Title: Influence of perceived height, masculinity, and age on each other and on perceptions of dominance in male faces

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Abstract

Several studies have examined the individual effects of facial cues to height, masculinity, and age on interpersonal interactions and partner preferences. We know much less about the influence of these traits on each other. We therefore examined how facial cues to height, masculinity, and age influence perceptions of each other and found significant overlap. This suggests that studies investigating the effects of one of these traits in isolation may need to account for the influence of the other two traits. Additionally, there is inconsistent evidence on how each of these three facial traits affects dominance. We therefore investigated how varying such traits influences perceptions of dominance in male faces. We found that increases in perceived height, masculinity, and age (up to 35 years) all increased facial dominance. Our results may reflect perceptual generalizations from sex differences as men are on average taller, more dominant, and age faster than women. Furthermore, we found that the influences of height and age on perceptions of dominance are mediated by masculinity. These results give us a better understanding of the facial characteristics that convey the appearance of dominance, a trait that is linked to a wealth of real-world outcomes.

Keywords: dominance, height, age, masculinity, perception, faces

Introduction

Dominance is multidimensional (Bernstein, 1981), but it can be broadly defined as the ability to influence others, through either social skills or physical aggression (Keating & Bai, 1986). Research has demonstrated that facial characteristics associated with dominant appearance have great effects on human personal and social life. Perceived dominance in male faces is associated with a variety of social outcomes, ranging from rank attainment of cadets in the military (Mueller & Mazur, 1997) to sexual activity levels of teenage boys (Mazur, Halpern, & Udry, 1994). Dominant-looking people are physically stronger (Fink, Neave & Seydel, 2007), are favored as leaders during times of intergroup conflict (Little, Burriss, Jones, & Roberts, 2007; Re, DeBruine, Jones, & Perrett, 2013), and are more successful leaders in the business world (Rule & Ambady, 2008). Cues to dominance have been theorized to function as both an indicator of mate value, as expressed through mate preferences (Perrett et al., 1998), and of physical formidability in intrasexual competition (Puts, 2010). Dominance is associated with a host of diverse real-world outcomes and, consequently, a great deal of research has focused on this complex trait (see Watkins et al., 2010 for a review).

Ratings of dominance are consistent in adults across cultures and are influenced by a variety of factors (Keating et al., 1981a). One physical factor that influences perceived dominance is height (Montepare, 1995; Undurraga, Zebrowitz, Eisenberg, Reyes-García, & Godoy, 2012). Adults often attribute taller boys with greater dominance, strength, and knowledge than shorter boys (Undurraga et al., 2012). Similarly, preschool-aged children judge tall men to be stronger, smarter, and more dominant than short men (Montepare, 1995). Research suggests that such judgments have some ecological validity, given the positive relationships between height and physical strength (Kuh et al., 2006), income attainment

(Judge & Cable, 2004), and leadership selection (Sorokowski, 2010). Furthermore, taller men are perceived to be more aggressive (Van Quaquebeke & Giessner, 2010) and also self-report more frequent dominant behavior (Melamed, 1992).

Facial cues to height, which correlate with actual height (Burton & Rule, 2013; Re et al., 2013b), have also been found to influence perceptions of dominance (Windhager, Schaefer, & Fink, 2011). One study found that facial cues associated with tall physical stature increase perceived dominance (Re et al., 2013a). Another study, however, found that facial characteristics of shorter men are associated with increased perceptions of dominance (Windhager et al., 2011). The apparent discrepancy in findings may be due to methodological differences. Re et al. (2013a) employed faces that had been altered to simulate changes in perceived height to test for perceptions of dominance. Conversely, Windhager et al. (2011) used a geometric morphometric analysis to find that facial shape associated with dominance was more similar to that of short men rather than tall men. Further research is therefore needed to clarify the relationship between perceptions of height and dominance in faces.

Masculinity is another key factor that influences judgments of dominance (Watkins, 2011). Facial masculinity is defined as the vector difference between the average male and the average female face shape (Perrett et al., 1998). Past research has consistently found that faces with high levels of masculinity are perceived as more dominant than faces with low levels of masculinity (DeBruine et al., 2006; Perrett et al., 1998). For example, faces of men with larger jaws are judged as more dominant than faces of men with smaller jaws (Keating at al., 1981a). Additionally, higher facial masculinity is correlated with hand-grip strength (Van Dongen & Sprengers, 2012) as well as with success in physical sports (Bailey & Hurd, 2004).

Both height and masculinity are sexually dimorphic traits that are related to an individual's level of physical strength (Kuh et al., 2006; Van Dongen & Sprengers, 2012). As

such, facial indicators of height and masculinity might be morphologically related, given that on average, men are taller than women (Gray & Wolfe, 1980). Facial features are similar in girls and boys until puberty (around age 13), when facial growth slows for girls but continues for boys (Bulygina, Mitteroecker, & Aiello, 2006). This pubertal facial growth leads to sexual dimorphism in face shape and results in men having larger noses, longer chins, wider jaws, and thicker eyebrows than women (Burton, Bruce, & Dench, 1993; Windhager et al., 2011).

