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Apparent height and body mass index influence perceived leadership ability in three-dimensional faces

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Abstract. Facial appearance has a well-documented effect on perceived leadership ability. Face judgments of leadership ability predict political election outcomes across the world, and similar judgments of business CEOs predict company profits. Body height is also associated with leadership ability, with taller people attaining positions of leadership more than their shorter counterparts in both politics and in the corporate world. Previous studies have found some face characteristics that are associated with leadership judgments, however there have been no studies with three-dimensional faces. We assessed which facial characteristics drive leadership judgments in three-dimensional faces. We found a perceptual relationship between height and leadership ability. We also found that facial maturity correlated with leadership judgments, and that faces of people with an unhealthily high body mass index received lower leadership ratings. We conclude that face attributes associated with body size and maturity alter leadership perception, and may influence real-world democratic leadership selection.

Keywords: facial adiposity, BMI, physical height, facial maturity

1 Introduction

Leadership judgments made from faces of unfamiliar political candidates have predicted real election outcomes from across the world (see Olivola and Todorov 2010 for review). Even face judgments of leadership ability made by children predict electoral success and match similar decisions made by adults (Antonakis and Dalgas 2009). Facial appearance also predicts leadership success in the corporate world. Judgments of power and leadership ability made from face images of business CEOs predict profit margins in businesses (Rule and Ambady 2008). Similar judgments made from faces of managing partners of law firms predict profits (Rule and Ambady 2011a), even if the face images are taken before a person ascends to a position of authority (Rule and Ambady 2011b). Previous studies have found that sexual dimorphism in face shape and facial attractiveness also influence leadership perception, with more masculine and attractive faces being preferred as leaders during times of inter-group conflict (Little et al 2007, 2012; Spisak et al 2011, 2012). These studies demonstrate how facial appearance influences perceived leadership ability, and how this perception is associated with success in a leadership role.

Leadership selection is also associated with body height. Height predicts career success and income (Judge and Cable 2004; Melamed 1994), and taller men and women are more likely to be selected to leadership positions within the business world (Judge and Cable 2004). Taller men and women are more dominant and assertive (Melamed 1992) less anxious (Melamed 1994), and run for positions of leadership more frequently (Murray and Schmitz 2011). The positive association between physical height and authority is present even in preverbal infants, who show more surprise when taller lines back away from shorter lines in simulated confrontations than vice versa (Thomsen et al 2011). In politics, popular candidates are perceived to be taller than their opponents (Sorokowski 2010), and successful candidates are perceived to be taller after winning an election, while the losers are perceived to be shorter (Higham and Carment 1992). Height has a well-known association

with United States presidential candidates' success. Presidential races in the 20th century saw the taller of two main candidates win 88% of the elections (Sorokowski 2010), and the difference in candidates' heights was proportional to the difference in obtained election votes from 1824–1992 (McCann 2001). Height may be associated with leadership through the appearance of physical dominance, which was crucial in attaining leadership roles in our evolutionary past (Murray and Schmitz 2011; Riggio and Riggio 2010).

Taller men are found to have longer faces and narrower jaws (Windhager et al 2011). Craniofacial research indicates that as the face develops with body growth from infancy to adulthood, the jaw becomes more prominent and the overall face changes from round to oval (Akgul and Toygar 2002; Enlow and Hans 1996; Ramanathan and Chellappa 2006). These findings suggest that there are cues to height in the face. Given the association between height and leadership status, it is possible that facial cues to height may influence judgments of leadership ability.

Just as cues to body height may affect face judgments of leadership ability, cues to body weight may influence such judgments as well. The World Health Organization (WHO) defines any body mass index (BMI/kg m^{-2}) above 25 as overweight (World Health Organization [WHO] 2006). Overweight people face many negative stigmas. For example, men and women with high BMI levels face social and professional discrimination (Rand and Macgregor 1990) and are more likely to be of lower socioeconomic status (Sobal and Stunkard 1989). High BMI is also correlated with body-image dissatisfaction and lower self-esteem (Stunkard and Wadden 1992). Previous research has demonstrated that BMI can be accurately judged from face images alone (Coetzee et al 2010) and face cues to high BMI affect decrease perceived facial health and attractiveness (Coetzee et al 2009, 2011; Re et al 2011). Rated facial adiposity from face images also negatively correlates with actual longevity, in that people who appear heavier from face photographs tend to die earlier (Reither et al 2009). Furthermore, women with higher facial adiposity also have poorer psychological health (as measured by questionnaires on stress, anxiety and depression; Tinlin et al 2012). These studies suggest that facial adiposity is associated with perceived and real indices of physical and psychological condition. It is therefore possible that facial cues to high BMI may decrease perceived leadership ability.

