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SHORT COMMUNICATION

The appeal of the devil's eye: social evaluation affects social attention

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Abstract Humans typically exhibit a tendency to follow the gaze of conspecifics, a social attention behaviour known as gaze cueing. Here, we addressed whether episodically learned social knowledge about the behaviours performed by the individual bearing the gaze can influence this phenomenon. In a learning phase, different faces were systematically associated with either positive or negative behaviours. The same faces were then used as stimuli in a gaze-cueing task. The results showed that faces associated with antisocial norm-violating behaviours triggered stronger gaze-cueing effects as compared to faces associated with sociable behaviours. Importantly, this was especially evident for participants who perceived the presented norm-violating behaviours as far more negative as compared to positive behaviours. These findings suggest that reflexive attentional responses can be affected by our appraisal of the valence of the behaviours of individuals around us.

Keywords Visual attention · Episodic learning · Gaze cueing · Social cognition

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Introduction

Research on social attention has largely investigated, in both humans and other animal species, a phenomenon known as gaze cueing, namely the automatic tendency to follow the gaze of others (Frischen et al. 2007). Gaze is a key indicator of the focus of attention of conspecifics and, therefore, it supports social interactions and environmental monitoring.

Gaze cueing appears to be influenced by several social factors such as social status (Shepherd et al. 2006) and friendship (Micheletta and Waller 2012) in non-human primates. In humans, it can be modulated by the perceived similarity with the self (Hungr and Hunt 2012; Porciello et al. 2014, 2016), familiarity (Deaner et al. 2007), shared group membership (Cazzato et al. 2015; Ciardo et al. 2014; Dalmaso et al. 2015; Pavan et al. 2011), perceived trustworthiness (Süßenbach and Schönbrodt 2014), political temperament (Liuzza et al. 2011; see also Carraro et al. 2015; Dodd et al. 2011, 2016), as well as by perceived dominance and status (Dalmaso et al. 2012, 2014; Jones et al. 2010). Importantly, all these social factors share key features. Indeed, stronger gaze-cueing effects are observed when faces are positively evaluated (e.g. ingroup members, similar individuals) or when their gaze may be considered as more informative because the exemplar is perceived as trustworthy or in a powerful position.

Although it is functional to shift attention in response to the gaze of liked and reliable conspecifics, especially when they are viewed as leaders, it might also be important to closely monitor the gaze of individuals conveying information with a negative valence. For instance, there is evidence that negative emotional expressions (e.g. fear) can lead to greater gaze cueing than positive emotional expressions (e.g. happiness), at least when some individual

differences are taken into account, such as the participants' anxiety levels (e.g. Fox et al. 2007), or when negative expressions are rare occurrences (Kuhn et al. 2016). Here, we investigated the potential influence exerted by the gaze direction of conspecifics who hold deviant attitudes and perform norm-violating behaviours. Norm violations can be defined as "behaviors that infringe one or more rules or principles of proper conduct" (van Kleef et al. 2015), as, for instance, when people ignore dress codes or insult other individuals. Social perceivers use these behaviours in order to infer the moral character of the actor which, in turn, may be indicative of the potential costs associated with an eventual interaction with such actor (Wojciszke 2005). Thus, exemplars who blatantly break social norms and stand in sharp contrast with personal and group values represent a threat, making the information about their intentions and behaviours highly valuable for ensuring individual and group safety. The high sensitivity to the level of conformity to social norms displayed by people around us is demonstrated by a recent study showing that social perceivers spontaneously categorize other individuals as either norm-violators or not (van Leeuwen et al. 2012). Once norm-violating individuals are identified, information about them tend to be more carefully attended and processed (Coull et al. 2001; Reese et al. 2013). Additional evidence about the careful analysis of norm-violating behaviours comes from neuroimaging data suggesting that the processing of norm violations engages the same brain regions that are deeply involved in the representation of others' mental states (i.e. prefrontal and temporal regions; Berthoz et al. 2002). Monitoring the behaviour and the likely intentions of norm-violating individuals is key for regulating social interactions with such individuals and, in the end, for preventing any personal harm and negative outcome that may originate.

