# Dominance Biases in the Perception and Memory for the Faces of Powerholders, with Consequences for Social Inferences

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**Abstract**

A great deal of research has shown that dominant-looking faces are afforded power. In this research, we tested the reverse link. As such, we examined whether knowledge of a target's power would lead to a dominance bias in face perception. Five studies were conducted by applying face morphing techniques to both controlled facial stimuli and faces of powerholders in the real world. Results showed that faces of powerholders were misrecollected (Studies 1A and 1B) and misperceived (Studies 3A and 3B) as more dominant-looking than their powerless counterparts. In addition, their faces were misrecollected as more prototypically dominant in physical appearance than they actually were (Studies 1A, 1B, and 2). Furthermore, enhanced facial dominance affected social inferences, with evaluations such as competence and attractiveness being sensitive to the gender of the target person (Study 3B). Implications for research on power and face perception are discussed.

*Keywords*: power, dominance, face perception, memory, gender, social inferences

## Introduction

Dominance hierarchies are pervasive across social species. They are typically determined by an animal's ability to prevail in agonistic encounters. To avoid costly fighting, primate species have evolved cognitive abilities to detect, respond to, and display signals of dominance (Boehm, 1999; De Waal & Waal, 2007). Humans are no exception. They use appearance to automatically process information concerning the social rank of others. This tendency can be observed in human neural activity (e.g. dorsolateral and medial prefrontal cortex), even when rank related information is irrelevant for the task at hand (Zink et al., 2008). In particular, people use facial observation to make spontaneous inferences regarding a person's tendency to dominate in encounters (Oosterhof & Todorov, 2008).

Considerable evidence points towards the benefits of looking dominant when it comes to power attainment, such that those with more dominant facial features are more likely to be favored as leaders (e.g. Alrajih & Ward, 2014; Mueller & Mazur, 1996; Rule & Ambady, 2008; Spisak, Homan, Grabo, & Van Vugt, 2012). The present research aims to examine the reverse link by testing how knowledge about a target's power affects face perception and memory. We propose that faces of powerholders will be misperceived and misremembered in a biased manner towards dominance. In addition, facial dominance in turn could shape the impressions formed about the personal attributes of powerholders, and some evaluations could be in a gender specific manner.

## Dominance as the Power Prototype

Stable hierarchies among peers form in preschool years, based on the ability to prevail in competition for property ownership (Kalish, 2005). As with other species, this ability in humans is initially determined by bodily strength, linked to body size. Therefore, children form symbolic links between bodily force and power. Six- to eight-year-olds anticipate that taller children will dominate in a property ownership conflict (Pietraszewski & Shaw, 2015).

Children also regulate their behavior depending on their relative hierarchical position. For example, subordinate children are more pro-social than dominant children (Guinote, 2017; Guinote, Cotzia, Sandhu, & Siwa, 2015). The association between physical dominance and social authority continues into adulthood. High-power has been associated with various forms of nonverbal cues signaling dominance, from physical height (e.g. Judge & Cable, 2004), a low-pitched voice (Klofstad, Anderson, & Peters, 2012) and a wide variation in loudness while speaking (Ko, Sadler, & Galinsky, 2015), to occupying space (Carney, Hall, & LeBeau, 2005). In addition, power also distorts people's visual perception, such that experiencing high- and low-power makes people underestimate and overestimate the physical size of others, respectively (Yap, Mason, & Ames, 2013).

Of most direct relevance to the current study, facial expressions and morphology associated with strength and formidability are thought to provide an insight into another's propensity to behave in dominant ways in social encounters (Fink, Neave, & Seydel, 2007; Holzleitner & Perrett, 2016). Inferences based on faces are also used for organizational and societal decisions. People with dominant-looking faces are more likely to be judged as leaders (Spisak et al., 2012), and are believed to possess better leadership skills (Rule & Ambady, 2008). Consequently, they are afforded more power. For example, a cadet's military rank is predicted by how dominant he looks (Mueller & Mazur, 1996). Business leaders in the UK have more dominant face morphology than their age- and sex-matched non-powerful counterparts (Alrajih & Ward, 2014). Furthermore, fWHR (i.e. an index for facial dominance) predicts perceived achievement drive of US presidents (Lewis, Lefevre, & Bates, 2012) and financial success of CEOs in the corporate world (Rule & Ambady, 2008; Wong, Ormiston, & Haselhuhn, 2011). Such evidence consistently suggests that people infer power-related skills from facial appearance. Facial dominance could therefore act as a physical prototype in the perception of powerholders.

## A Case for Misrepresentations of Powerholders' Faces

Humans are experts at identifying faces. They can recognize faces effortlessly and automatically in different poses and conditions of occlusion and luminosity (Bruce & Young, 2012). The automatic and efficient manner in which faces are identified has led to a widespread belief that face recognition is reasonably accurate and derives from the use of invariant face structures stored in memory (Tong, & Nakayama, 1999). From this perspective, a target's power should not affect how someone is perceived and remembered. However, face perception and memory are more malleable than previously assumed, and are construed and subject to biases (Hugenberg & Sacco, 2008). For instance, when race ambiguous faces are matched with low-status attire (vs. high-status attire), they are more likely to be perceived as Black (Freeman, Penner, Saperstein, Scheutz, & Ambady, 2011). People tend to recognize their own faces as looking more attractive than they really are (Epley & Whitchurch, 2008).

Given the cognitive efficiency of categorization, and the apparent ease with which categories are activated and applied (Allport, 1954), face perception and memory are also subject to the influence of categorical representations about appearance (Hugenberg & Sacco, 2008). That is, social categories of a target's face, for instance gender, race, and age, can elicit *assimilation* effects (aka, *accentuation*) in which the face is perceptually assimilated to a category prototype, affecting how it is perceived and remembered (Corneille, Huart, Becquart, & Brédart, 2004; Hugenberg, Young, Sacco, & Bernstein, 2011). Supportive evidence comes from studies on facial features of race and gender. Specifically, once a target face is categorized as a certain race (e.g. Black), people tend to perceive the face as more prototypical of its race category (Levin & Banaji, 2006; MacLin & Malpass, 2001). The same accentuation effect is also seen in face memory, such that faces are recollected as looking

more prototypical of their race and gender category than they actually are (Corneille et al., 2004; Huart, Corneille, & Becquart, 2005).

In this vein, if the prototype of the faces of powerholders entails facial dominance features, people may not only infer power-related skills from faces, as demonstrated in past research, but they may also engage in the reverse inference. That is, from knowledge of the power of the target to biased face perception and memory. Consequently, the faces of powerholders may be viewed and remembered in a distorted manner that is in line with the dominance prototype.

**Social Inferences of Facial Dominance: Competence and Attractiveness**

As aforementioned, if facial dominance is used to infer power related qualities, it could guide perceptions and memory in accordance with a target's power position. Such dominance bias could subsequently influence social trait inferences about a person. In the present research, we chose to focus on two social attributes that are crucial for the evaluation of leaders and likely to be affected by facial dominance: *perceived* competence and attractiveness (e.g. Olivola & Todorov, 2010; Berggren, Jordahl & Poutvaara, 2010).

