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Is beauty in the context-sensitive adaptations of the beholder? Shiwiar use of waist-to-hip ratio in assessments of female mate value

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Abstract

The proposition that universal standards of female beauty reflect adaptations for reproductive value assessment does not preclude cross-cultural variation that is contingent on local environmental variation. Cross-cultural tests of the hypothesis that men have adaptations generating preference for low female waist-to-hip ratios (WHR) have used stimuli that were not scaled to local conditions, and have confounded WHR with level of body fat. I present a reassessment of the WHR hypothesis, showing that when effects of WHR and body weight are less confounded, and local environmental context is taken into account, it appears that Shiwiar forager–horticulturist men of Ecuadorian Amazonia may use both WHR and body weight in assessments of female sexual attractiveness in a manner consistent with the prediction of a context-sensitive preference psychology.

Keywords: Beauty; Female mate value; Mate preference; Mate selection; Physical attractiveness; Shiwiar; Waist-to-hip ratio; Weight preference

1. Introduction

When analyzing female beauty standards, we must ask what cues were reliably associated with ancestral female mate value; what psychological mechanisms, if any, exist to assess

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them; what are the design, function, and effects of these mechanisms; what environmental information do they take as inputs; and how do changes in those inputs affect the mechanisms' behavioral outputs (Symons, 1995)? Information-processing adaptations often embody context-sensitive rules that generate different outputs in response to different conditions (Tooby & Cosmides, 1992). Thus, hypotheses regarding the design or function of human beauty criteria must delineate specific psychological properties (or their byproducts) that process local environmental cues to generate the range of cross-cultural similarities and differences in beauty standards that we find. From this perspective, I extend Singh's (1993a, 1993b) hypothesis that the mind instantiates a mate-assessment algorithm that uses one component of female morphology, the ratio of waist circumference to hip circumference (WHR), in assessments of female mate value, and test it among Shiwiar forager–horticulturalists of Ecuadorian Amazonia.

Possible cues to female mate value include body fat (e.g., Alley & Scully, 1994; Anderson, Crawford, Nadeau, & Lindberg, 1992; Brown & Konnor, 1987; Franzoi & Hertzog, 1987; Frisch & McArthur, 1974) and WHR (Singh, 1993a, 1993b). Fat provides a mate value cue because fertility, pregnancy, and lactation are supported by fat store accumulation stimulated by estrogen at puberty (Frisch, 1990). Fat reserves buffer effects of arduous work and negative protein-energy balance on female reproductive function (Bentley, Harrigan, & Ellison, 1998; Janienska & Ellison, 1998), as well as mortality risk and reproductive costs of health insults (e.g., Anderson et al., 1992; Brown & Konnor, 1987; Marlowe & Wetsman, 2001). Workload, resource availability, and health risks are ecologically variable, and psychological adaptations appear to adjust body fat preference to these and other relevant local cues. When presented with line drawings of female figures varying in volume (i.e., weight), subjects' estimations of figure weight vary cross-culturally. Body weight has large cross-culturally variable effects on attractiveness (e.g., Furnham & Alibhai, 1983; Furnham & Baguma, 1994; Marlowe & Wetsman, 2001; Tassinary & Hansen, 1998; Tovée & Cornelissen, 1999) with higher fat often preferred in subsistence-based societies with higher risk of food shortages (Anderson et al., 1992; Brown and & Konnor, 1987; Ford & Beach, 1951; Sobal & Stunkard, 1989).

Body fat distribution is patterned, however. Estrogen stimulates fat deposition on thighs, hips, and buttocks, inhibits it on the abdomen, and is linked to widening of the female pelvis (Ellison, 1990; Wood, 1994). Testosterone oppositely affects fat deposition, leading to postpubertal sex differences in WHR (Jones, Hunt, Brown, & Norgan, 1986; Singh, 1993a, 1993b). Western women with normal WHR (0.67–0.80) have reduced risk of primary infertility, cardiovascular disorders, and carcinoma, independent of body fat (Bjorntorp, 1988; Marti et al., 1991; Singh, 1993a, 1993b). Also, WHR increases with pregnancy, childbearing, and high intestinal parasite loads. Singh (1993a, 1993b) therefore argued that selection shaped men's mating psychology to prefer low female WHR regardless of body-fat preferences.

