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Power Moves Beyond Complementarity: A Staring Look Elicits Avoidance in Low Power Perceivers and Approach in High Power Perceivers

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Abstract

Sustained, direct eye-gaze—staring—is a powerful cue that elicits strong responses in many primate and non-primate species. The present research examined whether fleeting experiences of high and low power alter individuals' spontaneous responses to the staring gaze of an onlooker. We report two experimental studies showing that sustained, direct gaze elicits spontaneous avoidance tendencies in low power perceivers, and spontaneous approach tendencies in high power perceivers. These effects emerged during interactions with different targets and when power was manipulated between-individuals (Study 1) and within-individuals (Study 2), thus attesting to a high degree of flexibility in perceivers' reactions to gaze cues. Together, the present findings indicate that power can break the cycle of complementarity in individuals' spontaneous responding: low power perceivers complement and move away from, and high power perceivers reciprocate and move towards, staring onlookers.

Keywords: power, eye gaze, dominance, complementarity, approach and avoidance

Power Moves Beyond Complementarity: A Staring Look Elicits Avoidance in Low Power Perceivers and Approach in High Power Perceivers

The Iwatayama Monkey Park is a popular tourist attraction near Kyoto, Japan. Visitors can get up close to wild Japanese Macaque monkeys roaming freely in the park. In absence of any physical barriers, the park has issued guidelines to keep visitors safe and to prevent conflicts with the animals. This includes refraining from touching monkeys and throwing stones. The number one advice, which features first and foremost on all warning signs is not to stare in the eyes of the monkeys. Presumably, stares elicit what Kendon (1967) described as an “unnerving experience” (p. 48), causing monkeys to confront onlookers.

Macaques are of course not alone in their sensitivity to the gaze of others. Eye-gaze plays a vital role in human social cognition; a preference for engaging with the gaze of others emerges from birth and is supported by distinct neurological systems (e.g., Farroni, Csibra, Simion, & Johnson, 2002). Gaze behavior also plays a critical role in the regulation of social relations and interactions; including hierarchical relations of dominance and power. Tiedens and Fragale (2003) popularized the notion that non-verbal expressions of dominance (such as a staring look) elicit submissive gestures, creating a *complementary* pattern of spontaneous behaviors. However, this contrasts with anecdotal evidence and studies of animal behavior, which suggest that dominance displays do not always go unchallenged. In the present article, we propose that high power breaks the cycle of complementarity and emboldens perceivers to reciprocate dominance-signaling gaze cues. Below, we first review the social signaling function of eye-gaze before turning our attention to the moderating role of power.

Gaze and Social Cognition

People are remarkably attuned to the gaze of others (see George & Conty, 2008, for a review). Direct gaze attracts attention and facilitates the recognition and identification of others (e.g., Conty, Tijus, Hugueville, Coelho, & George, 2006; Macrae, Hood, Milne, Rowe,

& Mason, 2002). Witnessing someone else gazing at us triggers activation in the ‘social brain’—areas such as the medial prefrontal cortex that are implicated in mentalizing and outcome monitoring (Kuzmanovic et al., 2009). Accordingly, gaze and gaze processing play an important role in the development of normal and abnormal social cognition (e.g., Baron-Cohen, 1995; Langton, Watt, & Bruce, 2000).

The morphology of the eye—a white sclera surrounding the darker colored iris—facilitates the processing of gaze and gaze direction in humans (Kobayashi, & Kohshima, 1997). Non-human primates who do not have a white sclera nonetheless excel in recognizing whether someone else’s gaze is directed at them (Emery, 2000). Emery (2000) surmised that the signaling function of the eyes evolved as an adaptive response to the increased sophistication of social structures characterized by complex rank and dominance relations. Consistent with this supposition, gaze presents a crucial tool to communicate hierarchical relations and to exert control over conspecifics both in humans and non-human primates (e.g., Argyle and Dean, 1965).

In particular sustained, direct eye-gaze—staring—is perceived as a powerful cue (Argyle, Lefebvre & Cook, 1974; Heider, 1958) and elicits fear in many species, including non-human primates, birds, lizards and snakes (Gallup, Cummings, & Nash, 1972; Hennig, 1977; Nahm, Perret, Amaral, & Albright, 1997; Ristau, 1991; Skuse, 2003). A clever demonstration of this derives from Ellsworth, Carlsmith and Henson (1972), who observed that car drivers at intersections took off more quickly when confronted with a persistent stare of onlookers. The power of sustained gaze is perhaps unmatched by any other non-verbal cue and may explain the widespread use of the staring ‘evil’ eye in mythology, or animals donning eye markings to fend off predators (Tomkins, 1963; Hingston, 1933). Neurological studies provide converging evidence for the link between eye-gaze and threat, showing that eye contact modulates the amygdala and sub-cortical pathways implicated in fear responses (e.g., George & Conty, 2008; Skuse, 2003).

Of course, eye gaze provides a much richer signal than mere threat; direct gaze can be a sign of interest, affiliation, attraction, love, or other benign intents (Abele, 1986; Exline, 1963; Exline & Winter, 1965; Kleinke, 1986). According to Skuse (2003), this rich repertoire of social information is engendered by neocortical systems that modulate phylogenetically older subcortical system in line with the context in which the interaction takes place. Yet, the fact that high levels of eye-contact sometimes elicit a negative avoidance response and sometimes do not remains a puzzling phenomenon; even more so considering the crucial role of eye-gaze for social cognition. Variations between studies are significant and point to moderating variables that are not well understood. Previous studies established that factors such as the orientation of the head (e.g., Vuilleumier, George, Lister, Armony, & Driver, 2005), the duration of the gaze (e.g., Helminen, Kaasinen, & Hietanen, 2011), physical distance (e.g., Ioannou et al., 2014), and the realism of the interaction partner (Hietanen, Leppänen, Peltola, Linna-aho, & Ruuhiala, 2008) can alter individuals' response to direct gaze. As discussed next, here we posit that the power of the perceiver can explain differences in the way people react to high levels of eye contact.

Power, Eye-Gaze and Non-Verbal Behavior

Power refers to a person's actual or perceived control over others (see Fiske & Berdahl, 2007, for a review). Along with status, which describes the possession of attributes that are valued by others, power underpins the vertical dimension of social relations (Magee & Galinsky, 2008). Relative to low power individuals, high power individuals experience less fear of being evaluated by others (Schmid & Schmid Mast, 2013), and thrive when the going gets tough (Kang, Galinsky, Kray, & Shirako, 2015), presumably because they are challenged, not threatened (Scheepers, de Wit, Ellemers, & Sassenberg, 2012). Conversely, low power individuals, relative to high power individuals, are more inclined to experience anxiety and distress (Barlow, 1975; Mazur, 1985) and are more keenly aware of constraints (Weick & Guinote, 2010; Whitson et al., 2013), triggering vigilance and caution (e.g., Anderson & Galinsky, 2006; Weick, Guinote, & Wilkinson, 2011).

The aforementioned tendencies should create differences between low and high power individuals' spontaneous responses to the gaze of others. People who are apprehensive of others' evaluations exhibit arousal and avoidance in response to direct eye gaze (Schneier, Rodebaugh, Blanco, Lewin, & Liebowitz, 2011; Wieser, Pauli, Alpers, & Mühlberger, 2009), whereas people with more secure dispositions are much more comfortable with high levels of eye contact (Helminen, Kaasinen, & Hietanen, 2011; see also Mobbs, 1968; Kendon and Cook, 1969; Wiens, Harper, & Matarazzo, 1980). Thus, one would expect low power perceivers, but not high power perceivers, to display increased avoidance tendencies when confronted with the sustained gaze of another individual.

High power perceivers may not only exhibit less avoidance, but even resolve to approach and confront onlookers. Exline (1963) suggested that dominant individuals predisposed to assert themselves may treat high levels of eye contact as a challenge and respond with approach tendencies (see also Argyle & Dean, 1965; Fromme & Beam, 1974), dovetailing findings by McCall and Singer (2015) who observed that individuals keen to assert themselves are more likely to engage in approach behavior. Other evidence indicates that exposure to a single dose of testosterone—a substance found in greater concentration in high power individuals (e.g., Dabbs & Dabbs, 2000)—causes individuals to maintain longer eye contact with staring faces presented below the threshold of conscious awareness (Terburg, Aarts, & van Honk, 2012). Interestingly, Terburg and colleagues (2012) also observed that administering testosterone did not affect individuals' consciously experienced motivational states, suggesting that power may interact with eye gaze in an automatic fashion (see van Honk, Schutter, Hermans, & Putman, 2004) .

Moving beyond the literature on eye-gaze, dominance displays are thought to elicit submissive nonverbal responses (and vice versa). This pattern of *complementarity* supports social structures and coordination and can imbue an individual's spontaneous responses (e.g., Tiedens & Fragale, 2003). Yet, one's place in a given power structure is relative, requiring dynamic shifting from submissive to dominant roles in order to maintain the status quo (Anderson, Srivastava, Beer, Spartaro, & Chatman, 2006). Moreover, power structures are not permanent and can be challenged. Indeed, one function of nonverbal behaviors is to negotiate hierarchical relations in the moment (cf. Ellyson & Dividio, 1985). Consequently, it stands to reason that an individual's actual or perceived power can break the cycle of complementarity: while lower power perceivers may complement the dominance displays of others, high power perceivers may reciprocate such displays. Such a pattern in humans would be consistent with animal studies that find submissiveness increases to the extent that conspecifics occupy dissimilar ranks (Newton-Fisher, 2004).