The social dimension of the face evaluation model (Oosterhof & Todorov, 2008; Todorov, Said, Engell, & Oosterhof, 2008) posits that (neutral Caucasian) faces are automatically evaluated in terms of their trustworthiness (signaling targets' intentions) and dominance (signaling targets' capacity to implement those intentions). Such framework also maps onto a two-dimensional circumplex model, bisected by warmth and competence as the underlying dimensions of person perception (e.g. Fiske, Cuddy, Glick, & Xu, 2002). As such, it seems feasible that dominance in the West conveys competence. In fact, it has been argued that facial dominance leads to power affordance because it signals competence (Chen, Jing, & Lee, 2014). If so, it remains unclear whether this would occur equally for both gender groups. Facial dominance is more prevalent among males than females, and is consistent with

male but not female stereotypes (Eagly & Karau, 2002; Oosterhof & Todorov, 2008). Given that facial dominance is more frequently found in men than in women, and entails masculine rather than feminine morphology (Boothroyd, Jones, Burt, & Perrett, 2007; Buckingham et al., 2006; Oosterhof & Todorov, 2008), it is possible that facial dominance would have a greater impact on competence attributions of male than female powerholders. Initial supporting evidence from a meta-analysis showed that people expect women to adopt a democratic leadership style (Eagly, Johannesen-Schmidt, & Van Engen, 2003). Also, high-power women who display anger, a trait indicating dominance, are conferred lower status than those who do not (Brescoll & Uhlmann, 2008; Carli, 2001; Livingston, Rosette, & Washington, 2012). Thus, dominance could increase perceived competence for males, but not females.

Furthermore, it has been found that faces which deviate from the group prototype are viewed as less attractive than prototypical faces (Potter & Corneille, 2008). If visual representations of powerholders are in line with a dominance prototype, they will deviate from the female face prototype (i.e. femininity, Boothroyd et al., 2007; Buckingham et al., 2006; Oosterhof & Todorov, 2008)), and therefore lower perceived attractiveness in women. Indeed, facial features that make men look dominant or angry result in reduced attractiveness when seen in women (Jaensch et al., 2014; Keating, 1985). Conversely, femininity and babyfacedness, attributes being negatively correlated with dominance, are strong predictors of women's facial attractiveness (Cunningham, Roberts, Barbee, Druen, & Wu, 1995; Perrett et al., 1998). For these reasons, we hypothesized that facial dominance will lead to decreased attractiveness ratings of female powerholders. Such effect should be absent for male powerholders for whom attractiveness and dominance are compatible features.

## The Present Research

The primary aim of the current research was to test whether the faces of powerholders are subject to the influence of a dominance prototype, such that their faces would be perceived and remembered as more dominant-looking. The secondary aim was to examine how facial dominance and power further affect social trait inferences such as competence and attractiveness, attributes which are crucial for the evaluation of leaders.

To this end, five studies were conducted. Studies 1A and 1B investigated whether unfamiliar faces of powerholders are misremembered as more prototypically dominant in physical appearance. This was achieved by using controlled facial stimuli. Study 2 explored whether similar memory biases occur for faces of familiar powerholders in the real world. In addition, we tested for the effects of target power on judgments of competence and attractiveness.

Studies 3A and 3B further investigated whether knowledge of a target's power impacts face perception during initial impression formation. That is, we were interested in whether biased associations between power and dominance occur *during* stimulus presentation. In addition, Study 3B tested how facial dominance and power shape social trait inferences, including competence and attractiveness.

Given the positive association between facial dominance and power with the potential to shape perception and recollection through categorical representation, we first hypothesized that faces of powerholders would be remembered and perceived in a biased manner towards dominance. In addition, based on previous findings (Fiske, 2010), we also hypothesized that people in high-power positions would be perceived as more competent. Considering that dominance conveys competence and that dominance is consistent with a male and inconsistent with a female prototype, we predicted that facial dominance would increase competence ratings in men, but not in women. In parallel, facial dominance should decrease judgments of attractiveness in women, but not in men.

**Sample size determination.** Given our primary aim, calculations were based on the main effect of power (a within-subjects variable) on facial dominance perception. For the first 4 studies (Studies 1A, 1B, 2 and 3A), we followed a heuristic of 60 participants per gender group which amounts to 120 participants in total to test such effect. For the final study (Study 3B), given its secondary aim to explore the interaction between gender and power/facial dominance on social inferences, we aimed for 100 participants per gender group which amounts to 200 participants in total. In all studies, we intentionally oversampled in a single wave of data collection to account for potential drop-outs. According to sensitivity power analysis[1] (G*Power; Faul, Buchner, Erdfelder, & Lang, 2007), minimal effect sizes of $f = .10$ (Study 1A, $N = 128$, $r_{cor.} = 0.50$), $f = .10$ (Study 1B, $N = 126$, $r_{cor.} = 0.50$), $f = .09$ (Study 2, $N = 134$, $r_{cor.} = 0.50$), $f = .09$ (Study 3A, $N = 136$, $r_{cor.} = 0.50$), and $f = .07$ (Study 3B, $N = 218$, $r_{cor.} = 0.50$) could be detected under standard criteria ($\alpha = .05$ two-tailed, $\beta = .80$), respectively.

## Study 1

Studies 1A and 1B were designed to examine whether people associate power with facial dominance such that the faces of powerholders would be recognized as more dominant-looking than those of power receivers. In addition, we aimed to examine whether faces of powerholders were recollected as more dominant-looking than they really were. To this end, participants were presented with facial images of two targets in the form of power dyads (encoding phase). To exclude potential confounds due to perceived social-status, we focused on relative power. Relative power is defined as the perceived amount of power a person has in relation to another person or entity (Guinote, 2017), and thus is well-represented by power dyads. In a subsequent face recognition task, participants were asked to identify each target's face from a series of continuous morphs, containing the original facial images as well as

several modified versions that looked either more dominant or submissive than the original image (recall phase). If there exists an association between power and dominance, participants should select a more dominant-looking face for targets with high-power compared to those with low-power, even though the faces are exactly the same in both conditions. Participants should further be more likely to select a dominance enhanced facial version as the true likeness of a high-power target.

## Study 1A

## Method

### Participants

One hundred and twenty-eight White Caucasian participants (60 women, $M_{age}$ = 25.3 years, *SD* = 8.2) from the United States and Europe were recruited online and participated on a voluntary basis without receiving compensation. White Caucasian participants were chosen in order to match the ethnicity of target faces so as to avoid cross-race effects (Krumhuber, Swiderska, Tsankova, Kamble, & Kappas, 2015). Informed consent was obtained online prior to their participation. The two-factor experimental design included the target's gender (male, female) as a between-subjects variable, and the target's power (high, low) as a within-subjects variable. Participants were randomly assigned to one of the two target gender conditions, resulting in sixty-six people in the male condition and sixty-two people in the female condition. Measures, manipulations, and data exclusions for all five studies are fully disclosed.

### Stimuli

**Power manipulation.** Four pairs of power roles were chosen to represent various forms of power dyads. Each dyad always consisted of a high-power and a low-power

occupational position: employer vs. trainee, judge vs. petitioner, manager vs. subordinate, and supervisor vs. applicant

**Faces.** Color images of Caucasian male and female faces in frontal view and with a neutral expression were taken from various databases, including the Face Recognition Technology database (Phillips, Moon, Rizvi, & Rauss, 2000) and the Karolinska Directed Emotional Faces database (Goeleven, De Raedt, Leyman, & Verschuere, 2008). For the purpose of the present research, we selected eight male and eight female faces which were arranged into fixed same-sex pairs of two. Facial stimuli scored around the midpoint (7-point Likert scale, 1 = *not at all*, 7 = *very much*) in terms of perceived dominance ($M_{female}$ = 3.99, $SD_{female}$ = 0.43; $M_{male}$ = 4.09, $SD_{male}$ = 0.23), masculinity ($M_{female}$ = 3.96, $SD_{female}$ = 0.36; $M_{male}$ = 3.40, $SD_{male}$ = 0.46), attractiveness ($M_{female}$ = 4.55, $SD_{female}$ = 0.42; $M_{male}$ = 3.27, $SD_{male}$ = 0.61), and competence ($M_{female}$ = 4.37, $SD_{female}$ = 0.36; $M_{male}$ = 4.35, $SD_{male}$ = 0.17), as determined in two pilot studies (female targets: $N$ = 21; male targets: $N$ = 22). The matching between faces and power roles was counterbalanced so that each face was equally likely to be shown with a high-power and a low-power role across participants. All facial images were edited using Adobe Photoshop to center the head and create a uniform white background.