In studies using 12 stimulus figures varying in weight (under-, normal, or over-weight) and WHR (0.7, 0.8, 0.9, and 1.0), African American, Hispanic, White, and Indonesian males in the United States and Britain prefer lower WHR, normal-weight female figures. While figures with 0.7 WHR are usually judged most positively, in some studies WHRs of 0.6 and 0.8 are preferred (Furnham, Tan, & McManus, 1997; Henss, 1995; Singh, 1993a, 1993b, 1994a, 1994c; Singh & Luis, 1995). Idealized female WHR depicted in art varies across cultures, but is consistently lower than idealized male WHR (Singh & Haywood, 1999). Four variables affect the preferred WHR across studies: (1) the range of stimulus WHR used (Singh, 1994a; Tassinary & Hansen, 1998); (2) the population tested (Henss, 1995; Singh, 1993a, 1993b, 1994a, 1994b, 1994c, 1995; Singh & Luis, 1995; Singh & Young, 1995); (3) how figure rankings were calculated (Henss, 1995; Singh, 1993a, 1993b, 1994a); and (4) the qualities assessed and rating procedures (Henss, 1995). In sum, although body fat and WHR are positively correlated in real women (Singh, 1993a, 1994), they have separable effects on male preferences and preferred levels vary across societies.

Complex adaptations are usually expected to be species-typical (e.g., Tooby & Cosmides, 1992). Cross-cultural tests of Singh's WHR hypothesis are therefore critical. However, forager women have high fecundity, parasite loads, and caloric dependence on fibrous foods (e.g., Kelly, 1995); all increase WHR. These factors vary cross-culturally, so across ancestral populations: (1) normal female WHR was likely often higher than in Western populations; (2) what constituted locally "low" WHR varied; and (3) average WHR of nubile females and of females at peak fertility varied. Correlates of higher WHR usually indicate lower female mate value, but ability to digest quantities of fibrous food or periodic bonanzas of game, which increase WHR by altering stomach extension, would be advantageous in some ancestral environments. Moreover, the WHR values that are indicative of puberty, fertility, and hormonal irregularities may differ among populations, and environmental fluctuations could change the relationship between reproductive value cues and body morphology within lifetimes. Since assessment must often be calibrated to local parameters (e.g., body fat, skin tone, facial, and height preferences, Langlois & Roggman, 1990; Symons, 1995), I would expect WHR-preference mechanisms to assess the local distribution of female WHR in relation to other correlates of mate value, and to be recalibrated as conditions change.

A woman with low body fat (a cue of low mate value) may nevertheless have relatively low WHR (a potential cue of high mate value) due to her pelvic width, and one with higher body fat may have higher WHR (Marlowe & Wetsman, 2001; Sugiyama, 1996; Symons, 1995; Tovée & Cornelissen, 1999). Moreover, women with identical waist and hip dimensions who differ in height are not expected to evoke identical assessments of attractiveness. A well-designed mate-preference psychology ought to weight these components in assessments of attractiveness, or should at least be sensitive to the observed range of female WHR and body fat in relation to other aspects of bodily structure. Moreover, these assessments might ideally be mentally cross-correlated with assessments of other mate-value cues such as skin tone, activity level, breast development, hair luster, and bilateral symmetry (Symons, 1995) to compute the local WHR that provides the most reliable cue to sex, health, and reproductive status.

As multiple cues of female mate value are evaluated, those of the greatest local relevance should ideally be weighted more heavily, and one preference criterion may override others (e.g., Manning, Trivers, Singh, & Thornhill, 1999; Symons, 1995; Wetsman & Marlowe, 1999). As regards WHR, instead of expecting uniform cross-cultural preference for a specific value, we should anticipate only that values lower than the local average will be attractive, and that the influence of this factor relative to others will vary cross-culturally. These predictions may be intuitively less appealing than the idea of a universal preference for a certain value, but the problem of simultaneous information-processing tasks, the solution to each of which is codeterminate and necessary to come to final judgment, is one constantly faced by perceptual adaptations and routinely solved by the human mind (Pinker, 1997).