In the present study, we tested the hypothesis that human attention is influenced by knowledge about the valence of the behaviours performed by the individual who moves his eyes. We predicted that a tendency to shift attention in response to the gaze of deviant individuals who are known to perform negative/antisocial norm-violating behaviours rather than in response to individuals who perform positive/sociable behaviours would emerge. Most importantly, we made specific predictions about the modulatory role of individual differences in the appraisal of the targets. Indeed, because the same behaviours may be differently evaluated by different persons, we expected subjective judgments about the negative and positive behaviours to modulate the effect, predicting that the tendency to shift attention as a function of the gaze direction of antisocial versus social individuals would be affected by the extent to which the behaviours are considered far more negative as compared to the positive behaviours. In sum, we expected that especially participants who evaluated the presented norm-violating behaviours as actually very negative/bad, as compared to the presented positive/good behaviours, would follow the gaze of norm-violating persons.

Methods

Fifty-five undergraduates (M_{age} = 19.69 years, SD 0.858, 15 males) reporting normal or corrected-to-normal vision participated. The local ethics committee approved the study.

Six full-colour photos of young male adults, bearing neutral expressions, were used (see Dalmaso et al. 2012). Each face appeared with direct gaze, and gaze averted rightwards or leftwards. Participants sat 57 cm away from a 17-in. monitor (1024 × 768 pixel, 60 Hz). A PC running E-Prime 1.1 handled timing and stimuli presentation. The colour of the background was black.

The whole experimental sequence, depicted in Fig. 1, was similar to that employed by Dalmaso et al. (2014). The experiment started with a learning phase, in which participants were informed that they would be presented with members of two groups of friends, each composed of three college students living in the same apartment, and that their task was to memorize their typical behaviours. Afterwards, participants were shown, at the top of the computer screen, the three faces belonging to one specific group. Below the faces, six sentences describing the behaviours performed by group members appeared sequentially in a self-paced fashion. The sentences could either be all positive (e.g. "Relationships with neighbours are excellent and they gladly stop for a chat. When they come back from summer vacation, they always bring a present to the neighbours") or negative (e.g. "Relationships with neighbours are problematic: they disturb until late at night and react to complaints with threats"). Next, the three faces belonging to the other group were displayed together with the sequence of the six sentences describing the behaviours with the opposite valence. Both the association between valence and the specific set of faces and presentation order of the two sets of faces were counterbalanced across participants.

To further consolidate learning, a memory task was administered. A shortened version of each sentence was presented (e.g. "Excellent relationships with neighbours"), and participants were asked to carefully read it and press the spacebar. After a 1000-ms blank screen, one of the six faces appeared for 900 ms. Within that time, participants had to report whether the sentence applied ('Y' key) or not ('B' key) to the displayed individual. Each sentence appeared once and each face twice for a total of 12 trials. A