**Face morphing.** In order to test recognition memory at recall phase, facial stimuli were manipulated to create stimulus sequences of higher and lower physical dominance. For this, each target face was morphed with a dominant and submissive prototype using Psychomorph software (Tiddeman, Burt, & Perrett, 2001). Prototypes consisted of computer-generated faces that were averaged from a sample of 15 highly dominant (+3 SD) and submissive (-3 SD) faces developed by Oosterhof and Todorov (2008). By marking up feature points on the target faces that correspond to identical points on the prototype faces, each original image was transformed for shape in 3.33% increments (up to 10%) towards a

more dominant or submissive face. This resulted in seven images for each face identity: three increasingly dominant morphs, the original image, and three increasingly submissive morphs (for a similar procedure, see Epley & Whitchurch, 2008; Penton-Voak et al., 2007; Zell & Balcetis, 2012). For reasons of simplicity, we re-labelled the face continuum using a scale from -100% (most dominant) to +100% (most submissive) (see Figure 1).

**Design and Procedure**

The study was conducted using Qualtrics, a web-based software (Provo, UT), and consisted of two phases. In the encoding phase, participants were presented with the original images of each face pair in combination with the power roles, resulting in four types of face-power dyads for each gender. Participants were required to pay close attention to each face in combination with its occupational role for a later memory recognition task. Power roles and target faces within a dyad were counterbalanced so that each facial identity was equally likely to be shown with a high-power and a low-power role across participants. Power titles were displayed above the target face (display resolution: 200 x 200 pixels), with the two faces of each pair presented on the same screen for an overall duration of 12 s. The high-power and low-power targets always appeared at the top and bottom of the screen (separated by approximately 2 cm), respectively. The presentation order of the four power dyads was randomized. Once all face-power dyads had been initially viewed, participants were presented with the same faces of each pair again (323 x 323 pixels), but this time had to unscramble words (second encoding), convert word fragments into meaningful words (third encoding), or choose the correct label from a list of words which described the targets' respective power roles (fourth encoding). Feedback was provided after each learning stage.

After completing a 3-min filler task, participants engaged in the recall phase. For this, a series of seven images (the original image as well as three dominant and three submissive

morphs) was displayed for each facial identity in a scattered random order across the screen and devoid of any information about the target's job title. Participants were instructed to identify the original image of each target's face seen previously (see Epley & Whitchurch, 2008; Penton-Voak et al., 2007; Zell & Balcetis, 2012 for a similar procedure). After the recognition task, participants were asked to choose from a list the job title that corresponds to each face which served as manipulation and attention check. Every target identity was presented on a separate screen, with the order of presentation of the eight targets being randomized.

## Results and Discussion

Given that repeated-measure ANOVA in which participants respond to samples of stimuli can yield an unacceptable false positive rate (Judd, Westfall, & Kenny, 2012), a mixed-model analysis was used, with recognition rate as the dependent variable, crossing participants and stimuli as random factors. Fixed factors included power (within-participants: high-power = -0.5, low-power = 0.5), gender (between-participants: male = -0.5, female = 0.5), and their interaction. For trials (3%) in which the identity of a target face was incorrectly classified (failed attention check), data were discarded.

As predicted, recognition memory was significantly affected by the ascribed power levels within a face dyad, $B = 9.03$, $SE = 3.54$, 95% CI [2.07, 15.98], $t(849.0) = 2.55$, $p = .011$, $d = 0.22$. (see Figure 1). Specifically, faces of high-power targets ($M = -7.4$ %, $SD = 56.0$) were recollected as significantly more dominant looking than those of low-power targets ($M = 0.9$ %, $SD = 58.3$). When comparing their recognition rates to those of the original image ($M = 0$), the difference was statistically significant only for targets with high-power, $B = -7.47$, $SE = 2.78$, 95% CI [-13.1, -1.75], $t(849.0) = -2.68$, $p = .013$, $d = -0.24$[2]. As such, powerful targets in a dyad were remembered as being more dominant in facial

appearance than they actually were. This dominance bias in face recognition was absent for low-power targets whose scores did not differ significantly from the original image, $B$ = 1.04, $SE$ = 3.57, 95% CI [-6.33, 8.49], $t$(849.0) = 0.29, $p$ = .770, $d$ = 0.03. There was no significant interaction between target power and target gender, $B$ = 4.33, $SE$ = 7.08, 95% CI [-9.59, 18.23], $t$(849.0) = 0.61, $p$ = .541, $d$ = 0.05.

A main effect of target gender, $B$ = 14.95, $SE$ = 4.72, 95% CI [5.30, 24.59], $t$(24.1) = 3.16, $p$ = .004, $d$ = 0.28, revealed that dominance biases in face recognition were more pronounced for male ($M$ = -10.4 %, $SD$ = 58.5) than for female targets ($M$ = 3.8 %, $SD$ = 55.0). That is, face recollections tended to shift toward more dominant face exemplars for male targets. As such, people weighted their memory for male and female faces with gender prototypical facial information, independently of power position. This conceptually replicates the findings by Huart et al. (2005), given the strong correlation between facial dominance and masculinity (e.g. Oosterhof & Todorov, 2008).

## Study 1B

Study 1B aimed to replicate the finding of the first study with a slight modification to its method by presenting target faces in a new spatial location (i.e. left vs. right) and counterbalancing the position of high- and low-power targets during the encoding phase.

## Method

### Participants

One hundred and twenty-six White Caucasian participants (72 women, $M_{age}$ = 26.2 years, $SD$ = 7.8) from the United States and Europe were recruited online and participated on a voluntary basis without receiving compensation. White Caucasian participants were chosen to match the ethnicity of target faces. Informed consent was obtained online prior to their

participation. The two-factor experimental design included the target's gender (male, female) as a between-subjects variable, and the target's power (high, low) as a within-subjects variable. Participants were randomly assigned to one of the two target gender conditions, resulting in sixty people in the male condition and sixty-six people in the female condition.

**Stimuli**

These were identical to Study 1A.

**Procedure**

These were the same as in Study 1A except that the two targets within a power dyad appeared during the encoding phase on the left and right side of the screen (separated by approximately 6 cm), respectively. In addition, the position of the face targets was counterbalanced across participants such that a high-power target of each dyad was equally likely to appear on the left as well as right side of the screen.

## Results and Discussion

The same mixed-effect model as in Study 1A that crossed participants and stimuli as random factors and treated power (high-power = -0.5, low-power = 0.5), gender (male = -0.5, female = 0.5), and their interaction as fixed factors was used. Same as in Study 1A, data were discarded for trials (12.5%) in which the identity of a target face was incorrectly classified (failed attention check).

Replicating the findings of Study 1A, participants' memory for faces was affected by the ascribed power levels within a dyad, $B = 10.61$, $SE = 3.46$, 95% CI [3.83, 17.39], $t(774.4) = 3.07$, $p = .002$, $d = 0.27$. Specifically, faces of high-power targets ($M = -10.8$ %, $SD = 53.9$) were recognized as more dominant-looking than those of low-power targets ($M = -0.4$ %, $SD$

= 55.0). Same as in Study 1A, when comparing the recognition rates to the original image (*M* = 0), the difference was statistically significant only for targets with high-power, *B* = -10.58, *SE* = 2.95, 95% CI [-16.4, -4.74], *t*(774.4) = -3.59, *p* < .001, *d* = -0.32. As such, powerful targets in a dyad were remembered as being more dominant in facial appearance than they actually were. This dominance bias in face recognition was absent for low-power targets whose scores did not differ significantly from the original image, *B* = -0.18, *SE* = 3.32, 95% CI [-7.05, 6.71], *t*(774.4) = -0.06, *p* = .956, *d* = 0.01. There was no significant interaction between target power and target gender, *B* = 10.00, *SE* = 6.91, 95% CI [-3.56, 23.56], *t*(774.4) = 1.45, *p* = .148, *d* = 0.13. Replicating the finding of Study 1A, a main effect of target gender, *B* = 16.54, *SE* = 4.37, 95% CI [7.89, 25.16], *t*(124.1) = 3.78, *p* < .001, *d* = 0.34, revealed that dominance biases in face recognition were more pronounced for male (*M* = -13.8 %, *SD* = 52.1) than for female targets (*M* = 2.9 %, *SD* = 56.0).

