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ORIGINAL PAPER

The Interacting Effects of Height and Shoulder-to-Hip Ratio on Perceptions of Attractiveness, Masculinity, and Fighting Ability: Experimental Design and Ecological Validity Considerations

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Abstract
Previous research has shown that men's height and upper body size are both associated with the perception of attractiveness, because they might be cues to men's genetic fitness, fighting ability, and resource holding power. However, the combined effects of men's height and upper body size have not been explored. In this research, across four studies ($N = 659$ heterosexual women), we systematically explored the perception of men's muscular upper body at different heights on perceptions of attractiveness, masculinity, and fighting ability. Women rated male stimuli with heights ranging from 160 cm (5′3″) to 190 cm (6′3″) and three values of shoulder-to-hip ratio (SHR). In general, results showed that women considered taller men and men with larger SHR as more attractive, masculine, and better in fighting ability. However, a robust interaction between height and SHR was dependent on participants being exposed to variation on both variables and the ecological validity of the stimuli (silhouettes vs. more realistic rendered figures).

Keywords Height · Shoulder-to-Hip Ratio · Physical attractiveness · Masculinity · Fighting ability

Introduction

Under sexual selection pressure, males and females have evolved to display sexual dimorphism in secondary sexual characteristics (Darwin, 1871). Such characteristics can act as the primary cues in the perception and evaluation of physical attractiveness in humans (Barber, 1995; Rhodes et al., 2005). For instance, men's facial morphology in the form of facial width-to-height ratio (Geniole et al., 2015) and facial masculinity and beardedness (Clarkson et al., 2020; Mefodeva et al., 2020) have been shown to play a role in women's assessments of men's attractiveness. Some of the most conspicuous sexually dimorphic traits in humans are men's larger upper bodies and taller heights (Puts, 2010), which are associated with fighting ability, competitiveness, and resource holding ability (Barber, 1995; Puts, 2010; Symons, 1995), and may be linked to health and genetic quality (Krams et al., 2014; Leongoméz et al., 2020; Skrinda et al., 2014, but see Pawłowski et al., 2017). Female preferences for these male traits may have evolved because the traits were associated with genes that increase health, including immunocompetence, as well as success in contest competition. Accordingly, women tend to be attracted to such dimorphic bodily characteristics in men (Symons, 1995) that are associated with mating success (Rhodes et al., 2005). Research has shown that women prefer dominant and masculine men and traits associated with these variables, perhaps because such characteristics may indicate genetic quality and health (Puts, 2016).

Men's height may be a signal of biological quality (Pawłowski et al., 2017), because it is associated with increased fitness, health, and attractiveness. It has been suggested that women find tall men attractive because height can be both directly related to fitness suggesting increased resource potential and indirectly by providing good genes (Mueller & Mazur, 2001). Nonetheless, how height is associated with other physical features associated with fitness, such as upper body strength, has not been explored. One indicator of upper body strength is men's shoulder-to-hip ratio (SHR). Research has shown that men's SHR is associated with attractiveness perhaps because it is a conspicuous physical feature

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that may indicate good genes (Braun & Bryan, 2006). In the current study, we investigate whether men's height and SHR influence women's ratings of attractiveness, masculinity, and formidability.

Height

Research has demonstrated that height in men is associated with reproductive success (Mueller & Mazur, 2001; Nettle, 2002). Taller men are more successful in acquiring long-term partners than shorter men (Nettle, 2002), consistent with attractiveness ratings by women (Berscheid & Walster, 1974; Bogaert et al., 2009; Buss, 1994; Feingold, 1982; Nettle, 2002; Sell et al., 2017). Taller men have a higher reproductive output than shorter men, and this may be due to shorter men being disadvantaged in searching for a mate (Pawlowski et al., 2000). However, one study found that shorter men were more likely to have more sexual intercourse compared to taller men (Rurik et al., 2014). In a study investigating height and reproductive success in a group of military academy graduates, taller men had more children due to their ability to better attract mates independent of social status (Mueller & Mazur, 2001).

Upper Body Size

Another indicator of male physical attractiveness is quantified through the ratio of the circumference of their shoulders relative to that of the hips, known as the shoulder-to-hip ratio (SHR). This sexually dimorphic trait is associated with attractiveness ratings of men, as both men and women find men with greater chest muscularity and slimmer waist and hips more attractive (Braun & Bryan, 2006; Furnham & Nordling, 1998; Garza & Byrd-Craven, 2019; Garza et al., 2017; Horvath, 1981; Pazhoohi et al., 2019a; Sell et al., 2017; Tovée et al., 1999). Muscularity may be an honest indicator of immunocompetence, as muscularity is androgen dependent, and healthy males are hypothesized to disproportionately be capable of withstanding immunosuppressant effects of androgens (Folstad & Karter, 1992). Indeed, such preference for masculine men is reported by women across different cultures (e.g., Dixson et al., 2007a, 2007b, 2010; Mautz et al., 2013). Women prefer these features seemingly because they are associated with good genes, masculinity, and immunocompetence, and women may find them attractive due to their indirect (i.e., high quality genes) and direct benefits (i.e., resources acquisition) (Dixson et al., 2014; Gallup & Frederick, 2010).

Current Study

Perceptions of attractiveness are not only multimodal, including visual, auditory, and olfactory (Groyecka et al., 2017), but also multivariate (Brooks et al., 2015; Prokop & Drobniak, 2016), meaning that for mate selection individuals rely on multiple physical characteristics (Brooks et al., 2010; Fan et al., 2004, 2005; Mautz et al., 2013; Prokop & Drobniak, 2016). Previous research has investigated the effect of female body shape and size in multivariate combinations (e.g., Brooks et al., 2015; Donohoe et al., 2009; Pazhoohi et al., 2020). Although this research has tested women to examine the effects of men's upper body size or SHR (e.g., Braun & Bryan, 2006; Pazhoohi et al., 2019a) and height (e.g., Nettle, 2002; Pawlowski et al., 2000) on the perception of attractiveness, to the best of our knowledge, no previous study has tested how men's height and SHR combine to impact perceptions of attractiveness. Specifically, no research has explored the perception of muscular upper bodies at different heights. It may be predicted that taller men with large SHRs may be considered more attractive because large SHR connote indirect benefits (i.e., high-quality genes) or direct benefits in the form of protection. However, physical characteristics indicative of masculinity and dominance can also be perceived to be threatening and may present a cost in long-term partnerships to women (Borras-Guevara et al., 2019).

One study (Sell et al., 2017) alluded to the role of height, weight, and strength on women's ratings of men's attractiveness. Women found taller men more attractive, but interactions between men's height and strength were not tested. Whereas manipulating one physical characteristic at a time is experimentally simpler and isolates the variable of interest, it leaves unanswered how height and musculature might interact to inform attractiveness judgements. For instance, men's upper body size and height are among the characteristics that are known to be developmentally correlated (Fink et al., 2007), and they might be subjected to correlational selection (Hill et al., 2013). Thus, the present study examined height and SHR in isolation and their interaction on perceptions of attractiveness, masculinity, and fighting ability.

