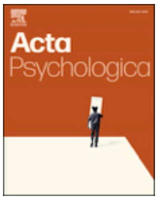
Acta Psychologica 255 (2025) 104934

Contents lists available at ScienceDirect

Acta Psychologica

journal homepage: www.elsevier.com/locate/actpsy



A direct comparison of gaze-mediated orienting elicited by schematic and real human faces

Mario Dalmaso *, Giovanni Galfano, Alessandra Baratella, Luigi Castelli

Department of Developmental and Social Psychology, University of Padova, Italy

ARTICLE INFO

Keywords:
Gaze cueing of attention
Gaze following
Real faces
Schematic faces
Social cognition

ABSTRACT

During social interactions, we tend to orient our visual attention towards the spatial location indicated by the gaze direction of others. However, modern societies are characterised by the increasing presence of facial stimuli of various natures, often schematic and pertaining to fictional entities, used in contexts such as advertisements or digital interfaces. In this study, we directly compared the impact of eye-gaze belonging to schematic and real faces on visual attention. These two types of stimuli were utilized in three experiments, where either manual (Experiment 1, $N = 160$; and Experiment 2, $N = 160$) or oculomotor (Experiment 3, $N = 80$) responses were recorded. In addition, schematic and real faces were presented either separately within two distinct blocks or intermixed within the same block of trials. The latter manipulation was aimed to test for eventual stronger differences between schematic and real faces in contexts that maximise the comparison processes between the two types of stimuli. In all experiments, a robust gaze-mediated orienting of attention effect emerged, and this was not significantly influenced by either the type of facial stimulus (i.e., schematic or real) or by the intermixed/blocked presentation. Overall, these results suggest that the human social attention system may treat both types of stimuli similarly. This finding suggests that schematic faces can be effectively used in various applied contexts, such as digital interfaces and advertising, without compromising gaze-mediated attentional orienting.

1. Introduction

During real life interactions, the gaze of others is a superstimulus, in that it can convey fundamental information that enables one to draw inferences concerning different aspects of the person we are facing (e.g., their intentions and emotional state) as well as about relevant events in the surrounding environment (Capozzi & Ristic, 2018; Hietanen, 2018). For instance, children develop linguistic and social competence by following the gaze of others, by means of referential learning processes (e.g., Csibra & Volein, 2008). Gaze is indeed the most reliable index signalling where the attention of an observer is allocated (e.g., Emery, 2000). In the laboratory, how gaze can push our attention has been mainly investigated by means of the gaze-cueing paradigm. Gaze cueing is the phenomenon whereby responses to a lateralised target stimulus appearing in a given spatial location are typically faster and/or more accurate when the target is looked at by a task-irrelevant gaze stimulus presented at fixation (e.g., Driver et al., 1999; Friesen & Kingstone, 1998; Hietanen, 1999). In particular, gaze-cueing magnitude is computed by comparing performance in spatially congruent trials (i.e., trials in which the target appears in the location signalled by the gaze stimulus) and spatially incongruent trials (i.e., trials in which the target appears in the location opposite to that signalled by the gaze stimulus). Despite some early sceptical views (see Risko et al., 2012), this effect has been shown to critically involve social processes, since it can be modulated as a function of different manipulations originating from social cognition (see Dalmaso, Castelli, & Galfano, 2020a for a review). Gaze cueing has been observed with different types of human face stimuli used to convey gaze, ranging from schematic faces (e.g., Friesen & Kingstone, 1998; Hietanen & Yrttimaa, 2005), to computer-generated stimuli (e.g., Dalmaso, Castelli, & Galfano, 2020b; Kuhn et al., 2016; Zhang et al., 2021), and images of real faces (e.g., Dalmaso, Castelli, & Galfano, 2021; Dalmaso, Zhang, et al., 2021; Driver et al., 1999; Frischen & Tipper, 2004; Hietanen, 1999). Less frequently, gaze stimuli consisting of simple pairs of eyes (either schematic or real) or embedded in non-human faces or non-facial stimuli have been employed for investigating a variety of research questions (e.g., Akiyama et al., 2008; Chevalier et al., 2020; Quadflieg et al., 2004; Ristic & Kingstone, 2005).

In a recent meta-analysis, McKay et al. (2021) have tested whether

---

* Corresponding author at: Department of Developmental and Social Psychology, University of Padova, Via Venezia 8, 35131 Padova, Italy.
E-mail address: mario.dalmaso@unipd.it (M. Dalmaso).

https://doi.org/10.1016/j.actpsy.2025.104934
Received 2 December 2024; Received in revised form 18 March 2025; Accepted 21 March 2025

the magnitude of gaze cueing is affected by whether a schematic vs. real face is used to display the gaze cue. This aspect is relevant in the broader context of social attention studies in order to clarify whether stimuli conveying a spatial meaning characterised by different ecological validity are more or less effective in pushing attention in the corresponding direction. For instance, in the case of real faces, one may expect stronger mentalising processing to occur, which, in turn, may trigger stronger orienting responses (e.g., Capozzi & Ristic, 2020; Morillo-Mendez et al., 2023). Although McKay et al. (2021) showed that gaze cueing was seemingly stronger for real than for schematic faces, when relevant variables (e.g., temporal parameters, task type) characterising the different studies were fully controlled for in the analysis, the difference between schematic and real faces completely disappeared. As acknowledged by McKay et al. (2021), however, because the studies included in the meta-analysis manipulated very different variables and were not originally designed to compare gaze cueing elicited by schematic vs. real faces, it may be premature to draw firm conclusions.