To date, studies of men in small-scale, isolated subsistence-economy populations indicate that they do not prefer low female WHR. Wetsman and Marlowe (1999) found that Hadza men preferred higher to lower weight figures, but expressed no preference between 0.9 and 0.7 WHR. Yu and Shepard (1998, 1999) presented Matsiguenka men with six female line drawings depicting two WHRs (0.7 and 0.9) and three body weights [overweight (O), normal (N), and underweight (U)], and reported that more isolated men ranked their attractiveness by weight (O.9, O.7, N.9, N.7, U.9, U.7), whereas more acculturated Matsiguenka ranked them by weight and then by WHR (O.7, O.9, N.7, N.9, U.7, U.9), even though Matsiguenka women have high WHR prior to first pregnancy, and are thin with low WHR after menopause.

Such results have been deemed evidence that preference for low WHR is an artifact of Western media exposure (Yu & Shepard, 1998), but this argument obscures the psychological design achieving this transformation, and begs the question of why Matsiguenka men prefer the shape of foreign to local women. These studies also contain several methodological oversights. Firstly, WHR was varied by changing waist width (Singh, 1993a), thus changing figure volume. When high weight/high WHR figures are preferred, one cannot tell if preference is for high body weight, high WHR, or both (Bronstad & Singh, 1999; Sugiyama, 1996; Symons, 1995; Tassinary & Hansen, 1998; Tovée & Cornelissen, 1999). Secondly, Matsiguenka women have higher WHR than Western women (Yu & Shepard, 1998), but the stimulus figures did not symmetrically bracket this range; indeed the "high" WHR figure presented matches the Shiwiar female *average* (Fig. 1), so interpreting 0.9 WHR as "high" is misleading, increasing the chance that high body weight preference will swamp WHR preference. Thirdly, acculturated Matsiguenka are exposed to a lower range of female WHR than unacculturated Matsiguenka, an exposure linked with other cues of high female mate value (Yu & Shepard, 1998). Fourthly, acculturation includes changes in famine risk, diet, age at marriage, and female work patterns expected to cause mate-assessment mechanisms to recalibrate the importance of body fat in judgments of attractiveness (Anderson et al., 1992; Marlowe & Wetsman, 2001; Sugiyama, 1996). Body fat has stronger independent impacts on attractiveness ratings than WHR (Furnham et al., 1997; Henss, 1995; Singh, 1993a, 1994a, 1994c; Singh & Luis, 1995), so decreasing high body fat preference may allow increased expression of low WHR preference.

The Matsiguenka and Hadza studies document WHR preference variation which may be explicable by the context-sensitive WHR-assessment hypothesis outlined above: (1) acculturated Matsiguenka are exposed to a lower female WHR range than less acculturated Matsiguenka, and predictably prefer lower WHR (Yu & Shepard, 1998); and (2) Hadza men prefer higher weight, and this may take precedence over WHR preference (Wetsman &

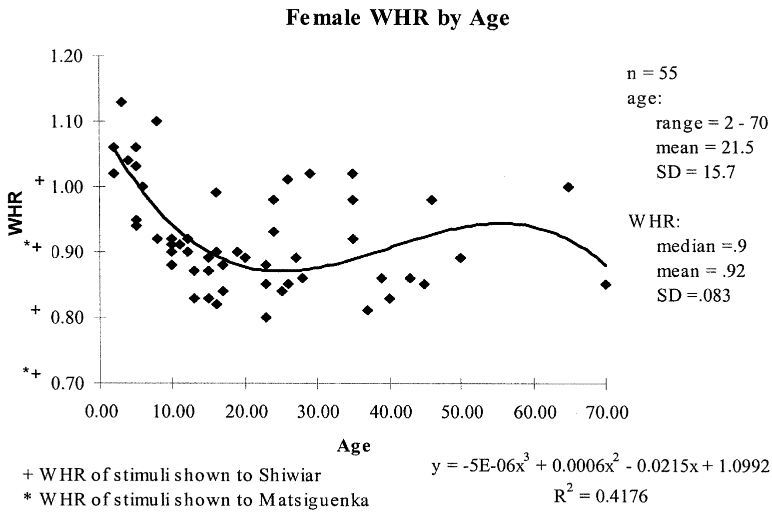

Fig. 1. Shiwiar female WHR by age.