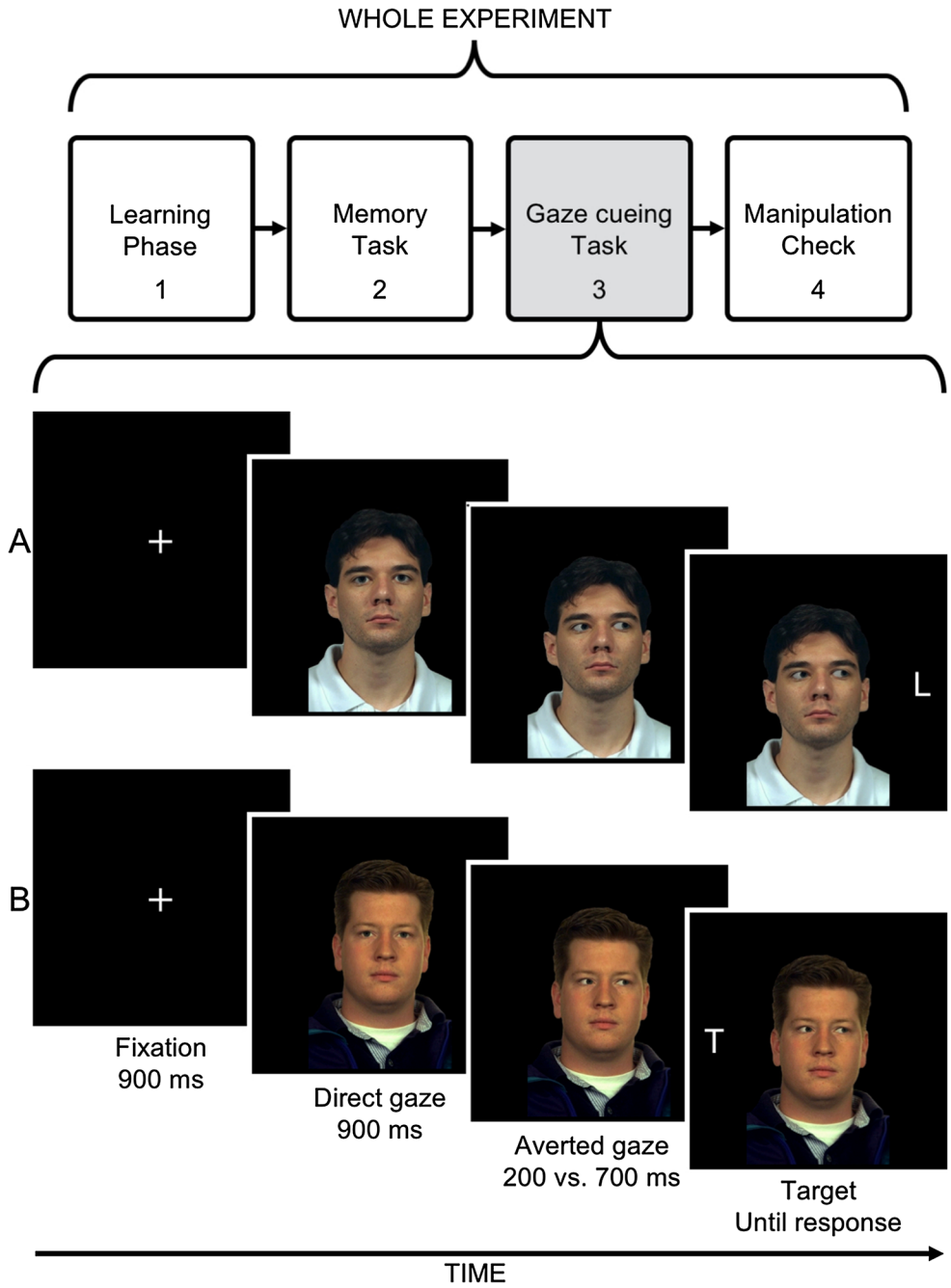

Fig. 1 *Four boxes* on the *top* illustrate the phases that composed the whole experimental sequence. The learning phase (*1*) was followed by the memory task (*2*). After that, the gaze-cueing task (*3*) started. Finally, a manipulation check (*4*) was administered. Below these four boxes, the gaze-cueing task is illustrated. **a** Congruent trial, **b** an incongruent trial

visual feedback appeared after each response. The feedback consisted of three different words, centrally presented for 2000 ms: "CORRECT", in the case of a correct response within the 900-ms time window; "ERROR", in the case of a wrong response within the 900-ms time window; "BE FASTER", in case no response was provided within the 900-ms time window. If at least one wrong or one missing response was detected, the memory task was administered again. If participants were unable to successfully complete the memory task after three cycles, they were again presented with both the faces and the associated information.

