Behavior 25, 249–257.

Shackelford, T.K., Larson, R.J., 1997. Facial symmetry as an indicator of psychological, emotional, and physiological distress. Journal of Personality and Social Psychology 72, 456–466.

Singh, D., 1993a. Adaptive significance of female physical attractiveness: role of waist-to-hip ratio. Journal of Personality and Social Psychology 65, 293–307.

Singh, D., 1993b. Body shape and women's attractiveness: the critical role of waist–hip ratio. Human Nature 4, 297–321.

Singh, D., 1994a. Is thin really beautiful and good? Relationship between WHR and female attractiveness. Personality and Individual Differences 16, 123–132.

Singh, D., 1994b. Ideal female body shape: role of body weight and WHR. International Journal of Eating Disorders 16, 283–288.

Singh, D., 1994c. WHR and judgments of attractiveness and healthiness by male and female physicians. International Journal of Obesity 18, 731–737.

Singh, D., 1994d. Body fat distribution and perception of desirable female body shape by young black men and women. International Journal of Eating Disorders 16, 289–294.

Singh, D., 1995. Female health, attractiveness and desirability for relationships: role of breast asymmetry and WHR. Ethology and Sociobiology 16, 465–481.

Singh, D., Luis, S., 1995. Ethnic and gender consensus for the effect of WHR on judgment of women's attractiveness. Human Nature 6, 51–65.

Singh, D., Young, R., 1995. Body weight, WHR, breasts and hips: role in judgments of female attractiveness and desirability for relationships. Ethology and Sociobiology 16, 483–507.

Streeter, S.A., McBurney, D.H., 2003. Waist–hip ration and attractiveness: new evidence and critique of "a critical test". Evolution and Human Behavior 24, 88–98.

Tassinary, L.G., Hansen, K.A., 1998. A critical test of the WHR hypothesis of female physical attractiveness. Psychological Science 9, 150–155.

Tovée, M.J., Cornelissen, P.L., 2001a. The mystery of female beauty. Nature 399, 215–216.

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

Wetsman, A., Marlowe, F., 1999. How universal are preferences for female waist-to-hip rations? Evidence from the Hadza of Tanzania. Evolution and Human Behavior 20, 219–228.