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ORIGINAL PAPER

Eye Gaze and Head Posture Jointly Influence Judgments of Dominance, Physical Strength, and Anger

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Abstract Social status hierarchies are a universal principle of organization in human societies. Status judgments are often influenced by perceptions of the face and posture. Two important nonverbal cues of social status are head postures and eye gaze. Prior research has shown contradictory results and little is known about the interaction of these two cues. Study 1 investigated how eye gaze (direct vs. averted) and head postures (bowed vs. neutral vs. raised) impact judgments of dominance and physical strength. Judgments of dominance were influenced more than judgments of physical strength. Furthermore, raised heads implied dominance and strength, but in contrast to common assumptions, a bowed head conveyed dominance if the eyes gazed at the observer. Study 2 showed that bowed heads with direct gaze conveyed anger, potentially explaining the increased judgments of dominance. Taken together, the results show that head posture and gaze interactively modulated status-related traits and emotions, namely, dominance, strength, and anger, and help clarify prior incompatible findings on head postures and eye gaze.

Keywords Social status hierarchies · Dominance · Physical strength · Eye gaze · Head postures · Anger

All data, analysis and materials have been made publicly available via Open Science Framework and can be accessed at https://osf.io/s8zrg/files/.

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Introduction

Across history and cultures, social hierarchies have been an important way of relating (Blaker and van Vugt 2014; Fiske 1992; van Vugt and Tybur 2015), and high status in social hierarchies has conferred benefits, influence, and resources (Cummins 2005; Magee and Galinsky 2008; von Rueden et al. 2011). Individuals who display behavior and traits typical of high status are usually labeled "dominant" (Cummins 2005). One important cue and predictor of dominance and social status is bodily strength (Sell et al. 2009a).

Because hierarchies are so important, humans use nonverbal cues to infer and communicate status to facilitate navigation in social hierarchies (see Hall et al. 2005). The human face seems to be a crucial source for social status inferences: Dominance is one of the most important traits inferred from facial morphology and facial expressions (Oosterhof and Todorov 2008; Sutherland et al. 2013). Physical strength can also be accurately judged from facial expressions (Sell et al. 2009a). Furthermore, it seems that facial expressions of anger configure the face in such a way that it appears stronger and more dominant (Sell et al. 2014).

Although important, facial morphology and expressions do not comprise the whole story. Humans also move their heads and direct their gaze to communicate status. However, previous findings on how eye gaze and head orientation influence the perception of dominance and physical strength are few and contradictory. In addition, there is a lack of research on how these cues interact and whether social dominance and physical strength judgments are influenced in the same way. In the current work, we explore how dominance and physical strength change according to nonverbal cues such as eye gaze direction and head posture.

Facial Dominance and Physical Strength

The human face is one of the most used cues to perceive social status. Oosterhof and Todorov (2008) found that in addition to trustworthiness, dominance is one of main dimensions underlying impressions from faces (see also Sutherland et al. 2013). The literature offers several possible conceptualizations of the term; for the purposes of this paper, we define facial dominance perception as the ability to influence others through the implementation of actions that have an impact on them, in particular actions that provide positive and negative rewards (Oosterhof and Todorov 2008). Facial dominance is related to masculinity and social status cues. Consequently, facial dominance perception might be associated with bodily strength that, throughout the evolution of our species, is related to the capacity to take actions through direct, bodily means, in particular, combat and constraint.

Some studies indicate that facial dominance is related to cues of physical strength, which is related to bodily strength (Oosterhof and Todorov 2008; Sell et al. 2009a). Over human history, physically strong people have been associated with high status positions. The ability to enforce rules and cooperation, and the defense against, or the submission of, external coalitions might have led to an interrelation between status and physical strength (Lukaszewski et al. 2016; Sell et al. 2009a, b; von Rueden 2014; von Rueden et al. 2011). Research has shown that physically strong men are judged as more dominant (Windhager et al. 2011) and masculinized men are also judged as dominant and physically strong (Jones et al. 2010; Perrett et al. 1998).

Judgments of these status-related traits from the face, dominance and physical strength, are highly correlated and their visual representations in the face share many similarities

(Toscano et al. 2011, 2016; Windhager et al. 2011). Low brows, small eyes, a large chin, a narrow mouth, and a wide nose signal both strength and dominance, although strength can still be present in the absence of dominance (Toscano et al. 2016).

However, inferences of dominance and physical strength from the face have been studied mainly with heads in a constant neutral posture and gaze. Changes of faces and heads across time and space may provide more valid information to the perceivers (McArthur and Baron 1983; Zebrowitz 2011). In daily interactions, heads are viewed in *multiple positions* or, in other words, in *multiple postures* (Jenkins et al. 2011; Rule et al. 2009; Sutherland et al. 2017; Todorov and Porter 2014), and with *different gazes* (Tipper and Bayliss 2011). These two nonverbal cues, *posture* and *gaze*, are a part of social status displays (Chiao 2010; Chiao et al. 2008).

Head Postures and Direct Eye Gaze

In nonhuman primates, the eye region tends to be the region that receives the most interest from conspecifics (Mendelson et al. 1982). Similarly, humans naturally become more interested in others when they gaze at us directly (Senju and Hasegawa 2005). From infancy on, humans can discriminate between direct and averted gaze (Farroni et al. 2002). Gaze indicates interest, but also conveys cues of dominance and submission. Direct eye gaze is seen as a threat by many animals (Coss 1978), including humans in some contexts (Argyle and Cook 1976; Perrett and Mistlin 1990). Recent research has shown that participants avert more their gazes when the targets manifest dominant behaviors (Holland et al. 2016). The perception of dominance-related emotions (e.g., anger) is intensified when eye gaze is direct, while the perception of submission-related emotions (e.g., fear) is intensified when eye gaze is averted (Marsh et al. 2005; but see Bindemann et al. 2008). People also pay more attention to the eye gaze direction of dominant (Jones et al. 2010) and high-status persons (Dalmaso et al. 2012, 2014). Additionally, eye gaze direction also influences dominance; direct eye gaze increases judgments of dominance, while averted eye gaze diminishes the judged dominance (Hall et al. 2005; Main et al. 2009). Thus, displays of dominance are typically expressed with direct eye gaze; conversely, submissive displays often involve averted eye gaze (see also Redican 1982).

One physical constraint and correlate of eye gaze is head posture. Head posture might also influence judgments of dominance, but there is markedly little evidence about it. Some studies suggest that a raised head increases judgment of dominance (Chiao et al. 2008; Mignault and Chaudhuri 2003; see also Rule et al. 2012). For instance, Mignault and Chaudhuri (2003) have shown that a person with a raised head is perceived as more dominant compared to one with a bowed head. Evidence from nonhuman primates indicates a similar finding; they tend to bow their heads when observing someone who is displaying dominance (de Waal 2007). Recently, Schneider et al. (2012) showed that persons with upward faces were perceived as heavier than persons with downward faces. Additionally, an upward posture increases the perceived masculinity of male targets (Burke and Sulikowski 2010).

One complicating factor may be that a deviation from a direct frontal view can result from a changed head position while the rest of the body does not move, or from a change of the observer or camera position while the viewed person does not move, or from both. In one study, participants were asked to select a portrait as a representation of either an influential leader or an assistant. They could choose from a set of three pictures that were either shot from the front, from above, or from below. The picture taken from below was more often chosen for the leader, and the picture from above was more often chosen for the assistant (Giessner et al. 2011). However, the portrayed individuals always looked into the camera, and the photos also showed parts of their upper body; this manipulation thus affected camera (and thus viewer) position stronger than actual posture of the target's head relative to the camera (or viewer).

We believe that when people feel threatened or want to intimidate somebody else, they actually do not always raise their heads to show displays of dominance. For instance, in boxing matches the fighters tend to lower their heads in order to defend and attack their opponents, probably to prevent straight blows to the eyes, nose, and lower jaw. Even during non-physical arguments, we sometimes lower our heads and look directly into others' eyes in order to try to convince them of our arguments. Empirical support exists for these anecdotal observations. Hehman, Leitner and Gaertner (2013) found that participants judged targets as more intimidating when their heads were tilted upwards, compared to when their heads were neutral, but when heads were angled downwards, targets also seemed more intimidating. Participants also attribute more social status to downward-tilted faces, at least for female targets (Schmid Mast and Hall 2004). Therefore, the relation between head postures and social status inferences thus seems to be more complicated than a simple up-is-higher status association.

The Current Research: Do Posture and Gaze Interact?

Taken together, the question of how eye gaze and head posture affect assessments of status-related traits (dominance and physical strength) seems worth further investigation. The current study is an exploratory one where we examined (1) how judgments of physical strength and dominance changed depending on head posture and eye gaze, (2) whether they changed in unison, and (3) whether eye gaze and posture interacted in their effects. The extant literature agrees that a raised head suggests dominance and may also suggest physical strength. Regarding a lowered head, however, the literature presents two competing hypotheses: Either the lowered head is a sign of submissiveness and weakness, or it is a sign of defiance and readiness to compete. Given the mixed findings, we did not have one singular hypothesis for this research, but test two opposing hypotheses. It might be the case that raised heads are judged stronger and more dominant than neutral and bowed heads. Nonetheless, it could be that bowed heads are seen as having more strength and dominance than neutral and raised heads. We conducted an exploratory study to test these competing predictions. Our idea is that eye gaze might determine which effect occurs. We therefore manipulated the two variables, head posture and eye gaze, orthogonally. We compared heads that are tilted upwards, tilted downwards, and neutral, and created averted eye gaze by having the targets look towards the sides (rather than down or up).