To achieve this aim, male stimuli with heights ranging from 160 cm (5′3″) to 190 cm (6′3″), and three degrees of SHR (small, intermediate, and large) were created. Heterosexual female participants were asked to rate the variables of interest (attractiveness, masculinity, and fighting ability) as a function of male variations in height and SHR. Before conducting the study we hypothesized that women would rate taller men, and those with higher SHR, as more attractive, masculine, and higher in fighting ability. The key question, however, was if, and how, these two factors would interact. For example, would the impact of a high SHR be the same on a short man as a tall man, or would its effect decline (or increase?) as men became shorter? Although the nature of this research is exploratory, we predict that when combined together, taller men with higher SHR would be considered more attractive by women. Accordingly, we predict that increase in SHR (single trait) does not improve attractiveness

ratings of shorter men, as much as it would increase attractiveness ratings of taller men (both traits).

Study 1

In Study 1, we created black and white silhouettes of a male and female. To conceal that the relationship of SHR to height was our research question, we manipulated SHR between groups of participants, and height within participants.

Method

Participants

A total of 196 female participants were recruited from Amazon Mechanical Turk workers located in the USA and after exclusion of those individuals who reported their sexual orientation as non-heterosexual our final sample consisted of 150 self-identified heterosexual women aged between 18 and 79 years ($M = 39.37$, $SD = 14.72$). A total of 64 participants (42.7%) reported being married, 2.7% reported widowed and an additional 14.7% reported being divorced or separated, while 23.2% reported being single, and 16.7% in a relationship. In terms of their highest academic degree, 42.0% had a high school diploma, 16.0% had a post-secondary diploma, 30.7% of the participants had an undergraduate degree, and 11.3% had a post-graduate degree (MA or PhD).

Stimuli

Three male 3D models were created by Daz3D (http://www.daz3d.com) each differing in SHR, creating low (1.1), intermediate (1.2), and high (1.3) SHR variations. Each of the models was located in front of a height chart scaling from 100 to 190 cm, beside a female model with a height of 172 cm as an anchor. Each of the three male models had seven heights from 160 to 190 cm, incrementing in 5 cm, resulting in 21 male stimuli (see Fig. 2 for an example). To control for color of the silhouettes another set of white silhouettes of the stimuli were generated and also used as stimuli (see Fig. 1 for an example). The average height of human males across different countries in the world range from 160 cm to over 180 cm (Perkins et al., 2016; Roser et al., 2013), and the average height of men in the USA (the country that participants were sampled from) is 5′9″ (175.3 cm) (Fryar et al., 2021). We based our range of male avatars according to this natural range, with the lower end at 160 cm (5′2″) to 190 cm (6′2″), with 175 cm as the midpoint. Previous research has measured a range of 1.03 to 1.40 for men's SHR with an average of 1.18 ± 0.07 (Hughes & Gallup, 2003). Accordingly, we considered an SHR of 1.2 intermediate and two variations of lower (1.1) and higher (1.3) ratios were created. These ratios were rounded values for mean and standard deviations of the SHR measured by Hughes and Gallup (2003) from a sample of men from the USA.

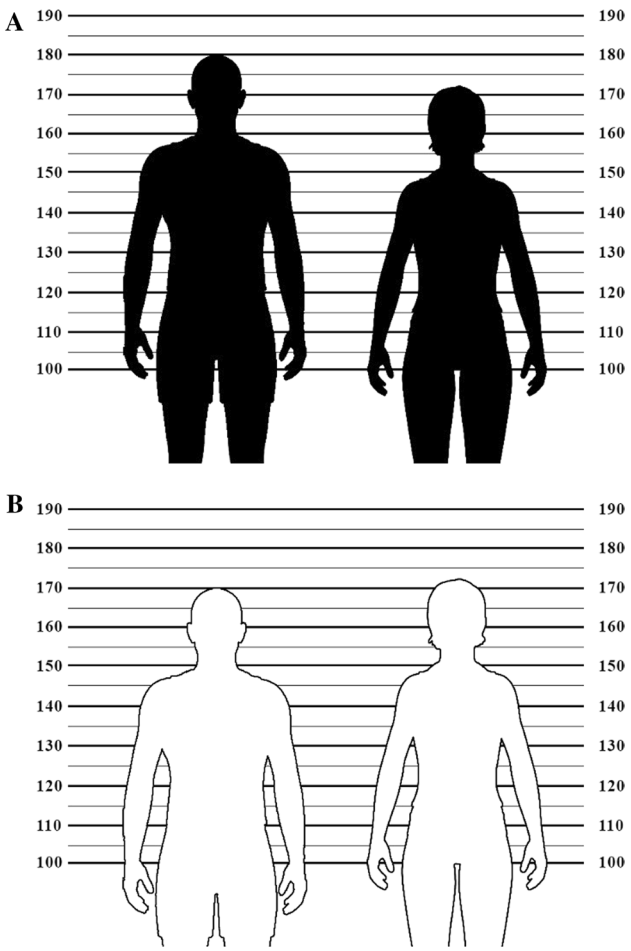

Fig. 1 Example of black and white silhouette stimuli used in the Studies 1 and 2: **A** a male stimulus with height of 180 cm and intermediate SHR, **B** a male stimulus with height of 170 and intermediate SHR

Procedure

After consenting to participate in the study, participants answered sociodemographic questions. Thereafter, in a between-subjects design participants were randomly assigned to either one of three groups of SHRs (small, intermediate, and large) and rated 14 randomly presented stimuli (7 heights × 2 silhouette colors) for perceived attractiveness, masculinity and fighting ability. Participants were asked to respond to the following questions on 7-point Likert scale, from 1 (not at all) to 7 (very): "How attractive do you find this man?", "How masculine do you find this man?", and "If this man was involved in a physical confrontation, how successful would he be?"

Results

Perception of Attractiveness

A 7 (Height) × 3 (SHR) × 2 (Silhouette Color) mixed analysis of variance (ANOVA) was performed on the perception of attractiveness with Height and Silhouette Color as within-subject variables, and SHR as a between-subject variable. All post hoc comparisons reported here, and throughout the results, were done using Bonferroni correction, and this is also reflected in the p values.

The main effects for Height and SHR were significant (Height: $F(6, 882) = 61.75$, $p < 0.001$, partial $\eta^2 = 0.29$; SHR: $F(2, 147) = 3.32$, $p = 0.039$, partial $\eta^2 = 0.04$; see Table 1). Ratings of attractiveness increased with an increase in height (all comparison were significant (all $ps < 0.003$), except between heights of 160 cm and 165 cm, and 180 cm, 185 cm and 190 cm). Post hoc comparisons for SHR did not return significant difference (all $ps > 0.065$).