The memory task was followed by a gaze-cueing task, in which the same six faces were employed. In each trial a central white fixation cross (0.82° height × 0.82° width) was presented for 900 ms, followed by a central face with

direct gaze (21.2° height × 14° width). After 900 ms, the same face appeared with the gaze averted either rightwards or leftwards for either 200 or 700 ms (i.e. Stimulus Onset Asynchrony, SOA). Two different SOAs were employed to explore the temporal dynamics of gaze cueing in response to the two groups of faces.[1] Here, a social modulation of the gaze-cueing effect was considered more likely at the shorter SOA, in line with previous evidence in which a similar paradigm was employed (Dalmaso et al. 2014). Then, a white target letter ('L' or 'T', 0.82° height × 0.82° width) appeared 11° rightwards or leftwards from the centre of the screen with the same probability (i.e. 50% chance). The averted-gaze face and the target remained visible until response or 1500 ms had elapsed. Participants were instructed to ignore gaze direction because it was uninformative with regard to target location, to maintain fixation, and to identify the target by pressing one of two possible response keys as fast and accurately as possible. The mapping between response keys and target letters was counterbalanced across participants. A visual feedback was provided for wrong or missing responses. There was a 10-trial practice block followed by three experimental blocks, each composed of 96 randomly selected trials.

Afterwards, a manipulation check was administered. It was similar to the memory task, the only exceptions being that a single cycle was presented, no feedback was provided, and there was no time limit for responding in order to maximize accuracy. The manipulation check was administered for assessing whether the information associated with each face group was correctly retained in memory for the whole duration of the gaze-cueing task.

Finally, in order to detect individual differences in the evaluation of the behaviours performed by the two groups, participants evaluated each of the 12 behaviours as either bad or good on 7-point scales (1 = very bad, 7 = very good). On the basis of these responses, for each participant, we calculated a novel variable (i.e. personal evaluation of behaviours) resulting from the difference between the evaluation of positive and negative behaviours. Higher scores indicated that the two sets of behaviours were perceived as more strongly differentiated on an evaluative dimension.

[1] SOA is a crucial variable to sample attention allocation over time in spatial cueing tasks (see Chica et al. 2014). As for the gaze cueing paradigm, there is evidence suggesting that the magnitude of the gaze-cueing effect can be stronger at longer SOAs, a finding reported in both healthy individuals (e.g., Dalmaso et al. 2016; Driver et al. 1999; Frischen and Tipper 2006) and in clinical populations (e.g., Dalmaso et al. 2013). However, when social variables are manipulated, the effects exerted by these social manipulations on gaze cueing seem to be more evident at shorter SOAs (e.g., Dalmaso et al. 2014; Jones et al. 2010).

Results

Data pre-processing

Data from participants who made more than one error in the manipulation check ($N = 7$) were removed, leaving the sample of 48 participants ($M_{age} = 19.65$ years, SD 0.863, 13 males). Incorrect responses (3.32% of trials) and outliers (i.e. RTs 3 SDs above or below the mean of each participant; 1.5% of trials) were also removed.

Errors analysis

Incorrect responses were analysed through a mixed-effect logit model (e.g. Jaeger 2008), with Congruency (congruent vs. incongruent), Face (positive vs. negative), and SOA (200 vs. 700 ms) as fixed effects, and participant as random effect. No significant results emerged ($ps > 0.256$).

Reaction times analysis

Because we predicted a role of participants' evaluation on the gaze-cueing effect, Personal evaluation of behaviours was treated as covariate. Before that, analyses without the covariate were performed, following the guidelines proposed by Simmons et al. (2011).