One perceptual face trait that has been found to affect leadership judgments is facial maturity. Faces perceived as having a mature look (as opposed to a baby-faced look) appear more dominant (Keating et al 1999, 2003). Dominance is historically associated with leadership quality (Riggio and Riggio 2010), and dominant faces are perceived to belong to better leaders (Olivola and Todorov 2010; Rule and Ambady 2008, 2009). Indeed, baby-faced individuals have been found to face disadvantages in actual leadership races (Zebrowitz and Montepare 2005). The reported effects of facial maturity on leadership judgments in two-dimensional faces indicates that maturity should always be assessed in analysing face cues to perceived leadership ability.

The vast majority of research on face cues to leadership has used two-dimensional (2-D) face stimuli. Here, we analyse correlates of perceived leadership ability in three-dimensional (3-D) faces. Specifically, we assess how face cues to height and weight (body dimensions that influence perceived dominance and competence) influence leadership judgments. We also extend upon previous studies by determining how facial maturity influences leadership judgments in 3-D faces, and control for maturity when assessing how perceived height and weight affects leadership perception. 3-D stimuli provide face information not available in stationary 2-D stimuli (Blanz and Vetter 1999; Tiddeman et al 2000), and have been successfully used in studies on how face cues to body size affect social attributes such as attractiveness (Coetzee et al 2011; Re et al 2011). 3-D faces allow viewers to see both the front and sides of a face, creating a more realistic representation of faces as seen in everyday life.

Determining cues that influence leadership judgments in 3-D faces could have implications for psychologists, political scientists, and anyone with interest in democratic leadership selection.

2 Methods

2.1 *Stimuli*

We recruited ninety women (mean age = 20.8 years, age range = 18–27 years) and fifty-nine men (mean age = 20.4 years, age range = 18–26 years) from both the University of St Andrews and McMaster University to have their faces photographed with a 3-D face scanner (www.3dmd.com), which provides a surface map of the 3-D face structure contours and surface colouration (figure 3). All photographed participants were Caucasian, had their hair pulled back and were asked to keep a neutral expression. All participants were seated at a constant distance from the camera, and were asked to keep their gaze on a fixed point.

The 90 women had an average height of 166.0 cm (range = 149.9–180.3 cm) and an average BMI of 23.3 (range = 18.2–39.1). The 59 men had an average height of 180.1 cm (range = 163.0–195.0 cm) and an average BMI of 22.3 (range = 17.5–33.4). To assess how healthy, high, and low BMIs affected leadership ratings, we divided BMI into three groups: healthy (BMI = 18.5–25), overweight (BMI > 25), and underweight (BMI < 18.5), as defined by the World Health Organization (WHO) 2006. There were 109 people (47 men) in the healthy range, 31 (6 men) in the overweight range, and 9 (6 men) in the underweight range.

2.2 *Participants and procedure*

Twenty-six participants (12 men, 14 women; mean age = 23.23 years, age range = 18–37 years) from the University of St Andrews participated in the experiment. All participants gave informed consent.

Participants were presented with two blocks of faces, one containing all the male faces and one containing all the female faces. In one block, participants were asked to rate each face for "how tall you think this person is" on a scale from 1 (very short) to 7 (very tall). In the other block, participants were asked to rate each face for "how good a leader you think this person would be" on a scale from 1 (very bad) to 7 (very good). Order of the blocks was randomised, and participants were not told what task they would complete in the second block until the first block was completed. Order of the individual faces was randomised within each block, as was the order of the male and female sex groups. Faces rotated 25º on the y axis and 30º on the x axis in a sinusoidal motion at 30º s^{-1}. This gave the impression that the head was "bobbing", allowing participants to see both the front and side profiles of each face. Participants were also allowed to scroll to "zoom" in and out on the face in order to view the faces from different apparent depths. All faces were presented on a black background and participants were encouraged to view the full face rotation before answering.