The ability to dominate others can reflect physical strength (i.e. physical dominance), as well as social skills (i.e. social dominance) (Keating, Mazur, & Segall, 1981b). Past research suggests that there are facial cues, such as apparent age, that signal social dominance (Keating et al., 1981b). For instance, decreasing the amount of cranial hair increases judgments of social maturity and age (Muscarella & Cunningham, 1996). Additionally, male faces with receded hairlines are perceived as more dominant (Keating et al., 1981b). The influence of age on overall facial dominance, however, remains unclear. Roll and Verinis (1971) found that balding figures are judged to be less potent and active, suggesting that baldness may actually indicate low dominance. Similarly, dominance scores assigned to the photographs of men from a military academy were slightly lower later in their career (approximately 40-49 years old) than they were as cadets (approximately 18-27 years old) (Mueller & Mazur, 1996). In addition, Hehman, Leitner, and Freeman (2014) revealed that the influence of facial width-to-height ratio (a facial cue predictive of dominant behavior; Carré, McCormack, & Mondloch, 2009; Valentine, Li, Penke, & Perrett, 2014) on judgments of personal traits, such as warmth and wisdom, is directly influenced by target age. These findings demonstrate the need for more research regarding the effect of age on perceptions of dominance.

The current study examines how perceptions of height, masculinity, and age influence one another in male faces. Several studies have examined the individual effects of these three

traits on a variety of social outcomes, such as voting decisions (Little et al., 2007; Re et al., 2013a,b; Spisak, 2012) and partner preferences (DeBruine et al., 2006; Re & Perrett, 2012), yet we know much less about the influence of these traits on each other. Past research has found a positive correlation between age and masculinity (Boothroyd et al., 2005) and we therefore hypothesized that faces with higher levels of masculinity would be perceived as older. Similarly, we predicted that faces transformed to look older would be perceived as more masculine.

Given that puberty increases both masculinity and height in men (Boxer, Tobin-Richards, & Peterson, 1983), we anticipated that alterations in facial cues to masculinity and height would have perceptual cross-influences on each other. We also predicted that the relationship between perceptions of height and age would follow an inverted-U pattern, given that the pubertal growth stage can last until age 22 (Frisancho & Baker, 1970) and height loss begins at age 30 (Sorkin, Muller, & Andres, 1999).

Height, masculinity, and age have all been found to have distinct effects on perceptions of dominance, although the relative weighting of these perceptual traits on such judgments is still unclear. We therefore investigated how altering perceived height, masculinity, and age each influence perceptions of dominance in male faces. We hypothesized that faces of men who appeared to be tall would be assigned higher dominance ratings because taller men are physically stronger (Sell et al., 2009), are perceived as more dominant (Melamed, 1992), and behave in a more domineering way (Melamed, 1992). Given that dominance scores of male faces decline later in life (Mueller & Mazur, 1996), we predicted that the relationship between men's ages and their dominance ratings would follow an inverted-U pattern, with the highest ratings around age 30. Following prior work on the relationship between masculinity and dominance (e.g. DeBruine et al., 2006; Perrett et al., 1998), we hypothesized that participants would assign higher dominance ratings to faces with

higher levels of masculinity. Height and masculinity are both sexually dimorphic traits that signal physical strength, and perceived height may therefore be based (at least in part) on the same facial characteristics as masculinity. Consequently, we predicted that masculinity would have the strongest influence on dominance perceptions.

Lastly, we investigated the effect of perceiver's sex on dominance ratings. Previous work has shown that judgments of dominance are biased by the perceiver's own dominance (Watkins et al., 2010). Shorter men rate themselves as less dominant than taller men and assign higher dominance ratings to masculine-looking men (Watkins et al., 2010). Women are on average less masculine, shorter, and less physically dominant than men (Gray & Wolfe, 1980); we therefore hypothesized that women would assign higher dominance ratings overall.

Study 1

Methods

Stimuli

We obtained face images of Caucasian men from an online database (3D.SK, 2012). We delineated them with 189 points for digital processing using Psychomorph, a custom software (Tiddeman, Perrett, & Burt, 2001), and aligned them to a standard inter-pupillary distance (Rowland & Perrett, 1995). We created five composite images (each one created by averaging a random selection of three original male faces together) and masked them to occlude clothes with a black oval around the head. We then created "prototypes" to use for

transforming the composites in perceived height, masculinity, and age (see Re et al., 2013b for details).

We created the prototypes for perceived height by first having 22 participants (M_{age}=25.25 years, *SD*=4.64) rate the apparent height of male faces. The faces of the ten men perceived as shortest and the faces of the ten men perceived as tallest (matched for age and body mass index) were averaged separately (see Re et al., 2013a for details). The individual faces in the short prototype had an average apparent height of 175.68 cm (M_{age}=22.50 years, *SD*=4.20). The individual faces in the tall prototype had an average apparent height of 183.76 cm (M_{age}=24.20 years, *SD*=4.26). In order to create the perceived height transforms, we applied ±100% of the mathematical difference in face shape between the short and the tall prototypes to each of the five male composites. A total of three perceived height transforms were created for each composite: -100%, 0%, and 100% (Figure 1, top row).