Marlowe, 1999). Thus, the following question remains open. When the local context of WHR is taken into account, and differences in body weight among stimulus figures are modified to reduce the confound between WHR and body weight, do males from non-Western, subsistence-based societies show evidence of a context-sensitive WHR-preference psychology as outlined above?

2. The local distribution of Shiwiar WHR

In 1994–1995, I tested for male use of WHR in attractiveness judgments among the Shiwiar of the Ecuadorian Upper Amazon in the context of local WHR and body fat distribution. Shiwiar in the study villages rarely have direct day-to-day contact with outsiders and depend on foraging and swidden horticulture for their livelihood (Sugiyama, 2003; Sugiyama, Tooby, & Cosmides, 2002). Consanguinial and affinal ties dominate social relationships mediated by cooperation, discussion, gossip, witchcraft, and the threat or use of force. Locally endogamous cross-cousin marriage is the norm. Preference for high female weight/fat (at least within the local range) is routinely expressed, and explicitly linked to health and fertility.

I measured waist and hip circumference of 100 consenting Shiwiar (56 females and 44 males) aged one to 70. Participants were asked to stand erect with abdomen relaxed, heels about 10 cm apart, and weight evenly distributed between both feet. Measurements were taken to the nearest 0.2 cm, with a standard tape measure held in a horizontal plane. Waist measurements were taken at the natural waist—usually the smallest circumference. When the natural waist was not visible, the waist was measured midway between the lower costal margin and the umbilicus. In waist measurements the tape measure was pulled just tight enough to maintain skin contact. Hip circumference was measured at the maximum extension of the buttocks seen from the lateral view. Most hip measurements were taken over very thin clothing. When necessary, hip measurements were adjusted to compensate for clothing by measuring fabric at the pants seam with calipers, and subtracting this from the overall measurement.

Fig. 1 shows WHR as a function of age for 56 female Shiwiar: WHR is high in early childhood and drops until approximately 12 years of age, when gynoid fat deposition appears. As predicted, WHR of Shiwiar females 12 and over ($n=38$, $M=0.89$, S.D. = 0.06, range = 0.81–1.02) is higher than the 0.68–0.80 range reported for normal women in industrialized societies (Lanska et al., 1985; Marti et al., 1991); no one had a WHR below 0.8. Pregnant women were self-identified during the study and cross-checked with updated birth records in a subsequent field season: removing five women known or reported pregnant during the study, as well as one woman who may be infertile, leaves mean adult female WHR of 0.87. (Removing these individuals from consideration is problematic, however, because it removes variation that WHR-preference psychology is allegedly designed to assess, and assumes that the mechanism "knows" a priori what it is supposedly designed to answer, namely which locally observable individuals are nonpregnant fertile females.)

WHR of male Shiwiar 12 and over ($n=23$, $M=0.932$, S.D. = 0.04, range = 0.89–1.03) is similar to that of healthy Western males (Jones et al., 1986; Singh, 1993a). Shiwiar females 12 years of age and over have significantly lower WHR than comparable males ($n=62$, Kruskal–Wallis $X^2=7.95$, $P=.0048$) and significantly lower WHR than females 11 and under ($n=57$, $X^2=12.69$, $P=.0004$). No sex difference in WHR exists among children under 12 ($n=39$, $X^2=0.00$). Although Shiwiar women have higher average WHR than Western women, the relationships between WHR, puberty onset, and sex accord with those predicted by the WHR hypothesis. In this population, however, the critical WHR for making these distinctions is approximately 0.9.

3. Male evaluation of female figures: test 1

I told 18 consenting Shiwiar males (ages 16 to 60) that I was interested in what people could tell about a woman from her body shape, then showed them a page with Singh's 12 standard female figures varying in 3 weights (low, normal, and high) and 4 WHRs (0.7, 0.8, 0.9, 1.0) arranged in mixed order, and asked them to choose the most, then the second most, the least, and finally the second least attractive figure. This was repeated for health, sexual desirability, fertility ($n=10$ informants), youthfulness ($n=10$), quality as mother, and quality as wife ($n=12$). Because responses on the multiple dependent measures are expected to be associated and sample size is small, I report only on questions for which either 18 or 12 subjects provided responses.