The Present Research

In the present research, we sought to examine if power moderates the effects of sustained gaze on implicit approach and avoidance tendencies. This work extends previous studies that looked at enduring individual differences, notably trait dominance (e.g., Fromme & Beam, 1974) and social anxiety (e.g., Wieser et al., 2009), as determinants of individuals' responses to direct gaze. Here, we focus on incidental power as a contextual variable that may change individuals' responses to gaze cues. A demonstration of this nature would be important because it would unveil a new degree of flexibility in the way eye-gaze regulates social relations and behaviors. To probe this flexibility, we carried out two studies manipulating power between- (Study 1) and within-individuals (Study 2).

A second aim is to advance our understanding of complementarity and reciprocity in individuals' spontaneous responding. To this end, we examined *interpersonal distance* as an indicator of individuals' implicit approach and avoidance tendencies. This measure has appeal for a number of reasons. First, people are largely unaware of the space they keep to their interaction partners (Love & Aiello, 1980), thus rendering distance exhibited incidentally during interactions a suitable marker of individuals' spontaneous responding. Second, bodily positioning provides a marker of dominance and rank (see Harper, 1985): high-ranking or dominant individuals occupy more space and have the means to control the approach of others (e.g., Henley, 1977). In a similar vein, keeping a greater distance signals respect and subordination (Dean, Willis, & Hewitt, 1975; Hall, 1966). This makes distance a suitable measure of complementarity (see also Harper, 1985; Mehrabian, 1981). Finally, the relationship between direct gaze and physical distance is well-established. All else being equal, people respond to reduced physical distance by diverting their gaze (Rosenfeld, Breck, Smith, & Kehoe, 1984), and prefer to keep a distance to people who display high levels of eye contact (Bailenson, Blascovich, Beall, & Loomis, 2001; Hayduk, 1981; Patterson, 1976, 1982). Taken together, interpersonal distance provides an ideal measure to examine the joint effects of power and eye-gaze on individuals' implicit approach and avoidance tendencies.

Below, we report two experimental studies, in which we exposed participants to a fully immersive virtual environment and examined the distance exhibited incidentally during interactions with virtual targets. Participants navigated the virtual world by walking, whilst motion tracking equipment provided high-fidelity measures of participants' bodily positioning (see Bailenson et al., 2001, for a detailed discussion of this research paradigm). This set-up enabled us to probe individuals' spontaneous responses to a range of targets displaying different gaze behaviors whilst maintaining tight control over the environment. Numerous studies have validated the use of immersive virtual environments as a tool to study social behavior (e.g., Slater et al., 2006; Slater et al., 2013; Navarette et al., 2012), including individuals' response to gaze cues (e.g., Bailenson et al., 2001; Wieser, Pauli, Grosseibl, Molzow, & Mühlberger, 2010). The use of virtual reality technology further enabled us to manipulate embodied power by altering individuals' body height in the virtual world (Study 2), in addition to a common mindset priming (Study 1), thus providing convergent evidence for the effects of power.

Study 1

In Study 1, our principal aim was to provide initial evidence for the assumption that power modulates individuals' responses to gaze cues. We manipulated high, low, and neutral levels of power using a mindset priming (Galinsky, Gruenfeld, & Magee, 2003), and then placed participants in a virtual world where they interacted with targets who displayed different levels of eye-contact. For exploratory purposes, we also varied the nature of the target across trials, which was either humanoid or a robot (see Figure 1). We reasoned that a pattern of dominance complementary (in case of low power perceivers) and reciprocity (in case of high power perceivers) might be more likely to emerge in interactions with conspecifics where hierarchical relations bear greater relevance than in interactions with objects (such as a robot). At the same time, studies have shown that even simplified, schematic representations of eyes attract attention in human infants (Johnson, Dziurawiec, Ellis & Morton, 1991) and can elicit gaze aversion in a range of species (e.g., Coss, 1978, 1979; Jones, 1980). From this perspective, it could be the case that the moderating effects of power extend to more schematic gaze cues with a lower level of realism. A secondary aim of the present study was to explore these contrasting views.

Method

Participants and Design

Eighty-two students enrolled in a US university participated for course credit. Position tracking data from two participants were lost due to a technical error, thus leaving a final sample of eighty participants (34 females, 44 males, 2 unknown, M_{Age} = 19.32, SD_{Age} = 1.50), who had no missing data. The study employed a 3 (power: low power vs. neutral vs. high power) x 2 (gaze: looking ahead vs. looking towards) x 2 (target: humanoid vs. robot) mixed design with repeated measurement on the last two factors. All experimental conditions included in the study are reported; the sample size was determined a priori and provided over 90% power at α = .05 to detect a medium-to-large sized effect. Our sample size calculation was informed by Bailenson et al. (2001), who employed a similar between-subjects design, and based on the reasoning that, as outlined above, a staring gaze is a potent cue and can be expected to elicit a strong response, thus implying that the predicted interaction with perceivers' power should translate into a sizable effect.

Procedure and Materials

Participants were invited to take part in a study on virtual environments and communication. Upon arrival, participants completed a health screening questionnaire and volunteered consent. They then put on an nVis head-mounted display (HMD) and familiarized themselves with the equipment and the virtual environment, which at this point consisted of an empty virtual room (approximately 10 m (L) x 10 m (W) x 3 m (H)) that participants were invited to explore by walking around. Next, participants removed the HMD and were seated behind a screen, where they were asked to complete a brief writing task about a past event to induce a mindset of high power (n=26), low power (n=26), or a neutral mindset (n=28) (Galinsky et al., 2003). Participants were randomly assigned to one of the three mindset priming conditions. A questionnaire was placed in an unmarked envelope on the desk, and participants were instructed to put the questionnaire back when finished, leaving the experimenter blind to the condition assignment. The writing task lasted for seven minutes. Participants also indicated how much control they had in the situation described in the questionnaire (1=*not at all*; 9=*very much*). This item served as a manipulation check. Participants were then led back to an open space in the laboratory, where they put on the HMD and commenced a locomotion task. Participants were instructed to walk up to, and around, a stationary virtual target that appeared 4 meters away in the center of the room. The virtual target had a number written on the back, and participants were instructed to read and memorize the number and then return to the starting position to report the number back to the experimenter (see Bailenson et al., 2001). Participants completed a practice run, followed by four experimental trials. Across trials, the target represented a male human or a robot (see Figure 1). Crucially, across trials the two targets also displayed different gaze behaviors and either made a head-movement turning towards, and persistently gazing at, the participants traversing the room (looking towards), or did not move and looked ahead, thus ignoring the participants during the locomotion task (looking ahead). In both gaze conditions, the virtual characters had their eyes open, blinked from time to time, and performed small idling (humanoid) or rotation (robot) movements. Position data was tracked and recorded continuously at 10 Hz throughout the locomotion task using a WorldViz PPT-H tracking system. Towards the end, and after having removed the HMD, participants filled in an online questionnaire to indicate their demographic background and what they thought were the aims of the study (none correctly guessed). Finally, participants were thanked and debriefed.

Results and Discussion

We commenced the analysis after all data were collected. Initial inspection of the data revealed no systematic differences between male and female participants. Participant gender is therefore not discussed any further.

Manipulation Check

Employing the General Linear Model (GLM), we entered two dummy variables comparing the neutral baseline condition with the high power (D_1=1, D_2=0) and the low power (D_1=0, D_2=1) condition as predictors of how much in charge participants felt in the situation described in their essays. Participants assigned to the high power condition felt more in charge, B_{D1} = .98, SE = .44, *p* = .029, 95% CI [.10, 1.85], and participants assigned to the low power condition less in charge, B_{D2} = -4.22, SE = .44, *p* < .001, 95% CI [-5.09, -3.34], than participants assigned to the neutral baseline condition, intercept = 6.68, SE = .31, *p* < .001, 95% CI [6.07, 7.29]. The experimental manipulation was thus deemed successful.