Thirteen separate participants (6 men, 7 women; average age = 28.38 years, range = 23–55 years) rated the faces for facial maturity. Participants were asked to rate "how mature-looking do you think this person is" on a scale from 1 (extremely baby-faced) to 7 (extremely mature-faced). Such ratings have been successfully used to assess facial maturity in previous studies (Berry and Zebrowitz-McArthur 1988; Friedman and Zebrowitz 1992).

3 Results

Inter-rater reliability was high for judgments of height (Cronbach's $\alpha = 0.92$), leadership (Cronbach's $\alpha = 0.87$), and facial maturity (Cronbach's $\alpha = 0.81$). These ratings were then averaged for each face and used in subsequent analyses. Since BMI was grouped into three main categories (healthy, overweight, and underweight), BMI group was entered as a fixed factor in subsequent analyses.

A MANCOVA was run to determine if actual height (the covariate) predicted ratings of height and leadership ability. Sex of the face was entered as a fixed factor. The MANCOVA revealed actual height, predicted height ratings ($F_{1,145} = 27.74$, $p < 0.01$, $\eta_p^2 = 0.16$), but not leadership ratings ($F_{1,145} = 0.40$, $p = 0.53$, $\eta_p^2 < 0.01$). There was no effect of sex of face in either rating (both $Fs_{1,145} \leqslant 0.03$, both $ps \geqslant 0.87$), and no interaction between actual height and face sex on either dependent variable (both $Fs_{1,145} \leqslant 0.03$, both $ps \geqslant 0.86$).

A custom univariate ANCOVA was run to determine the effects of perceived height and facial maturity (covariates), sex of face, and BMI group (fixed factors) on leadership ratings. The model also tested to see if sex of face interacted with any other variable. Perceived height ($F_{1,139} = 12.32$, $p < 0.01$, $\eta_p^2 = 0.08$; figure 1), facial maturity ($F_{1,139} = 5.60$, $p = 0.02$, $\eta_p^2 = 0.04$), and BMI group ($F_{2,139} = 5.12$, $p < 0.01$, $\eta_p^2 = 0.07$; figure 2) had significant effects on leadership ratings. Neither sex of face nor any interaction had a significant effect (all $Fs \leqslant 0.95$, all $ps \geqslant 0.39$). Figure 3 displays facial averages of the 10 faces rated highest and lowest (per sex) in leadership ability. A separate univariate ANCOVA was run to determine if BMI had an effect on leadership ratings when entered as a covariate (as opposed to being grouped by WHO classifications), with sex of face entered as a fixed factor. We found that