Chance performance would dictate that each of the three body weight levels would be given each rank (most, 2nd most, least, and 2nd least) on each quality an equal number of times, namely 6 and 4 times, by 18 and 12 subjects, respectively. SPSS software was used to conduct chi-squared tests between expected and observed frequency of choices, and

Step-down Bonferroni correction used to determine appropriate significance levels given multiple tests (Hotchberg, 1988). SPSS excludes empty cells, so expected frequencies were based only on cells with one or more observations (yielding more conservative results). For four rankings no statistical analysis was necessary. Consistent with predictions, only high weight figures were chosen as most healthy, second most sexy, and second best wife, while only low weight figures were chosen least healthy (Table 1). Chi-square tests show that overweight figures were chosen most attractive ($\chi^2 = 10.89$, $df = 1$, $P = .001$), sexually attractive ($\chi^2 = 14.22$, $df = 1$, $P = .000$), best wife ($\chi^2 = 8.33$, $df = 1$, $P = .006$) and mother ($\chi^2 = 8$, $df = 1$, $P = .008$), as well as second most attractive ($\chi^2 = 16$, $df = 1$, $P = .000$), and second best mother ($\chi^2 = 20.33$, $df = 2$, $P = .000$) significantly more often than expected by chance. Conversely, underweight figures were chosen least attractive ($\chi^2 = 16$, $df = 2$, $P = .000$) and worst mother ($\chi^2 = 12.33$, $df = 2$, $P = .003$), as well as second least attractive ($\chi^2 = 13$, $df = 2$, $P = .001$), second least sexually appealing ($\chi^2 = 16.33$, $df = 2$, $P = .000$), and second least preferable as wife ($\chi^2 = 13.5$, $df = 2$, $P = .002$) significantly more often than expected. In sum, 14 of the 20 rankings on four different qualities indicate preference for high over low weight figures.

Table 1
Number of subjects choosing each figure in the 12 figure array (empty cells indicate that no subject chose the figure)

		Figure weight and WHR											
		Under				Normal				Over			
Quality assessed		0.7	0.8	0.9	1	0.7	0.8	0.9	1	0.7	0.8	0.9	1
Attractive	Most					2				3	4	3	6
	2nd most	1		1			1	1		5	3	3	3
	2nd Least	3	3	5	2		1	1	2				1
	Least	1	7		6	1			1			1	1
Healthy	Most									3	7	4	4
	2nd Most					1	2			4	1	3	6
	2nd Least	1	2	5	6		1	1	3				
	Least	1	6	4	7								
Mother	Best					1		1	1	3	5	6	1
	2nd Best	1						2		6	3		6
	2nd Worst	1	4	2	3	1	2	2		1		1	1
	Worst		4	4	5		3				1	1	
Sexy	Most						1			5	6	3	3
	2nd Most									8	3	2	5
	2nd Least	1	4	6	3	1	1	1					1
	Least	3	1	3	6	1	1	2	1				
Wife	Best									2	2	2	5
	2nd Best									3	3	3	3
	2nd Worst	1	1	2	6		1						
	Worst		2	3	2	1	1	1	1				

Stimulus figures exhibited four WHR levels, so for each quality assessed, each ranking (most, second most, least, and second least attractive) is expected to be chosen 4.5 of 18 or 3 of 12 times. Observed data seldom departed from expected: only least attractive ($\chi^2=8.22$, $df=3$, $P=.042$) and second least healthy ($\chi^2=7.78$, $df=3$, $P=.051$) exhibited marginally significant differences between observed and expected frequencies (with high WHR figures judged inferior in both cases) and Step-down Bonferroni correction indicated that the null hypothesis cannot be rejected at the .05 level for the study as a whole. Thus, contrary to the simplest WHR hypothesis, there were no demonstrable effects of WHR on the assessments.