Approach and Avoidance Behavior

Since targets (agent vs. robot) and eye-gaze (ahead vs. towards) are nested within participants, our data lend themselves to multi-level modelling (see Quené & van den Bergh, 2004, for a discussion of the benefits of this procedure). We began by fitting a random intercept model with heterogeneous variances to the *minimum distance* data depicted in Figure 2. Full details on all variance estimates are provided in the Supplemental Materials (Table S1). Next, we added the two dummy variables described above denoting the different levels of power (D_1, D_2), a dummy variable to denote the two targets (robot: D_3=0; agent: D_3=1), and a dummy variable to indicate the eye-gaze condition (looking ahead: D_4=0; looking towards: D_4=1). The addition of the fixed effects improved the model fit, Δ-2LL = 25.03, *df* = 11, *p* = .009. The highly significant fixed intercept indicates that participants kept a comfortable distance to the robot, coeff = 83.03, SE = 5.56, *p* < .001, 95% CI [71.77, 94.29]. The same held for the humanoid agent (coeff$_{D3}$ = -1.01, SE = 3.59, *p* = .779, 95% CI [-8.14, 6.13]. However, participants were somewhat more inclined to stay away when the humanoid agent looked *towards* them, which was not the case for the robot, coeff$_{D3xD4}$ = 9.88, SE = 5.07, *p* = .055, 95% CI [-0.20, 19.97]. Importantly, there was also an interaction between high power and type of target, coeff$_{D1xD3}$ = 12.53, SE = 5.64, *p* = .028, 95% CI

[1.39, 23.67], qualified by a three-way interaction involving eye-gaze, $\text{coeff}_{D1xD3xD4} = -16.08$, SE = 7.97, $p = .046$, 95% CI [-31.83, -0.32]. To explore what gave rise to this interaction, we proceeded to examine the effects of eye-gaze (ahead vs. towards) and high power separately for the two targets (robot vs. agent). To probe the simple interactions, we examined the interaction between high power and eye-gaze (D_1xD_4) in our analysis with the 'target' dummy (a) coded as described above (robot: $D_3=0$; agent: $D_3=1$; in which case D_1xD_4 denotes the simple interaction between high power and eye-gaze for the robot condition), and (b) recoded such that 0 represent the humanoid agent (agent: $D_3=0$; robot: $D_3=1$; in which case D_1xD_4 denotes the simple interaction between high power and eye-gaze for the humanoid agent condition). This procedure revealed that, relative to participants in the control condition, participants primed with high power approached the humanoid agent looking *towards* them, but they did not approach the agent looking *ahead*, resulting in a significant interaction, $\text{coeff}_{D1xD4} = -14.23$, SE = 5.64, $p = .013$, 95% CI [-25.37, -3.09]. In contrast, neither eye-gaze nor power affected participants' behavior towards the robot, all *p*s $\geq .166$. Taken together, the results provide evidence for variations in the effect of high (vs. neutral) power for different gaze behaviors displayed by the humanoid agent. Furthermore, there was no evidence for any reliable differences between participants primed with low power and those in a neutral mindset across targets and gaze conditions. To provide an alternative way of looking at these results, we also explored the effects of different gaze behaviors (looking ahead: $D_4=0$; looking towards: $D_4=1$) of the humanoid agent (agent: $D_3=0$; robot: $D_3=1$) on participants primed with high power (high power: $D_1=0$; low *and* neutral power: $D_1=1$), and, separately, on participants primed with low and neutral power (high power: $D_1=1$; low *and* neutral power: $D_1=0$).[1] This revealed that relative to the non-staring gaze (looking ahead) the agent looking *towards* the participants triggered approach behavior in participants primed with high power, $\text{coeff}_{D4} = -9.36$, SE = 4.35, $p = .035$, 95%

CI [-18.03, -0.70], and avoidance tendencies in participants assigned to the low power and the neutral condition, $\text{coeff}_{D4} = 4.96$, $SE = 2.72$, $p = .070$, 95% CI [-0.40, 10.33]. No other significant effects emerged (all *p*s ≥ .260).

Discussion

The results of Study 1 provide preliminary evidence that power modulates implicit approach and avoidance tendencies in response to sustained, direct eye-gaze. We asked participants immersed in a virtual environment to walk up to virtual targets that did or did not keep gazing at the participants. Compared to participants primed with low power or assigned to a neutral condition, participants primed with high power approached targets more that displayed sustained eye-gaze. However, priming power did not affect participants' behavior towards targets that did not maintain eye contact. What is more, these differential responses to sustained gaze only emerged when the target represented a human, but not when the target represented a robot, which could be interpreted as an indication that social motives may underpin the effects of power. In particular, the differential responses to the human target may be triggered by an implicit desire to signal hierarchical relations to conspecifics. This pattern of results is consistent with Hietanen and colleague's (2008) finding that gaze-induced approach and avoidance tendencies are stronger for stimuli with a high degree of realism.

In the present study, targets established eye contact via head movements as participants were walking around. It is conceivable that the head movement, not eye gaze, triggered differential responses in low and high power perceivers. We conducted a subsequent study to address this confound. We also sought to probe the generalizability of the present findings by examining individuals' responses to a wider range of targets and using a different manipulation of power. Finally, we note that the effects of power and eye-gaze observed in the present study were smaller than anticipated and moderated by type of target (agent vs.

robot), which renders the findings somewhat tentative. To address this limitation, we sought to obtain confirmatory evidence in a study that had greater statistical power (see Sakaluk, 2016).

Study 2

In the second study, participants again walked up to virtual characters that exhibited different gaze behaviors. In addition to the gaze behaviors employed in Study 1 (looking towards; looking ahead), we also included a third condition in which the targets performed head movements and looked *away*. If power affects people's responses to direct, sustained eye-gaze, we should only observe differences in participants' behaviors when targets are looking *towards* the participants, but not when targets are looking away. Furthermore, to probe the generalizability of our earlier findings, participants walked up to different humanoid targets that also varied in gender (female vs. male), thus sampling both participants and stimuli (Wells & Windschitl, 1999). The variation in target gender was solely aimed at increasing the representativeness of the stimuli, and we did not have any predictions for interactions with the main experimental variables (i.e., power and gaze behavior). Capitalizing on the embodied grounding of power in vertical space (Schubert, 2005), we varied participants' eye-height in the virtual world such that participants either walked up to targets that were taller and required looking up to (low embodied power), or shorter and required looking down on (high embodied power) (see also Giessner, Ryan, Schubert, & van Quaquebeke, 2011; Schoel, Eck, & Greifeneder, 2013). By varying participants' height and thus embodied power repeatedly within the same testing session, we sought to provide a stronger test of the assumption that the effects of power are contextual and automatic, triggering moment-to-moment changes in individuals' spontaneous responding. Furthermore, the exclusive use of within-subjects manipulations coupled with a large sample size (for a within-subjects design) afforded high statistical power.

Method

Participants and Design

One-hundred and three students enrolled in a UK university participated for course credit. Position tracking data from three participants were lost due to a technical error, thus leaving a final sample of one-hundred participants (76 females, 24 males, M_{Age} = 19.69, SD_{Age} = 1.89). The study employed a 2 (power: low vs. high) x 3 (gaze: looking ahead vs. looking away vs. looking towards) within-subjects design. All experimental conditions included in the study are reported; the sample size was determined a priori and provided over 90% power at $\alpha = .05$ to detect a small-to-medium sized effect. The statistical power fulfilled Sakaluk's (2016) criterion for a 'big' confirmation study.

Procedure and Materials

Prior to the arrival at the laboratory, participants completed an online questionnaire measuring demographics. Upon arrival, participants filled in a health screening questionnaire, while the experimenter measured participants' height unobtrusively aided by a grid painted on a wall. Participants were then placed in an immersive virtual environment that consisted of an empty room (8.25m (L) x 4.2m (W) x 2.37m (H)) using an nVis head-mounted display and a WorldViz PPT-H infrared tracking system. Once accustomed to the virtual world, participants performed the same locomotion task described in Study 1 with the following alterations: Participants approached six humanoid targets (3 females, 3 males; referred to as *agents* hereinafter), which appeared in random order at a distance of 4.4 meters (see Figure S1, Supplementary Materials, for a depiction of all six agents). To manipulate different levels of power, we set the participants' virtual eye-height to either 25 cm above or 25 cm below the eye-height of the agents (female agents: 160 cm; male agents: 170 cm). As a result, participants were shorter and looking up to the agents (low embodied power), or taller and looking down on the agents (high embodied power), depending on the trial. In addition, we varied the agents' non-verbal behavior such that participants' locomotion triggered (a) a head-movement towards the participants with the gaze firmly fixated at the participants as they traversed the room (looking towards), (b) a head-movement (and associated gaze) in the opposite direction, away from participations (looking away), or (c) no movement, with the gaze direct ahead, not responding to participants' movements (looking ahead). Participants performed a total of 36 trials in which they witnessed each agent displaying the three gaze behaviors twice – once from each viewing level (shorter vs. taller) (see Figure 3). At the end of each trial, and having reported a number written on the agent's back to the experimenter, participants were presented with pictures of two same-sex faces displayed on a wall; one corresponding to the agent they had just seen, and one sampled randomly from a pool of six additional agents (see Figure S2, Supplementary Materials). The aim of the face recognition task was to draw participants' attention to the agents' face during the locomotion task. This was deemed necessary in light of the repeated exposure to the targets and participants' increased familiarity with the walking task. The experimenter recorded the participants' response and then proceeded to the next trial. On completion, and having indicated what they thought were the aims of the study (none correctly guessed), participants were thanked and debriefed.

Results and Discussion

We commenced the analysis after all data were collected. On four occasions, the experimenter terminated the experimental software prematurely, resulting in the omission of four trials in all (0.1%). Accuracy in the face matching task was high (91.6%) and did not differ between experimental conditions (*p*s $\geq .203$). We excluded trials for which participants did not recognize the targets' face, thus leaving a final sample of 3,292 trials. Inclusion of all available data did not affect the results reported below. Initial inspection of the data indicated that neither participant gender (male vs. female) nor target gender (male vs. female) contributed to differences in the locomotion task. These variables are therefore not discussed any further.