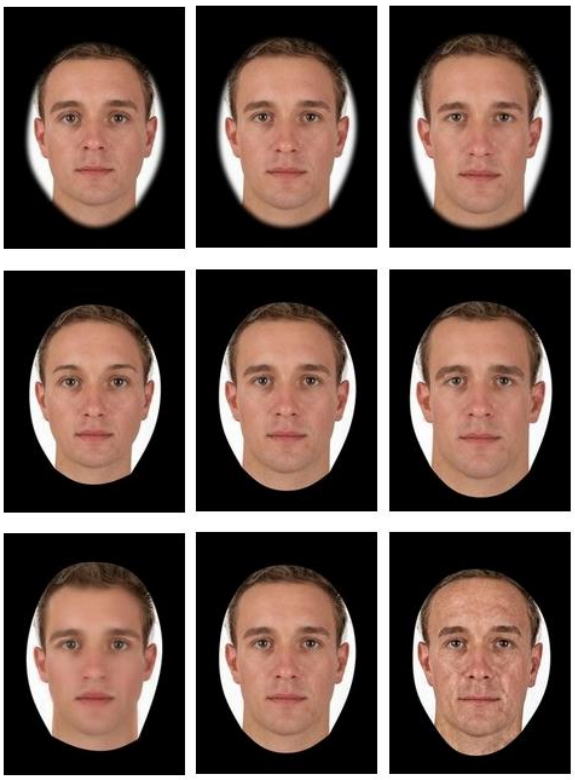


Figure 1. Example of transforms for perceived height (top row), masculinity (middle row), and age (bottom row) for one of the composites. Certain facial features of the same face change based on each manipulation (e.g. elongation of the face with the height transforms, prominence of the eyebrows with the masculinity transforms, wrinkling of the skin with the age transforms). The corresponding degrees of transformation are -100%, 0%, and 100% from left to right.

The prototypes for masculinity were generated by digitally blending photographs of same-sex individuals (Perrett, May, & Yoshikawa, 1994). We averaged the faces of 83 women (M_{age}=23.04 years, *SD*=3.81) to produce a female prototype, and averaged the faces of 47 men (M_{age}=25.25 years, *SD*=4.64) to produce a male prototype. We then used the shape difference between the male and

female prototypes to define an axis of transformation from feminine to masculine and applied ±100% of the shape difference to the five male composites to create masculinity transforms. A total of three masculinity transforms were created for each composite: -100%, 0%, and 100% (Figure 1, middle row).

We generated the prototypes for age by separately averaging the faces of younger and older men to create composites corresponding to ages 28 and 58, respectively (see Tiddeman et al., 2001 for details). In order to create the age transforms, we applied ±100% of the shape and texture difference between the younger and the older prototypes to each of the five male composites. A total of three age transforms were created for each composite: -100%, 0%, and 100% (Figure 1, bottom row).

Procedures and Participants

Ethical approval was received from the University of St Andrews Ethics Board and all participants provided consent. Study 1 was comprised of three separate tasks, conducted between subjects. In each task, participants rated 45 transformed images (3 transform percentages x 3 transform types x 5 composites) individually and in random order. Participants rated the faces for either height (8 point Likert-scale, 1="*very short [150-155 cm; 4'11-5'1 ft' in]*", 8="*very tall [201-206 cm; 6'7-6'9 ft' in]*"), masculinity (8 point Likert-scale, 1="*not at all masculine*", 8="*very masculine*"), or age (11 point Likert-scale, 1="*under 15 years old*", 11="*over 60 years old*"). The intervals in the Likert scales were selected to facilitate participant comprehension and ease of response (e.g. 5 year increments for age, 2 inch increments for height).

Study 1 was conducted online via a volunteer sample of participants, with every task available for one month. Only data from participants who reported completing the whole task

successfully (i.e. answering "yes" to the question "were you able to see and rate all images successfully?") and truthfully (i.e. answering "yes" to the question "have you answered all questions truthfully?") were used in the analyses. 18 men (M_{age}=22.78 years, *SD*=8.97) and 64 women (M_{age}=21.08 years, *SD*=3.66) completed the height rating task. 47 men (M_{age}=23.62 years, *SD*=8.18) and 66 women (M_{age}=23.95 years, *SD*=9.59) completed the masculinity rating task. 44 men (M_{age}=28.73 years, *SD*=13.00) and 103 women (M_{age}=26.77 years, *SD*=11.15) completed the age rating task.

Results

We averaged ratings for each task across composites of the same transform type and transform level, and aggregated data to the participant level. We analyzed the data for each task with repeated-measures ANOVAs with the three transform levels (i.e. -100%, 0%, and 100%) as the within-subjects variable and participant sex as the between-subjects variable. A Levene's test was used to check for homogeneity of variances and was non-significant for all the analyses except for the 0% perceived height transform on height ratings (p=0.028) and the 100% age transform on masculinity ratings (p=0.043). Rater's sex had no effect on the height and age ratings, as neither the main effects ($p\geq$0.646 for all analyses) nor the interactions ($p\geq$0.452 for all analyses) were significant in the analyses. Rater's sex did have a significant main effect on masculinity ratings ($p\leq$0.044 for all analyses), with men assigning higher masculinity ratings than women to every transform level among every transform type.