Results also returned a significant Height × SHR interaction, $F(12, 882) = 2.13$, $p = 0.013$, partial $\eta^2 = 0.02$. At 160 cm of height, women rated intermediate SHR ($M = 3.81$, SEM = 0.23) more attractive than small SHR ($M = 2.28$, SEM = 0.22, $p = 0.014$). At 165 cm of height, women rated intermediate ($M = 3.89$, SEM = 0.22, $p = 0.007$) and large SHRs ($M = 3.72$, SEM = 0.21, $p = 0.036$) as more attractive than small SHR ($M = 2.94$, SEM = 0.21). At 190 cm of height, women rated large SHR ($M = 5.15$, SEM = 0.24) as more attractive than small SHR ($M = 4.19$, SEM = 0.24, $p = 0.020$). For other heights (i.e., 170, 175, 180 and 185 cm), variation in SHR had no effect on ratings of attractiveness (all $ps > 0.087$).

Perception of Masculinity

A 7 (Height) × 3 (SHR) × 2 (Silhouette Color) mixed ANOVA was also performed on the perception of masculinity. The main effects for Height and SHR were significant (Height: $F(6, 882) = 59.98$, $p < 0.001$, partial $\eta^2 = 0.29$; SHR: $F(2, 147) = 3.07$, $p = 0.049$, partial $\eta^2 = 0.04$; see Table 2); however, the Height × SHR interaction was not significant, $F(12, 882) = 1.66$, $p = 0.069$, partial $\eta^2 < 0.02$. Large SHR ($M = 4.66$, SEM = 0.17) was rated significantly more masculine than small SHR ($M = 4.06$, SEM = 0.17, $p = 0.045$). Ratings of masculinity increased with increase in height (all comparison were significant (all $ps < 0.043$), except between heights of 160 cm and 165 cm, and 180 cm and 185 cm).

Perception of Fighting Ability

A 7 (Height) × 3 (SHR) × 2 (Silhouette Color) mixed ANOVA was performed on perceived fighting ability. The main effects for Height and SHR were significant (Height: $F(6, 882) = 79.72$, $p < 0.001$, partial $\eta^2 = 0.35$; SHR: $F(2, 147) = 3.61$, $p = 0.029$, partial $\eta^2 = 0.04$; see Table 3). Ratings of fighting ability increased with an increase in height (all comparison were significant (all $ps < 0.010$), except between heights of 160 cm and 165 cm). Large SHR ($M = 4.77$, SEM = 0.16) was rated significantly higher on fighting ability than small SHR ($M = 4.20$, SEM = 0.16, $p = 0.045$).

Results also returned a significant Height × SHR interaction, $F(12, 882) = 2.63$, $p = 0.002$, partial $\eta^2 = 0.03$. At 165 cm of height, women rated intermediate SHR ($M = 4.33$, SEM = 0.21) higher on fighting ability than small SHR ($M = 3.42$, SEM = 0.20, $p = 0.007$). At 170 cm of height, women rated intermediate ($M = 4.53$, SEM = 0.21) as higher on fighting ability than small SHR ($M = 3.71$, SEM = 0.21, $p = 0.026$). At 190 cm of height, women rated large SHR ($M = 5.85$, SEM = 0.18) as higher on fighting ability than small SHR ($M = 4.99$, SEM = 0.18, $p = 0.003$). For other heights (i.e., 160, 175, 180 and 185 cm), variation in SHR had no effect on ratings of fighting ability (all $ps > 0.091$).

Table 1 Main effects and interaction effects for attractiveness ratings

Study	Effect	df num	df denom	*F*	*p*	Partial η^2
1	Height	6	882	61.75	< .001	0.29
	SHR	2	147	3.32	.039	0.04
	Height * SHR	12	882	2.13	.013	0.02
2	Height	6	230	0.29	.937	0.01
	SHR	2	460	17.08	< .001	0.07
	Height * SHR	12	460	1.44	.141	0.03
3	Height	6	936	144.07	< .001	0.48
	SHR	2	312	13.28	< .001	0.01
	Height * SHR	12	1872	1.33	.192	0.01
4	Height	6	684	71.10	< .001	0.38
	SHR	2	228	8.11	< .001	0.06
	Height * SHR	12	1368	2.06	.017	0.01

Table 2 Main effects and interaction effects for masculinity ratings

Study	Effect	df num	df denom	*F*	*p*	Partial η^2
1	Height	6	882	59.98	< .001	0.29
	SHR	2	147	3.07	.049	0.04
	Height * SHR	12	882	1.66	.069	0.02
2	Height	6	230	0.71	.637	0.01
	SHR	2	460	38.60	< .001	0.14
	Height * SHR	12	460	1.28	.226	0.03
3	Height	6	936	126.31	< .001	0.44
	SHR	2	312	35.05	< .001	0.18
	Height * SHR	12	1872	0.36	.976	0.01
4	Height	6	684	74.09	< .001	0.39
	SHR	2	228	15.00	< .001	0.11
	Height * SHR	12	1368	2.67	.001	0.02

Table 3 Main effects and interaction effects for fighting ability ratings

Study	Effect	df num	df denom	*F*	*p*	Partial η^2
1	Height	6	882	79.72	< .001	0.35
	SHR	2	147	3.61	.029	0.04
	Height * SHR	12	882	2.63	.002	0.03
2	Height	6	230	1.69	.122	0.04
	SHR	2	460	27.56	< .001	0.10
	Height * SHR	12	460	0.58	.857	0.01
3	Height	6	936	171.07	< .001	0.52
	SHR	2	312	41.11	< .001	0.20
	Height * SHR	12	1872	1.37	.172	0.01
4	Height	6	684	86.28	< .001	0.43
	SHR	2	228	17.38	< .001	0.13
	Height * SHR	12	1368	0.99	.454	0.01

Discussion

In the first study, we used a mixed design by blocking the SHR as a between-subjects variable and employed silhouettes as stimuli, investigating the effect of men's height and SHR on women's perceptions of attractiveness, masculinity, and fighting ability. Women's ratings for attractiveness, masculinity, and fighting ability increased with an increase in male height. However, a relatively large SHR was only rated higher on masculinity and fighting ability, but not on attractiveness compared to a small SHR. Moreover, results for attractiveness and fighting ability ratings showed SHR interacted with height, as women perceived larger SHR higher in attractiveness and fighting ability only on the very short and very tall males (160, 165, and 190 cm for attractiveness and 165, 170, and 190 cm for fighting ability).

The unexpected finding that differences in SHR was only noticeable in very short and tall males indicates that participants were more attentive of heights which potentially could have resulted from participants experiencing variation on height but not SHR, as SHR was manipulated between not within participants. To test this possibility, Study 2 manipulated SHR within participants and height between participants.

Study 2

Study 1 manipulated height within participants and SHR between participants. The results returned a more robust effect of height than SHR. This could be due to the design of our study, or a reflection of the relative impact of each variable on perceptions of attractiveness, masculinity, and fighting ability. To tease this issue apart, Study 2 repeated the design of Study 1, but manipulated SHR within participants and height between participants. If the relative impact of SHR and height are reversed in Study 2, then the nature of our design will be implicated. This will not be the case if we replicate the findings of Study 1.