Approach and Avoidance Behavior

We again began by fitting a random intercept model to the minimum distance data [cm] (see Figure 4), followed by random slopes, and then adding fixed effects for dummy variables representing the two power conditions (low power: D_1=0; high power: D_1=1) and the three gaze-direction conditions (looking towards: D_2=1, D_3=0; looking away: D_2=0, D_3=1; looking ahead: D_2=0, D_3=0) (see Table S2, Supplementary Materials, for a description of all variance estimates). The addition of fixed effects improved the model fit, Δ-2LL = 29.90, *df* = 5, *p* < .001. Participants kept a similar distance to the agents as in Study 1, $\text{coeff}_{\text{intercept}}$ = 82.84, SE = 2.62, *p* < .001, 95% CI [77.65, 88.03]. However, participants approached agents more that were shorter and required looking down compared to agents that were taller and required looking up, coeff_{D1} = -2.04, SE = .91, *p* = .025, 95% CI [-3.83, -0.25]. As expected and in line with Study 1, this effect was more pronounced when the agents looked *towards* the participants, resulting in a significant interaction between power and gaze direction, coeff_{D1xD2} = -2.78, SE = 1.15, *p* = .016, 95% CI [-5.03, -0.53]. An examination of simple effects revealed that agents looking *towards* the participants triggered avoidance behavior when participants were shorter and looking up, coeff_{D2} = 1.79, SE = .82, *p* = .031, 95% CI [0.17, 3.16], and—as revealed through a separate analysis (high power: D_1=0; low power: D_1=1)—approach tendencies when participants were taller and looking down, although the latter effect did not reach significance, coeff_{D2} = -.99, SE = .86, *p* = .248, 95% CI [-2.69, 0.70]. In contrast, and underscoring the critical role of sustained eye-gaze, participants did not change their behaviors when the agents looked *away*, coeff_{D3} = -.03, SE = .83, *p* = .973, 95% CI [-1.66, 1.60], regardless of any differences in power, coeff_{D1xD3} = -.13, SE = 1.15, *p* = .907, 95% CI [-2.40, 2.13]. No other significant effects emerged (all *p*s ≥ .907).

Discussion

The results of Study 2 bolster our initial findings and support the conclusion that power affects people's spontaneous responses to sustained eye-gaze. Participants were more inclined to approach targets from a vantage point that implied high power than from a vantage point that implied low power. This effect was most pronounced for targets that maintained high levels of eye contact, and least pronounced for targets that did not engage them visually, or that looked away. This pattern of results underscores the critical role of eye-gaze as a cue that promotes differences in powerful and powerless individuals' behaviors. It is important to note that participants' relative height varied from trial to trial, and these variations fostered moment-to-moment changes in individuals' behaviors.

Meta-Analytic Summary

To provide a summary of the effects of power and eye-gaze, we meta-analyzed the results of Studies 1 and 2 (see Cumming, 2014). We have reported all relevant studies that we conducted, so the meta-analysis provides an accurate representation of all evidence currently available to us. As shown in Table 1, power modulated individuals' behavioral responses to targets that displayed high levels of eye-contact, $r_{\text{combined}} = -.222$, Cohen's d = .455, but did not affect individuals' responses to targets that did not engage perceivers through their gaze, $r_{\text{combined}} = -.027$, Cohen's d = .054. Furthermore, sustained, direct gaze elicited behavioral tendencies that were similar in magnitude but opposite in direction in low power perceivers and perceivers in a neutral mindset, who displayed avoidance tendencies, $r_{\text{combined}} = .120$, Cohen's d = .242, and in high power perceivers, who displayed approach tendencies, $r_{\text{combined}} = -.154$, Cohen's d = .312. Overall, the observed effects of power on perceivers' spontaneous approach and avoidance behaviors fell into the small-to-medium size range.

General Discussion

Eye-gaze is a fundamental social signal that has deep evolutionary roots. Hierarchical relations can be communicated and regulated via eye-gaze; in particular sustained, direct gaze is perceived as a sign of dominance and can elicit fear and arousal amongst perceivers (e.g., Skuse, 2003). At the same time, past work has documented a great deal of variability in individuals' responses to direct gaze, finding, for example, that stable individual differences such as social anxiety and trait dominance predict how people respond to high levels of eye contact. Here, we tested the novel assumption that incidental power—a contextual variable—modulates individuals' spontaneous responses to gaze cues.

In Study 1, we observed that a high power mindset fostered spontaneous approach tendencies towards a persistent onlooker. In contrast, a low power or neutral mindset triggered spontaneous avoidance tendencies vis-à-vis a persistent onlooker. In Study 2, we sought to confirm our initial findings whilst ruling out head movements as a potential confound. Furthermore, we manipulated power within-individuals by varying participants' viewing position, thus rendering perceivers either taller (high embodied power) or shorter (low embodied power) than their interaction partners. Again, power modulated individuals' behaviors; participants approached targets more that were shorter and required looking down compared to targets that were taller and required looking up, and this difference was most pronounced when targets kept staring at participants. Together, the studies provide converging support for the notion that power modulates individuals' spontaneous responses to gaze cues.

In Study 1, we also varied the nature of the target whereby participants engaged with a humanoid character and a robot, who both showed the same variations in gaze behaviors. Interestingly, power only interacted with the gaze behavior of the humanoid target, but did not affect participants' responses to the gaze of the robot. We reasoned that this pattern of results could point to the role of social motives as a key driver of the effects of power (see also Hietanen et al., 2008). However, this interpretation is preliminary and we are in no position to rule out alternative explanations or confounds, such as the robot's physical appearance, which may also account for the divergent results (cf. Whalen et al., 2004).

The present findings align with previous studies on interpersonal distance and further point to power differences as an important factor in determining implicit approach and avoidance behaviors in interpersonal settings. For example, Caplan and Goldman (1981) had two confederates, one tall and one short, stand on opposite sides of a commuter train, and observed the position of commuters walking down the corridor. The majority of passers-by walked closer to the short target, suggesting that people are more inclined to approach shorter compared to taller targets (see also Hartnett, Bailey, & Hartley, 1974). Other, work in military settings indicates that subordinates are more reluctant to approach superiors than vice versa (Dean et al., 1975). The present findings are consistent with these earlier studies, but also highlight the importance of eye-gaze as a trigger that elicits differential responses in low and high power perceivers.

Technological innovation enabled us to expand on, and move beyond, previous studies on interpersonal distance. A common technique to study interpersonal distance involved asking participants to reflect on, and report, the distance that feels 'comfortable' (see Evans & Howard, 1973). Using this technique, Fromme and Beam (1974) found that a group of males (n=4) who scored high on a measure of trait dominance responded more positively to direct (vs. averted) gaze compared to a group of males (n=4) who scored low on trait dominance. The present research corroborates Fromme and Beam's findings, showing that power affects individuals' responses to gaze cues. However, using state-of-the art motion tracking equipment, we were further able show that momentary experiences of high and low power affect interpersonal distance exhibited *spontaneously* during interactions.

The finding that power modulates individuals' spontaneous responding to social cues (here: eye-gaze) dovetails a recent study by Carr and colleagues (2014), who observed that high power perceivers reciprocated the smiles of low power, but not high power, targets. In contrast, low power perceivers reciprocated the smiles of all targets to a similar extent. The authors also found that the anger displays of high power targets yielded stronger facial responses than the anger displays of low power targets, irrespective of the perceivers' power. As Carr and colleagues acknowledged, the pattern or results emerging from their study is complex and does not lend itself to easy interpretation. However, the present findings and Carr and colleagues' study converge in showing that power modulates individuals' spontaneous responding, thereby attesting to the malleability and context-sensitivity of behavioral responses that are often considered to be 'hard-wired' (e.g., Rizzolatti & Craighero, 2004).

Strengths and Limitations

It is worth pointing out some methodological strengths of the present studies. We found converging support for the assumption that power modulates individuals' behavioral responses to gaze cues by manipulating power both between (Study 1) and within (Study 2) individuals. To the best of our knowledge, no previous set of studies has been reported using this combination of approaches. This is noteworthy because, together, the present studies provide compelling evidence that fleeting experiences of high or low power can trigger moment-to-moment changes in perceivers' spontaneous behaviors to gaze cues. Furthermore, we have addressed a common limitation in studies of social behavior by sampling not only participants (perceivers) but also stimuli (interaction targets), thereby enhancing the robustness and generalizability of our findings beyond a singular target stimulus (Monin & Oppenheimer, 2014; Wells, & Windschitl, 1999). This was also reflected in our data analysis, which used a modern multi-level approach that is in many ways superior to traditional techniques such as ANOVA (see Quené & van den Bergh, 2004, for an overview). Finally, and related to the previous point, the use of immersive virtual reality enabled us to exert a high level of control over the stimuli and thus rule out confounds such as (unintended) variations in individuals' nonverbal behaviors.