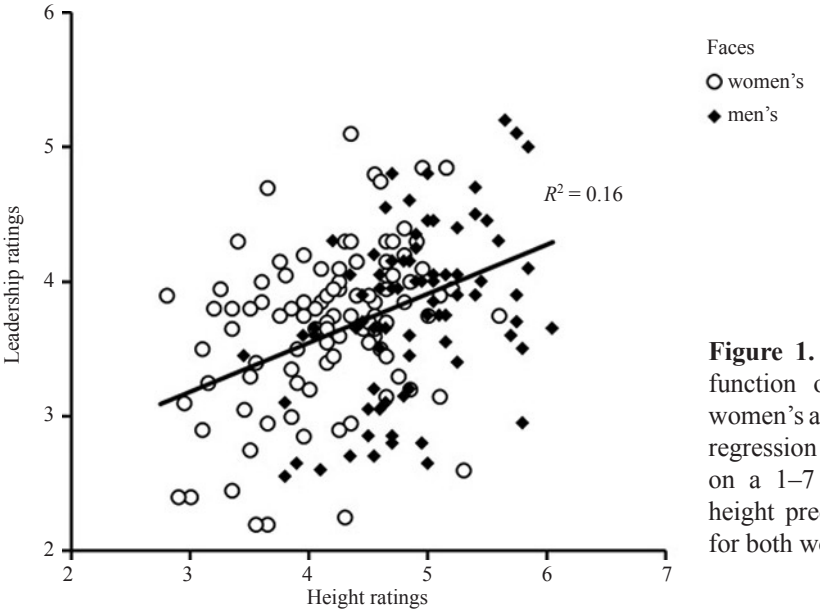

Figure 1. Leadership ratings as a function of perceived height for women's and men's faces, including regression line. Both ratings were on a 1–7 Likert scale. Perceived height predicted leadership ratings for both women's and men's faces.

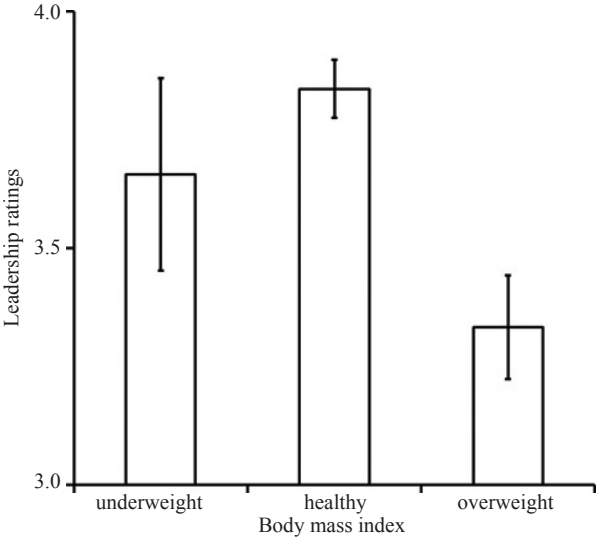

Figure 2. Leadership ratings as a function of body mass index (BMI) for underweight (BMI < 18.5), healthy (BMI = 18.5–25), and overweight (BMI > 25) groups. Leadership ratings were significantly lower for the overweight group, while ratings for the underweight and healthy group were not significantly different.

BMI had a significant effect on leadership ratings ($F_{1,145} = 15.26$, $p < 0.01$, $\eta_p^2 = 0.10$). There was no significant interaction between BMI and sex of face ($F_{1,145} = 0.04$, $p = 0.85$, $\eta_p^2 < 0.01$).

A-posteriori tests with Bonferroni correction revealed that people in the healthy BMI range had higher leadership ratings than those defined as overweight ($p = 0.01$), while leadership ratings for underweight people were not significantly different from healthy ($p = 0.74$) or overweight ($p = 1.0$) people (figure 2).