A Note on Gender

We also added gender of both target and perceiver to the design. When male targets gaze directly at the perceiver, they are judged as being more masculine than when their eye gaze is averted (Campbell et al. 1996). Masculinity is associated with more dominance (e.g., Jones et al. 2010). Additionally, non-dominant faces appear more feminine and very dominant faces look more masculine (e.g., Oosterhof and Todorov 2008). Males are on average stronger than females and the accuracy of perceiving physical strength for female faces is lower than for male faces (e.g., Sell et al. 2009a). Moreover, facial markers of dominance tend to be more rapidly associated with male faces than with female faces (see Hess and Hareli 2015). We therefore compared faces with different genders to check whether gender moderates the effects of head posture and eye gaze direction. Additionally, Sell and collaborators (Sell et al. 2009a, Study 2) suggested that male raters, compared to female raters, might be more accurate in perceiving strength from faces, especially for female targets. Consequently, we also added participants' gender to our analysis. However, because effects of gender are not the primary focus of our inquiry, we reported limited statistics of those. Graphs illustrating gender differences appear in the Supplementary Material.[1]

Study 1

Study 1 investigated judgments of dominance and strength of faces when heads were in a neutral, raised, or bowed position, and gazes were direct or averted. These two factors were manipulated orthogonally and within participants. Participants judged either dominance or strength.

Method

In Study 1 we report the results from three separate samples. Sample 1 consisted of Portuguese participants who participated in an online study and were recruited from a university in Lisbon. Participants were randomly assigned to judge either dominance or strength of faces. Sample 2 consisted of American participants sampled online via MTurk, in order to check replicability in a different culture. Because we observed some minor differences in strength judgments, we repeated the strength judgment component of the study, again sampling American participants, to get reliable estimates from a larger sample: This represents Sample 3.

In preliminary analyses testing for differences between these three samples, we found that the differences between them were negligible (see Supplemental Material). We thus report the three samples as one study below. We present our complete data. We did not collect additional variables in these studies, nor did we collect additional samples on this research question or other conditions. All data exclusions are reported below.

Samples and Participants

Our study had a total of 295 participants across three different samples. Sample 1 was comprised of 93 Portuguese students (68 female, age $M = 23.26$, $SD = 5.91$) recruited from ISCTE-IUL in Lisbon. For compensation, participants were entered in a lottery and one person won 80€ in vouchers. Sample 2 was recruited in the U.S. through Amazon Mechanical Turk (Buhrmester, Kwang, and Gosling 2011) and consisted of 137 participants (74 female, $M_{age} = 36.46$, $SD = 10.29$); 9 additional participants were excluded due to missing over 20% of responses. The participants of Sample 2 were compensated $1.75. Sample 3 was again recruited through MTurk and consisted of 65 participants (35 Male, $M_{age} = 35.86$, $SD = 11.16$); 7 additional participants were excluded due to missing over 20% of responses. Again, participants of Sample 3 were compensated $1.75. Note that

[1] Further details are available from the authors or can be computed from the publicly available data.

Sample 3 was smaller than 1 and 2 because it only collected data on one condition, the strength judgment.

Sample numbers were not based on a formal power analysis, partly because power analysis for the type of multilevel models, as used here, is not straightforward. Instead, we followed Simmons et al. (2013) recommendations that researchers include at least 50 participants per condition (here the judgment). Sample 1 fell just short of that recommendation, which is why we collected Sample 2. Note that all comparisons of interest were within participants, and when we computed correlations, we did so with faces as the unit of analyses, aggregating across participants.

Materials

Participants judged computer-generated faces. For every portrait created, we used three different head postures (bowed head, − 25°, neutral head, 0°, or raised head, + 25°) and two types of eye gaze (direct, averted). We created 60 identities in FaceGen software (FaceGen Modeller program version 3.5, http://facegen.com), 30 female and 30 male using the gender defaults in FaceGen. We thus sampled randomly from the population of portraits that can be created based on the statistical face model implemented in FaceGen; the 30 identities per gender can be thought of as a cell size.

We generated faces randomly in the *European Racial Origin* tab of FaceGen. All stimuli were White faces in order to avoid additional complications by stereotypes (see the General Discussion), but the skin tone was not homogeneous because some faces had more pigmentation (i.e., resembled more Southern Europeans) and others less (i.e., resembled more Northern Europeans). Nonetheless, the skin tone was randomly distributed across all faces. Additionally, for each picture we generated three head postures in FaceGen (bowed head posture or − 25°, neutral head posture or 0°, and raised head posture or + 25° degrees)[2] and three eye gaze directions (direct, averted to the right + 1 [in a scale from 0, minimum, to + 1, maximum] in the variable LookRight in the Morph tab of FaceGen,[3] and averted

[2] We used the ± 25 degrees due to practical reasons related to FaceGen. These degrees of tilt is the maximum tilt at which the targets' eyes and, consequently, their gazes can still be clearly seen. For this reason, we used these levels to manipulate our targets' head positions in order to maximize the tilt manipulation while still enabling the gaze manipulation.

[3] We ran an additional study on Amazon Mturk where we asked participants ($N = 84$) to judge the perceived gaze of the target faces. We wanted to check if the faces with direct gaze were really perceived as looking directly towards participants and if the faces with averted gaze were seen by participants as looking away from them. Participants had to judge on a scale from -3 (looks away from me) to + 3 (looks directly at me). The methodology was otherwise identical to the main studies. Perceived gaze judgments were influenced by gaze direction, $F(1, 707.27) = 8177.8$, $p < .001$. Faces with direct gaze were perceived as looking more towards the participants ($M = 1.60$ [1.44, 1.75]) than faces with averted gaze ($M = -2.30$ [− 2.51, − 2.09]), $B = 1.94$ [1.90, 1.98], $\beta = 0.16$. However, we found an interaction between head posture and gaze direction, $F(1, 708.795) = 15.35$, $p < .001$, $B = -0.10$ [− 0.15, − 0.05], $\beta = -0.01$—albeit this effect was much weaker than the main effect of gaze. When the gaze was direct, faces with bowed heads were perceived as having more direct gaze ($M = 2.17$ [2.03, 2.31]) than faces with raised heads ($M = 1.53$, [1.39, 1.67], $p < .001$), and neutral heads ($M = 1.07$ [0.93, 1.21], $p < .001$). Faces with bowed heads were also judged as having more direct gaze than faces with neutral heads ($p < .001$). When the gaze was averted, both faces with bowed heads ($M = -2.22$, [− 2.37, − 2.08]), and neutral heads ($M = -2.20$ [− 2.34, − 2.06]) were judged as having less averted gaze than faces with raised heads ($M = -2.46$ [− 2.60, − 2.32], $p < .001$). Faces with bowed heads and neutral heads did not show significant differences ($p = .70$). Due to these results, we re-ran the analyses of Study 1 and Study 2, substituting the judged directness of the gaze for the gaze contrast. We found essentially the same results except a strengthened linear head contrast effect on dominance. See discussion and Supplementary materials file – Study 1 and Study 2 with perceived gaze as an independent variable. Note, however, that the pictures we intended to show direct

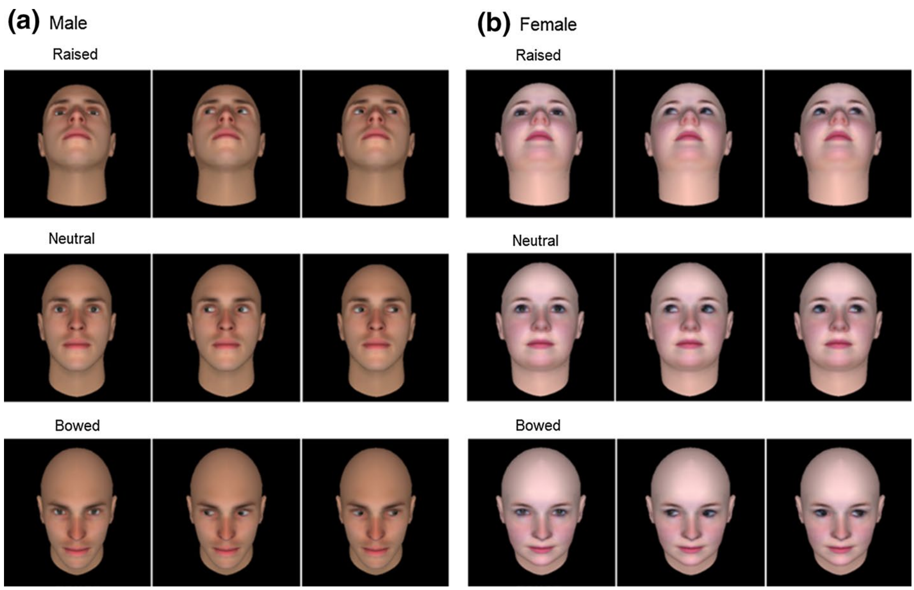

Fig. 1 Examples of pictures used in all studies: **a** male face and **b** female face across all head postures (raised, + 25° vs. neutral, 0° vs. bowed, − 25°) and gaze directions (direct and averted–rightward and leftward)

to the left + 1 (in a scale from 0, minimum, to + 1, maximum) in the variable LookLeft in the Morph tab of FaceGen). In total, we created 540 portraits (60 identities × 3 head postures × 3 gazes). All portraits were 400 × 400 pixels (see Fig. 1 for an example).

Design and Procedure

All data were collected online. Participants were told that there were no right or wrong answers and they were asked to respond intuitively. Using response scales from 1 (*very weak/not at all dominant*) to 7 (*very strong/very dominant*), participants judged 60 pictures on physical strength or dominance, and each picture was judged twice on each dimension to increase reliability. The order of pictures was randomized. Each picture was shown at the center of the screen with a question below: "How physically strong is this person?" or "How dominant is this person?" The participants were asked to rate the two dependent variables using the scales. Before the dominance judgment, we explained that by dominance we meant "how much this person wants to influence other people and how much she or he is able to do so".[4]

Because judging all 60 faces twice (120 trials) with every head posture and eye gaze direction (120 × 3 × 2 = 720 trials in total) would have resulted in a very difficult task, we

Footnote 3 (continued)
gaze were not all judged as looking directly into the camera, which is a limitation of our study and might have attenuated effects.