There are also noteworthy limitations. Our studies do not offer any insights into how power affects perceivers' appraisals of the onlookers. We know from previous studies that individuals with more secure dispositions tend to evaluate targets exhibiting high levels of eye contact more positively than targets exhibiting low levels of eye contact (Helminen et al., 2011). Thus high power perceivers' heightened approach tendencies may reflect a positive response motivated by a desire to engage onlookers, rather than a negative response motivated by the desire to confront an opponent (cf. Ellsworth & Ross, 1975; Fromme & Beam, 1974). On the other hand, both prolonged stares and stares without accompanying facial movements—as those studied in the present research—tend to elicit fear and flight responses (Emery, 2000), rendering negative responses more likely. Future studies should investigate in more detail the motivational underpinnings of low and high power perceivers' responses to high levels of eye contact. Valuable insights could be gained by varying targets' facial expressions in conjunction with different gaze behaviors.

Another limitation is that our studies remain mute to gender differences in relation to gaze cues specifically, and non-verbal behaviors more generally (see Hall, 2006, for a review). We did not set out to study gender differences, and thus perceivers' gender was not considered as a factor in the design of our studies. Future studies should address this limitation by setting quota for male and female participants. It is interesting to note that we witnessed individuals—males and females—changing their behaviors depending on whether an onlooker was shorter or taller. Given that body height differs between men and women in the population, it is intriguing to speculate whether some of the gender differences observed in previous studies were, in fact, an artefact of differences in body height. The present findings highlight the need to control for height differences when studying non-verbal behaviors in interpersonal settings.

Finally, we only examined physical distance as a marker of approach and avoidance. According to equilibrium theory (Argyle & Dean, 1965), other than increasing one’s physical distance, averting one’s gaze provides another route to cope with, or complement, the staring gaze of an onlooker. Likewise, individuals can assert themselves through their own gaze behavior and reciprocate a persistent stare. Thus, even though we have gained novel insights by studying interpersonal distance, our data may only provide a partial reflection of how power impacts individuals’ spontaneous responses to the gaze of others. Future studies should incorporate precision eye-tracking to corroborate and expand on the present findings. Notably, the existence of coping strategies other than physical approach or avoidance may have weakened the effects of power observed in the present studies, which were smaller than expected from the outset.

Implications

The present research refines our understanding of dominance complementarity processes, according to which dominance displays (such as a staring look) trigger spontaneous submissive gestures (Tiedens & Fragale, 2003). Thus far, complementarity theory did not take into account the power of the perceiver as a factor that can moderate individuals’ responses to dominance displays. We have argued, and found empirical support for the notion that power can break the cycle of complementarity: low power perceivers *complement* dominance-signaling gaze cues by avoiding onlookers, whereas high power perceivers *reciprocate* dominance-signaling gaze cues by approaching onlookers. It is interesting to speculate about the origins of these behavioral patterns. The moment-to-moment changes observed in our studies may indicate the existence of behavioral templates or repertoires that are activated by the presence or absence of power. The cognitive architecture that underpins these processes likely involves phylogenetically older subcortical systems (cf. Skuse, 2003).

The present research enhances our understanding of how social relations are manifested non-verbally. One of the functions of eye gaze is to communicate and thereby regulate social relations and interactions, including hierarchical relations of dominance and control. We have uncovered a dynamic process whereby individuals' responses to direct, sustained gaze differed depending on perceivers' fleeting experiences of power. In their review of the literature on vertical relations and non-verbal behavior, Hall, Coats and LeBeau (2005) noted a high level of variability between studies that remained poorly understood, which led the authors to conclude "main effect predictions for V [vertical relations] are likely to be far less successful" (p. 916). The interactive pattern unveiled in the present research echoes Hall and colleagues' (2005) supposition, showing that power and gaze cues combine to affect individuals' implicit approach and avoidance tendencies.

The tendencies of high power individuals to reciprocate, and of low power individuals to complement, dominance displays may contribute to explain the link between power and improved performance in high-pressure contexts such as negotiations (Kang et al., 2015) or job interviews (Lammers, Dubois, Rucker & Galinsky, 2013).[2] In this context, switching into an approach mode can benefit high power individuals, not least because others are likely to interpret (reciprocal) dominance displays as a sign of competence (Anderson & Kilduff, 2009). In this view, dominance complementarity and reciprocity may contribute to legitimize and reinforce hierarchical differentiation in societies and organizations that endorse meritocratic principles.

It is also interesting to reflect on the extent to which the present findings align with current theories on the psychology of power. According to the Social Distance Theory of

Power, high power individuals feel more distant to others than low power individuals (Magee & Smith, 2013). This assumption is consistent with a range of findings, including the observation that high power individuals, more than low power individuals, prefer independent, solitary activities (Lammers et al., 2012). In the present studies, we found little evidence for a greater distancing of high, compared to low power individuals in the realm of individuals' spontaneous approach and avoidance behaviors. Thus, our studies highlight the need to distinguish between psychological and behavioral facets of social distance, which power may affect in contrasting ways (see also Dean et al., 1975; Hall, 1966; Henley, 1977). Moving on to other theories, the present findings are in general agreement with the Approach/Inhibition Theory, which posits that high power instigates approach tendencies, and low power inhibition tendencies (Keltner, Gruenfeld, & Anderson, 2003). However, we found these behavioral tendencies not to be universal, and instead triggered by contextual social cues (eye-gaze). Thus far, there has not been much work on the circumstances that engender approach and inhibition in high and low power individuals. Judging from the present studies, this appears to be a fruitful avenue for future research.

In conclusion, we have presented evidence that power modulates the effects of sustained gaze cues on implicit approach and avoidance tendencies. In particular, we found that direct, sustained eye-gaze triggers spontaneous approach responses in high power individuals, and spontaneous avoidance responses in low power individuals. These findings indicate that individuals' spontaneous responding to gaze cues is more flexible than hitherto assumed, and further suggests that fleeting experiences of power can break the cycle of dominance complementarity.

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Footnotes

[1] D_2 was not included in this analysis, which focused on the effects of eye-gaze for participants assigned to the high power condition, and for participants assigned to the low power and the neutral conditions. As outlined earlier, the latter two groups did not differ in their responses to the different gaze cues.

[2] We thank an anonymous reviewer for suggesting this discussion point.

Table 1.

Meta-analytic summary of the effects of power for different gaze cues (left columns), and the effects of eye-gaze for different levels of power (right columns)

	Simple Effects							
	Within looking towards: effects of high power (vs. low/neutral power)		Within looking ahead: effects of high power (vs. low/neutral power)		Within high power: effects of looking towards (vs. looking ahead)		Within low/neutral power: effects of looking towards (vs. looking ahead)	
Sample	Effect Size	Significance Level	Effect Size	Significance Level	Effect Size	Significance Level	Effect Size	Significance Level
Study 1	r = -.154	p = .223	r = .088	p = .488	r = -.241	p = .035	r = .144	p = .070
Study 2	r = -.275	p < .001	r = -.118	p = .025	r = -.083	p = .248	r = .101	p = .031
Combined (Meta-Level)	Z_{Fisher} = -.226 r = -.222	Z = -4.850 p < .001	Z_{Fisher} = -.027 r = -.027	Z = -1.314 p = .189	Z_{Fisher} = -.155 r = -.154	Z = -2.221 p = .026	Z_{Fisher} = .121 r = .120	Z = 2.820 p = .005

NB: Effect sizes in Studies 1 and 2 are derived from the conversion of *t*-values and weighted by sample size. The combined significance level is distinct from the combined effect size and calculated following the procedure described in Mullen (1989). The combination of significance levels estimates the likelihood for the combined results of the studies to emerge if the null hypothesis were true; all *p* values are two-tailed.