Height

Height ratings were significantly altered by the perceived height transforms ($F(2, 160)=306.27$, $p<0.001$, $\eta_p^2=0.79$), masculinity transforms ($F(2, 160)=359.05$, $p<0.001$, $\eta_p^2=0.82$), and age transforms ($F(2, 160)=8.85$, $p<0.001$, $\eta_p^2=0.10$) (see Figure 2a). Bonferroni-corrected post-hoc tests showed significant differences in height ratings between the three perceived height transform levels and between the three masculinity transform levels. Height ratings also significantly increased between the -100% vs 0% age transform levels, but significantly decreased between the 0% vs 100% age transform levels.

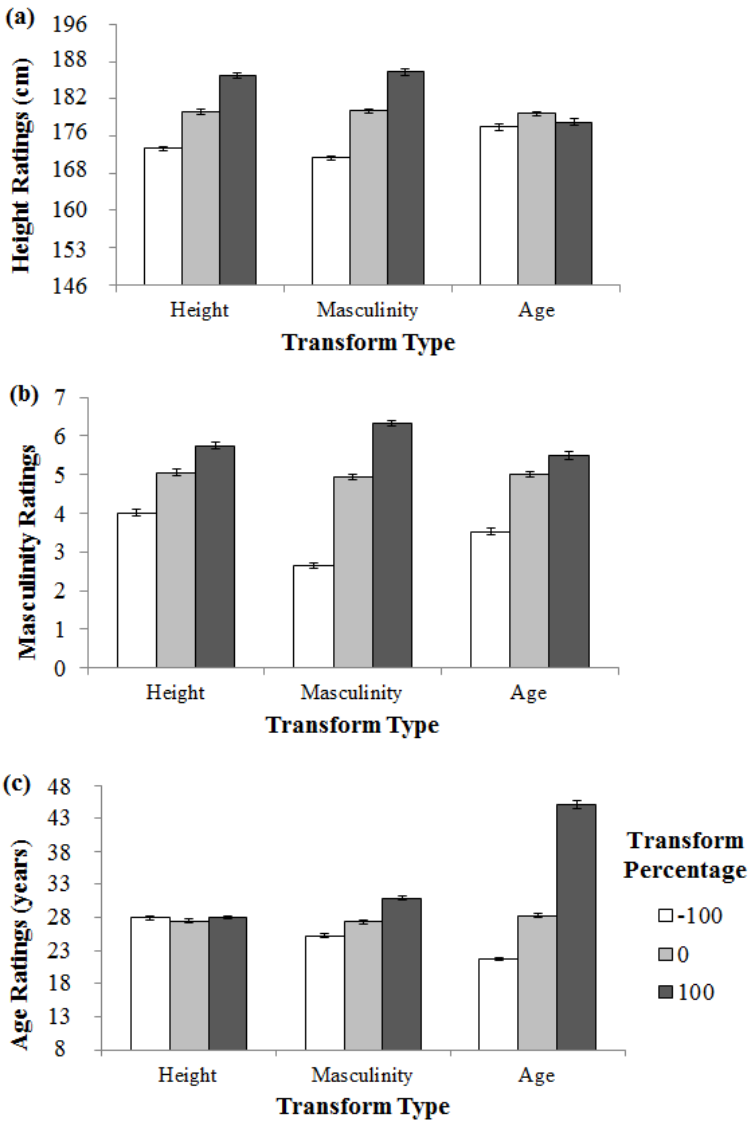


Figure 2. Average ratings for (a) height, (b) masculinity, and (c) age assigned to the transforms for perceived height (first clusters), masculinity (second clusters), and age (third clusters). Standard error bars are displayed.

Masculinity

Masculinity ratings were significantly altered by the perceived height transforms ($F(2, 222)=270.34$, $p<0.001$, $\eta_p^2=0.71$), masculinity transforms ($F(2, 222)=759.16$, $p<0.001$, $\eta_p^2=0.87$), and age transforms ($F(2, 222)=209.24$, $p<0.001$, $\eta_p^2=0.65$) (see Figure 2b).

Bonferroni-corrected post-hoc tests showed that the differences in the masculinity ratings were significant between the three transform levels for all three transform types.

Age

Age ratings were significantly altered by the perceived height transforms ($F(2, 290)=3.28$, $p<0.05$, $\eta_p^2=0.02$), masculinity transforms ($F(2, 290)=165.14$, $p<0.001$, $\eta_p^2=0.53$), and age transforms ($F(2, 290)=1075.69$, $p<0.001$, $\eta_p^2=0.88$) (see Figure 2c). Bonferroni-corrected post-hoc tests showed that the differences in the age ratings were significant between all transform levels for masculinity and age, and between the 0% vs 100% transform levels for perceived height.