[4] In this definition, we associate motivation and potential to influence in order to define dominance. Influence is one of the main qualities of social dominance (e.g., Cheng et al., 2013).

broke down the total number of stimuli into 12 sets (6 for each trait judgment: dominance vs. physical strength) of 60 faces each (30 male and 30 female). Each participant judged only one set, but rated each face twice to increase reliability.[5] Participants were randomly assigned to one of those sets. In sum, the mentioned independent variables were counterbalanced across participants and across each one of the sets. Consequently, the study had a 3 (head posture: raised head [+ 25°] vs. neutral head [0°] vs. bowed head [− 25°], within) × 2 (eye gaze: direct vs. averted, within) × 2 (gender of the target: male vs. female, within) × 2 (gender of the participant: male vs female, between) × 2 (judgment: physically strength vs. dominant, between) design with 120 ratings in total per participant.

Results

Analytic Strategy

We used mixed models (also known as hierarchical linear models or multilevel models), without centering the data across the grand mean or the individual mean, to analyze how dominance and physical strength judgments were influenced by eye gaze direction, head posture, gender of the stimuli, and gender of the participant. In these analyses, the units of analysis were the individual judgments of dominance and physical strength provided by the participants, instead of averaging across conditions. In all models, both stimulus (i.e., face identity) and participant were entered as cross-classifying random factors (Judd et al. 2012).

We operationalized averted eye gaze as looking to the side in the photos, and implemented averted eye gazes both to the left and the right to avoid confounds. Because we had no specific hypothesis regarding eye gaze direction, we did not distinguish between eye gaze averted to the left versus right in the analysis below, but coded it as direct eye gaze (+ 1/2) or averted eye gaze (−1/2) to simplify the model.

Head posture was manipulated with three levels: raised, neutral, and bowed. Such factors are often analyzed using omnibus tests with more than one between-groups degree of freedom. We computed such omnibus models here, but only to report estimated means and to run some crucial pairwise comparisons. In our main analysis, we replaced the omnibus tests by coding the factor into two orthogonal contrasts that formulate specific comparisons, facilitating inferences (Judd 2000; Judd et al. 2009). Specifically, we coded one linear contrast (raised head posture = + 1/2 vs. neutral head posture = 0 vs. bowed head posture = − 1/2), and one quadratic contrast (bowed head posture and raised head posture = − 1/3 vs. neutral head posture = + 2/3). The linear contrast tested whether the dependent variable linearly decreased from raised over neutral to bowed heads. The quadratic contrast tested whether the neutral condition differed from both tilted conditions combined.

Finally, both gender of stimulus and gender of participant were also contrast coded as − 1/2 for female versus + 1/2 for male. Note that all contrasts were fractional and their weights always spanned differences of 1. The *B* values that we reported can thus be interpreted directly as mean differences.

[5] Due to a programming mistake, 2 sets of the total 12 missed one face in all samples. Thus, these participants judged only 59 faces twice (118 judgments in total).

Preliminary analyses (see Supplemental Material) led to two conclusions: (1) Sample could be dropped from the model because intercepts and slopes of hypothesis-testing factors were equivalent across samples. (2) Judgments of dominance and judgments of strength were affected differently, and should thus be analyzed in separate models. This was implemented in the main analyses. By running separate analyses, we lose a direct comparison of dominance and strength judgment. However, we preferred this option because a) that comparison is not the main goal of the manuscript, and b) because one sample (Sample 3) only judged strength, so judgment was not completely randomly assigned.

Using the total sample of $N = 295$, the main analysis consisted of two mixed models, one for dominance judgments and one for physical strength judgments. Predictors were one linear and one quadratic contrast coding head posture, and contrast codes of direct versus averted eye gaze, gender of stimulus, and gender of participant. We also included all interactions, except interactions among the two head posture contrasts. Intercepts varied across stimulus identity and participant nested within sample. We call these models the *contrast models*. We ran them entering the contrast codes as covariates. We reported significant effects in these contrast models with accompanying slopes (B values).

To ease interpretation, we additionally estimated means for the crucial head posture by eye gaze interaction and some of the other interactions with the head posture variable. To that purpose, we ran two additional models that were equivalent to the two models just mentioned except that they featured head posture as a variable with three conditions (rather than two contrasts). We called these the *omnibus models*. From these models, we only reported the estimated means to point out some instructive simple comparisons, but not the significance tests because these were provided by the contrast tests mentioned above.

In sum, we diagnose mean patterns with contrasts, and illustrate these with mean estimates from omnibus models. Figure 2 shows estimated means of the eye gaze by head posture interaction based on the omnibus model. Figure 3 shows the estimated means with direct eye gaze of female and male faces judged across all head postures.

Effects of Head Posture and Eye Gaze on Dominance Judgments

The contrast model showed that dominance judgments were influenced by eye gaze direction, $F(1, 348.62) = 245.79$, $p < .001$. A more direct eye gaze increased judged dominance by almost one scale point on the seven-point scale, $B = 0.89$ [0.78, 1.00], $\beta = 0.36$.

The quadratic head posture contrast was significant, $F(1, 348.91) = 46.22$, $p < .001$, $B = -0.41$ [-0.53, -0.29], $\beta = -0.20$. However, eye gaze and head posture interacted. The prediction by the quadratic head posture contrast differed depending on gaze, $F(1, 348.91) = 26.93$, $p < .001$; differences between faces with bowed and raised heads versus neutral heads were stronger for direct eye gaze, $B = -0.63$ [-0.86, -0.39], $\beta = -0.53$. The linear head posture contrast (which was not significant on its own, $p = .19$), also differed in its influence depending on gaze, but this interaction was much smaller, $F(1, 348.28) = 4.54$, $p = .034$. The linear effect had a larger impact for faces with more direct eye gaze, $B = 0.30$ [0.02, 0.57], $\beta = 0.30$.

These patterns can best be understood using the estimated means from the omnibus models (see Fig. 2). There were no significant differences in dominance judgments between the three head postures when the eye gaze was averted, ps $> .05$. However, when eye gaze was more direct, participants judged the faces with raised heads as more dominant, $M = 4.67$ [4.40, 4.94], than faces with neutral heads, $M = 3.83$ [3.56, 4.10], $p < .001$, and faces with bowed heads, $M = 4.43$ [4.16, 4.70], $p = .015$. Crucially, however, bowed heads with more direct eye gaze were still judged significantly more dominant than heads

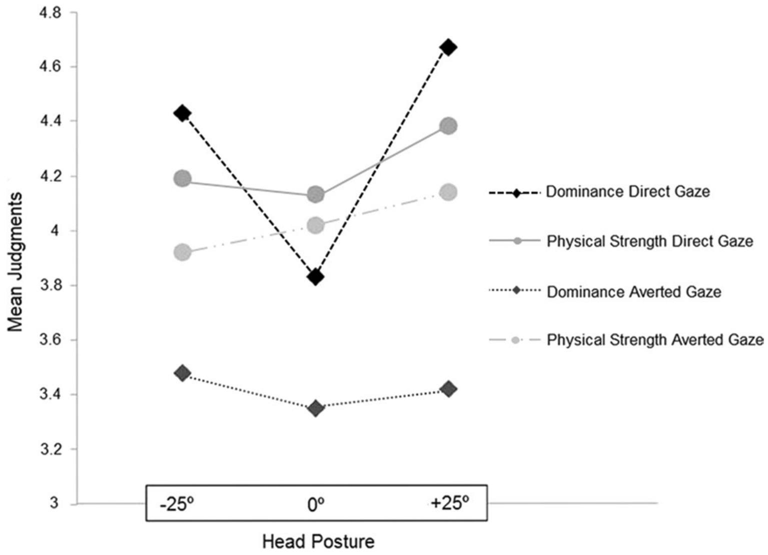

Fig. 2 Judgments of dominance and physical strength by gaze and head posture (bowed head [− 25°] vs. neutral head [0°] vs. raised head [+ 25°])

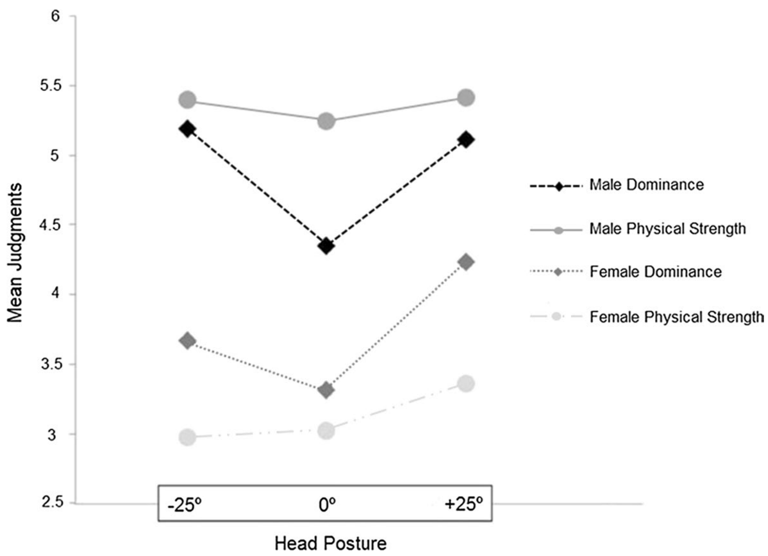

Fig. 3 Judgments of dominance and physical strength with direct gaze by gender and head posture (bowed head [− 25°] vs. neutral head [0°] vs. raised head [+ 25°])

with more direct eye gaze that were not tilted, $p < .001$. Together, this produced the "tilted V" pattern for dominance judgments when eye gaze was direct.