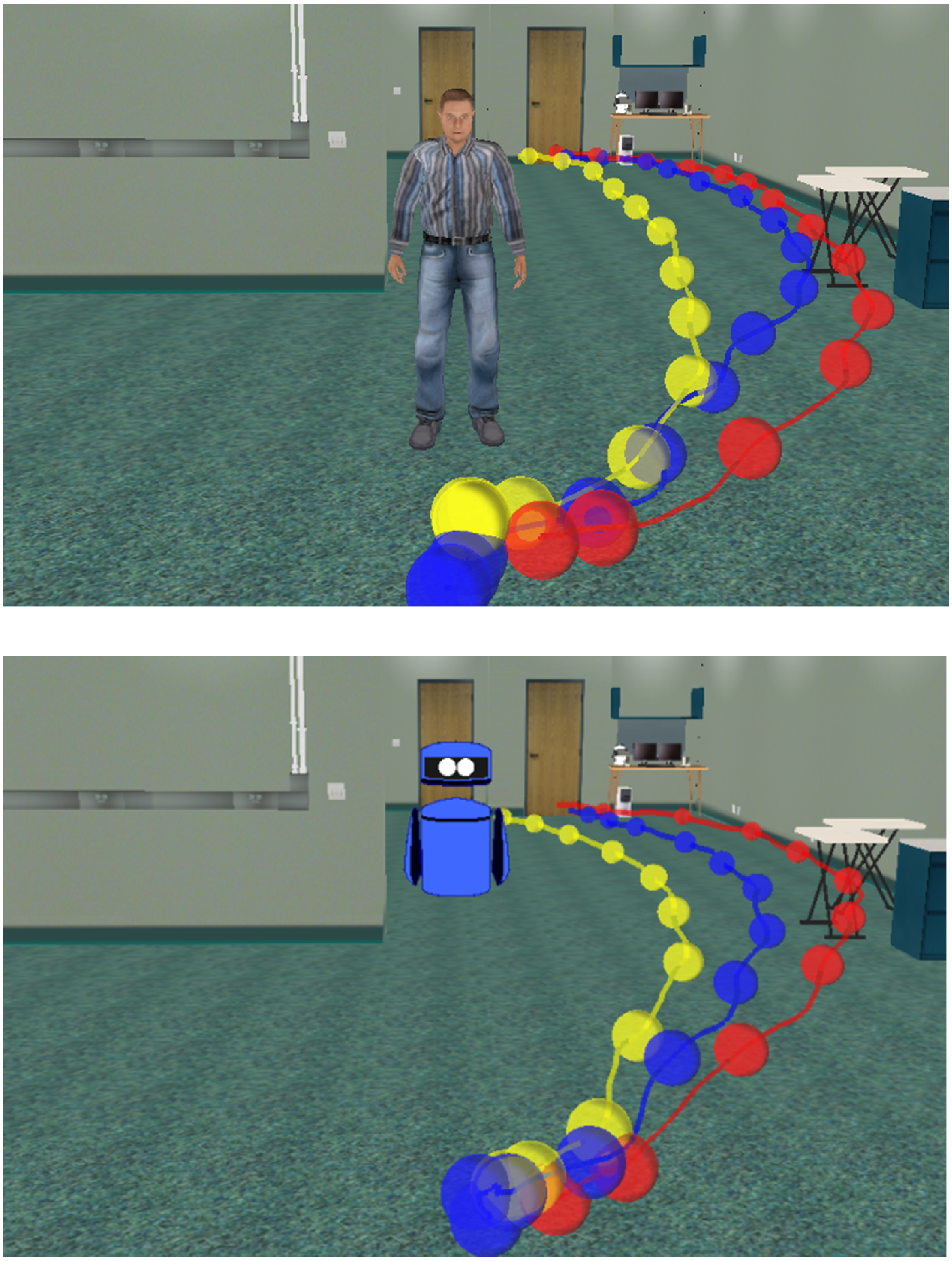


Figure 1. Screenshots of the humanoid (top) and robot (bottom) agents in the virtual room (Study 1). The colored lines represent example data of participants’ walking paths.

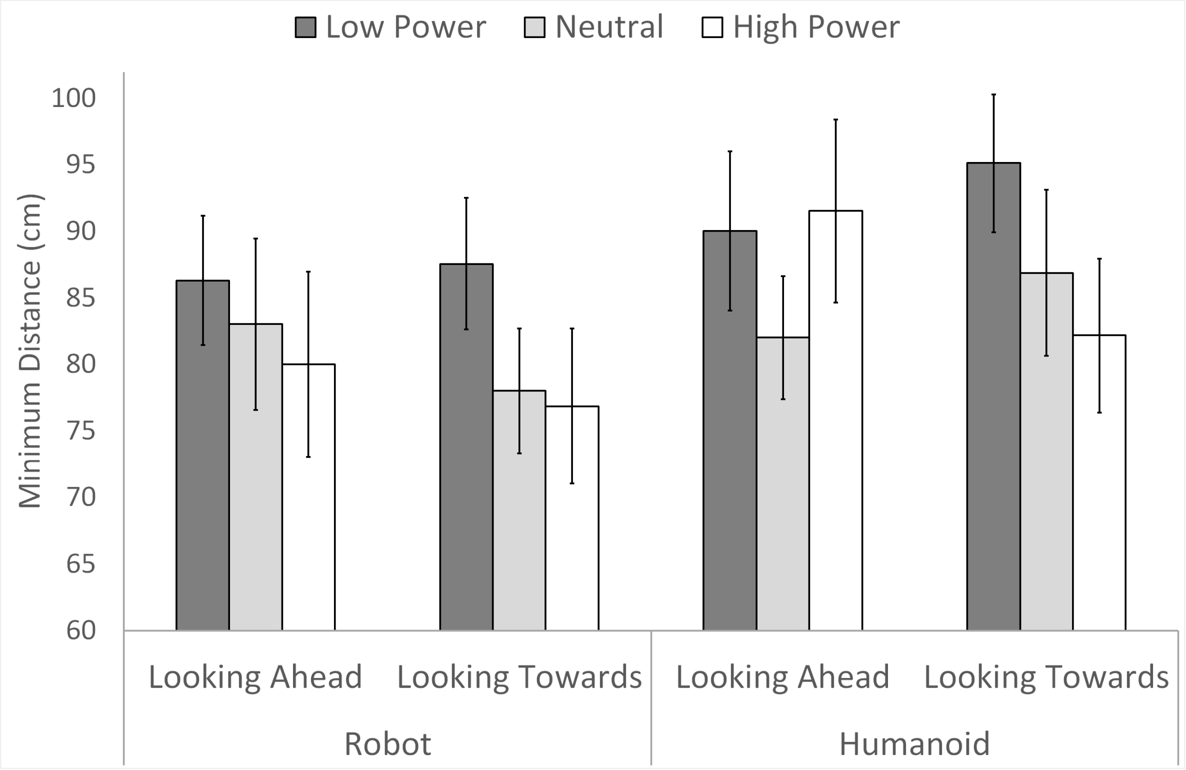


Figure 2. Observed physical distance exhibited towards a robot (left) and a humanoid target (right) as a function of perceiver power and target gaze behavior (Study 1). Error bars represent standard errors of the arithmetic mean in the different cells of the design.

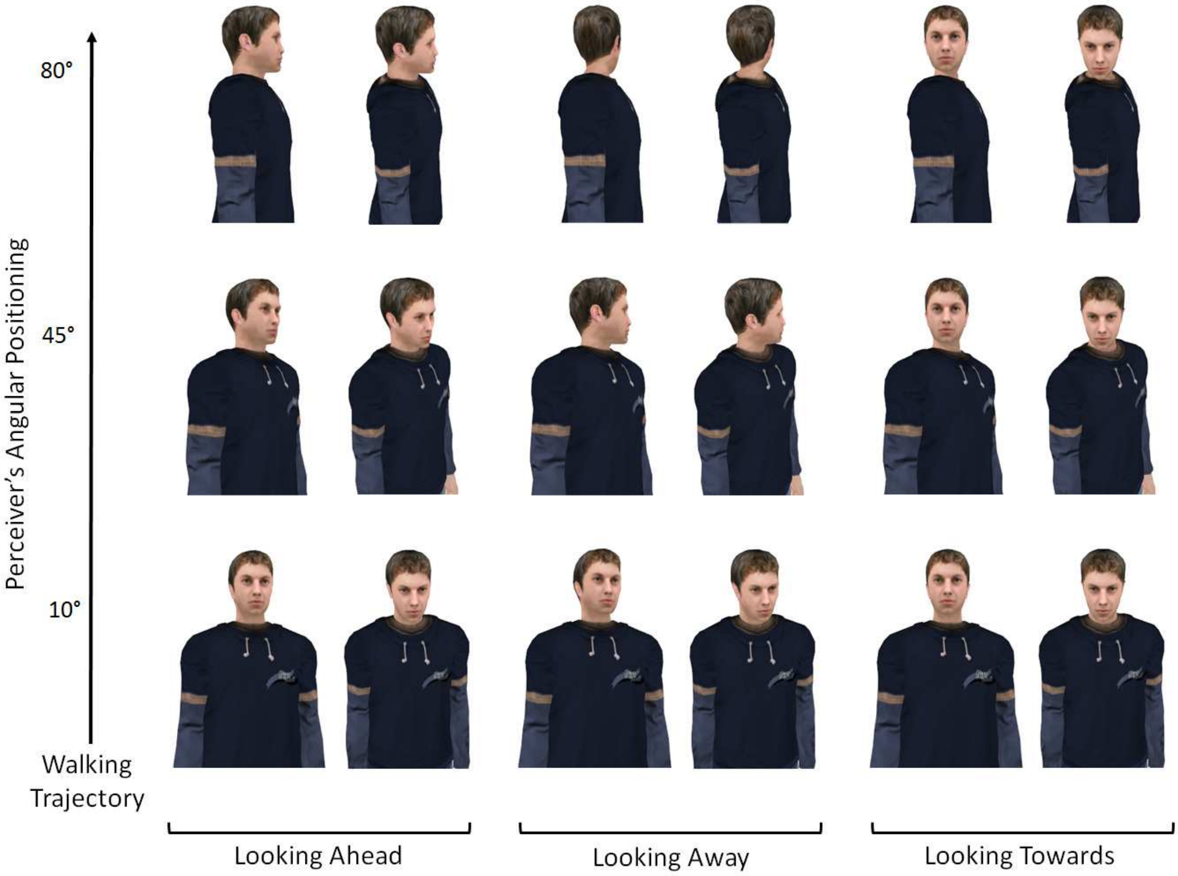


Figure 3. Example of the stimuli encountered by participants in Study 2. Participants walked up to and around virtual agents (trajectory: lower row to upper row) displaying different gaze behaviors (looking ahead vs. looking away vs. looking towards). Within each gaze condition, the viewing position rendered participants either shorter (left column) or taller (right column) than the agent, depending on the trial. Screenshots of the upper torso are shown for illustrative purposes; all targets were full-body size (see Figure S1, Supplementary Materials).