Discussion

The results from Study 1 show that perceived height, masculinity, and age are not independent and that there is a significant amount of perceptual cross-influence between these three traits. Such overlap suggests that studies that examine one of these traits in isolation may need to account for the influence of the other two traits. The results also reveal that transforming faces for a particular trait increases perceptions of that trait monotonically. For example, the masculinity ratings increased monotonically with the degree of masculinity transformation. This confirms that transform manipulations are an effective method to alter perceptions of a desired trait.

The male and female prototypes we used for creating the masculinity transforms were not matched in age, which may have contributed to the influence of masculinity on perceived age. We note, however, that masculinity transforms based on age-matched sex prototypes

also increase perceptions of age (Perrett et al., 1998; Boothroyd et al., 2005). We also recognize that the influences of age and masculinity are bidirectional and symmetric, as our age transformation enhances masculinity (as has been previously reported; Boothroyd et al., 2005). The male and female prototypes will also reflect natural height differences, as men are significantly taller than women (Jousilahti et al., 2000). Hence, it is not surprising that masculinity transforms enhance perceived height. Regardless, the influences between height and masculinity are also bidirectional and symmetric, with our aged-matched perceived height transforms enhancing masculinity.

The influence of age on height showed the inverted-U pattern we predicted, with height ratings diminishing when the 25-year-old male faces were transformed both to look more youthful and to look older. The perceived height transforms had only a minor impact on perceived age, with increases in perceived height producing a small but significant increase in apparent age. This effect is consistent with pubertal bone growth, though very little growth would be expected after age 25. The decrease in perceived height did not significantly decrease age perceptions.

Study 2

Methods

Stimuli

The same transform levels from Study 1 (i.e. -100%, 0%, and 100%) were used, but in order to capture more detailed information regarding perceptions of dominance, two additional transform levels were added (i.e. -50% and 50%). To keep the number of facial

stimuli constant at 45, only three of the five composites were used in Study 2. As all five composites received similar ratings in Study 1, the three composites used in Study 2 were chosen at random.

Procedures and Participants

We received ethical approval from the University of St Andrews Ethics Board and all participants provided consent. Study 2 was conducted online via a volunteer sample of participants over the course of one month. Only data from participants who reported completing the whole task successfully and truthfully were used in the analyses. 77 men (M_{age}=27.32 years, *SD*=12.64) and 117 women (M_{age}=23.45 years, *SD*=8.02) participated in Study 2. Participants rated the 45 transformed images (5 transform percentages x 3 transform types x 3 composites) for dominance (8 point Likert-scale, 1="*not at all dominant*", 8="*very dominant*"). Faces were presented individually and in random order.

Results and Discussion

Ratings were averaged across composites of the same transform type and transform level, and aggregated at the participant level. The data were analyzed using repeated-measures ANOVAs with the five transform levels (i.e. -100%, -50%, 0%, 50%, and 100%) as the within-subjects variable and participant sex as the between-subjects variable. Rater's sex had no effect on any of the ratings, as neither the main effects ($p \geq 0.646$ for all analyses) nor the interactions ($p \geq 0.187$ for all analyses) were significant for any of the analyses.

Dominance ratings were significantly altered by the perceived height transforms ($F(4, 768)=95.19$, $p<0.001$, $\eta_p^2=0.33$), masculinity transforms ($F(4, 768)=199.93$, $p<0.001$,

η_p^2=0.51), and age transforms (F(4, 768)=56.25, p<0.001, η_p^2=0.23) (see Figure 3). Bonferroni-corrected post-hoc tests showed that the differences in the dominance ratings were significant between all the perceived height transform levels, except for those between 0% vs 50%, and between all the masculinity transform levels. Curve estimation analyses revealed that the quadratic model did not explain additional variance beyond the linear model for the influence of both perceived height (both adjusted R^2≥0.99) and masculinity (both adjusted R^2≥0.99) on judgments of dominance. Bonferroni-corrected post-hoc tests showed that the differences in the dominance ratings were significant between all the age transform levels, except for 0% vs 100% and 50% vs 100%. A curve estimation analysis revealed that the quadratic model (adjusted R^2=0.94) showed a stronger fit than the linear model (adjusted R^2=0.78) for the influence of age on judgments of dominance. In order to determine whether the relationship between men's ages and their dominance follows an inverted-U pattern, older faces would need to be used as this study only provides evidence for an asymptotic relationship between age and dominance.

The results from Study 2 show that perceived height, masculinity, and age all influence perceptions of dominance in male faces. Specifically, maximum dominance was achieved by increasing perceived height and masculinity while maintaining age at around 35.