Together, Studies 1A and 1B provide consistent evidence for the association between power and facial dominance. For both male and female targets, faces associated with power were misremembered as more dominant looking than those were not. In addition, the faces of powerholders were recollected as more dominant-looking than they actually were.

## Study 2

To explore whether the findings of the first two studies using novel faces extend to familiar faces of powerholders, Study 2 employed public figures. To this end, male and female faces of well-known people in elevated power positions, such as those of scientists and politicians, were chosen as exemplars of expert or legitimized power roles, respectively (French, Raven, & Cartwright, 1959). To rule out the possibility that face memory misrepresentations derive from high prestige (i.e., status) attached to powerholders, we chose a control group with comparable prestige and visibility but less power, i.e. well-known

female and male pop-singers and models. The faces of the two groups were matched on gender and objective facial dominance. Besides exploring the effects of power on face memory, this study also aimed to investigate whether power changes perceptions of the targets' social attributes, including attractiveness and competence.

We predicted a recognition bias for male and female targets, such that those occupying powerful positions would be remembered as more dominant-looking than they really were. Such bias should be absent for targets in the control group. In addition, high-power targets should be perceived as more competent but less attractive than those of the control group given the nature of their job requirement and baseline differences in facial features.

## Method

### Participants

One hundred and thirty-four White Caucasian participants (75 women, $M_{age}$ = 26.0, *SD* = 8.35) from the United States and Europe were recruited online and participated on a voluntary basis without receiving compensation. Informed consent was obtained online prior to their participation. The two-factor experimental design included the target's gender (male, female) as a between-subjects variable, and the target's power (high, control) as a within-subjects variable. Participants were randomly assigned to one of the two target gender conditions, resulting in sixty-eight people in the male condition and sixty-six people in the female condition.

### Stimuli

Twenty-four well-known public male and female figures were selected. Twelve of the targets represented the high-power group (i.e., politicians and scientists): Ronald Reagan, Tony Blair, Francois Hollande, Barry Marshall, Henrik Dam, Ronald Evans, Angela Merkel,

Christiane Nüsslein-Volhard, Elizabeth Blackburn, Hillary Clinton, Margret Thatcher, and Susan Greenfield. As a control group, twelve professional models and pop singers were selected for being famous, but less powerful: Noah Mills, Ollie Edwards, Garrett Neff, Justin Bieber, Zac Efron, Justin Timberlake, Adriana Lima, Alessandra Ambrosio, Britney Spears, Heidi Montag, Miranda Kerr, and Lindsay Lohan. To increase familiarity with the targets, brief descriptions of each person's occupational role (e.g., "Ronald Reagan, President of the United States") were created.

For all 24 targets color pictures with neutral expression and direct gaze were chosen from publicly accessible Internet sources (i.e., online magazines and tabloids). Images were edited and cropped using Adobe Photoshop in the same manner as done in the previous study. Based on a morphometric analysis (i.e., ratio of facial width to height, see Valentine, Li, Penke, & Perrett, 2014), both target groups were found to be comparable in terms of their objective facial dominance. As such, the physical dominance of those in the high-power group did not differ significantly from those of the control group, female targets: $t(10) = -0.20$, 95% CI [-0.22, 0.18], $p = .847$, $d = 0.06$; male targets: $t(10) = -0.11$, 95% CI [-0.11, 0.10], $p = .916$, $d = 0.00$.

In order to test for recognition memory, image sequences with varying levels of dominance were created for all targets using the same morphing technique as employed in Study 1. This resulted in seven images for each face identity: three increasingly dominant morphs, the original image, and three increasingly submissive morphs (see Figure 2).

**Procedure**

The study was conducted online using Qualtrics survey software. In the encoding phase, participants were first presented with the original images of each target face together with the name and brief job description of the person. To measure attributions of power,

participants made explicit evaluations of the person's perceived influence, on a 7-point Likert scale ranging from 1 = *not influential at all* to 7 = *very influential*.

In the recall phase, they then completed a face recognition task in which the seven images of the target person (original image, dominant and submissive morphs) were shown together with the person's name and job title. Participants were instructed to choose the image which they believed would depict the real person out of an array of stimuli (display resolution: 200 x 200 pixels), presented in a scattered, random order across the screen (for a similar procedure, see Epley & Whitchurch, 2008; Penton-Voak et al., 2007; Zell & Balcetis, 2012). It was encouraged to make a decision within 30 s and to guess if the answer was unknown.

Next, participants provided explicit evaluations of all facial targets by rating their apparent attractiveness and competence. Both questions appeared on the same screen and in a random order. Responses were made on 7-point Likert scales ranging from 1 (*very unattractive; incompetent*) to 7 (*very attractive; competent*). The order of presentation of the 12 faces was randomized within a target gender group. Finally, participants indicated for each target whether they were familiar with the person prior to this study.

## Results and Discussion

The same mixed-effect model as in Study 1 that crossed participants and stimuli as random factors and treated power (high-power = -0.5, control = 0.5), gender (male = -0.5, female = 0.5), and their interaction as fixed factors was used for each dependent measure.

Firstly, high-power targets ($M$ = 5.99, $SD$ = 1.58) were judged as significantly more influential than those in the control group ($M$ = 3.76, $SD$ = 1.64), $B$ = -1.67, $SE$ = 0.37, 95% CI [-2.42, -0.90], $t(23.0) = -4.51$, $p < .001$, $d$ = -0.39, suggesting that inferences of power indeed significantly differed between the two groups.

Importantly, recognition bias significantly differed for targets with high-power and those in the control group, $B$ = 16.40, $SE$ = 4.18, 95% CI [7.87, 24.93], $t$(24.0) = 3.92, $p$ < .001, $d$ = 0.34 (see Figure 2). This remained to be the case when only the trials in which participants stated that they were familiar with the target person prior to this study (68%) were included in the analysis, $B$ = 20.21, $SE$ = 4.90, 95% CI [10.51, 31.31], $t$(17.5) = 4.11, $p$ < .001, $d$ = 0.36. When comparing their recognition rates to those of the original image, the difference was statistically significant only for targets with high-power ($M$ = -21.49%, $SD$ = 55.6), $B$ = -25.70, $SE$ = 5.05, 95% CI [-38.13, -15.66], $t$(17.5) = -5.09, $p$ < .001, $d$ = -0.44. That is, people in high-profile roles of legitimate or expert power were recognized as more dominant in appearance than they actually were. In contrast, there was no systematic recognition bias for the equally well-known but less powerful models and pop-singers ($M$ = -0.79%, $SD$ = 60.7), $B$ = -1.35, $SE$ = 5.75, 95% CI [-13.43, 10.82], $t$(17.5) = -0.23, $p$ = .815, $d$ = -0.02. As such, only the possession of high-power produced a reliable shift in face recollection towards more dominant faces.

Consistent with Study 1, a main effect of target gender, $B$ = 24.32, $SE$ = 5.94, 95% CI [11.81, 36.02], $t$(33.96) = 4.09, $p$ < .001, $d$ = 0.35, indicated that dominance biases in participants' recollection were more pronounced for male ($M$ = -29.25 %, $SD$ = 51.06) than for female faces ($M$ = -12.19 %, $SD$ = 59.44). Same as in Studies 1A and 1B, the interaction between gender and power on face recognition was not significant, $B$ = 16.6, $SE$ = 9.80, 95% CI [-3.30, 37.41], $t$(17.5) = 1.70, $p$ = .108, $d$ = 0.15.