Correct mean RTs were therefore submitted to an initial ANOVA with Congruency (2: congruent vs. incongruent), Face (2: positive vs. negative), and SOA (2: 200 vs. 700 ms) as within-subject factors. Where necessary, two-tailed t tests were performed. The main effect of Congruency was significant, $F(1, 47) = 60.150$, $p < .001$, $\eta_p^2 = .56$, reflecting a gaze-cueing effect, with shorter RTs on congruent ($M = 531$ ms, SE 9.59) than on incongruent trials ($M = 547$ ms, SE 9.36). The main effect of the SOA was also significant, $F(1, 47) = 114.838$, $p < .001$, $\eta_p^2 = .71$, indicating faster responses at the 700-ms ($M = 526$ ms, SE 9.66) than 200-ms SOA ($M = 553$ ms, SE 9.35), likely reflecting a foreperiod effect. At the longer SOA, gaze cueing was also accentuated as demonstrated by a significant Congruency × SOA interaction, $F(1, 47) = 17.827$, $p < .001$, $\eta_p^2 = .27$. Most importantly, the Congruency × Face interaction approached significance, $F(1, 47) = 3.243$, $p = .078$, $\eta_p^2 = .065$. As expected, a relatively smaller gaze-cueing effect emerged for the positive faces ($M_{congruent} = 533$ ms, SE 9.61; $M_{incongruent} = 546$ ms, SE 8.96; $t(47) = 4.507$, $p < .001$, $d = .506$, two-tailed) as compared to the negative faces ($M_{congruent} = 531$ ms, SE 9.68; $M_{incongruent} = 550$ ms, SE 9.88; $t(47) = 8.041$, $p < .001$, $d = .497$, two-tailed). The three-way Congruency × Face × SOA interaction was not significant, $F(1, 47) = 1.517$, $p = .224$, $\eta_p^2 = .031$. No other

significant effects emerged (Fs < 1; ps > .578). Bayes factor values (BF_{10}; e.g. Wagenmakers 2007) were also computed in order to assess which model (H0 vs. H1) was more likely supported by these data. In line with previous analyses, the presence of the gaze-cueing effect (i.e. H1)—rather than its absence (i.e. H0)—was much more likely in response to the negative faces ($BF_{10} = 4.8e^{10}$) than in response to the positive faces ($BF_{10} = 498$).

Because we predicted that the participants' evaluation regarding the behaviours performed by the two groups would play a key role, Personal evaluation of behaviours was entered in the analyses as a covariate. RTs were thus submitted to an ANCOVA with Congruency, Face and SOA as within-subject factors, and Personal evaluation as covariate. A significant main effect of both Congruency, $F(1, 46) = 7.872$, $p = .007$, $\eta_p^2 = .14$, and SOA, $F(1, 46) = 4.723$, $p = .035$, $\eta_p^2 = .09$, emerged. Crucially, as expected, both the Congruency × Face, $F(1, 46) = 5.022$, $p = .030$, $\eta_p^2 = .09$, and the Congruency × Face × Personal evaluation, $F(1, 46) = 8.015$, $p = .007$, $\eta_p^2 = .14$, interactions were significant.

In order to further explore the role of participants' evaluation of the behaviours on the modulation of gaze cueing, this index (i.e. Personal evaluation of behaviours) was then correlated with the difference between the cueing effect elicited by negative and positive faces. More specifically, the cueing effect was calculated separately for each face group by subtracting RTs on congruent trials from RTs on incongruent trials. In so doing, higher values indicated greater cueing effects. Then, the gaze-cueing effect observed in response to positive faces was subtracted from the gaze-cueing effect observed in response to negative faces. Hence, higher values indicated greater gaze cueing in response to negative faces. Results showed a significant correlation between the personal evaluation of behaviours and the difference between the cueing effect elicited by negative and positive faces, $r(48) = .385$, $p = .007$ (see Fig. 2a), suggesting that participants for whom negative behaviours were far more negative as compared to positive behaviours were also more likely to shift their attention in response to the gaze of negative as compared to positive faces. BF value confirmed that the model supporting the presence of a correlation (i.e. H1) was preferable over the model supporting the absence of a correlation (i.e. H0; $BF_{10} = 6.8$).