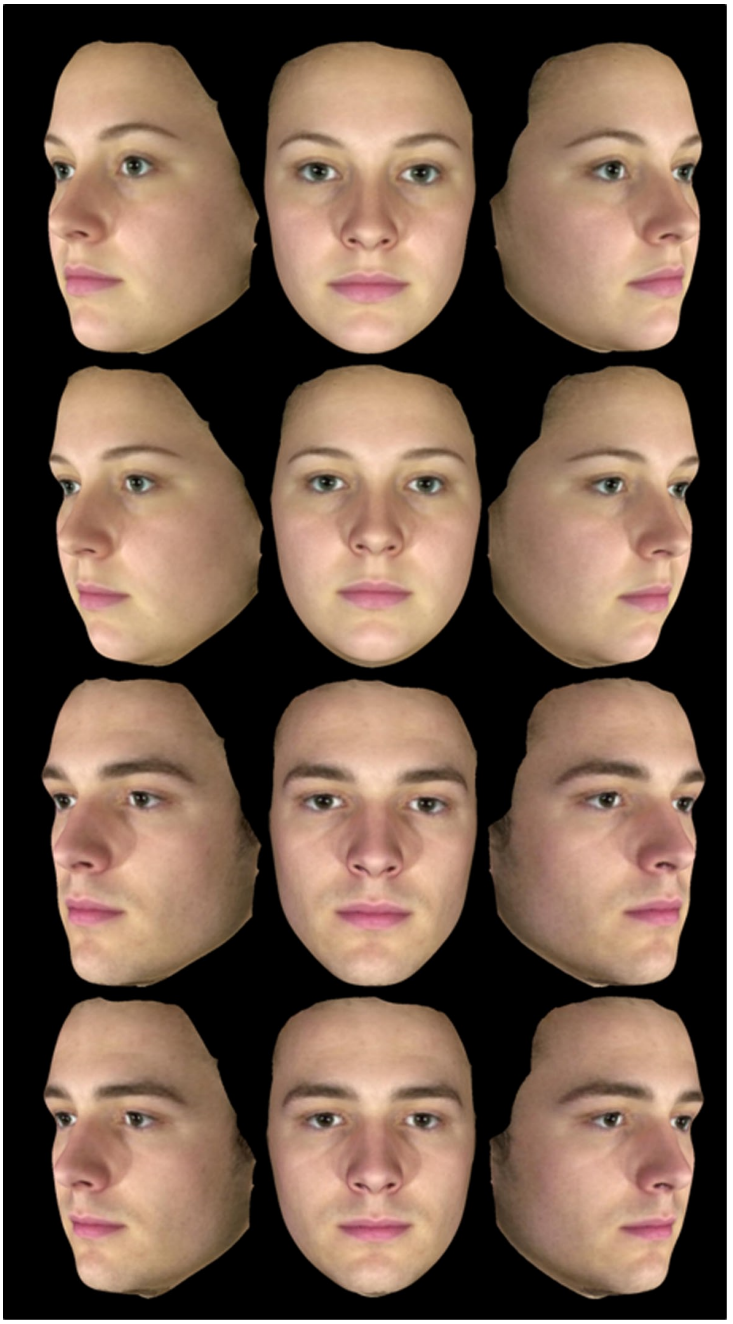

Figure 3. [In colour online, see http://dx.doi.org/10.1068/p7342] Face averages of the 10 people with the highest (rows 1 and 3) and lowest (rows 2 and 4) leadership ratings within sex. While frontal and profile views are shown here, participants viewed whole faces as they rotated 25º from side to side and 30º up and down in a sinusoidal manner. Perceived height and maturity predicted leadership ratings, while faces of overweight people had lower leadership ratings.

Brand and Bradley (2012) suggest that calculating relationships between ratings averaged across participants (such as the perceived height and leadership ratings calculated here) can inflate correlation estimates. To confirm any relationships, they suggest calculating the correlations between two variables of interest for each participant, then computing the average of these correlations. On their recommendations, we calculated the individual correlations between height ratings and leadership ratings for each participant, and then averaged those correlations together. We found that height and leadership ratings for each face were significantly correlated within-participant ($n = 149$, average $r = 0.16$, SEM = 0.03, $p < 0.05$). Similarly, we also calculated the average of correlations between individual leadership ratings and BMI, actual height, and averaged facial maturity ratings for each face. We found BMI ($n = 149$, average $r = –0.17$, SEM = 0.02, $p = 0.04$) and averaged facial maturity ratings ($n = 149$, average $r = 0.16$, SEM = 0.02, $p = 0.048$) significantly correlated with leadership ratings, while actual height ($n = 149$, average $r = 0.03$, SEM = 0.02, $p = 0.67$) did not. Thus, perceived height, BMI, and facial maturity all significantly correlated with leadership ratings at the level of individual raters, and support the calculations made with averaged ratings.

4 Discussion

Faces perceived to belong to taller people were perceived to be better leaders in both men's and women's faces. Height has a well-documented effect on leadership choices in both politics (Sorokowski 2010) and the business world (Judge and Cable 2004). The results of the current experiment suggest that face cues to apparent height may mediate part of the perceptual relationship between height and leadership ability. Interestingly, while perceived height showed a strong relationship with leadership judgments, the actual height of the people photographed did not affect perceived leadership ability. These results are in contrast to the association typically found between body height and leadership perception (Judge and Cable 2004; Sorokowski 2010). Previous research on face perception has demonstrated how face cues can be overgeneralised for rapid trait processing, often at the expense of accurate judgments (Zebrowitz and Montepare 2008; Zebrowitz and Rhodes 2004). It is possible that face cues to height are overgeneralised to a point where apparent height can induce effects of height biases disproportionate to actual height.