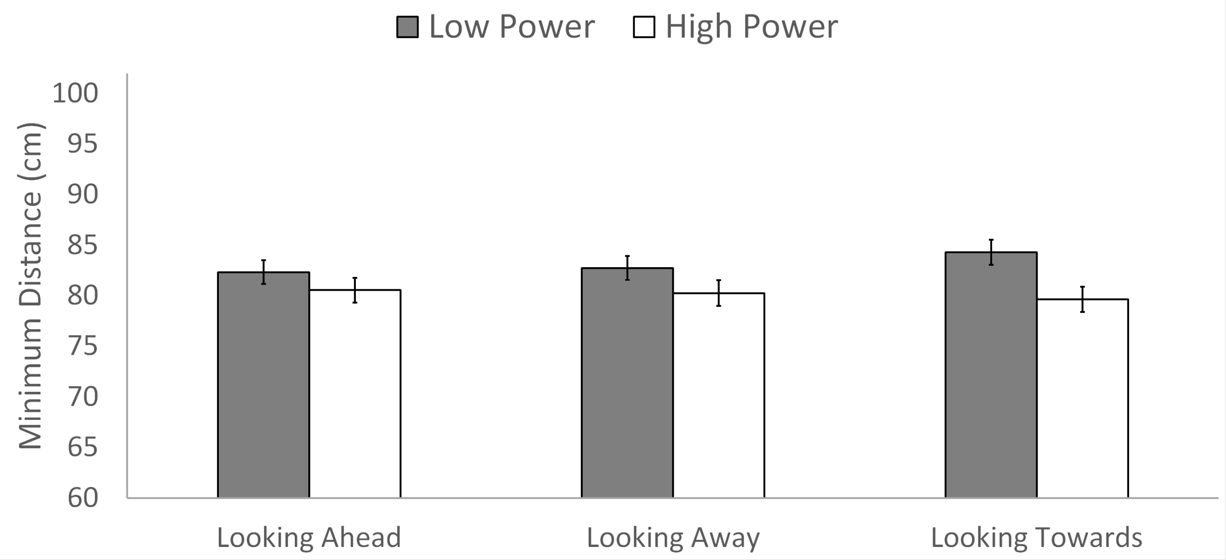


Figure 4. Observed physical distance as a function of perceiver power and target gaze behavior (Study 2). Error bars represent standard errors of the arithmetic mean in the different cells of the design.

Power Moves Beyond Complementarity: A Staring Look Elicits Avoidance in Low Power Perceivers and Approach in High Power Perceivers

Methodology File / Supplementary Materials

Contents

Power Priming Task (Study 1)

[High power condition]

This part focuses on your perception of a past event. We would like you to describe a particular incident in your life. Please recall a situation in which you had power over another individual or individuals. By power, we mean a situation in which you controlled the ability of another person or persons to get something they wanted, or you were in a position to evaluate those individuals. Please describe the situation in which you had power – what happened and how you felt.

It is important that you imagine this situation as vividly as possible. There are no right or wrong answers and your answers will be strictly confidential. You can write about whatever incident comes to your mind that made you feel *really* powerful and in control – no matter how others would feel or think about this incident. Please use the spaces below to describe the incident and how you felt.

[Low power condition]

This part focuses on your perception of a past event. We would like you to describe a particular incident in your life. Please recall a situation in which someone else had power over you. By power, we mean a situation in which someone had control over your ability to get something you wanted, or was in a position to evaluate you. Please describe this situation in which you did not have power – what happened and how you felt.

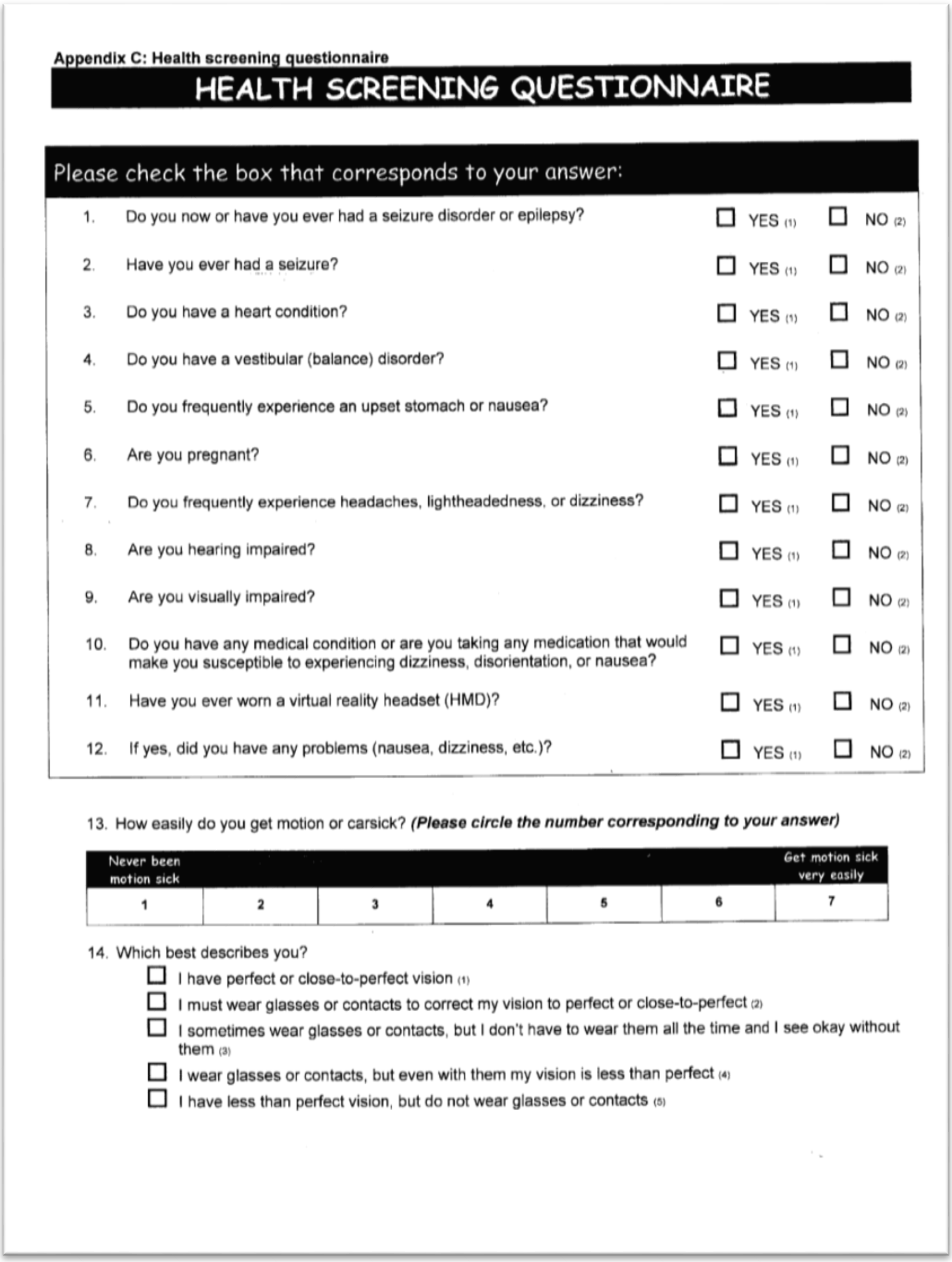
It is important that you imagine this situation as vividly as possible. There are no right or wrong answers and your answers will be strictly confidential. You can write about whatever incident comes to your mind that made you feel *really* powerless – no matter how others would feel or think about this incident. Please use the spaces below to describe the incident and how you felt.

[Neutral condition]

Please recall a day during the last week. Please think about all the things you did during that day, starting from the morning to the evening. Imagine the day as vividly as possible. In the space below, please describe all your experiences during that day – what you did, what happened, how you felt, etc.

There are no right or wrong answers and you can write about whatever incident comes to your mind.