Effects of Target Gender on Dominance Judgments

Female faces were seen as less dominant by more than a scale point, $F(1, 348.62) = 365.54$, $p < .001$, $B = -1.09$ [-1.20, -0.98], $\beta = -0.66$. Additionally, we also observed interactions of gender variables. The linear head posture contrast was moderated by gender of the judged face, $F(1, 348.29) = 22.32$, $p < .001$. Supplementary Material, Fig. 1 shows the pattern: The *tilt* of the V was only present for dominance judgments of female targets. Only for female targets, raised heads were judged as more dominant than bowed heads, $B = 0.66$ [0.38, 0.93], $\beta = 0.65$. Bowed heads of male targets were judged as just as dominant as raised heads. However, the quadratic head posture contrast did not interact with the target's gender, $F(1, 348.92) = 1.81$, $p = .179$. For both genders, tilted heads with more direct eye gaze were judged as more dominant that non-tilted heads.

Effects of Participant Gender on Dominance Judgments

The linear head posture contrast also interacted with gender of the participant, $F(1, 6538.18) = 13.19$, $p < .001$; female participants differentiated more between faces with bowed heads and faces with raised heads, $B = 0.24$ [0.11, 0.38], $\beta = 0.12$. Finally, gender of the judged face interacted with gender of the participant, $F(1, 6538.76) = 13.58$, $p < .001$; female participants differentiated more between male and female faces, $B = -0.20$ [-0.31, -0.10], $\beta = -0.08$. The interactive findings mentioned above were not influenced by these factors, all ps $> .05$.

Effects of Head Posture and Eye Gaze on Strength Judgments

Eye gaze direction had a main effect on judged physical strength, $F(1, 344.721) = 27.42$, $p < .001$. More direct eye gaze increased judged strength by a fifth of a scale point, $B = 0.21$ [0.13, 0.28], $\beta = 0.08$.

The linear head posture contrast was significant, $F(1, 344.53) = 18.36$, $p < .001$. The more raised the head was, the stronger the person was judged, $B = 0.21$ [0.11, 0.30], $\beta = 0.09$. The quadratic head posture contrast showed only a marginal effect, $F(1, 344.92) = 3.66$, $p = .057$. The estimated means from the omnibus models showed that raised head faces were judged as stronger, $M = 4.26$ [4.17, 4.35], than neutral heads, $M = 4.08$ [3.98, 4.17], $p < .001$, and bowed head faces, $M = 4.05$ [3.96, 4.15], $p < .001$. Bowed head faces and faces in a neutral posture did not show significant differences, $p = .624$.

In contrast to the analysis of dominance judgments, eye gaze and head posture did not significantly interact for physical strength. We only found a marginal interaction of eye gaze direction and quadratic head posture contrast, $F(1, 344.93) = 3.20$, $p = .075$; bowed head faces and raised head faces combined lead to slightly higher strength judgments when the eye gaze was more direct, $B = -0.15$ [-0.31, 0.01], $\beta = -0.11$. The interaction of eye gaze with the linear head posture contrast was not significant, $p = .823$. There were also no higher order interactions involving these.

Effects of Target Gender on Strength Judgments

Male faces were judged as 2 scale points stronger than female faces, $F(1, 344.73) = 3167.71$, $p < .001$, $B = -2.20$ [-2.28, -2.13], $\beta = -0.78$. In other words,

Table 1 Correlations between judgments of dominance and physical strength according to head posture (raised, + 25° vs. neutral, 0° vs. bowed, − 25°) and gaze (direct vs. averted)

Head posture	Direct gaze	Averted gaze
− 25°	0.90 [0.84, 0 .93]	0.88 [0.82, 0.93]
0°	0.76 [0.65, 0.86]	0.79 [0.71, 0.86]
+ 25°	0.77 [0.69, 0.85]	0.71 [0.61, 0.80]

These correlations were calculated with faces as units of analysis. Dominance and strength were judged by different participants. Judgments were averaged across participants

for strength judgments we found that gender had 10 times the impact of gaze. Gender of the judged face interacted with the linear head posture contrast, $F(1, 344.50) = 10.54$, $p = .001$. For female targets, participants judged raised heads to be physically stronger than to bowed head, $B = 0.31$ [0.12, 0.50], $\beta = 0.27$. Supplementary Material Figure 1 illustrates this pattern. The omnibus models showed that regarding male faces, judged physical strength was the same whether the faces were raised, $M = 5.28$ [5.17, 5.40], bowed, $M = 5.23$ [5.12, 5.35], or neutral, $M = 5.18$ [5.07, 5.30], $ps > .05$. However, females faces that were raised were judged as stronger, $M = 3.24$ [3.12, 3.35], than female faces with neutral heads, $M = 2.98$ [2.86, 3.09] and female faces with bowed heads, $M = 2.87$ [2.76, 2.99]. The quadratic head posture contrast did not interact with the gender of the judged face, $F < 1$.

Effects of Participant Gender on Strength Judgments

Gender of the participant also had a main effect, $F(1, 178.48) = 6.94$, $p = .009$; male participants gave higher strength judgments on average, $B = 0.18$ [0.05, 0.32], $\beta = 0.11$. Gender of participant also interacted with the head posture quadratic contrast, $F(1, 10{,}407.98) = 7.12$, $p = .008$. Every participant assigned less physical strength to the faces with neutral heads than to raised/bowed ones, but female participants showed this difference more strongly, $B = -0.10$ [− 0.17, 0.17], $\beta = -0.04$. Gender of participant also interacted with eye gaze, $F(1, 10{,}407.84) = 4.26$, $p = .039$. Both female and male participants assigned more strength to faces with more direct eye gaze, but female participants differentiated more strongly between averted and direct eye gaze, $B = 0.07$ [0.00, 0.14], $\beta = 0.02$. Finally, the two gender variables interacted with each other, $F(1, 10{,}407.97) = 38.97$, $p < .001$. Male participants differentiated more between female and male targets, $B = 0.21$ [0.15, 0.28], $\beta = 0.06$, but all assigned more physical strength to male targets.

Correlation Between Dominance and Physical Strength

In addition to the profile of physical strength and dominance across head postures and eye gaze directions, we also investigated whether dominance and physical strength judgments were related. For this purpose, we ran Pearson correlations. We aggregated judgments of dominance and strength for each picture across all participants; thus, picture became the unit of analysis. The correlations were significant for every head posture and eye gaze direction—see Table 1. Nevertheless, there were some differences. We found that judgments of dominance and physical strength were more correlated for bowed heads. Using a Steiger test (Steiger 1980) to compare these correlations, we found that both averted and direct eye gaze with bowed heads showed significantly higher correlations in comparison with faces with neutral and raised heads, $ps < .001$.

Discussion

Study 1 investigated how dominance and strength were influenced by changes in head posture and eye gaze. The most intriguing finding was that dominance and physical strength were judged as higher when heads were bowed, compared to a neutral head posture. Thus, when our heads are bowed and look more directly at the perceiver, impressions of both dominance and physical strength increase. Therefore, faces with neutral heads are not necessarily seen as more powerful than faces with bowed heads. Some previous studies had shown that a person with a neutral head is judged as more dominant than persons with bowed heads (e.g., Mignault and Chaudhuri 2003). Evidence from our research shows a more complex pattern. Displays of dominance or physical strength are not always better transmitted with neutral heads than with bowed heads. It seems that some previous studies did not consider the role that both gaze and head position can have in displays of dominance (but see Hehman et al. 2013; Schmid Mast and Hall 2004).[6]

Thus, we did not find a linear effect in the form of dominance decreasing from raised to neutral to bowed head; instead, we observed a quadratic V-shaped effect (see Fig. 2, also see Supplementary Materials file and General Discussion—we discuss an additional analysis where it was found a strengthened linear head contrast effect on dominance judgments). This V pattern varied in its strength, however. First, it was stronger for faces with more direct eye gaze compared to averted eye gaze; head posture had no influence for faces with averted eye gaze. Second, although there was no overall linear effect, the V-shape was "tilted" by a linear effect for dominance judgments of female targets (i.e., by an interaction with target gender). A man's bowed head was more readily interpreted as dominant than a woman's bowed head. Third, the quadratic effect was much stronger for dominance judgments than for strength judgments: Although dominance and physical strength seem to change in a similar fashion overall, head posture and eye gaze influenced dominance *more* than they influenced physical strength.

We found both similarities and differences between dominance and physical strength judgments. First, they were correlated across all head postures and eye gaze directions. This confirms previous work that showed how physical strength is associated with dominance (Toscano et al. 2014; Windhager et al. 2011). The highest correlations existed between judgments of dominance and physical strength when head postures were bowed. However, dominance was affected more than strength. The differences between judgments of more direct and averted eye gaze stimuli were about five times larger for dominance than for physical strength judgments. This effect is comparable to the gender difference effect. Looking the perceiver more directly in the eyes increased ratings of dominance by about as much as being male did. In contrast, a more direct eye gaze only added a tenth of the gender difference in judged strength. In the neutral head posture, the effect of eye gaze was

[6] More recently, Schneider and Carbon (2017) asked participants to judge faces on dominance. In contrast to previous studies, they did not find an effect of head posture. Raised heads were not perceived as more dominant than bowed heads. Given the presence of muscles around human necks and the role of muscular strength in perceiving dominance (e.g., Toscano et al., 2016), the authors wrote that one likely reason for these results was that they only showed faces without necks. Therefore, it might be the case that our stimuli, where the necks can be seen by the participants, could have influenced our data. However, as it can be seen in Fig. 1, bowed heads exposed less their necks than neutral and raised heads, but were perceived as more dominant than the former. Nonetheless, we suggest that further studies investigating the effects found in our research should only use faces without necks.

much more pronounced for dominance than for physical strength judgments. Therefore, our data clearly show that status-related traits are not judged in the same way.