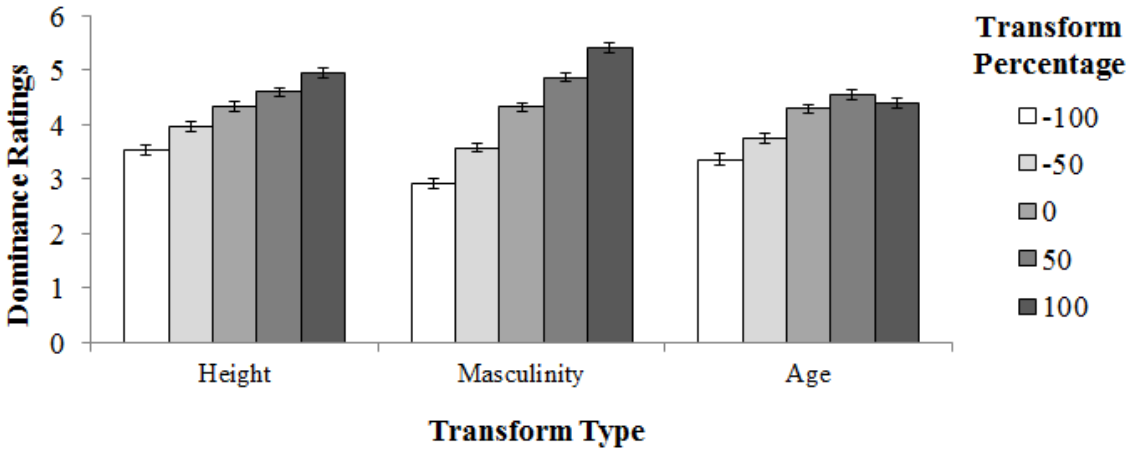


Figure 3. The average dominance ratings assigned to the transforms for perceived height (first cluster), masculinity (second cluster), and age (third cluster) according to transform percentage. Standard error bars are displayed.

The findings from Studies 1 and 2 suggest it is difficult to disentangle the effects of perceived height, masculinity, and age on perceptions of dominance. In order to examine their unique effects, un-manipulated faces were rated for height, masculinity, age, and dominance in Study 3.

Study 3

Methods

Stimuli

The un-manipulated face images from Study 1 were used for Study 3. The face images consisted of 49 Caucasian men (3D.SK, 2012) photographed facing forward, under constant camera and lighting conditions, with closed-mouth neutral expressions, and no adornments (e.g. glasses, jewelry).

Procedures and Participants

Ethical approval was received from the University of St Andrews Ethics Board and all participants provided consent. Study 3 was conducted online via a volunteer sample of participants over the course of one month. Only data from participants who reported completing the whole task successfully and truthfully were used in the analyses. 13 men (M_{age}=26.38 years, *SD*=4.54) and 35 women (M_{age}=23.17 years, *SD*=4.46) participated in the study. Participants rated all target faces in random order and one at a time. Each face was

rated for height, masculinity, age, and dominance simultaneously using the same Likert scales from Studies 1 and 2.

Results and Discussion

Participants showed high levels of inter-rater reliability for all judgments (all Cronbach's a>0.95) and we therefore averaged participant's ratings to produce a mean rating for every trait. The bivariate correlations were significant for all the traits except between height and age (see Table 1 for the correlation values and Figure 4 for a scatterplot). Separate linear regression models of each trait on the other two traits were conducted for collinearity diagnostics. All the variance inflation factors≤1.80 and all the tolerance values≥0.55, indicating that multicollinearity was not an issue. The data were then analyzed using a two-step regression (dependent variable: dominance; first independent variables: height and age; second independent variable: masculinity). Height (β=0.41, p<0.001) and age (β=0.54, p<0.001) were both significant predictors of dominance perceptions in the first model (R^2=0.49, F(2, 48)=22.25, p<0.001). In the second model, height (β=0.01, p=0.873) and age (β=-0.06, p=0.479) were no longer significant predictors of dominance but masculinity (β=0.95, p<0.001) did significantly predict dominance judgments (R^2=0.84, F(3, 48)=77.48, p< 0.001).

Table 1. Bivariate correlations between ratings of height, masculinity, age, and dominance.

	Height	Masculinity	Age	Dominance
Height		0.47*	0.09	0.45*
Masculinity			0.67*	0.91*
Age				0.57*
Dominance				

*Note. *Significant at the 0.01 level (2-tailed).*

To test whether masculinity mediates the effect of height or age on dominance, the SPSS plugin PROCESS was used (Hayes, 2013). We conducted a mediation analysis with dominance as the outcome variable, masculinity as the mediator, and height and age as exogenous variables (see Figure 5). The model was saturated, but showed acceptable fit (CFI=1.00, SRMR=0.00). Height (β=0.42, p<0.001) and age (β=0.63, p<0.001) both significantly predicted masculinity (overall model: R^2=0.62, F(2,46)=36.90, p<0.001). The direct effect of masculinity was a significant predictor of dominance (β=0.95, p<0.001), whereas the direct effects of height (β=0.01, p=0.873) and age (β=-0.06, p=0.479) were both not significant in predicting dominance (overall model: R^2=0.92, F(3,45)=77.48, p<0.001). Bias-corrected confidence intervals for indirect effects were calculated using 5000 bootstrapped resamples. The indirect effects of height (β=0.39, Bootstrap SE=0.10, 95% CI [0.23, 0.60]) and age (β=0.60, Bootstrap SE=0.09, 95% CI [0.44, 0.80]) on dominance through masculinity were both significant.