Furthermore, high-power targets were perceived as more competent ($M$ = 5.15, $SD$ = 1.46), $B$ = -1.33, $SE$ = 0.19, 95% CI [-1.72, -0.95], $t$(24.7) = -7.00, $p$ < .001, $d$ = -0.60, but less attractive ($M$ =3.14, $SD$ = 1.20), $B$ = 1.82, $SE$ = 0.21, 95% CI [1.40, 2.23], $t$(24.5) = 8.86, $p$ < .001, $d$ = 0.75, than those of the control group ($M$ = 3.91, $SD$ = 1.26; $M$ = 5.02, $SD$ = 1.44).

As was the case with unfamiliar targets in Studies 1A and 1B, memory for faces of familiar powerholders was also distorted toward more typical exemplars of dominance. That is, their faces were remembered as more dominant-looking than they actually were. In addition, power also shaped inferences of social traits such as competence and attractiveness.

## Study 3

The first three studies demonstrated that power prototypes trigger top-down biases in dominance perception, such that the faces of powerholders are seen as prototypically dominant in physical appearance. One could argue that such facial distortions merely apply to recognition memory; hence, they should not be present when the faces are viewed during judgment. On the other hand, perception is a constructive process which has been shown to be subject to contextual influences (e.g., Balcetis & Dunning, 2006; Hugenberg & Sacco, 2008; Krumhuber, Manstead, & Kappas, 2007; Webster & MacLeod, 2011). The next studies aimed to test whether the biased association between power and dominance occurs *during* face perception. In particular, we examined whether judgments are influenced by the targets' power *while* their faces are being viewed (Studies 3A and 3B). Furthermore, we investigated how facial dominance together with target power affect social trait inferences (Study 3B).

### Study 3A

The purpose of Study 3A was to provide initial evidence that knowledge about a person's power biases face perception towards dominance during initial exposure. To this end, participants were shown a series of headshots of unknown targets together with their professional occupation of either high- or low-power. Participants' task was to evaluate each face on perceived facial dominance. If there exists an association between power and dominance, facial dominance ratings should vary as a function of the target's power level.

That is, when faces are matched with high-power jobs, they would be perceived as more dominant-looking than when they are matched with low-power jobs.

## Method

### Participants

One hundred and thirty-six White Caucasian participants (50 women, $M_{age}$ = 24.1 years, *SD* = 7.18) from the United States and Europe were recruited online and participated on a voluntary basis without receiving compensation. Informed consent was obtained online prior to their participation. The two-factor experimental design included the target's gender (male, female) as a between-subjects variable, and the target's power (high, low) as a within-subjects variable. Participants were randomly assigned to one of the two target gender conditions, resulting in sixty-eight people in the male condition and sixty-eight people in the female condition.

### Stimuli

**Power manipulation.** Six high-power (chief financial officer, global HR director, medical director, senior executive, senior marketing manager, and solicitor) and six low-power job titles (bar assistant, cashier, cleaner, dishwasher, fast food worker, and grocery store worker) were chosen. Pre-testing with a separate group of participants (*N* = 20) showed that high-power job titles (*M* = 6.22, *SD* = 0.60) implied significantly more power than low-power titles (*M* = 1.61, *SD* = 0.54, 7-point Likert scale, 1 = *not influential at all*, 7 = *very influential*), $t(19) = 24.8$, 95% CI [4.22, 5.00], $p < .001$, $d = 11.4$.

**Faces.** Color images of Caucasian male and female faces in frontal view and with a neutral expression were taken from the same databases as in Study 1. For the purpose of the present research, we selected twelve male and twelve female faces that scored around the

midpoint (7-point Likert scale, 1 = *not at all*, 7 = *very much*) in terms of perceived dominance ($M_{female}$ = 4.08, $SD_{female}$ = 0.23; $M_{male}$ = 3.89, $SD_{male}$ = 0.52), masculinity ($M_{female}$ = 3.90, $SD_{female}$ = 0.45; $M_{male}$ = 3.48, $SD_{male}$ = 0.44), attractiveness ($M_{female}$ = 4.44, $SD_{female}$ = 0.68; $M_{male}$ = 3.30, $SD_{male}$ = 0.52), and competence ($M_{female}$ = 4.44, $SD_{female}$ = 0.55; $M_{male}$ = 4.20, $SD_{male}$ = 0.36), as determined in two pilot studies (female targets: $N$ = 21; male targets: $N$ = 22). More crucially, the matching between the power role and face was counterbalanced so that each face was equally likely to appear with a high- and a low-power role across participants. All facial images were edited using Adobe Photoshop to center the head and create a uniform white background.

**Design and Procedure**

The study was conducted as a web-based experiment using Qualtrics survey software. Participants were instructed that they would view facial images of twelve targets together with each individual's occupational position. Their task was to evaluate each person based on their first impression. Job titles were presented simultaneously with each target face (display resolution: 323 x 323 pixels) and appeared directly above a stimulus image. The matching between faces and job titles was counterbalanced so that each target face was equally likely to be shown with a high-power and a low-power job title across participants. Participants rated each facial image on facial dominance ("How dominant does this person look on this image?"). Ratings were made on 7-point Likert scales, with response options ranging from 1 (*very submissive*) to 7 (*very dominant*). For all trials, stimuli stayed visible on the screen until the question was answered. The order of presentation of the twelve targets was randomized.

## Results and Discussion

The same mixed-effect model that crossed participants and stimuli as random factors and treated power (high-power = -0.5, low-power = 0.5), gender (male = -0.5, female = 0.5), and their interaction as fixed factors was used. As predicted, faces matched with high-power job titles were judged as significantly more dominant-looking ($M$ = 4.19, $SD$ = 1.45) than those with low-power job titles ($M$ = 3.85, $SD$ = 1.41), $B$ = -0.35, $SE$ = 0.07, 95% CI [-0.48, -0.22], $t(1472.0) = -5.21$, $p < .001$, $d$ = -0.43. This result shows that face perceptions changed in line with the power label of the target, thereby pointing towards the influence of prototypical face representations of dominance.

## Study 3B

The final study aimed to replicate the findings of Study 3A regarding the effects of power on face perception during initial impression formation. Furthermore, we investigated the consequences of facial dominance. Given that all targets were public figures in Study 2, the impressions formed by participants could have derived partly from knowledge about the targets beforehand. To better address these issues and to examine the direct causal link between facial dominance and its social inferences, we systematically manipulated facial dominance in this last study. In order to examine the direct consequences of power, we further manipulated the apparent power of the target person via its occupational position.

In line with the findings from Study 3A, we expected that when faces matched with high-power labels, they would be rated as more dominant in appearance compared to when they are matched with low-power labels. We also expected that facial morphology and the power position would affect social inferences and some inferences are also in a gender-specific manner. Consistent with the notion that people in positions of authority are afforded competence (Fiske, 2010), high-power targets should be perceived as more competent than their low-power counterparts. In addition, dominant faces of females should be perceived as

less attractive than their non-dominant counterparts, an effect which should be absent in male faces (Jaensch et al., 2014; Keating, 1985). In contrast, competence attributions should be higher for dominant than non-dominant faces, but only for male targets (Boothroyd et al, 2007; Buckingham et al., 2006).