Finally, as a different strategy to explore this effect, we divided our sample in two subgroups (i.e. split half) as a function of the extent to which they differentiated negative from positive behaviours (i.e. Personal evaluation of behaviours). The median value was 3.67, a score reported by four participants. The split half thus resulted in groups with different size (23 vs. 25). Mean RTs were then submitted to a 2 (Congruency) × 2 (Face) × 2 (SOA) × 2 (Subgroup, based on Personal evaluation of behaviours) ANOVA. The expected Congruency × Face × Subgroup interaction was significant, $F(1, 46) = 11.896$, $p = .001$, $\eta_p^2 = .20$. Indeed, participants who did not strongly differentiate between positive and negative behaviours showed a reliable cueing effect, $F(1, 22) = 37.46$, $p < .001$, $\eta_p^2 = .63$, that was not modulated by whether the cueing face had previously performed either positive or negative behaviours ($p = .25$; see Fig. 2b). Indeed, a similar and reliable gaze-cueing effect emerged in response to both positive (19 ms) and negative faces (15 ms; see Fig. 2 legend for more details). In contrast, participants who considered negative behaviours as far more undesirable as compared to positive behaviours showed a reliable cueing effect, $F(1, 24) = 24.081$, $p < .001$, $\eta_p^2 = .50$, that was modulated by the characteristics of the cueing face, $F(1, 24) = 13.117$, $p = .001$, $\eta_p^2 = .35$. The cueing effect was remarkably stronger for faces depicting individuals used to perform norm-violating behaviours (23 ms) rather than positive behaviours (7 ms; see Fig. 2 legend for more details). In line with this pattern, the model supporting H1 was much more likely over the model supporting H0 for the negative faces ($BF_{10} = 9e^3$) but not for the positive faces ($BF_{10} < 1$).

Discussion

Previous research has extensively shown that social factors can modulate attentional processes demonstrating that desirable features of the person perceived increase the tendency to follow gaze direction (e.g. Deaner et al. 2007; Hungr and Hunt 2012; Jones et al. 2010; Pavan et al. 2011; Süßenbach and Schönbrodt 2014). Being more influenced by ingroup members or powerful and trustworthy individuals has an important adaptive function in that it maximizes the likelihood of accurately detecting self-relevant stimuli in the environment. On the other hand, when faced with individuals who blatantly perform norm-violating actions breaking the rules of civic society, it might also become important to closely monitor their attention behaviours. Gaze direction can indeed be a relevant cue for inferring the goals and future behaviours of the individual (e.g. Frischen et al. 2007). Therefore, the gaze of people used to enact deviant conducts and harm others may represent a valuable signal that allows achieving a better control over a potentially damaging situation. The present findings support this view by showing that stronger gaze-cueing effects were indeed elicited by persons performing negative rather than positive behaviours. This is also in line with recent experimental evidence indicating that outgroup faces, that usually do not lead to reliable gaze-cueing effects, trigger significant effects when they are perceived