Health Screening Questionnaire (Studies 1 and 2)



Appendix C: Health screening questionnaire

HEALTH SCREENING QUESTIONNAIRE

Please check the box that corresponds to your answer:

1.	Do you now or have you ever had a seizure disorder or epilepsy?	☐ YES (1)	☐ NO (2)
2.	Have you ever had a seizure?	☐ YES (1)	☐ NO (2)
3.	Do you have a heart condition?	☐ YES (1)	☐ NO (2)
4.	Do you have a vestibular (balance) disorder?	☐ YES (1)	☐ NO (2)
5.	Do you frequently experience an upset stomach or nausea?	☐ YES (1)	☐ NO (2)
6.	Are you pregnant?	☐ YES (1)	☐ NO (2)
7.	Do you frequently experience headaches, lightheadedness, or dizziness?	☐ YES (1)	☐ NO (2)
8.	Are you hearing impaired?	☐ YES (1)	☐ NO (2)
9.	Are you visually impaired?	☐ YES (1)	☐ NO (2)
10.	Do you have any medical condition or are you taking any medication that would make you susceptible to experiencing dizziness, disorientation, or nausea?	☐ YES (1)	☐ NO (2)
11.	Have you ever worn a virtual reality headset (HMD)?	☐ YES (1)	☐ NO (2)
12.	If yes, did you have any problems (nausea, dizziness, etc.)?	☐ YES (1)	☐ NO (2)

13. How easily do you get motion or carsick? ***(Please circle the number corresponding to your answer)***

Never been motion sick						Get motion sick very easily
1	2	3	4	5	6	7

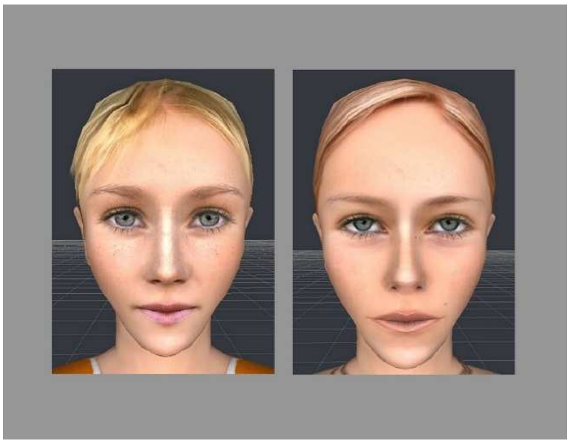
14. Which best describes you?

☐ I have perfect or close-to-perfect vision (1)
☐ I must wear glasses or contacts to correct my vision to perfect or close-to-perfect (2)
☐ I sometimes wear glasses or contacts, but I don't have to wear them all the time and I see okay without them (3)
☐ I wear glasses or contacts, but even with them my vision is less than perfect (4)
☐ I have less than perfect vision, but do not wear glasses or contacts (5)

Experimental Stimuli (Study 2)

Figure S1. Interaction targets encountered by participants in Study 2. The stimuli are taken from the Vizard Complete Characters© toolkit. The file identifiers are as follows (top left to bottom right): sportive04_f_highpoly.cfg; casual18_f_highpoly.cfg; sportive07_f_highpoly.cfg; sportive03_m_highpoly.cfg; casual02_m_highpoly.cfg; sportive04_m_highpoly.cfg.

(a)



(b)

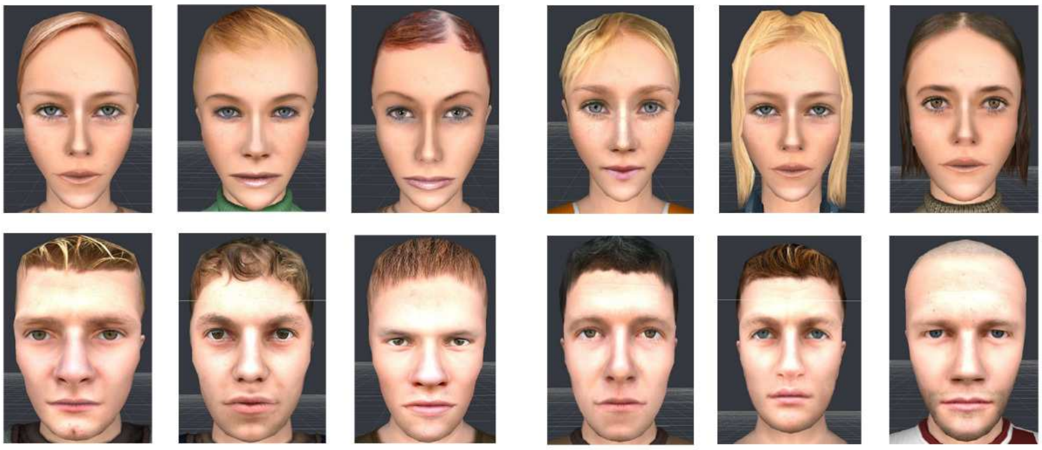


Figure S2. Stimuli employed in the auxiliary face matching task in Study 2. The top panel (a) shows an example display viewed by participants, who made a left/right verbal response. The bottom panel (b) shows the full set of target (left) and distractor (right) stimuli.

Variance Estimates (Studies 1 and 2)

Table S1.

Multi-level model predicting variations in minimum distance (Study 1).

	Model 1				Model 2			
Parameter	Est	SE	95% CI		Est	SE	95% CI	
Fixed Effects								
Intercept	85.48***	2.94	79.63	91.33	83.03***	5.56	71.77	94.29
Target Dummy (0=robot, 1=agent)					-1.01	3.59	-8.14	6.13
Gaze Dummy (0=looking ahead, 1=looking towards)					-5.01	3.59	-12.15	2.12
Target Dummy * Gaze Dummy					9.88†	5.07	-0.20	19.97
Low Power Dummy (0=neutral, 1=low power)					3.30	7.66	-11.95	18.55
Target Dummy * Low Power Dummy					4.72	5.53	-6.21	15.65
Gaze Dummy * Low Power Dummy					6.25	5.53	-4.68	17.19
Target Dummy * Gaze Dummy * Low Power Dummy					-6.03	7.82	-21.49	9.43
High Power Dummy (0=neutral, 1=high power)					-3.00	8.47	-19.89	13.88
Target Dummy * High Power Dummy					12.53*	5.64	1.39	23.67
Gaze Dummy * High Power Dummy					1.84	5.64	-9.30	12.98
Target Dummy * Gaze Dummy * High Power Dummy					-16.08*	7.97	-31.83	-0.32

NB: ***p < .001, **p < .01, *p < .05, †p < .10.

Table S1 (cont.).

Multi-level model predicting variations in minimum distance (Study 1).

	Model 1				Model 2			
	Est	SE	95% CI		Est	SE	95% CI	
Variance Components								
Random intercept variance								
Low Power condition	495.36**	156.75	266.42	921.02	490.97**	155.47	263.94	913.27
Neutral condition	675.60***	194.39	384.39	1187.43	685.86***	199.04	388.34	1211.31
High Power condition	791.00***	239.72	436.73	1432.65	815.73***	248.32	449.19	1481.38
Residual variance								
Low Power condition	237.11***	37.97	173.24	324.53	230.81***	37.69	167.59	317.87
Neutral condition	186.83***	28.83	138.07	252.81	179.96***	28.28	132.26	244.86
High Power condition	276.45***	44.27	201.98	378.37	245.98***	40.17	178.61	338.76
Fit Statistics								
ML deviance (number of parameters)	2846.69 (7)				2821.66 (18)			

NB: ***$p < .001$, **$p < .01$, *$p < .05$, †$p < .10$. Fit indices and model comparisons are based on maximum likelihood (ML) estimates, whereas regression coefficients are estimated using a restricted solution (REML) (see Raudenbush & Bryk, 2002). Both estimation methods yielded virtually identical results. The model presented here provides estimates for heterogeneous error variances; an alternative model using homogenous error variances yields the same results (for the fixed effects). See Hoffman and Rovine (2007) and Weaver and Black (2015) for computational examples akin to the present model. Note that in the present design within-subject observations (target x gaze) are not replicated and consequently random slopes are not included; attempts to do so prevents the model from converging (see Barr, 2013).

Table S2.

Multi-level model predicting variations in minimum distance (Study 2).

	Model 1				Model 2			
Parameter	Est	SE	95% CI		Est	SE	95% CI	
Fixed Effects								
Intercept	82.75***	2.57	77.66	87.84	82.84***	2.62	77.65	88.03
Power Dummy (0=low power, 1=high power)					-2.04*	0.91	-3.83	-0.25
Gaze Avoid Dummy (0=looking ahead, 1=looking away)					-0.03	0.83	-1.66	1.60
Gaze Avoid Dummy * Power Dummy					-0.13	1.15	-2.40	2.13
Gaze Follow Dummy (0=looking ahead,1=looking towards)					1.79*	0.82	0.17	3.41
Gaze Follow Dummy * Power Dummy					-2.78*	1.15	-5.03	-0.53
Variance Components								
Random participant variance	643.48***	92.77	485.08	853.60	646.00***	93.06	487.09	856.75
Random slope variance:								
Power Dummy	25.17***	6.80	14.83	42.73	16.32**	5.64	8.29	32.11
Gaze	2.58	2.15	0.51	13.19	2.67	2.18	0.54	13.23
Power Dummy * Gaze	2.78	4.16	0.15	52.21	2.76	4.20	0.14	54.46
Random item variance	0.34	0.42	0.03	3.77	0.35	0.42	0.03	3.75
Residual variance	172.62***	4.60	163.83	181.88	172.33***	4.60	163.56	181.58
Fit Statistics								
ML deviance (number of parameters)	26911.08 (7)				26881.18 (12)			

NB: ***$p < .001$, **$p < .01$, *$p < .05$, †$p < .10$. Fit indices and model comparisons are based on maximum likelihood (ML) estimates, whereas regression coefficients are estimated using a restricted solution (REML) (see Raudenbush & Bryk, 2002). Both estimation methods yielded virtually identical results.

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