Study 2

Given that the lowering of the head is usually associated with displays of submission (see Mignault and Chaudhuri 2003, but see Hehman et al. 2013), it may seem odd that lowered faces were judged as stronger and more dominant than faces with neutral heads, and, in some cases, even in comparison to faces with raised heads. We propose that this can be partly explained by the recognition of anger cues.

Anger is a status-related emotion and people tend to associate anger with high-status individuals (Tiedens et al. 2000). Expressing anger increases the chances of status attribution. Tiedens (2001) showed that participants attributed more status to targets that displayed anger. Anger also seems to be correlated with facial dominance characteristics (Hess et al. 2000; Knutson 1996). Anger is related to aggression, but also to cooperation (see Sell et al. 2009b). Some authors argue that anger evolved to resolve hostilities in favor of the angry person through two interpersonal mechanisms: harm of others and increase of their cooperation (Sell et al. 2009b). In line with this reasoning, researchers gathered evidence to find that the human facial expression of anger possibly developed to show cues of physical strength (Sell et al. 2014).

We studied anger attributions in Study 2, testing whether they follow the pattern observed in Study 1 for dominance and strength. As in Study 1, all faces had neutral expressions and were judged in the same three head postures (bowed, neutral, and raised) and two eye gaze directions (direct versus averted).

Method

Participants and Materials

Sixty-one participants (33 female, M_{age} = 34.28, SD = 9.72) were recruited through Amazon Mechanical Turk (Buhrmester et al. 2011). Each participant was paid $1.75.

Materials were the same as in Study 1.

Design and Procedure

The design and procedure were similar to Study 1. The only difference was that we asked for judgments of anger only. Participants were asked to answer the question: "How angry is this person?" on a 7-point scale from 1 (*not at all angry*) to 7 (*very angry*).

Results

We followed the same analytical strategy as in Study 1.

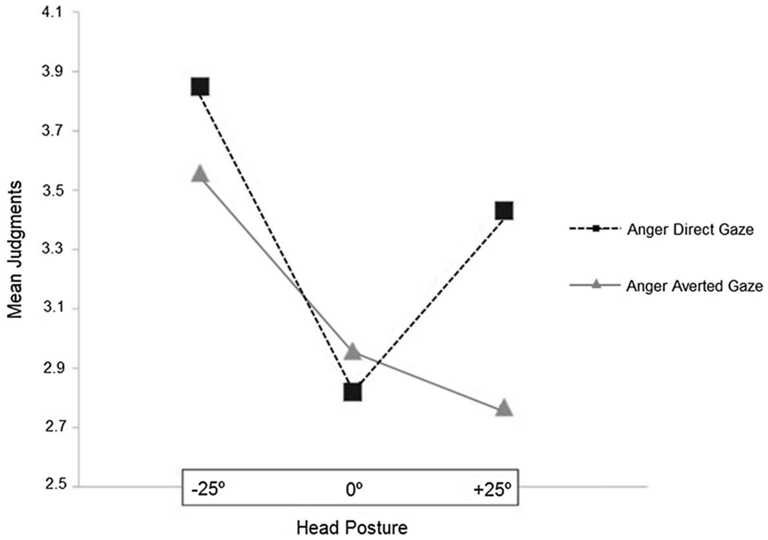

Fig. 4 Judgments of anger depending on gaze and head posture (bowed head [− 25°] vs. neutral head [0°] vs. raised head [+ 25°])

Effects of Head Posture and Eye Gaze on Anger Judgments

Our multilevel model revealed a main effect of eye gaze direction on judged anger, $F(1, 340) = 13.92$, $p < .001$. Faces with more direct eye gaze were judged as angrier than averted eye gaze faces, $B = 0.27$ [0.13, 0.42], $\beta = 0.09$.

The linear head posture contrast was significant, $F(1, 339.75) = 46.12$, $p < .001$, $B = -0.61$ [− 0.78, − 0.43], $\beta = -0.26$ but it also interacted with eye gaze, $F(1, 339.73) = 4.43$, $p = .036$; the linear contrast played a larger role for judgments of faces with a more direct eye gaze than for faces with averted eye gaze, $B = 0.38$ [0.02, 0.73], $\beta = 0.32$. Eye gaze also interacted with the quadratic head posture contrast, $F(1, 340.25) = 15.75$, $p < .001$; participants judged the combination of faces with raised and bowed heads as angrier when faces had a more direct eye gaze, than when they were averted, $B = -0.61$ [− 0.92, − 0.31], $\beta = -0.43$.

These results can be seen in the means estimated by the omnibus models and are graphed in Fig. 4. When eye gaze was more direct, participants saw significant differences in anger between the three head posture levels: Faces with bowed heads were judged as significantly angrier, $M = 3.85$ [3.56, 4.14], than faces with raised heads, $M = 3.43$ [3.14, 3.72], which in turn were judged as angrier than neutral heads, $M = 2.82$ [2.53, 3.11], *p*s < .01. When eye gaze was averted, participants still judged faces with faces of bowed heads as angrier, $M = 3.56$ [3.27, 3.85] than both faces of raised heads, $M = 2.77$ [2.48, 3.06], and faces of neutral heads (M = 2.96, [2.67, 3.25]), *p*s < .001. The difference between the latter two was not significant, $p = .131$.

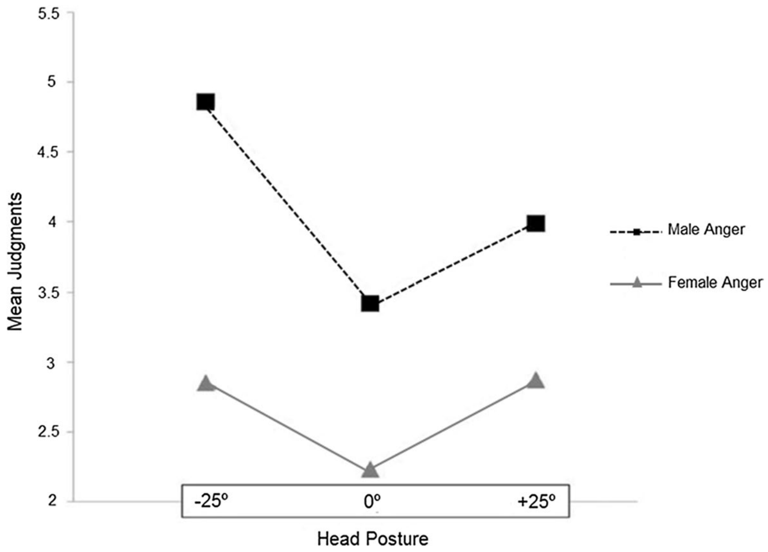

Fig. 5 Judgments of anger with direct gaze by gender and head posture (bowed head [− 25°] vs. neutral head [0°] vs. raised head [+ 25°])

Effects of Target Gender on Anger Judgments

Male faces were judged as angrier, $F(1, 340) = 325.72$, $p < .001$, $B = -1.32$ [− 1.46, − 1.17], $\beta = -0.43$. Gender of the judged face interacted with the linear head posture contrast, $F(1, 339) = 22.12$, $p < .001$. The tilt of the V-shape is only present for male targets and not for females, $B = 0.84$ [0.49, 1.19], $\beta = 0.71$, see Fig. 5. Data from the omnibus models showed that female faces with neutral heads were perceived as less angry, $M = 2.32$ [2.03, 2.61] than female faces with raised heads, $M = 2.61$ [2.32, 2.90], $p = .020$, and faces with bowed heads, $M = 2.80$ [2.51, 3.09], $p < .001$. The two tilted head conditions did not differ from each other, $p = .139$. Males with bowed heads were judged as angrier, $M = 4.62$, [4.33, 4.91] than male faces with raised heads, $M = 3.59$ [3.30, 3.88]) and male faces with neutral heads, $M = 3.47$ [3.18, 3.76], *p*s < .001. The latter two did not differ, $p = .328$.

In contrast, we did not find an interaction between gender of the judged face and the quadratic head posture contrast, $F(1, 340.25) = 2.62$, $p = .107$. Thus, the effect that tilted heads with more direct eye gaze were judged as angrier was not moderated by target gender. Additionally, the interaction between gender of the judged face and eye gaze was only marginal, $F(1, 339.98) = 2.85$, $p = .092$. Likewise, the interaction between gender of the judged face and gender of the participant was again marginal, $F(1, 3492.88) = 3.19$, $p = .074$.

Effects of Participant Gender on Anger Judgments

Gender of the participant interacted with the linear head posture contrast, $F(1, 3491.85) = 19.11$, $p < .001$. Participants judged faces with bowed heads as angrier than faces with raised heads or neutral heads; however, male participants differentiated even more between these types of head postures, $B = -0.39$ [− 0.56, − 0.21], $\beta = -0.16$.

Table 2 Correlations between judgments of dominance and anger (left), and physical strength and anger (right), depending on head posture (raised, + 25° vs. neutral, 0° vs. bowed, − 25°) and gaze (direct vs. averted)

Head posture	Dominance and anger		Physical strength and anger	
	Direct gaze	Averted gaze	Direct gaze	Averted gaze
− 25°	0.89 [0.82, 0.94]	0.91 [0.87, 0.95]	0.83 [0.72, 0.91]	0.85 [0.77, 0.91]
0°	0.72 [0.55, 0.83]	0.71 [0.56, 0.83]	0.72 [0.57, 0.83]	0.74 [0.61, 0.84]
+ 25°	0.77 [0.66, 0.86]	0.57 [0.46, 0.69]	0.75 [0.64, 0.84]	0.77 [0.67, 0.85]

These correlations were calculated with faces as units of analysis. Each variable was judged by a separate set of different participants. Judgments were averaged across participants

Participant gender did not interact with the quadratic head posture contrast, $F(1, 3492.79) = 0.757$, $p < .384$. Nonetheless, we found an interaction between gender of the participant and eye gaze direction, $F(1, 3492.78) = 8.13$, $p = .004$. Male participants differentiated more between faces with direct versus averted eye gaze, $B = -0.21$ [-0.35, -0.06], $\beta = -0.07$.