Method

Participants

A total of 291 female participants were recruited from Amazon Mechanical Turk workers located in the USA and after exclusion of those individuals reported their sexual orientation as non-heterosexual our final sample consisted of 237 self-identified heterosexual women aged between 18 and 83 years ($M = 36.62$, $SD = 12.80$). A total of 82 participants (34.6%) reported being married, 1.7% reported widowed and an additional 9.7% reported being divorced or separated, while 35.5% reported being single, and 21.5% in a relationship. In terms of their highest academic degree, one individual (0.4%) had elementary school, 47.7% had a high school diploma, 16.9% had a post-secondary diploma, 22.8% of the participants had an undergraduate degree, and 12.3% had a postgraduate degree (MA or PhD).

Stimuli and Procedure

The stimuli were the same as those in Study 1. After consenting to participate in the study, participants answered sociodemographic questions. Thereafter, in a between-subjects design participants were randomly assigned to either one of seven groups of Heights and rated 6 randomly presented stimuli (3 SHRs × 2 silhouette colors) for perceived attractiveness, masculinity and fighting ability. The questions' wordings were the same as Study 1.

Results

Perception of Attractiveness

The perception of attractiveness was analyzed by a 7 (Height) × 3 (SHR) × 2 (Silhouette Color) mixed ANOVA, with SHR and Silhouette Color as within-subject variables and Height as a between-subject variable. The main effect for SHR was significant, $F(2, 460) = 17.80$, $p < 0.001$, partial $\eta^2 = 0.07$. Women rated large ($M = 4.18$, SEM = 0.10) and intermediate SHRs ($M = 4.03$, SEM = 0.10) more attractive than small SHR ($M = 3.84$, SEM = 0.10, $ps < 0.001$). Large SHR was also rated more attractive than intermediate SHR ($p = 0.023$). The main effect of Height, and Height × SHR interaction were not significant (Height: $F(6, 230) = 0.29$, $p = 0.937$, partial $\eta^2 < 0.01$; Height × SHR: $F(12, 460) = 1.44$, $p = 0.141$, partial $\eta^2 = 0.03$.

Perception of Masculinity

A 7 (Height) × 3 (SHR) × 2 (Silhouette Color) mixed ANOVA was performed to measure masculinity. The main effect for SHR was significant, $F(2, 460) = 38.60$, $p < 0.001$, partial $\eta^2 = 0.14$. Women rated large ($M = 4.51$, SEM = 0.09) and intermediate SHRs ($M = 4.18$, SEM = 0.09) more masculine than small SHR ($M = 4.01$, SEM = 0.10, $ps < 0.003$). Large SHR was also rated more masculine than intermediate SHR ($p < 0.001$). The main effect of Height, and Height × SHR interaction were not significant (Height: $F(6, 230) = 0.71$, $p = 0.637$, partial $\eta^2 = 0.01$; Height × SHR: $F(12, 460) = 1.28$, $p = 0.226$, partial $\eta^2 = 0.03$.

Perception of Fighting Ability

A 7 (Height) × 3 (SHR) × 2 (Silhouette Color) mixed ANOVA was performed to measure fighting ability. The main effect for SHR was significant, $F(2, 460) = 27.56$, $p < 0.001$, partial $\eta^2 = 0.11$. Women rated large ($M = 4.63$, SEM = 0.09 $p < 0.001$) and intermediate SHRs ($M = 4.35$, SEM = 0.09, $p = 0.049$) higher on fighting ability than small SHR ($M = 4.22$, SEM = 0.09). Large SHR was also rated higher on fighting ability than intermediate SHR ($p < 0.001$). The main effect of Height, and Height × SHR interaction were not significant (Height: $F(6, 230) = 1.69$, $p = 0.122$, partial $\eta^2 = 0.04$; Height × SHR: $F(12, 460) = 0.58$, $p = 0.859$, partial $\eta^2 = 0.01$.

Discussion

In the second study, we used a mixed design by blocking the Height as a between-subjects variable, investigating the effect of men's height and SHR on women's perceptions of attractiveness, masculinity, and fighting ability. Contrary to the results of Study 1, women's ratings for attractiveness, masculinity, and fighting ability did not show any significant effect for males' height; nor was there an interaction between height and SHR. On other hand, the effect of SHR was significant for attractiveness, masculinity, and fighting ability; with all three variables increasing with an increase in SHR. Collectively these data suggest that by blocking one of the variables of interest—SHR (Study 1) or height (Study 2)—can dampen its perceptual effect, presumably because participants are not being exposed to variation on that factor and it is being excluded in their perceptual judgements. This despite the fact that there was a female avatar as an anchor. Study 3 addresses this possible limitation.

Study 3

In this third study participants were presented with both SHR and height as within-subject variables.

Method

Participants

A total of 182 female participants were recruited from Amazon Mechanical Turk workers located in the USA who completed an online survey. After exclusion of those individuals reported their sexual orientation as non-heterosexual, our final sample consisted of 157 self-identified heterosexual women aged between 18 and 76 years ($M = 40.59$, $SD = 16.20$). A total of 55 participants (35.0%) reported being married and an additional 10.8% reported being divorced and 6.2% being separated or widowed, while 24.2% reported being single, and 23.6% in a relationship. In terms of their highest academic degree, 37.6% had a high school diploma, 12.1% had a post-secondary diploma, 57% of the participants had an undergraduate degree, and 14.0% had a post-graduate degree (MA or PhD).

Stimuli and Procedure

The stimuli were the same as previous studies. After consenting to participate in the study, participants answered sociodemographic questions. Thereafter, all the images from two sets of stimuli (21 black and 21 white stimuli) were presented in a random order and participants were asked to respond to the questions as worded in procedure of Study 1 for each of 42 stimuli.

Results

Perception of Attractiveness

A 7 (Height) × 3 (SHR) × 2 (Silhouette Color: Black and White) repeated measures ANOVA was performed with Height, SHR, and Silhouette Color as within-subjects variables on perceived attractiveness. The main effects for Height and SHR were significant (Height: $F(6, 936) = 144.07$, $p < 0.001$, partial $\eta^2 = 0.48$; SHR: $F(2, 312) = 14.97$, $p < 0.001$, partial $\eta^2 = 0.08$). Ratings of attractiveness increased with increase in height (all $ps < 0.003$), except on difference between 185 and 190 cm. Large ($M = 3.97$, SEM = 0.09) and intermediate SHRs ($M = 3.92$, SEM = 0.09) were rated significantly higher on attractiveness than small SHR ($M = 3.81$, SEM = 0.10, $ps < 0.001$). The difference between large and intermediate SHRs was not significant ($p = 0.189$). The Height × SHR interaction was not significant, $F(12, 1872) = 0.87$, $p = 0.198$, partial $\eta^2 < 0.01$.