## Method

### Participants

Two hundred and eighteen White Caucasian participants (99 women, $M_{age}$ = 24.2, *SD* = 6.32) from the United States and Europe were recruited online and participated on a voluntary basis without receiving compensation. Informed consent was obtained online prior to their participation. The three-factor experimental design included the target's gender (male, female) as a between-subjects variable, and the target's power (high, low) and facial dominance (high, low) as within-subjects variables. Participants were randomly assigned to one of the two target gender conditions, resulting in one hundred and twelve people in the male condition and one hundred and six people in the female condition.

### Stimuli

**Power manipulation.** To manipulate target power, the same 12 job titles (six high-power and six low-power) from Study 3A were selected and extended in the form of brief occupational descriptions. For example, the description of a high-power position was as follows: "Senior Executive: This person is the most senior corporate officer in charge of managing the firm, leading the implementation of the company's long-term strategy and reporting to the board of directors."

**Faces**. The same twelve female and male identities as in Study 3A were used. To manipulate facial dominance, each facial identity was morphed with a dominant and

submissive prototype as achieved in previous studies. For the purpose of the present experiment, we only kept the -100% (most dominant) and +100% (most submissive) morphs from the outer ends of each morph continuum to depict faces of high vs. low physical dominance. This led to a total of 24 female and 24 male facial stimuli (12 face identities x 2 dominance levels).

**Design and Procedure**

A nested factorial design was employed in which each facial stimulus was paired with a high-power and a low-power job title and description. The resulting forty-eight female and male stimuli, 12 (face identity) x 2 (facial dominance) x 2 (target power), were subdivided into four sets of twelve. Approximately the same number of participants responded to one of the four sets (consisting of 12 faces) that showed each face identity in a different combination of facial dominance and target power. Stimulus trials were counterbalanced so that each of the twelve identities was seen only once by a participant. Also, each face was equally likely to be matched with a high-power and a low-power role across participants.

The study was conducted online using Qualtrics survey software. Participants were informed that they would view images of several target faces together with their occupational roles. Their task was to evaluate each person based on their first impression. Job titles and descriptions were presented simultaneously with the target face (display resolution: 323 x 323 pixels) and appeared directly above a stimulus image. To validate the manipulation of physical dominance and to replicate the finding of Study 3A, each image was judged in terms of perceived facial dominance on a 7-point Likert scale (1 = *very submissive*, 7 = *very dominant*). To examine how social inferences are affected by facial dominance, participants rated each facial image on two traits using 7-point Likert scales: attractiveness (1 = *very unattractive*, 7 = *very attractive*), and competence (1 = *very incompetent*, 7 = *very*

*competent*). For exploratory purposes, participants also evaluated the likeability of each target on a 7-point Likert scale, ranging from 1 (*very unlikeable)* to 7 (*very likeable).* Images remained on the screen until a response on all four trait dimensions was provided. The order of stimulus and rating items was randomized.

## Results and Discussion

Mixed-effect model that crossed participants and stimuli as random factors and treated power (high-power = -0.5, low-power = 0.5), facial dominance (high-dominance = -0.5, low-dominance = 0.5), gender (male = -0.5, female = 0.5), and their interactions as fixed factors was used for each dependent measure.

As predicted, stimuli with a more dominant facial appearance ($M$ = 4.67, $SD$ = 1.35) were judged to be more dominant-looking than those with a less dominant appearance ($M$ = 3.86, $SD$ = 1.42), $B$ = -0.79, $SE$ = 0.05, 95% CI [-0.89, -0.70], $t$(2376.1) = -16.80, $p$ < .001, $d$ = -1.07, verifying perceivers' ability to infer trait dominance from facial morphology.

Crucially, faces matched with high-power job titles ($M$ = 4.72, $SD$ = 1.39) were rated as more dominant than those matched with low-power job titles ($M$ = 3.81, $SD$ = 1.34), $B$ = -0.92, $SE$ = 0.05, 95% CI [-1.01, -0.83], $t$(2376.1) = -19.46, $p$ < .001, $d$ = -1.24, thereby replicating the findings of Study 3A.

Furthermore, there was a significant interaction between target gender and facial dominance for perceived attractiveness, $B$ = 0.76, $SE$ = 0.09, 95% CI [0.58, 0.94], $t$(2376.6) = 8.50, $p$ < .001, $d$ = 0.57, and competence, $B$ = 0.19, $SE$ = 0.09, 95% CI [0.02, 0.36], $t$(2376.6) = 2.14, $p$ = .033, $d$ = 0.14. Facial dominance led to lower ratings of attractiveness for female targets, $B$ = 0.07, $SE$ = 0.01, 95% CI [0.60, 0.86], $t$(1155.0) = 10.95, $p$ < .001, $d$ = 0.47 ($M_{\text{high\_dominance}}$ = 3.40, $SD_{\text{high\_dominance}}$ = 1.41; $M_{\text{low\_dominance}}$ = 4.14, $SD_{\text{low\_dominance}}$ = 1.36), but not male targets, $B$ = -0.03, $SE$ = 0.06, 95% CI [-0.15, 0.08], $t$(1220.9) = -0.57, $p$ = .566, $d$ = -

0.03 ($M_{high\_dominance}$ = 3.52, $SD_{high\_dominance}$ = 1.31; $M_{low\_dominance}$ = 3.48, $SD_{low\_dominance}$ = 1.28). In contrast, facial dominance enhanced perceptions of competence for male targets, $B$ = -0.16, $SE$ = 0.06, 95% CI [-0.27, -0.04], $t$(1220.7) = -2.66, $p$ = .008, $d$ = -0.18 ($M_{high\_dominance}$ = 4.67, $SD_{high\_dominance}$ = 1.26; $M_{low\_dominance}$ = 4.51, $SD_{low\_dominance}$ = 1.26), but not female targets, $B$ = 0.03, $SE$ = 0.06, 95% CI [-0.10, 0.16], $t$(1156.0) = 0.46, $p$ = .643, $d$ = 0.03 ($M_{high\_dominance}$ = 4.76, $SD_{high\_dominance}$ = 1.34; $M_{low\_dominance}$ = 4.80, $SD_{low\_dominance}$ = 1.35).

Target power also affected perceptions of competence. High-power targets ($M$ = 5.00, $SD$ = 1.29) were perceived as more competent than low-power targets ($M$ = 4.37, $SD$ = 1.24), $B$ = -0.63, $SE$ = 0.04, 95% CI [-0.72, -0.55], $t$(2376.6) = -14.45, $p$ < .001, $d$ = -1.07. In addition, female targets were more likely to benefit from power acquisition. That is, enhanced competence due to power roles was more pronounced for female targets ($M_{high\_power}$ = 5.20, $SD_{high\_power}$ = 1.24; $M_{low\_power}$ = 4.35, $SD_{low\_power}$ = 1.30) compared to male targets ($M_{high\_power}$ = 4.80, $SD_{high\_power}$ = 1.31; $M_{low\_power}$ = 4.39, $SD_{low\_power}$ = 1.39), $B$ = -0.44, $SE$ = 0.09, 95% CI [-0.61, -0.27], $t$(2376.6) = -5.02, $p$ < .001, $d$ = -0.33.

Finally, likability ratings decreased both as a function of target power, $B$ = 0.41, $SE$ = 0.05, 95% CI [0.32, 0.50], $t$(2376.2) = 8.78, $p$ < .001, $d$ = 0.56, and facial dominance, $B$ = 0.38, $SE$ = 0.05, 95% CI [0.29, 0.47], $t$(2376.2) = 8.25, $p$ < .001, $d$ = 0.51. Specifically, targets were liked less when they were powerful ($M$ = 3.89, $SD$ = 1.35) and high in facial dominance ($M$ = 3.90, $SD$ = 1.36) compared to when they were powerless ($M$ = 4.29, $SD$ = 1.29) and low in facial dominance ($M$ = 4.29, $SD$ = 1.29).