Correlations Between Anger and Judgments of Dominance and Physical Strength

We also ran Pearson Correlations to check for correlations between anger judgments and physical strength or dominance judgments. As in the previous correlational analysis, judgments of anger, dominance and physical strength were aggregated across all participants; consequently, the judged faces were the unit of analysis. We found that the correlations were significant across every head posture and eye gaze direction (see Table 2). Importantly, the correlations were higher again for faces with bowed heads. The Steiger test (Steiger 1980) showed that, independently of eye gaze direction and head posture, bowed heads showed higher correlations between anger and dominance judgments, and between anger and physical strength judgments compared to these correlations in neutral and raised heads, $ps < .001$.

Discussion

Anger judgments showed similarities with the pattern of dominance and physical strength judgments. Anger cues seem to drive partly how dominance and physical strength are perceived in the face. Consistent with Study 1 results, status-related traits seem to be better displayed with both raised and bowed heads: Lowered faces were perceived as displaying more anger than faces with neutral heads. Thus, it is possible that faces with bowed heads were judged as more dominant and stronger than faces with neutral heads, and in some cases even faces with raised heads, because this pose is perceived as angry. Note however, that the dominance of raised heads cannot be explained by increased anger, as indicated by the direction the V tilts for anger judgments. Inferences of anger can thus not be a mediator of the complete pattern of effects of position and gaze on dominance; it only qualifies as an explanation for part of the pattern—namely bowed heads with direct gaze.

In sum, our data show that head posture and eye gaze influence anger perception, and do so by way of interaction. Anger judgments were higher when the heads were bowed or raised rather than in a neutral pose (see Figs. 4 and 5), but only when eye gaze was direct.

This is comparable to findings in Study 1 for dominance and, more attenuated, for physical strength. We again observed a tilt of the V pattern, and its interaction with eye gaze. However, this time the tilt was to the other side; bowed heads with direct eye gaze were judged as angrier than raised heads with direct eye gaze. The tilt was stronger for male targets. In other words, bowed heads of males were judged as particularly angry.

The correlations between anger, dominance, and physical strength judgments were higher for faces with bowed heads in comparison with faces with neutral and raised heads. This suggests to us that this pose combines these three aspects in one gestalt, more so than the other poses.

General Discussion

In the current paper, we explored how social status is perceived in the human face depending on eye gaze direction and head posture. Separate groups of participants judged status-related traits and emotions (i.e., dominance, physical strength, and anger). In total, we collected data on 60 computer-generated heads (30 of each gender) with three head postures and varying eye gaze from 356 American and Portuguese participants.

What may not be surprising is that overall, raised head postures were perceived as having more social status. Raised head postures were judged as stronger and more dominant than heads in a neutral posture. What may be striking, however, is that bowed head postures were not simply seen as less dominant, less strong, and less angry than heads in a neutral pose. A bowed head also led to increased judgments of dominance, strength, and anger. This was particularly true for dominance judgments and for anger judgments (compared to strength), when eye gaze was more direct (compared to averted), and for male targets (compared to female). Bowing the head and simultaneously averting the gaze sends a signal of submission and physical weakness, but bowing the head while keeping eye contact overcomes this, especially for male targets.

We ran an additional analysis (see Supplementary Materials file and Footnote 2) where we used judged directed of gaze from an additional study instead of the gaze contrast. We found in this supplementary analysis essential the same results as in the analysis using reported in Study 1 and Study 2. The main significant difference was that dominance judgments were also influenced by the linear head contrast. Therefore, raised heads tended to be seen as even more dominant than in the models reported above for Study 1. The remaining effects maintained a similar profile both for physical strength and anger judgments.

The effect of a bowed head and direct eye gaze probably arose because the facial configuration suggests anger, as we showed in Study 2, and anger is a status-related emotion (Hess et al. 2000; Knutson 1996). In Study 2, participants reported more anger in faces with downward heads and more direct gaze. This result corresponds with earlier work that connected expressions of anger with descending movements of the upper face, more specifically, the forehead area (Bassili 1979). Moreover, anger cues seem to be displayed by a V-shaped downward angle (Aronoff et al. 1992; LoBue and Larson 2010). Faces in the bowed head posture—see Fig. 1—have a much more marked V-shape in the forehead and brow regions than faces in neutral and raised postures. What appears to happen is that a bowed head gives the impression of anger.

Curiously, the perceived gaze direction (see also Footnote 3) showed some significant differences depending on the head posture. Thus, when the gaze was direct, faces with bowed heads were judged as looking more directly to the participants than faces with raised and neutral heads. It is possible that this small difference is due to either an imperfect manipulation on our part, or the anatomy of the human face itself, which might occlude gaze more for raised than bowed heads. However, it could also be that perceived gaze itself can be influenced by head posture. The reason for this effect could be related to the perception of anger. Some research suggests that an angry look can influence how gaze direction is perceived (Ewbank et al. 2009; Lobmaier et al. 2008). Angry faces are judged as looking more directly to a person than neutral faces. Given our findings that faces with bowed heads were perceived as looking more often to the observers, we might argue that this is caused by the increased display of anger.

Importantly, the effects of eye gaze direction and head posture were larger for dominance than for physical strength judgments. Head posture and eye gaze direction did not actually interact for physical strength judgments. The absence of an interaction of eye gaze and head posture on physical strength, but its presence on dominance judgments, indicates that the assessment of traits related to social status is influenced in a different way by nonverbal cues. Social status traits, dominance, and physical strength, perceived in the human face are clearly related to each other; physical strength is used as heuristic to predict dominance (Toscano et al. 2014). However, the impressions derived from seeing a head in a specific posture combined with a direct eye gaze impacts dominance judgments beyond physical strength. This aligns with the fact that in humans, a great number of abilities are associated with social status beyond physical strength, such as emotional intelligence, willingness to lead, and cognitive aptitudes (Cheng et al. 2013; Henrich and Gil-White 2001).

A common assumption in the literature is that people perceive concrete information (physical strength) and then overgeneralize to abstract social information (dominance trait; Oosterhof and Todorov 2008; Sell et al. 2009a; Toscano et al. 2014; Windhager et al. 2011; Zebrowitz 2011). Eye gaze and head posture are related to processes associated with the display (Darwin 1872; Mignault and Chaudhuri 2003) and inference of intentions (Baron-Cohen 1995). Recent research has shown that people show more variability in making judgments related to intentions (e.g., social traits like trustworthiness) and less variability while making judgments related to abilities (e.g., physical strength; Hehman et al. 2015). This might explain the greater role of head posture and eye gaze direction for dominance.

Hitherto the literature of social status and its nonverbal cues has assumed that head posture was related to displays of supremacy or appeasement in a social hierarchy that would transmit intentions to maximize influence, enter into conflict, or maintain social unity (Mignault and Chaudhuri 2003). The idea was that there was a simple contrast between raised heads that look dominant and bowed heads that look submissive (but see Hehman et al. 2013). We show here, however, that the story is far more complicated, and that eye gaze is a decisive moderator. Mignault and Chaudhuri's (2003) stimuli were schematized to a degree that no gaze was discernible. Our data showed that the bowed head with a fixed eye gaze was more dominant than the neutral head with the same direct eye gaze. This may seem counterintuitive from the simplistic theoretical standpoint, but it is intelligible when we think about displays of frowning or even anger: In both, the head is often slightly bowed rather than raised.

Our findings may seem to contradict some earlier work. Previously, Giessner et al. (2011) have found that targets with faces seen from above, which resemble faces with bowed heads, were judged as less powerful than targets with faces seen from the front (i.e., neutral heads) and with faces seen from below, which are similar to our faces with raised heads. One could see these results as contradictory. However, in that study, participants saw the neck and part of the targets' torso; which made it clear that the camera moved. This is one possible explanation for the differences in our results. When the camera hovers above a head that is seen from above and seems to bow, a vertical difference between the two is implied. However, when the head is bowed while the observer (or camera) remains at the same height, no vertical difference is created. We believe this latter description is the impression created by our stimuli, explaining the difference found in our results and that of prior research.

Limitations

The current research has several limitations due to the stimuli, or faces, used. The stimuli were bald due to the limitations of our software. Research has shown that hair is an important cue in social perception (Freeman and Ambady 2011; Macrae and Martin 2007). The mere presence of hair facilitates gender categorization, since short hair is usually associated with males and long hair with females (Macrae and Martin 2007). The baldness of our stimuli might have male-biased the judgments. Therefore, the presence of hair could have led to even more pronounced differences in dominance judgments between female and male faces. Moreover, hair is also one important facial region used in the perception of dominance (Dotsch and Todorov 2012). The accuracy in judging dominance could have been even higher in stimuli with hair. However, we found clear effects of target gender, suggesting that the categorization was clear.[7]

We asked participants to judge status-related traits and emotions of two-dimensional and still images. A more ecologically valid way to study the influence of head postures and eye gaze would be to use videos or three-dimensional faces with movement. Thus, heads moving upwards or downwards and eye gazing directly or avertedly could have had a different impact on judgments of dominance, physical strength, and anger. Recent research indicates a strong relationship between trait judgments of dynamic and still images (Rhodes et al. 2011). However, Rymarczyk and collaborators found that dynamic stimuli compared to static stimuli enhanced the perception of anger (Rymarczyk et al. 2016). Thus, it remains to be investigated if the same pattern of results is the same for dynamic stimuli.

The way we manipulated the directness of the gaze also has some limitations: It turn out to be difficult to convey direct gaze in all conditions. While for faces with neutral heads, the eyes can be accurately positioned, FaceGen software does not permit sufficiently precise control over the direction of the eyes for the bowed and raised heads in the direct gaze condition. As a result, the manipulation of the direction of the eyes could only be done *manually* for the faces with bowed and raised heads. Notwithstanding, as our additional check assured (see Footnote 6), faces with raised and bowed heads were seen as looking *more* towards the participants than faces with neutral heads, and perceived directness of gaze had the same effect as manipulated gaze.