People in the overweight BMI group were less likely to be perceived as good leaders than people in the healthy or underweight group (though the small sample size in the underweight group should be noted). Previous research has demonstrated that BMI can be accurately estimated from faces (Coetzee et al 2009, 2010). Face cues to BMI alter perceived attractiveness (Coetzee et al 2011; Re et al 2011) and health (Coetzee et al 2009), and preferences for facial adiposity mimic preferences for BMI in full bodies (Coetzee et al 2011; Tovee and Cornelissen 2001; Tovee et al 1998, 1999). The negative relationship between perceived leadership ability and BMI aligns with other research on perceived personality attributes and weight (Melamed 1994; Rand and Macgregor 1990; Sobal and Stunkard 1989; Stunkard and Wadden 1992). People with high facial adiposity also suffer from poorer mental health (Tinlin et al 2012), which may adversely affect leadership ability. The perceptual association between high facial adiposity and negative personality traits and poor mental condition may deter people from viewing obese individuals as good leaders. The results of the current study suggest that people with an unhealthily high BMI do face disadvantages when it comes to perceived leadership ability. Further research could elucidate the specific facial dimensions that lead to weight perception in 3-D faces.

Facial maturity also positively correlated with perceived leadership ability in 3-D faces, similar to results found in 2-D faces (Rule and Ambady 2008, 2011a, 2011b; Zebrowitz and Montepare 2005). Facial maturity affected leadership ratings independently of perceived height and BMI, even though the age range in stimuli used here was relatively small

(ages 18–26 years). Facial maturity influences perceived dominance (Keating et al 1999, 2003), an attribute that is historically associated with leadership ability (Riggio and Riggio 2010). Together, these results suggest perceived facial maturity influences face judgments of leadership independently of cues to physical body size, and likely impacts actual leadership votes (Zebrowitz and Montepare 2005).

The use of 3-D faces allowed participants to view extra shape information not available in 2-D face images. While the current study focuses on face correlates of perceived size (height and weight) and facial maturity, further research could examine quantifiable face dimensions that alter leadership perception. For example, facial width-to-height ratio correlates with leadership success in men leading companies with simple authority hierarchies (Wong et al 2011), and has been found to correlate with achievement drive in US presidents (Lewis et al 2012). Anatomical features associated with dominance (high cheekbones, eyes closer to eyebrows) also correlate with leadership judgments (Mueller and Mazur 1996; Olivola and Todorov 2010). Sexual dimorphism in face structure and facial attractiveness affect leadership judgments differentially based on leadership context (Little et al 2007, 2012; Spisak et al 2011, 2012). Future studies could measure these and other dimensions to assess their relationship with leadership judgments in 3-D faces, where extra face shape cues are visible. Furthermore, the current study used face stimuli that bobbed in a sinusoidal manner, giving the impression that the head was turning in different directions. Previous research has demonstrated that biological motion can influence perceived health and bias voting behaviour (Kramer et al 2010). Future research could assess how various head movements (such as projecting the chin forward or turning the face down) alter attributions of personality and influence perceived leadership ability.

Face judgments of leadership ability influence actual leadership choices in both politics (see Olivola and Todorov 2010) and business (Rule and Ambady 2008, 2009; Rule et al 2011), and body characteristics such as height and weight affect perceived leadership ability (Murray and Schmitz 2011). We find that facial traits associated with height and BMI affect leadership judgments in realistic 3-D faces. These results have implications for real-world leadership selection. Visual cues to the body characteristics of potential leaders are not often displayed; for example political candidates are often seated at tables or stand behind podium during debates, and are viewed from the waist or neck up on television and in media campaign advertisements. The same visual media focus extensively on leader candidates' faces, however, and the current results indicate such face presentation can sway perception of leadership adequacy. Face images of leader candidates are displayed with high frequency during times of leadership elections, and the influence of facial cues to apparent height, BMI, and maturity are likely to impact on real-world leadership choices.

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