Together, Studies 3A and 3B consistently demonstrate that powerful targets are misperceived as more prototypically dominant in physical appearance, even when their faces are viewed during judgment. As such, faces matched with high-power roles were perceived as more dominant-looking than those matched with low-power ones. In addition, there are social inferences resulted from power and facial dominance. While power increased

perceived competence, it also decreased targets' likeability. Furthermore, some impressions formed about personal attributes differed between male and female targets. While facial dominance increased competence ratings in men, it decreased attractiveness ratings in women.

## General Discussion

A great deal of research has shown that dominant-looking faces are afforded power, (e.g. Alrajih & Ward, 2014; Mueller & Mazur, 1996; Rule & Ambady, 2008). The primary goal of the current study was to investigate the reverse causal link, i.e. from knowledge of a person's power to the ways in which his/her face is perceived and remembered. Across five studies, we consistently found that powerholders' faces were viewed and remembered in a biased manner towards the dominance prototype. This occurred both for unfamiliar and familiar faces of people in high societal echelons.

Using controlled facial stimuli, Studies 1A and 1B demonstrated that the faces of powerholders were subject to a memory bias towards the dominance prototype. In particular, powerholders (e.g. a supervisor) were misremembered as looking more dominant than their subordinates (e.g. an applicant). In addition, the faces of powerholders were recollected as looking more dominant than they really were. Biased recollection linked to facial dominance was also observed in Study 2, when the targets were familiar powerholders in the political and social positions. People who held formal political power (politicians) or authority due to their expertise (scientists) were misremembered as looking more dominant than they actually were. In contrast, no systematic bias occurred for equally well-known targets with less power (i.e. pop singers and models). Distortions also occurred during the initial exposure to the faces in Studies 3A and 3B. Specifically, faces of high-power occupational roles (e.g. senior executive officer) were judged as more dominant-looking than those of low-power roles (e.g.

grocery store worker), and such biased perception was obtained when faces were viewed during judgment. Together, the findings demonstrate that people rely on facial dominance prototypes when they perceive and remember faces.

Such findings have several important implications. Firstly, in modern society, power is afforded to people on the basis of their expertise and competence to advance collective interests associated with religious, social, or political aims (Keltner, Gruenfeld, Galinsky, & Kraus, 2010). It would appear that bodily features became an obsolete signal of power potential given that power structures are generally not determined by force. In addition, it is still a matter of debate whether facial dominance is predictive of actual behavior (e.g. Carré, McCormick & Mondloch, 2009; Gomez-Valdes et al., 2013; Kramer, 2015; Özener, 2012: Třebický et al., 2015; Zilioli et al., 2015). Crucially, to our knowledge there is no evidence that facial dominance is related to actual competence and leadership skills, attributes that are the primary basis of power affordance. Nevertheless, the current finding contributes to the existing literature suggesting that people continue to associate power with facial dominance.

Moreover, the current finding supports the recent view in the field of social cognition that rather than being an accurate process, face-perception is a constructive process subject to the influence of categorical information (e.g. stereotypes). In particular, people rely on dominance face prototypes while perceiving and remembering faces of powerholders. This occurs despite the fact that targets with high-power attract higher visual attention (Ratcliff, Hugenberg, Shriver, & Bernstein, 2011). As is the case with other group-related prototypes (Hamilton & Sherman, 1996), such as those linked to gender and race, prototypes of powerholders' faces enter as an input biasing perception and memory. While categorical information can be extracted from physical features of faces (linked for example to gender or race), as demonstrated in previous studies (e.g. Corneille et al., 2004; Huart et al., 2005;

MacLin & Malpass, 2001), it can also derive from the context in which the targets are presented (e.g. occupational label).

Apart from showing a bias in face perception and memory caused by the knowledge of target's power, the current study also reveals that social inferences due to facial dominance could occur in a gender specific manner. Ratings of attractiveness were significantly reduced for women as a result of having a dominant appearance, but not for men. In contrast, dominance increased perceived competence only for male targets (Study 3B). These findings corroborate existing evidence showing that women risk negative social reactions when they exhibit dominance (Eagly & Karau, 2002). Traits that serve as cues to dominance are still strongly correlated with facial masculinity (Boothroyd et al., 2007; Buckingham et al., 2006; Oosterhof & Todorov, 2008; Quist, Watkins, Smith, DeBruine, & Jones, 2011), hence they violate the standards for female gender. This perceived incongruence between a woman's role and behavior could then lead to negative evaluations at the personal and professional level (Eagly & Karau, 2002; Rudman & Phelan, 2008).

In line with the Stereotype Content Model (Fiske et al., 2002), we found that people in positions of authority were generally rated as competent. This applied to both familiar targets in high societal echelons (Study 2) as well as novel targets (Study 3B). Furthermore, competence ratings due to power were more pronounced for females than males. Given that women are still underrepresented in top leadership positions (e.g. only 4% of CEOs are women at S&P 500 companies (Catalyst, 2017). High-power jobs may have therefore been particularly informative for judging female targets' competence.

In addition to gender-specific effects, both dominance and power led to lower likeability of men and women. This finding is not surprising, as powerholders are often feared by people (Guinote, 2017; Guinote & Vescio, 2010). Being dominant is a double-edged sword that can signal competence but also convey a threatening and aggressive image

(Chen et al., 2014). In this vein, Cheng and colleagues (Cheng, Tracy, Foulsham, Kingstone, & Henrich, 2013) showed that those who adopted dominance strategies to obtain power, compared to those who used soft strategies linked to prestige and reputation, were disliked.

## Limitations and Future Avenues

Despite these important findings, there are some limitations to note. Firstly, even though the bias towards dominance for high-power targets has been demonstrated by using both controlled novel faces (Studies 1A and 1B, Studies 3A and 3B) and faces of powerholders in actual power positions (Study 2), comparisons between powerful and control targets in the latter study need to be considered with caution. Unlike the novel faces, the baseline features of well-known faces in the two groups (high-power and control) could not be perfectly matched (e.g., with regard to attractiveness given the nature of their occupations). This aspect of the research could potentially be improved in future studies.

Noteworthy is the fact that Studies 1A and 1B did not find memory bias for the faces of powerless individuals. Even though we did not have hypotheses for powerless individuals, it would seem possible that they are associated with a submissive looking prototype, which in turn could have distorted their facial representations. However, very little is known about the links between low-power and face prototypes. It is likely that the face prototypes for powerless individuals are less well-defined compared to those for the faces of powerholders, given that powerless individuals are a less salient category, as in fact, the majority of people belong to this category. In this vein, the face prototype of low-power individuals could be either more neutral and/or motivationally less important, and therefore, less accessible, compared to that of powerholders. These hypotheses could be tested in future research.

## Conclusion

The present research shows that people rely on dominance face prototypes when perceiving and remembering faces of powerholders. As such, powerholders' faces are

biasedly perceived and remembered towards more distinctive categorical features of the dominance prototype. In addition, social inferences, e.g. competence and attractiveness, are shaped by facial dominance and target's power, and such effects are more mixed in valence for women than for men.

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## Footnotes

1. Given that there is no consensus on how sensitivity power analysis should be conducted for mixed-effect models and also that there is no such option in G*Power software, we alternatively used repeated-measures ANOVAs to calculate the minimum effect sizes.

2. A mixed effect model was used with recognition rate of high-power targets as the dependent variable, crossing participants and stimuli as random factors. Given that the intercept ($B$ = -7.47) differed significantly from 0, suggesting that people on average showed a systematic bias toward dominance by selecting a morph that is more dominant-looking than the original face (0). Alternatively, a one-sample t-test as used in previous research, e.g. Epley and Whitchurch (2008) and Zell and Balcetis (2012), yielded a similar result, $t(127) = -2.77$, $p = .006$, $d = -0.25$, 95% CI [-13.2, -2.21].