Perception of Masculinity

A 7 (Height) × 3 (SHR) × 2 (Silhouette Color) repeated measures ANOVA was conducted on perceived masculinity. The main effects for Height and SHR were significant (Height: $F(6, 936) = 126.31$, $p < 0.001$, partial $\eta^2 = 0.44$; SHR: $F(2, 312) = 35.05$, $p < 0.001$, partial $\eta^2 = 0.18$); however, the Height × SHR interaction was not significant, $F(12, 1872) = 0.36$, $p = 0.976$, partial $\eta^2 < 0.01$. Ratings of masculinity increased with increase in height (all $ps < 0.002$). Large SHR ($M = 4.25$, SEM = 0.09) was rated significantly more masculine than both intermediate ($M = 4.09$, SEM = 0.09, $p < 0.001$) and small SHRs ($M = 3.94$, SEM = 0.09, $p < 0.001$). Intermediate SHR was also significantly rated more masculine than small SHR ($p < 0.001$).

Perception of Fighting Ability

A 7 (Height) × 3 (SHR) × 2 (Silhouette Color) repeated measures ANOVA was conducted on perceived fighting ability. The main effects for Height and SHR were significant (Height: $F(6, 936) = 171.07$, $p < 0.001$, partial $\eta^2 = 0.52$; SHR: $F(2, 312) = 41.11$, $p < 0.001$, partial $\eta^2 = 0.20$); the Height × SHR interaction was not significant, $F(12, 1872) = 1.37$, $p = 0.172$, partial $\eta^2 < 0.01$. Ratings of fighting ability increased with increase in height (all $ps < 0.001$). Large SHR ($M = 4.40$, SEM = 0.08) was rated significantly higher on fighting ability than both intermediate ($M = 4.24$, SEM = 0.08, $p < 0.001$) and small SHRs ($M = 4.09$, SEM = 0.09, $p < 0.001$). Intermediate SHR was also significantly rated higher on fighting ability than small SHR ($p < 0.001$).

Discussion

In the third study, we tested the effect of men's height and SHR on women's perceptions of attractiveness, masculinity, and fighting ability using a within-subjects design. Once both height and SHR were varied for participants, both factors had significant and robust effects on perceptions. Taller men were rated as more attractive, masculine, and better in fighting ability. Similarly, SHR was generally associated with higher attractiveness, masculinity, and fighting ability. The interaction of height and SHR was not significant for these variables.

One possible notable remaining limitation of our study was our use of silhouettes. Kościński (2014) compared the effect of photographed and silhouetted women stimuli on the perception of attractiveness when waist-to-hip ratios were manipulated for male observers. Results indicated that the effects were more pronounced for realistic stimuli compared to silhouettes. Similarly, Versluys and Skylark (2017) showed that there is less sensitivity to variations in silhouettes compared to more realistic rendered figures, concluding that perception of attractiveness depends on the format of the stimuli. Collectively these data suggest that the present work may be underestimating the magnitude of the effects of height and SHR by the use of silhouettes. Study 4 addresses this possibility.

Study 4

Study 4 repeated our previous study after replacing the silhouetted stimuli with more colorful realistic stimuli.

Method

Participants

A total of 127 female participants were recruited from Amazon Mechanical Turk workers located in the USA who completed an online survey. Twelve individuals reported their sexual orientation as non-heterosexual and, given the aims of the present study, they were excluded from analysis. Our final sample consisted of 115 self-identified heterosexual women aged between 21 and 68 years ($M = 38.24$, $SD = 11.26$). A total of 68 participants (59.1%) reported being married and an additional 9.6% reported being divorced, while 17.4% reported being single, and 13% in a relationship. In terms of their highest academic degree, 17.4% had a high school diploma, 7.8% had a post-secondary diploma, 53% of the participants had an undergraduate degree, and 21.7% had a post-graduate degree (MA or PhD).

Stimuli

The stimuli (see Fig. 2) were colored and more realistic renderings of the silhouettes used in Studies 1–3. Note that the outline of the present stimuli matches the silhouettes. As in Studies 3, both height and SHR were varied.

Procedure

After consenting to participate in the study, participants answered sociodemographic questions. Thereafter, the 21 stimuli were presented in a random order and participants were asked to respond to the questions as worded in the procedure of Study 1 for each of the stimuli.

Results

Perception of Attractiveness

A 7 (Height) × 3 (SHR) repeated measures ANOVA was performed with Height and SHR as within-subjects variables on perceived attractiveness.

The main effects for Height and SHR were significant (Height: $F(6, 684) = 71.10$, $p < 0.001$, partial $\eta^2 = 0.38$; SHR: $F(2, 228) = 8.11$, $p < 0.001$, partial $\eta^2 = 0.06$). Ratings of attractiveness increased with an increase in height (all comparison were significant, except between heights of 180 cm and 185 cm, and 185 cm and 190 cm; see Fig. 3A).

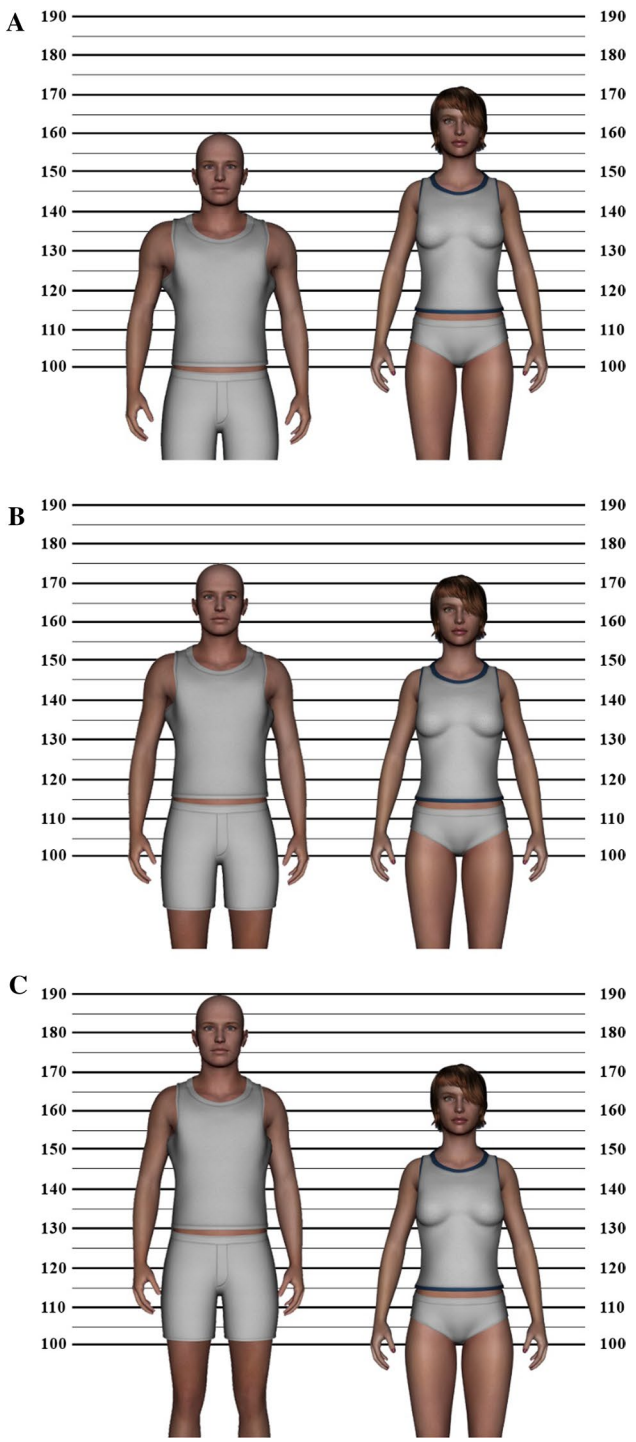

Fig. 2 Example of stimuli used in Study 4: **A** a male stimulus with a height of 160 cm and large SHR, **B** a male stimulus with height of 175 and intermediate SHR, **C** a male with height of 190 cm and small SHR, each position with a female stimulus with 172 cm height and small SHR