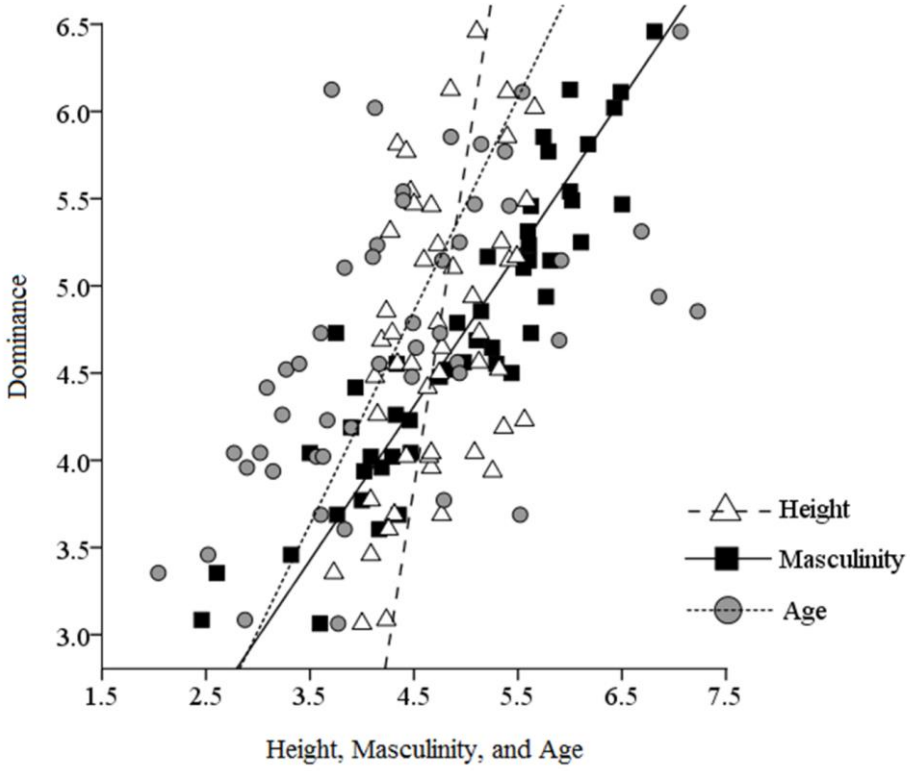
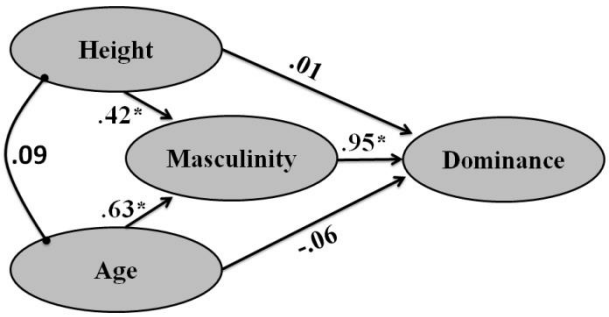


Figure 4. Scatterplot depicting the relationships between height (triangles on an 8 point Likert-scale, 1="*very short [150-155 cm; 4'11-5'1 ft' in]*", 8="*very tall [201-206 cm; 6'7-6'9 ft' in]*"), masculinity (squares on an 8 point Likert-scale, 1="*not at all masculine*", 8="*very masculine*"), and age (circles on an 11 point Likert-scale, 1="*under 15 years old*", 11="*over 60 years old*") on dominance (8 point Likert-scale, 1="*not at all dominant*", 8="*very dominant*"). Separate linear trendlines for the association between height and dominance (dashed line), masculinity and dominance (solid line), and age and dominance (dotted line) are also included.

These results indicate that there are significant correlations between perceptions of height, masculinity, and age in male faces. The strong relationship between masculinity and dominance suggests that masculinity plays a crucial role in perceptions of dominance. Additionally, the results show that the influences of height and age on perceptions of dominance are mediated by masculinity.



Note. *Significant at the 0.001 level (2-tailed).

Figure 5. Diagram depicting how masculinity mediates the effect of height and age on dominance.

General Discussion

The results from Study 3 suggest that there are significant correlations between height, masculinity, age, and dominance. Male faces that appear very masculine are also perceived as taller, older, and more dominant. Additionally, height and age were both found to significantly influence perceptions of dominance, though these influences were mediated by masculinity.

The results from Study 1 show that experimentally manipulating faces to alter perceived height, masculinity, or age all affect perceptions of the other two traits. This finding suggests that judgments of one of these traits are subject to perceptual cross-influences of the other two traits. As predicted, height ratings were found to be strongly influenced by masculinity, with more feminine-looking men being perceived as shorter. Ratings of masculinity were also found to be strongly influenced by perceived height, with shorter-looking men being perceived as more feminine. The correlation between height and masculinity judgments suggests that these perceptual traits are not independent. This finding

is perhaps expected considering that both masculinity and height are sexually dimorphic traits (Hönekopp, Voracek, & Manning, 2006).