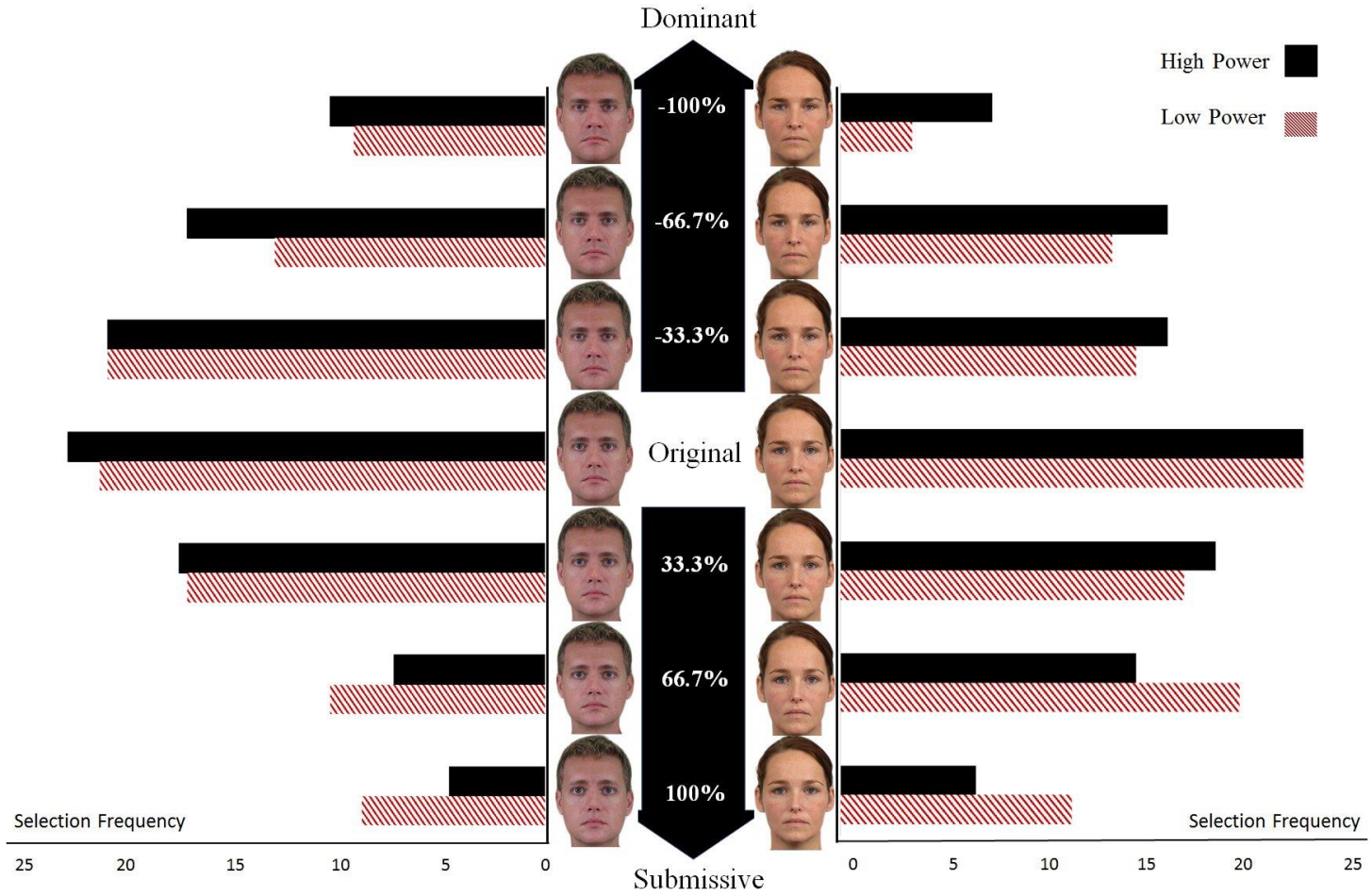


*Figure. 1.* Stimulus examples and recognition results for Study 1A. Vertical axis: Facial images ranging from most dominant to most submissive versions of the original. Horizontal axis: Percentage of participants selecting a facial image which was believed to represent the true likeness of a high-power or low-power target.

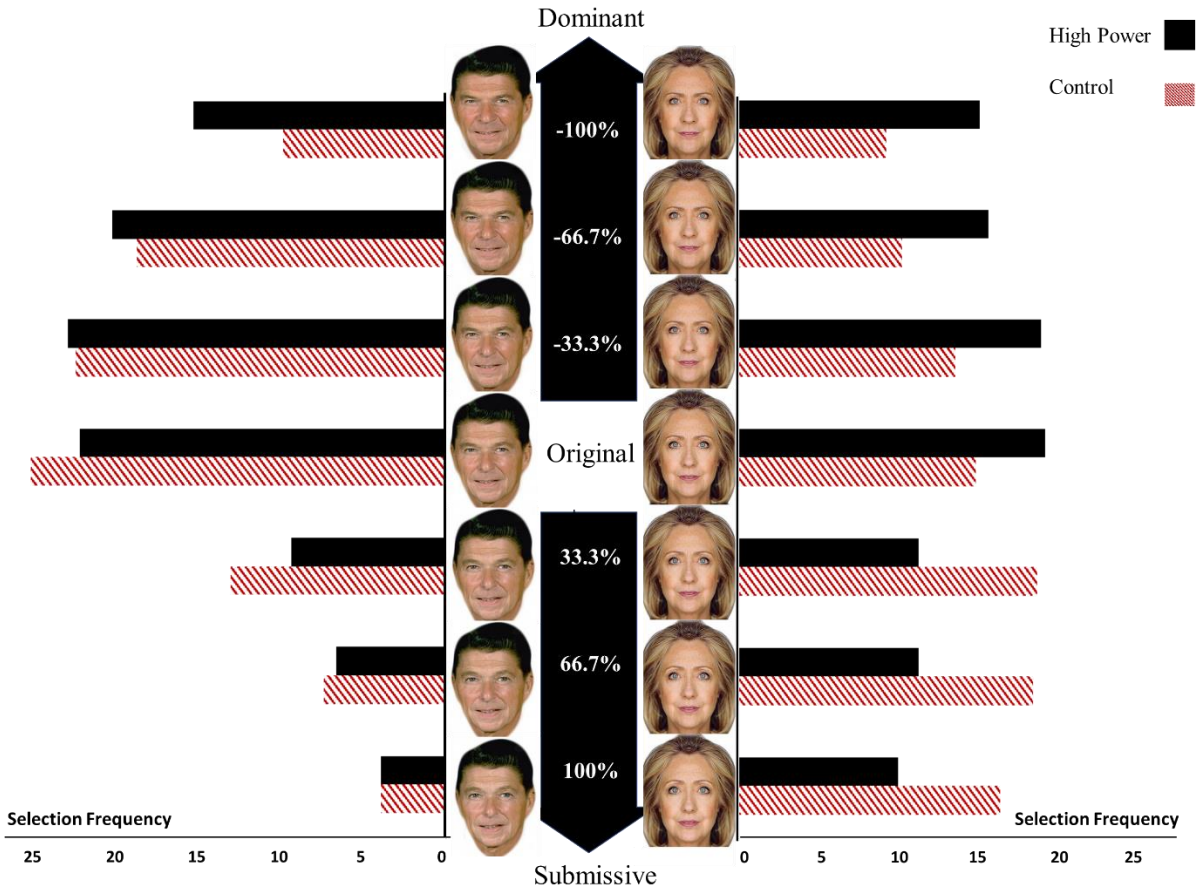


*Figure. 2*. Stimulus examples and recognition results for Study 2. Vertical axis: Images of Ronald Reagan and Hillary Clinton (high-power group), ranging from most dominant to most submissive versions of the original. Horizontal axis: Percentage of participants selecting a facial image which was believed to represent the true likeness of a target from the high-power or control group.