4. Male evaluation of female figures: test 2

In the above test, men exhibited a strong preference for heavier women, and little or no response to WHR. To test whether high-body-fat preference was overriding influences of WHR in the first task, and whether preferences are calibrated to local WHR, I presented stimulus figures separately by weight group: 10 Shiwiar men were each presented with four female figures depicting WHRs of 0.7, 0.8, 0.9, and 1.0, and asked to identify the most and least attractive. I did this separately for low, normal, and overweight figure sets. For analysis, ratings were collapsed across weight classes yielding 30 sets of judgments for each quality assessed (Table 2). WHR was classified as low (0.7 and 0.8) or medium–high (0.9 and 1.0) based on the Shiwiar female average. Fisher's Exact Test of proportions, using Bonferroni Stepwise Correction with an adjusted .05 cutoff level, shows that low-WHR figures were now rated significantly above high-WHR figures on sexually desirable ($n=30$, FI$=3.244$,

Table 2
Choice frequency for low vs. high WHR figures when choosing within body weight category

Quality assessed		Frequency chosen WHR: Low	High
Attractive	Most	18	12
	Least	13	17
Healthy	Most	23	7
	Least	10	20
Mother	Best	21	9
	Worst	9	21
Sexually desirable	Most	20	10
	Least	13	17
Wife	Best	21	9
	Worst	9	21
Fertile	Most	21	9
	Least	10	20
Youthful	Most	20	9
	Least	8	21

$P=.04$), fertile ($n=30$, FI = 8.01, $P=.004$), healthy ($n=30$, FI = 11.39, $P=.001$), youthful ($n=30$, FI = 11.28, $P=.001$), and best mother ($n=30$, FI = 9.559, $P=.002$).

5. Discussion

Although small sample size means further tests are required to determine the reliability of these findings, results suggest that Shiwiar males may use female WHR as well as body weight in a way consistent with the hypothesis that males have evaluative mechanisms for both WHR and body weight, and that WHR assessment is sensitively calibrated to local parameters. Shiwiar prefer higher-body-fat females within locally observed levels; thus, if WHR and body fat were not independently assessed, Shiwiar men would prefer high-WHR figures because they appear to weigh most among the high-weight figures. However, Shiwiar men exhibit preference for lower-than-locally-average female WHR when differences in body weight are minimized.

However, the stimuli did not completely unconfound body weight and WHR, nor did they symmetrically bracket the female Shiwiar WHR range. A fairer test would compare 0.7, 0.8, and 0.9 WHRs with WHRs of 1.0, 1.1, and 1.2, but the actual Shiwiar WHR distribution was not known when the stimuli for testing preferences were developed. These problems also affect Marlowe and Wetsman's (2001) follow-up to their Hadza study. Presented with seven high-weight figures with waist width manipulated to achieve WHRs of 0.4–1.0, Hadza men ranked figures with 0.8, 0.9, and 1.0 WHR more attractive, healthy, and desirable as wife than 0.7 WHR or lower, but it is unclear whether this WHR range symmetrically brackets the Hadza female range or if pairwise differences between 0.7 and higher WHRs are statistically significant, so the results are hard to interpret. They could mean that high WHR within this range is preferred, that no preference for lower local WHR exists, or that small apparent differences in body weight are given more import than differences in WHR. Shiwiar results would have been similarly impossible to interpret had no preference for lower WHR been found.

Stimuli for future cross-cultural tests for WHR-assessment psychology must symmetrically bracket the local range of female WHR. When high body weight is preferred, a wide range of WHR and body fat should be included in the stimulus figures presented, with choices limited to figure sets that vary little in body fat. Because widening the waist simultaneously increases figure volume and WHR, while narrowing the hips decreases figure volume and increases WHR, effects of body weight and WHR may be more clearly evaluated by independently using both manipulations. Finally, other visible cues to age, reproductive status, or sex (e.g., breasts) should be eliminated from stimulus figures because they provide independent cues of mate value that may potentially be confounded with weight or WHR; showing only the mid and lower body and/or showing figures from behind are possible solutions to this problem.

The argument that cultural diffusion explains Matsiguenka WHR preferences or a convergence of experimental results between Shiwiar and Western subjects raises the question of why one evaluation (the effect of WHR on attractiveness) responds to Western influence while another (the effect of body weight) does not. Media exposure and other agents of acculturation may have psychological effects, but explanation of these effects demands specification of (1) the relevant information to which subjects are exposed, (2) the psychological features which process each component of this information, (3) the output of this psychological processing, and (4) the way in which these outputs affect subject preferences or behavior. Effects of acculturation and other environmental inputs on perceptions and behavior are mental phenomena to be explained, rather than explanations in and of themselves.

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