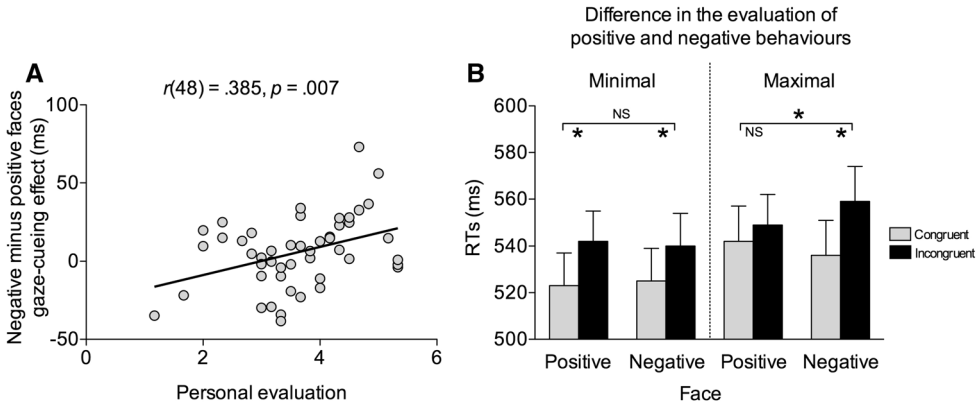

Fig. 2 **a** Correlation between Personal evaluation of behaviours (higher scores indicated that the two sets of behaviours were perceived as more strongly differentiated) and an index of the overall gaze-cueing effect (higher values indicated a greater gaze-cueing effect in response to negative faces as compared to positive faces). **b** Mean RTs as a function of Congruency (congruent vs. incongruent), Face (positive vs. negative) and Personal evaluation treated as a dichotomic variable (minimal vs. maximal difference between the evaluation of positive and negative behaviours). *Asterisks* denote $p < .05$; *NS* non-significant. *Error bars* are SEM. As for the group of participants who showed minimal differences in evaluating the two behaviours, a similar and reliable gaze-cueing effect emerged in response to both positive ($M_{congruent} = 523$ ms, SE 13.9; $M_{incongruent} = 542$ ms, SE 13.07; $t(22) = 4.7$, $p < .001$, $d = 1$, two-tailed) and negative faces ($M_{congruent} = 525$ ms, SE 14.1; $M_{incongruent} = 540$ ms, SE 14.9; $t(22) = 5.3$, $p < .001$, $d = 1.2$, two-tailed). On the contrary, as for the group of participants who showed maximal differences in evaluating the two behaviours, a greater and significant gaze-cueing effect emerged in response to negative faces ($M_{congruent} = 536$ ms, SE 14.67; $M_{incongruent} = 559$ ms, SE 15.31; $t(24) = 6.2$, $p < .001$, $d = .506$, two-tailed) as compared to positive faces ($M_{congruent} = 542$ ms, SE 14.52; $M_{incongruent} = 549$ ms, SE 13.46; $t(24) = 1.871$, $p = .078$, $d = .513$, two-tailed)

as being threatening at an intergroup level (Chen and Zhao 2015). In addition, the current findings specifically indicate that the subjective appraisal and evaluation of the behaviours was the key factor. Indeed, the extent to which negative behaviours were considered as far more negative as compared to positive behaviours modulated the differential impact of negative and positive individuals. It thus appears that our view about how others' behaviours can be considered as either good or bad in social relations significantly impacts onto our reflexive attentional responses. It has to be noted that in the current study we did not use extreme negative norm-violating behaviours in order to be able to detect the influence of personal evaluation in the modulation of the gaze-cueing effect. It would be interesting in the future to further investigate this phenomenon by including more extreme negative behaviours, which might be less affected by personal evaluation and less prone to individual differences. Moreover, in the opposite direction, future investigation may also further analyse this phenomenon by taking into account other types of negative norm-violating behaviours that may elicit discrepant reactions in different people. For instance, according to the Moral Foundation Theory (MFT, Graham et al. 2011) one may expect that people are more likely to follow the gaze of persons whose behaviour blatantly breaks the foundations they valued more. Another aspect that it might be interesting to address is whether gender can further modulate the specific social attention effect demonstrated in the present study, by including a balanced number of both female versus male participants and faces, as well as using a wider range of stimuli. Future studies may also consider examining the temporal dynamics underlying the effects emerged in the present study in more detail by including both shorter and longer SOAs as compared to those used here. Finally, it would be of great interest to assess whether other social information conveyed by facial appearance (e.g. perceived friendliness or dominance) interacts with the appraisal of the performed behaviour in shaping the gaze-cueing effect reported here.

To conclude, the present findings show a larger gaze-cueing effect for faces associated with norm-violating behaviours, especially in individuals who perceived them in more negative terms, reflecting the high relevance of norm-violating behaviours for personal and group safety. Overall, the present study provides evidence that the social attention system is sensitive to the appraisal of the valence of others' behaviours.

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