In order to have more statistical control over our data, the participants only judged White faces; however, this may limit our interpretations. The literature has shown that facial skin color plays a role in categorization, attention, and memory processes (e.g., Correll et al. 2016). Importantly, given the role that anger seems to play in dominance as well as in physical strength judgments, some authors argued that anger was better recognized in White than in other-race faces (Zebrowitz et al. 2010). Even though we did not

[7] We ran an additional study and found that both female and male faces were correctly identified. We asked participants ($N = 90$) on Amazon MTurk to select the gender of the faces used in both studies. Male faces were identified as males in 99% of the cases, $p < .001$. Female faces were selected as female in most cases (91%), $p < .001$.

manipulate facial expressions, it is conceivable that the use of other-race faces (i.e., Asian, Black) could have modulated the results. Recent research suggests that both eye gaze and race modulate the recognition of faces (Sessa and Dalmaso 2016). While averted eye gaze seems to equally disrupt the processing of own-race and other-race faces, direct eye gaze seems to disrupt more the processing of other-race than own-race faces. Interestingly, some authors found that other-race faces when the gaze was direct were judged as more threatening than own-race faces, while when the gaze was averted no differences were seen between both types of faces (Richeson et al. 2008). Given the positive relationship between dominance and threat (see Oosterhof and Todorov 2008), it is possible that a similar pattern would be present while judging facial dominance and strength.

An additional limitation is the absence of body cues. Future work should combine head and body displays. Some recent studies have indicated the importance of body cues in the transmission of affective intentions, which may influence or even cancel out the information perceived from faces (Aviezer et al. 2012; de Gelder et al. 2006). Additionally, the basic emotions cannot be fully perceived using only facial information; body cues add information, which disambiguates facial displays (Martinez et al. 2016). Interestingly, Martinez et al. (2016) showed that anger, contrary to other basic emotions, might be perceived slightly better from the body alone than from the face. Given the role that perceived anger plays in dominance and physical strength judgments, it is likely that the presence of bodies in our targets could have increased the range of our interpretations.

Conclusion

In this paper, we explored how social status inferences from faces change according to eye gaze and head posture. Our data show that dominance, physical strength and anger are influenced both similarly and differently by eye gaze direction and head posture. Both raised and bowed heads give the impression of dominance and strength, especially when the eye gaze is direct and the person is male. The dominance inferred from a bowed (male) head with a direct eye gaze may come about because this posture is seen as indicating anger. The dynamic interplay between eye gaze and head posture impacts the impression of dominance stronger than physical strength, presumably because it communicates intention and attitude. In conclusion, we have provided evidence of how nonverbal cues influence one of the most ubiquitous foundations of human relationships, social status hierarchies.

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References

Argyle, M., & Cook, M. (1976). *Gaze and mutual gaze*. Oxford: Cambridge University Press.

Aronoff, J., Woike, B. A., & Hyman, L. M. (1992). Which are the stimuli in facial displays of anger and happiness? Configurational bases of emotion recognition. *Journal of Personality and Social Psychology, 62,* 1050–1066.

Aviezer, H., Trope, Y., & Todorov, A. (2012). Body cues, not facial expressions, discriminate between intense positive and negative emotions. *Science, 338,* 1225–1229.

Baron-Cohen, S. (1995). The eye direction detector (EDD) and the shared attention mechanism: Two cases for evolutionary psychology. In C. Moore & J. Philip (Eds.), *Joint attention: Its origins and role in development* (pp. 41–59). Hillsdale, NJ, England: Lawrence Erlbaum Associates.

Bassili, J. N. (1979). Emotion recognition: The role of facial movement and the relative importance of upper and lower areas of the face. *Journal of Personality and Social Psychology, 37,* 2049–2058.

Bindemann, M., Burton, A. M., & Langton, S. R. (2008). How do eye gaze and facial expression interact? *Visual Cognition, 16,* 708–733.

Blaker, N. M., & van Vugt, M. (2014). The status-size hypothesis: How cues of physical size and social status influence each other. In J. T. Cheng, J. L. Tracy, & C. Anderson (Eds.), *The psychology of social status* (pp. 119–137). New York: Springer.

Buhrmester, M., Kwang, T., & Gosling, S. D. (2011). Amazon's Mechanical Turk: A new source of inexpensive, yet high-quality, data? *Perspectives on Psychological Science, 6,* 3–5.

Burke, D., & Sulikowski, D. (2010). A new viewpoint on the evolution of sexually dimorphic human faces. *Evolutionary Psychology, 8,* 573–585.

Campbell, R., Wallace, S., & Benson, P. J. (1996). Real men don't look down: Direction of gaze affects sex decisions on faces. *Visual Cognition, 3,* 393–412.

Cheng, J. T., Tracy, J. L., Foulsham, T., Kingstone, A., & Henrich, J. (2013). Two ways to the top: Evidence that dominance and prestige are distinct yet viable avenues to social rank and influence. *Journal of Personality and Social Psychology, 104,* 103–125.

Chiao, J. Y. (2010). Neural basis of social status hierarchy across species. *Current Opinion in Neurobiology, 20,* 803–809.

Chiao, J. Y., Adams, R. B., Peter, U. T., Lowenthal, W. T., Richeson, J. A., & Ambady, N. (2008). Knowing who's boss: fMRI and ERP investigations of social dominance perception. *Group Processes & Intergroup Relations, 11,* 201–214.

Correll, J., Hudson, S. M., Guillermo, S., & Earls, H. A. (2016). Of kith and kin: Perceptual enrichment, expectancy, and reciprocity in face perception. *Personality and Social Psychology Review*. https://doi.org/10.1177/1088868316657250.

Coss, R. G. (1978). Perceptual determinants of gaze aversion by the lesser mouse lemur (Microcebus murinus), the role of two facing eyes. *Behaviour, 64,* 248–270.

Cummins, D. D. (2005). Dominance, status, and social hierarchies. In D. M. Buss (Ed.), *The evolutionary psychology handbook* (pp. 676–697). Hoboken, NJ: Wiley.

Dalmaso, M., Galfano, G., Coricelli, C., & Castelli, L. (2014). Temporal dynamics underlying the modulation of social status on social attention. *PLoS ONE, 9,* e93139.

Dalmaso, M., Pavan, G., Castelli, L., & Galfano, G. (2012). Social status gates social attention in humans. *Biology Letters, 8,* 450–452.

Darwin, C. (1872). *The expression of the emotions in man and animals*. New York: D. Appleton.

de Gelder, B., Meeren, H. K. M., Righart, R., Stock, J., van de Riet, W. A. C., & Tamietto, M. (2006). Beyond the face: Exploring rapid influences of context on face processing. *Progress in Brain Research, 155,* 37–48.

de Waal, F. (2007). *Chimpanzee politics: Power and sex among apes*. Baltimore, MD: John Hopkins University Press.

Dotsch, R., & Todorov, A. (2012). Reverse correlating social face perception. *Social Psychological and Personality Science, 3,* 562–571.

Ewbank, M. P., Jennings, C., & Calder, A. J. (2009). Why are you angry with me facial expressions of threat influence perception of gaze direction. *Journal of Vision, 9*(12), 1–7.

Facegen Main Software Development Kit 3.5. (2013). Vancouver, BC: Singular inversions.

Farroni, T., Csibra, G., Simion, F., & Johnson, M. H. (2002). Eye contact detection in humans from birth. *Proceedings of the National Academy of Sciences, 99,* 9602–9605.

Fiske, A. P. (1992). The four elementary forms of sociality: Framework for a unified theory of social relations. *Psychological Review, 99,* 689–723.

Freeman, J. B., & Ambady, N. (2011). A dynamic interactive theory of person construal. *Psychological Review, 118,* 247–279.

Giessner, S. R., Ryan, M. K., Schubert, T. W., & van Quaquebeke, N. (2011). The power of pictures: Vertical picture angles in power pictures. *Media Psychology, 14,* 442–464.

Hall, J. A., Coats, E. J., & LeBeau, L. S. (2005). Nonverbal behavior and the vertical dimension of social relations: A meta-analysis. *Psychological Bulletin, 131,* 898–924.

Hehman, E., Flake, J. K., & Freeman, J. B. (2015). Static and dynamic facial cues differentially affect the consistency of social evaluations. *Personality and Social Psychology Bulletin, 41,* 1123–1134.

Hehman, E., Leitner, J. B., & Gaertner, S. L. (2013). Enhancing static facial features increases intimidation. *Journal of Experimental Social Psychology, 49,* 747–754.

Henrich, J., & Gil-White, F. (2001). The evolution of prestige: Freely conferred deference as a mechanism for enhancing the benefits of cultural transmission. *Evolution and Human Behavior, 22,* 165–196.

Hess, U., Blairy, S., & Kleck, R. E. (2000). The influence of facial emotion displays, gender, and ethnicity on judgments of dominance and affiliation. *Journal of Nonverbal Behavior, 24,* 265–283.

Hess, U., & Hareli, S. (2015). The role of social context for the interpretation of emotional facial expressions. *Understanding facial expressions in communication* (pp. 119–141). India: Springer.

Holland, E., Wolf, E. B., Looser, C., & Cuddy, A. (2016). Visual attention to powerful postures: People avert their gaze from nonverbal dominance displays. *Journal of Experimental Social Psychology, 68,* 60–67.

Jenkins, R., White, D., Van Montfort, X., & Mike Burton, A. (2011). Variability in photos of the same face. *Cognition, 121,* 313–323.