Although ratings of height were also found to be influenced by age, the effect was weak. Men who appeared to be 18.5 years old were perceived as shorter than men who appeared to be 25 years old. This finding may reflect the effects of pubertal growth, which may not finish until age 22 (Frisancho & Baker, 1970). Related to this point, teenaged men likely appear somewhat more neotenous, or babyfaced, than their older counterparts, a perceptual trait associated with weakness and low dominance (Zebrowitz-McArthur & Apatow, 1984). Men who appeared to be 42 years old were perceived to be somewhat shorter than men who appeared to be 25 years old. It is possible that people may associate older age with a decline in stature as height loss in men begins at around age 30 (Sorkin et al., 1999). These results confirm the hypothesis that there is an inverted-U relationship between perceived height and age.

As predicted, ratings of age were influenced by masculinity and vice versa. These findings are consistent with past research that has found a positive correlation between age and masculinity (Boothroyd et al., 2005). One possible explanation for such a relationship is that feminine-looking men might be attributed with a pre-pubertal status and might therefore be perceived as younger. A lack of masculinity also relates to the aforementioned effects of neoteny (Zebrowitz-McArthur & Apatow, 1984).

In Study 2, dominance perceptions were found to be influenced by perceived height, masculinity, and age. As hypothesized, perceived height and masculinity both had a positive linear relationship with dominance. Increasing masculinity produced a corresponding increase in perceptions of dominance, consistent with previous research (DeBruine et al., 2006; Perrett et al., 1998). Increasing perceived height also gave a corresponding boost to perceptions of dominance, providing support for the positive relationship between judgments

of height and dominance found in a recent study (Re et al., 2013a). Age also had an effect on dominance, with dominance ratings increasing until around the age of 35 before plateauing. Although it is difficult to disentangle which of these traits is truly driving judgments of dominance given that manipulating any one of the traits leads to changes in perceptions of the other two traits, the results from Study 3 suggest that masculinity drives the effects of height and age on perceptions of dominance.

Only ratings of masculinity differed between male and female participants, with men assigning higher masculinity ratings than women to all the stimuli. Surprisingly, dominance ratings did not differ significantly between men and women. It was predicted that women would assign higher dominance ratings overall, but this was not the case. Men and women might both make accurate judgments of dominance as it is an important cue for both sexes. For men, accurately assessing other men's dominance is important for intrasexual competition as dominance correlates with physical strength (Fink et al., 2007; Undurraga et al., 2010). As such, the ability to assess an individual's dominance without having to engage in aggressive competition will spare the less dominant individual potential injuries that could arise from an unsuccessful agonistic encounter (Bernstein, 1981). For women, correctly assessing men's dominance is important for intersexual selection as dominant men have higher status positions in society (Mueller & Mazur, 1997) and have greater resource acquisition potential (Parker, 1974), both of which could confer benefits to a man's partner (Gangestad & Simpson, 2000). Indeed, women prefer high-status partners (DeWall & Maner, 2008) and therefore accurate assessments of men's dominance may afford selective advantages in women's mate choice.

The results from this study have implications for a wide field of research. Many studies employ manipulations of height (e.g. Re et al., 2013a), masculinity (e.g. Batres & Perrett, 2014), and age (e.g. Burt & Perrett, 1995). The current research suggests that these

domains are not perceptually distinct, but rather that changes in one domain can influence perceptions of the other two. Thus, studies that attempt to manipulate one domain need to be cognizant of the fact that such manipulations may be influencing perceptions in other ways. For example, previous studies have shown that perceptions of physical traits (e.g. attractiveness) and social traits (e.g. leadership) are affected by facial cues to masculinity, age, and height (DeBruine, 2014; Little et al., 2007; Re et al., 2013a; Spisak, 2012). The current research suggests that altering one of these traits may also influence perceptions of the others, thereby complicating the interpretation of results. Although this does not negate the effects found in previous studies using experimental manipulations of faces, it does reveal the potential of alternative factors influencing perceived trait changes. Indeed, in humans, masculinity, height, age, and dominance are inextricably linked as men are on average taller (Jousilahti et al., 2000), age faster (as evidenced by shorter life expectancy; Kruger & Nesse, 2006), and are perceived as more dominant than women (Hayes & Wolleat, 1978; Re, Lefevre, DeBruine, Jones, & Perrett, 2014). Future studies aiming to investigate the influence of height or age, independent of masculinity, should create composites that vary in height or age but not in masculinity. This can be achieved by averaging faces that differ in either height or age but are rated the same on masculinity. Doing so would allow researchers to experimentally examine the influence of age or height, independent of masculinity, without the need for regressions analyses and control variables.

Our findings suggest that perceived height, masculinity, and age all influence perceptions of dominance in male faces. The positive linear relationship between masculinity and dominance is well established, but the effects of perceived height and age on dominance have been unclear. This study helps explain the relationship between perceived height and dominance by providing evidence of a positive linear relationship. In addition, this study provides evidence that perceived dominance increases with age until the face appears to be 35

years old. These findings clarify the role of perceived height, masculinity, and age on dominance and suggest that maximum dominance in a male face is achieved by increasing perceived height and masculinity while maintaining age at around 35.

Acknowledgements

We thank Dengke Xiao for the experimental interface, Anne Perrett for proofreading, Sean N Talamas and Iris J Holzleitner for help with mediation analyses, Lesley Ferrier for logistical support, and everyone who participated in the studies.

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