Small SHR ($M = 4.41$, SEM = 0.12) was rated significantly less attractive than intermediate (M = 4.50, SEM = 0.11, $p = 0.030$) and large SHRs ($M = 4.56$, SEM = 0.11, $p = 0.001$).

Results also returned a significant Height × SHR interaction, $F(12, 1368) = 2.06$, $p = 0.017$, partial $\eta^2 = 0.01$. At 180 cm of height, women rated large SHR ($M = 5.04$, SEM = 0.12) more attractive than small SHR ($M = 4.70$, SEM = 0.13, $p = 0.001$). At 185 cm of height, women rated intermediate ($M = 5.11$, SEM = 0.12, $p = 0.042$) and large SHRs ($M = 5.21$, SEM = 0.11, $p < 0.001$) as more attractive than small SHR ($M = 4.87$, SEM = 0.12). At 190 cm of height, women rated intermediate SHR ($M = 5.28$, SEM = 0.12) as more attractive than small SHR ($M = 5.07$, SEM = 0.13, $p = 0.042$; Fig. 3A). For heights less than 180 cm (i.e., 160, 165, 170 and 175 cm), variation in SHR had no effect on ratings of attractiveness (all $ps > 0.154$).

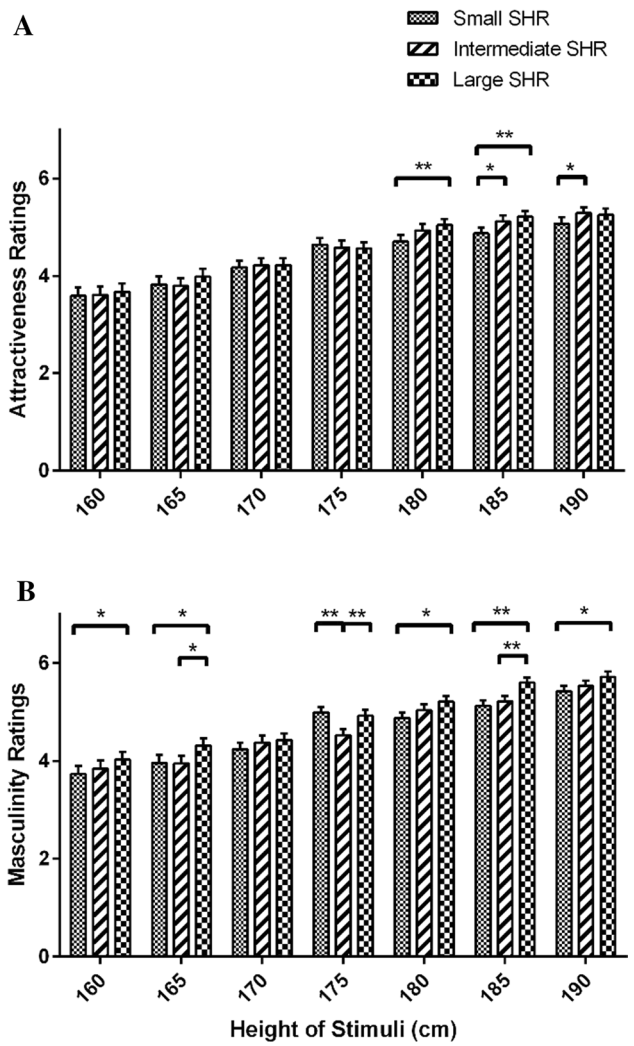

Fig. 3 Mean ratings (+SEM) of female participants for **A** attractiveness and **B** masculinity of male stimuli varying in Height (160, 165, 170, 175, 180, 185 and 190 cm) and SHR (low, intermediate, or high). *$p < 0.05$, **$p < 0.01$

Perception of Masculinity

A 7 (Height) × 3 (SHR) repeated measures ANOVA was conducted on perceived masculinity. The main effects for Height and SHR were significant (Height: $F(6, 684) = 74.09$, $p < 0.001$, partial $\eta^2 = 0.39$; SHR: $F(2, 228) = 15.00$, $p < 0.001$, partial $\eta^2 = 0.11$). Ratings of masculinity increased with increase in height (all $ps < 0.044$; Fig. 3B). Large SHR ($M = 4.88$, SEM = 0.09) was rated significantly more masculine than both intermediate ($M = 4.63$, SEM = 0.10, $p < 0.001$) and small SHRs ($M = 4.61$, SEM = 0.10, $p < 0.001$).

Results also returned a significant Height × SHR interaction, $F(12, 1368) = 2.67$, $p = 0.001$, partial $\eta^2 = 0.02$. At 160 cm of height, women rated large SHR ($M = 4.02$, SEM = 0.16) as more masculine than small SHR ($M = 3.37$, SEM = 0.17, $p = 0.038$). At height of 165 cm, women rated large SHR ($M = 4.31$, SEM = 0.14) more masculine than intermediate ($M = 3.94$, SEM = 0.15, $p = 0.021$) and small SHRs ($M = 3.95$, SEM = 0.17, $p = 0.017$). At 175 cm of height small ($M = 4.98$, SEM = 0.11, $p < 0.001$) and large SHRs ($M = 4.92$, SEM = 0.12, $p = 0.006$) were rated more masculine than intermediate SHR ($M = 4.52$, SEM = 0.13). At 180 cm of height, women rated large SHR ($M = 5.20$, SEM = 0.10) as more masculine than small SHR ($M = 4.87$, SEM = 0.12, $p = 0.013$). At 185 cm of height, women rated large SHR ($M = 5.60$, SEM = 0.10) as more masculine than intermediate ($M = 5.21$, SEM = 0.11, $p = 0.004$) and small SHRs ($M = 5.12$, SEM = 0.11, $p < 0.001$). At 190 cm of height, women rated large SHR as more masculine than small SHR ($M = 5.41$, SEM = 0.11, $p = 0.045$; see Fig. 3B).