Jones, B. C., DeBruine, L. M., Main, J. C., Little, A. C., Welling, L. L., Feinberg, D. R., et al. (2010). Facial cues of dominance modulate the short-term gaze-cuing effect in human observers. *Proceedings of the Royal Society B, 277,* 617–624.

Judd, C. M. (2000). Everyday data analysis in social psychology. Comparisons of linear models. In H. T. Reis & C. M. Judd (Eds.), *Handbook of research methods in personality psychology* (pp. 370–392). Cambridge: Cambridge University Press.

Judd, C. M., McClelland, G. H., & Ryan, C. S. (2009). *Data analysis. A model comparison approach*. New York: Routledge.

Judd, C. M., Westfall, J., & Kenny, D. A. (2012). Treating stimuli as a random factor in social psychology: A new and comprehensive solution to a pervasive but largely ignored problem. *Journal of Personality and Social Psychology, 103,* 54–69.

Knutson, B. (1996). Facial expressions of emotion influence interpersonal trait inferences. *Journal of Nonverbal Behavior, 20,* 165–182.

Lobmaier, J., Tiddeman, B. P., & Perrett, D. I. (2008). Emotional expression modulates perceived gaze direction. *Emotion, 8,* 573–577.

LoBue, V., & Larson, C. L. (2010). What makes an angry face look so… angry? Examining visual attention to the shape of threat in children and adults. *Visual Cognition, 18,* 1165–1178.

Lukaszewski, A. W., Simmons, Z. L., Anderson, C., & Roney, J. R. (2010).The role ofphysical formidability in human social status allocation. *Journal of Personality andSocial Psychology, 110,* 385–406.

Macrae, C. N., & Martin, D. (2007). A boy primed Sue: Feature-based processing and person construal. *European Journal of Social Psychology, 37,* 793–805.

Magee, J. C., & Galinsky, A. D. (2008). Social hierarchy: The self-reinforcing nature of power and status. *The Academy of Management Annals, 2,* 351–398.

Main, J. C., Jones, B. C., DeBruine, L. M., & Little, A. (2009). Integrating gaze direction and sexual dimorphism of face shape when perceiving the dominance of others. *Perception, 38,* 1275–1283.

Marsh, A. A., Adams, R. B., & Kleck, R. E. (2005). Why do fear and anger look the way they do? Form and social function in facial expressions. *Personality and Social Psychology Bulletin, 31,* 73–86.

Martinez, L., Falvello, V. B., Aviezer, H., & Todorov, A. (2016). Contributions of facial expressions and body language to the rapid perception of dynamic emotions. *Cognition and Emotion, 30,* 939–952.

McArthur, L. Z., & Baron, R. M. (1983). Toward an ecological theory of social perception. *Psychological Review, 90,* 215–238.

Mendelson, M. J., Haith, M. M., & Goldman-Rakic, P. S. (1982). Face scanning and responsiveness to social cues in infant rhesus monkeys. *Developmental Psychology, 18,* 222–228.

Mignault, A., & Chaudhuri, A. (2003). The many faces of a neutral face: Head tilt and perception of dominance and emotion. *Journal of Nonverbal Behavior, 27,* 111–132.

Oosterhof, N. N., & Todorov, A. (2008). The functional basis of face evaluation. *Proceedings of the National Academy of Sciences, 105,* 11087–11092.

Perrett, D. I., Lee, K. J., Penton-Voak, I., Rowland, D., Yoshikawa, S., Burt, D. M., et al. (1998). Effects of sexual dimorphism on facial attractiveness. *Nature, 394,* 884–887.

Perrett, D. I., & Mistlin, A. J. (1990). Perception of facial characteristics by monkeys. In W. C. Stebbins & M. A. Berkley (Eds.), *Comparative perception: Complex signals. Wiley series in neuroscience* (Vol. 2, pp. 187–215). Oxford: Wiley.

Redican, W. K. (1982). An evolutionary perspective on human facial displays. In P. Ekman (Ed.), *Emotion in the human face* (pp. 212–280). New York: Cambridge University Press.

Rhodes, G., Lie, H. C., Thevaraja, N., Taylor, L., Iredell, N., Curran, C., et al. (2011). Facial attractiveness ratings from video-clips and static images tell the same story. *PLoS ONE, 6,* e26653.

Richeson, J. A., Todd, A. R., Trawalter, S., & Baird, A. A. (2008). Eye-gaze direction modulates race-related amygdala activity. *Group Processes & Intergroup Relations, 11,* 233–246.

Rule, N. O., Adams, R. B., Jr., Ambady, N., & Freeman, J. B. (2012). Perceptions of dominance following glimpses of faces and bodies. *Perception, 41,* 687–706.

Rule, N. O., Ambady, N., & Adams, R. B., Jr. (2009). Personality in perspective: Judgmental consistency across orientations of the face. *Perception, 38,* 1688–1699.

Rymarczyk, K., Żurawski, Ł., Jankowiak-Siuda, K., & Szatkowska, I. (2016). Do dynamic compared to static facial expressions of happiness and anger reveal enhanced facial mimicry? *PLoS ONE, 11,* e0158534.

Schmid Mast, M., & Hall, J. A. (2004). Who is the boss and who is not? Accuracy of judging status. *Journal of Nonverbal Behavior, 28,* 145–165.

Schneider, T. M., & Carbon, C. C. (2017). Taking the perfect selfie: Investigating the impact of perspective on the perception of higher cognitive variables. *Frontiers in Psychology*. https://doi.org/10.3389/fpsyg.2017.00971.

Schneider, T. M., Hecht, H., & Carbon, C. C. (2012). Judging body weight from faces: The height–weight illusion. *Perception, 41,* 121–124.

Sell, A., Cosmides, L., & Tooby, J. (2014). The human anger face evolved to enhance cues of strength. *Evolution and Human Behavior, 35,* 425–429.

Sell, A., Cosmides, L., Tooby, J., Sznycer, D., von Rueden, C., & Gurven, M. (2009a). Human adaptations for the visual assessment of strength and fighting ability from the body and face. *Proceedings of the Royal Society B: Biological Sciences, 276,* 575–584.

Sell, A., Tooby, J., & Cosmides, L. (2009b). Formidability and the logic of human anger. *Proceedings of the National Academy of Sciences, 106,* 15073–15078.

Senju, A., & Hasegawa, T. (2005). Direct gaze captures visuospatial attention. *Visual Cognition, 12,* 127–144.

Sessa, P., & Dalmaso, M. (2016). Race perception and gaze direction differently impair visual working memory for faces: An event-related potential study. *Social Neuroscience, 11,* 97–107.

Simmons, J. P., Nelson, L. D., & Simonsohn, U. (2013). Life after p-hacking. In *Meeting of the society for personality and social psychology*, New Orleans, LA (pp. 17–19).

Steiger, J. H. (1980). Tests for comparing elements of a correlation matrix. *Psychological Bulletin, 87,* 245–251.

Sutherland, C. A., Oldmeadow, J. A., Santos, I. M., Towler, J., Michael Burt, D., & Young, A. W. (2013). Social inferences from faces: Ambient images generate a three-dimensional model. *Cognition, 127,* 105–118.

Sutherland, C. A., Young, A. W., & Rhodes, G. (2017). Facial first impressions from another angle: How social judgements are influenced by changeable and invariant facial properties. *British Journal of Psychology, 108,* 397–415.

Tiedens, L. Z. (2001). Anger and advancement versus sadness and subjugation: The effect of negative emotion expressions on social status conferral. *Journal of Personality and Social Psychology, 80,* 86–94.

Tiedens, L. Z., Ellsworth, P. C., & Mesquita, B. (2000). Stereotypes about sentiments and status: Emotional expectations for high- and low-status group members. *Personality and Social Psychology Bulletin, 26,* 560–574.

Tipper, S., & Bayliss, A. (2011). The impact of social gaze perception on attention. In A. Calder, G. Rhodes, M. Johnson, & J. Haxby (Eds.), *Handbook of face perception* (pp. 551–570). Oxford, UK: Oxford University Press.

Todorov, A., & Porter, J. (2014). Misleading first impressions: Different for different facial images of the same person. *Psychological Science, 25,* 1404–1417.

Toscano, H., Schubert, T. W., Dotsch, R., Falvello, V., & Todorov, A. (2016). Physical strength as a cue to dominance: A data-driven approach. *Personality and Social Psychology Bulletin, 42,* 1603–1616.

Toscano, H., Schubert, T. W., & Sell, A. N. (2014). Judgments of dominance from the face track physical strength. *Evolutionary Psychology, 12,* 1–18.

van Vugt, M., & Tybur, J. M. (2015). The evolutionary foundations of hierarchy: Status, dominance, prestige, and leadership. In D. M. Buss (Ed.), *The handbook of evolutionary psychology* (2nd ed., pp. 788–809). Hoboken, NJ: Wiley.

von Rueden, C. (2014). The roots and fruits of social status in small-scale human societies. In J. Cheng, J. Tracy, & C. Anderson (Eds.), *The psychology of social status* (pp. 179–200). New York, NY: Springer.

von Rueden, C., Gurven, M., & Kaplan, H. (2011). Why do men seek status? Fitness payoffs to dominance and prestige. *Proceedings of the Royal Society B, 278,* 2223–2232.

Windhager, S., Schaefer, K., & Fink, B. (2011). Geometric morphometrics of male facial shape in relation to physical strength and perceived atractiveness, dominance, and masculinity. *American Journal of Human Biology, 23,* 805–814.

Zebrowitz, L. A. (2011). Ecological and social approaches to face perception. In A. Calder, G. Rhodes, M. Johnson, & J. Haxby (Eds.), *The Oxford handbook of face perception* (pp. 31–50). New York: Oxford University Press.

Zebrowitz, L. A., Kikuchi, M., & Fellous, J.-M. (2010). Facial resemblance to emotions: Group differences, impression effects, and race stereotypes. *Journal of Personality and Social Psychology, 98,* 175–189.