Perception of Fighting Ability

A 7 (Height) × 3 (SHR) repeated measures ANOVA was conducted on perceived fighting ability. The main effects for Height and SHR were significant (Height: $F(6, 684) = 86.28$, $p < 0.001$, partial $\eta^2 = 0.43$; SHR: $F(2, 228) = 17.38$, $p < 0.001$, partial $\eta^2 = 0.13$). Ratings of fighting ability increased with increase in height (all $ps < 0.039$). Large SHR (M = 4.86, SEM = 0.09) was rated significantly higher on fighting ability than both intermediate ($M = 4.64$, SEM = 0.10, $p < 0.001$) and small SHRs ($M = 4.63$, SEM = 0.10, $p < 0.001$; Fig. 4). The Height × SHR interaction was not significant, $F(12, 1368) = 0.99$, $p = 0.454$, partial $\eta^2 < 0.01$.

Multivariate Analysis of Variance (MANOVA)

To further explore the differences in the strength of relationships between height, SHR, and their interaction on the one hand and variables of interest (attractiveness, masculinity, and fighting ability) on the other, a MANOVA was conducted. Women's perceptions of men's attractiveness, masculinity, and fighting ability were entered into a repeated

measures MANOVA with SHR and height as within-subjects factors. We followed significant findings in the MANOVA with univariate ANOVAs and Bonferroni correction. The MANOVA revealed a significant main effect for SHR, *Pillai's Trace* = 0.24, $F(6, 109) = 5.59$, $p < 0.001$, $\eta^2_p = 0.23$, and height, *Pillai's Trace* = 0.56, $F(18, 97) = 6.88$, $p < 0.001$, $\eta^2_p = 0.56$. The interaction between SHR and height was not significant, *Pillai's Trace* = 0.35 $F(36, 79) = 1.18$, $p < 0.001$, $\eta^2_p = 0.35$; therefore, only main effects were explored further across the dependent variables.

SHR significantly predicted attractiveness, $F(2, 228) = 8.11$, $p < 0.001$, $\eta^2_p = 0.06$, masculinity, $F(2, 228) = 15.00$, $p < 0.001$, $\eta^2_p = 0.12$, and fighting ability, $F(2, 228) = 17.38$, $p < 0.001$, $\eta^2_p = 0.13$. Small SHR ($M = 4.41$, SEM = 0.12) was rated significantly less attractive than intermediate ($M = 4.50$, SEM = 0.11, $p = 0.030$) and large SHRs ($M = 4.56$, SEM = 0.11, $p = 0.001$). Small SHR ($M = 4.41$, SEM = 0.12) was rated significantly less attractive than intermediate ($M = 4.50$, SEM = 0.11, $p = 0.030$) and large SHRs ($M = 4.56$, SEM = 0.11, $p = 0.001$). For masculinity, large SHR ($M = 4.88$, SEM = 0.09) was rated significantly more masculine than both intermediate ($M = 4.63$, SEM = 0.10, $p < 0.001$) and small SHRs ($M = 4.61$, SEM = 0.10, $p < 0.001$). For fighting ability, large SHR ($M = 4.86$, SEM = 0.09) was rated significantly higher on fighting ability than both intermediate ($M = 4.64$, SEM = 0.10, $p < 0.001$) and small SHRs ($M = 4.63$, SEM = 0.10, $p < 0.001$).

Height significantly predicted attractiveness, $F(6, 684) = 71.10$, $p < 0.001$, $\eta^2_p = 0.38$, masculinity, $F(6, 684) = 74.09$, $p < 0.001$, $\eta^2_p = 0.39$, and fighting ability, $F(6, 684) = 86.28$, $p < 0.001$, $\eta^2_p = 0.43$. Ratings of attractiveness increased with an increase in height (all comparison were significant, except between heights of 180 cm and 185 cm, and 185 cm and 190 cm). For masculinity, ratings of masculinity increased with an increase in height. For fighting ability, ratings of fighting ability increased with an increase in height (all $ps < 0.039$).

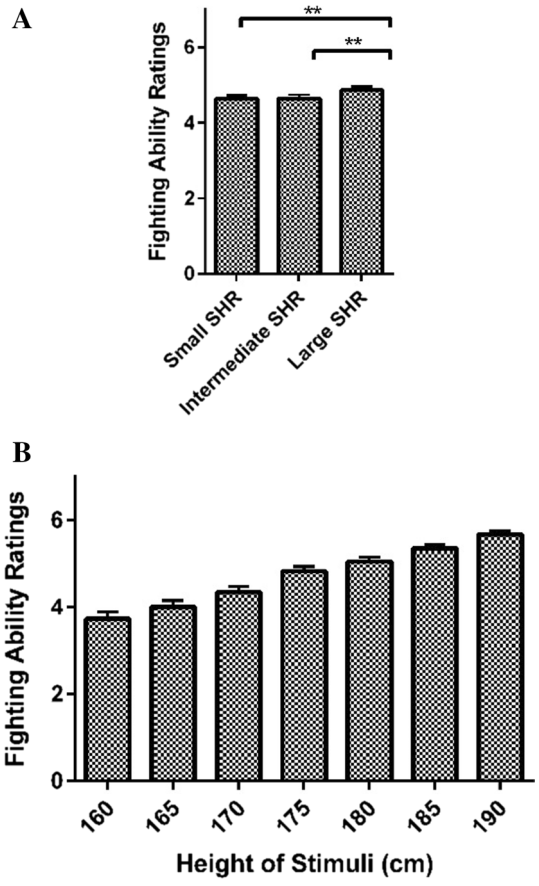

Fig. 4 Mean ratings (+SEM) of fighting ability for **A** SHR and **B** height of male stimuli. All heights mean ratings are significantly different (all $ps < .039$). $^{**}p < 0.01$

Discussion

In the fourth study, we tested the effect of men's height and SHR on women's perceptions of attractiveness, masculinity, and fighting ability using a within-subjects design and realistic colorful stimuli. With regard to attractiveness, our results showed that as men's height increased, the effect of SHR on attractiveness became more salient. That is, higher SHRs were rated as more attractive in taller men, where no significant differences were noted for shorter men. Moreover, with the exception of men who were 175 cm, masculinity ratings were influenced by both height and SHR. Men who were taller and had higher SHRs were rated as more masculine. For fighting ability, there were no interacting effects. Instead, SHR and height independently predicted fighting ability. The effects of height and SHR on perceptions of attractiveness, masculinity, and fighting ability found in Study 4 dovetail with the results from the previous research showing that women prefer taller men, and men with larger SHR (Braun & Bryan, 2006; Dixson et al., 2007a, 2007b, 2010; Furnham & Nordling, 1998; Mautz et al., 2013; Nettle, 2002; Pawlowski et al., 2000; Pazhoohi et al., 2019a; Sell et al., 2017; Tovée et al., 1999), possibly because these traits signal men's genetic fitness, resource holding power, and social status (Blaker et al., 2013; Ellis, 1994; Fessler et al., 2012; Mueller & Mazur, 2001; Pazhoohi et al., 2019b; Sell et al., 2009; Stulp et al., 2015).

Interestingly, although the results showed that women rated larger SHR on short men as well as on tall men as more masculine, they did not consider a larger SHR as appealing on short men. Specifically, this finding suggests that women prefer larger SHR on men taller than 175 cm. This displayed preference by women may not be mirrored by men (Pazhoohi et al., 2019a), because men generally believe larger upper bodies (i.e., larger SHRs) are attractive to women and increase their chance of mating success (Frederick et al.,

2007; Hughes & Gallup, 2003). However, it appears for women, height is more important than SHR, because height is a direct cue to genetic fitness, compared to SHR which is malleable, and as such is much more of an indirect signal of one's genetic characteristics.

Collectively, the results of this study suggest that our use of colored realistic stimuli in place of silhouettes enhanced the results observed in Study 3, which had itself demonstrated the importance of manipulating height and SHR in a within-subject design.

General Discussion

Regarding women's perceptions of men's attractiveness, previous research has focused on the independent role played by men's height and shoulder-to-hip ratio (SHR). However, in the real world these factors are correlated (Fink et al., 2007; Hill et al., 2013) and women seem to rely on a combination of male physical characteristics when evaluating their attractiveness for mating (Hill et al., 2013); thus, it seems unlikely that women base their decision makings on a single phenotypic trait (e.g., only height or SHR). Accordingly, in the current study we aimed to investigate the separate and combined effects of male height and SHR on women's perceptions of male attractiveness, masculinity, and fighting ability. We found that women's perceptions of males' attractiveness, masculinity, and fighting ability were influenced by, and interacted with, height and SHR. These results provide a deeper understanding on how men's height and SHR interact to influence women's preference and mate choice. We show that in general women prefer taller and broader shouldered men, and in particular when these two variables positively interact (i.e., men that are both tall and broad-shouldered). The implication of this finding is that when investigating women's preference for men's bodily attractiveness, masculinity and fighting ability, future research should consider a more comprehensive integration of physical characteristics.

The studies demonstrate that women rely on phenotypic attributes associated with good genes in mate selection. Across all 4 studies, women perceived increases in SHR and height as more attractive. These findings are in line with previous research showing that taller men and men with higher SHRs are preferred by women (Berscheid & Walster, 1974; Bogaert et al., 2009; Buss, 1994; Feingold, 1982; Nettle, 2002; Pazhoohi et al., 2019a, 2019b; Sell et al., 2017). Given that these traits are also associated with masculinity, they may be used as observable cues to indicate biological quality. However, it is important to note that height and SHR were also associated with fighting ability, which are physical features that are important in contest competition (Puts, 2010). Women may face a trade-off in choosing the best fit male that may offer protection and high-quality genes but may also cause harm to them and invest less in parenting (Borras-Guevara et al., 2019).

Of particular note, our investigation indicates that the effects of these variables, and their interaction, are sensitive to the experimental design and realism of stimuli. Specifically, the effects were maximized when participants were allowed to experience variation in both height and SHR with colorful realistic stimuli (Study 4) rather than silhouettes (Study 3) that were blocked on either height (Study 2) or SHR (Study 1).

To control for the possibility that participants might guess the aim of the study and adjust their responses accordingly (Greenwald, 1976), we used a mixed design in the first two studies. Studies 1 and 2 were conducted using black and white silhouettes and a between-subjects design was employed. In Study 1 SHR and in Study 2 Height were blocked as between-subjects variables, whereas the other variable treated as within-subjects. When SHR was blocked (Study 1), women's ratings for male's attractiveness, masculinity, and fighting ability generally increased with increase of males' height. However, the effect of SHR was relatively muted, suggesting the possibility that it was important for participants to experience variation on the variables of interest, as they had with height. To test this possibility, Study 2 examined the effect of height and SHR when height was blocked as a between-subjects variable. Results showed pronounced effects of SHR on women's perception of attractiveness, masculinity, and fighting ability, with their ratings increasing with SHR. However, there was no significant effect for height. Collectively, these results demonstrated the importance of presenting height and SHR as within-subject variables.

Accordingly, Study 3 manipulated height and SHR within participants, while maintaining our presentation of the stimuli as black and white silhouettes. Now, taller men, and men with higher SHRs, were rated as more attractive, masculine, and better in fighting ability. There was no interaction. We noted, however, that recent studies have noted that silhouettes may lead one to underestimate the actual effects of interest, effects that are better tapped by the use of more realistic renderings of human stimuli. For instance, the effects of waist-to-hip and leg-to-body ratios on perceptions of attractiveness are more pronounced with realistic human renderings than silhouettes (Kościński, 2014; Versluys & Skylark, 2017).

Study 4 repeated our third study but now with colorful 3D avatars in place of the silhouettes (although the outline of the avatars matched the silhouettes). Results showed that women preferred taller men and broader shoulders, and height and SHR interacted in a way that larger upper bodies (larger SHRs) were considered more attractive on taller men, but not on shorter men.

In sum, the results across four studies suggest that women are sensitive to the differences in male stimuli differing in height and SHR when they are permitted to observe variation

on these variables (i.e., in a within-subject design). Moreover, these effects are accentuated when 3D models rather than silhouettes serve as stimuli. Here, we find that women prefer tall and broad-shouldered men, especially when the men were both tall and broad-shouldered. It is important to note that there are limitations on using ratios (SHRs) as a categorical variable (Dixson, 2018), because studies using multivariate approaches suggest that selection acts on multiple bodily characteristics, rather than a true ratio (Brooks et al., 2015). To increase ecological validity, future research may obtain estimates for height and SHR from the literature of the variance in height and SHR in the population and use more nuanced measures of SHRs. These findings open the door to future lines of investigation, such as the role that individual differences, such as egalitarianism, mate value, and short-term mating orientation (Waynforth, 2001), might play in women's rating of these stimuli. For instance, studies have shown that short-term mating in women is associated with attractiveness for men with upper body strength (Garza & Byrd-Craven, 2020; Provost et al., 2006, 2008). Moreover, although using a height chart scale in the metric system might have provided less ecological validity for participants from the USA, many of whom can be assumed to be more familiar with the Imperial system, the current study was concerned with the relative height rather than scales and absolute height of the models. Indeed, it is perhaps worth noting that measuring systems and numeric measurements are evolutionary novel, and in studies where the effect of relative height is of interest (such as the current study), the anchoring stimulus (the female model and the scaling lines) could be argued to provide a better reference for comparison than absolute height measures. Nonetheless, future research may wish to match the chart scale according to the subjects' preferred measuring system for the sake of ecological validity. In conclusion, women prefer men who are taller and have larger SHR, and consider them more masculine and better in fighting ability; however, the interaction of these two is dependent on the availability of other choices for comparison (experimental design) and the ecological validity of the stimuli (3D avatars rather than silhouettes).

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Availability of Data and Material Authors will share upon request.

Declarations

Conflict of interest The authors declare no conflict of interest.

Ethical Approval All participants consented to taking part in the study. This research was approved by the Behavioural Research Ethics Committee of the [university name] and was conducted in accordance with the Declaration of Helsinki as it pertains to research with human participants.

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