Regarding empirical studies, to the best of our knowledge, the inclusion of schematic and real faces has almost invariably been instrumental to address goals other than the pure effectiveness of the two types of gaze stimuli in pushing one's attention (e.g., Dalmaso et al., 2024; Hietanen & Leppänen, 2003; Tipples, 2005; Zhang et al., 2019). For instance, Hietanen and Leppänen (2003) were interested in exploring the effects of facial expression of emotion on gaze cueing and run several experiments using both schematic and real face stimuli, but they did not carry out any statistical analyses aimed to directly compare the magnitude of gaze cueing elicited by the two types of stimuli. Importantly, in no study the two types of faces were manipulated using a within-participant approach. This, in turn, undermines the possibility to provide a robust comparison shielded against inter-individual variability. One of the objectives of the set of experiments illustrated in the present work was to carry out a proper, direct, within-participant comparison. Based on the meta-analysis performed by McKay et al. (2021), it could be expected that the two types of stimuli would elicit gaze-cueing effects of similar magnitude. Alternatively, given that previous studies did not carry out any within-participant comparison, one might hypothesize a larger gaze-cueing for real faces in light of their higher ecological value.

Another relevant aspect often neglected in gaze-cueing studies is related to the variability in the cueing stimuli administered to participants. In this regard, a recent line of research is starting to address the effects of contextual information on gaze cueing. More specifically, it has been suggested that the very same stimulus can elicit gaze cueing to a different extent as a function of the broader context in which such stimulus is embedded (e.g., Kuhn et al., 2016; Zhang et al., 2023; see also Pavan et al., 2011). For instance, Kuhn et al. (2016) were interested in addressing the impact of emotional expressions in gaze cueing and observed a larger gaze-cueing effect for fearful as compared to happy faces but only when fearful faces were relatively infrequent – and were thus contextually more salient. This empirical evidence is consistent with the eyeTUNE theoretical framework (Dalmaso, Castelli, & Galfano, 2020a), according to which gaze cueing can be influenced by several variables, and in particular by the comparative setting. A simple way to manipulate the presence of a comparative setting is to present different face stimuli intermixed in the same block of trials, as opposed to present the different stimuli in distinct blocks (Macrae & Cloutier, 2009). The studies performed so far that implemented this manipulation were characterised by the use of real faces either belonging to different social categories (e.g., Zhang et al., 2023) or carrying different facial expressions of emotions (Kuhn et al., 2016). A second goal of the present study was thus to address whether differences in gaze-cueing magnitude between schematic and real faces, if any, might be further modulated by manipulating the presence of a comparative context. In particular, one might expect eventual differences in gaze-cueing magnitude to be more likely to appear in the intermixed condition, namely when the ecological relevance of real faces was made contextually more salient (e.g., Zhang et al., 2023). The outcomes may have both a theoretical relevance for attention models, by clarifying whether contextual manipulations are effective only when social features are involved (e.g., Dalmaso, Castelli, & Galfano, 2020a), and also have implications from an applied perspective, given the widespread use of simplified faces and gaze cues in everyday applications (e.g., from advertising to user interfaces).

1.1. *Overview of the study*

This study aimed to directly compare the effectiveness of schematic and real faces in eliciting the gaze-cueing effect (i.e., a better performance on spatially congruent than on spatially incongruent trials), while also examining the role of contextual manipulations. Specifically, we tested the null hypothesis that there would be no difference in the magnitude of gaze-mediated orienting of attention between schematic and real faces (i.e., a main effect of congruency without a further interaction involving face type) against the alternative hypothesis that gaze-mediated orienting of attention would differ between the two types of stimuli (i.e., an interaction between congruency and face type).

Three experiments based on a similar structure and experimental design were performed. In all experiments, both schematic and real faces were administered to the same participants. In addition, in one condition (blocked condition) they were presented in separate blocks of trials, whereas in a different condition (intermixed condition) they were interspersed within the same blocks. In Experiment 1, a manual response task was used in combination with a standard gaze-cueing paradigm, in which a direct-gaze face pre-cue always preceded the averted-gaze face providing the spatial cue. This procedure is the most often used in the literature (McKay et al., 2021). Because the presence of a pre-cue can give rise to apparent movement phenomena that, in principle, might inflate the gaze-cueing effect, in Experiment 2, the direct-gaze frame was eliminated. This allowed us to obtain a more conservative measure of gaze cueing, immune to spurious perceptual effects extraneous to gaze processing. In Experiment 3, we used the same manipulations as in Experiment 2 but switched to an oculomotor task, with the aim of providing a comprehensive test about the possible differential effects of schematic and real faces and the eventual interaction between them.

2. Experiment 1: gaze-cueing task with apparent eye-gaze movement

In this experiment, we employed a manual gaze-cueing paradigm. This featured a pre-cue stimulus of a face with a direct gaze, followed by the same face exhibiting an averted gaze, thereby creating an apparent motion of the eyes. Half of the participants were assigned to the intermixed condition, where schematic and real faces were presented within the same blocks of trials. The other half were assigned to the blocked condition, in which the two types of faces were presented in separate blocks of trials.

2.1. *Methods*

2.1.1. *Participants*

Brysbaert and Stevens (2018) advocate for a minimum number of 1600 observations for each cell of the experimental design. Based on our experimental setup (see the Procedure section), this translated into a minimum requisite of 50 participants for each of the two (i.e., intermixed vs. blocked) conditions. Moreover, following Brysbaert (2019), in order to further increase power, we also decided to recruit a larger sample. The final sample was composed of 160 individuals (*Mean age* = 24 years, *SD* = 7.98, 29 males): Eighty participants completed the intermixed condition, whereas the remaining eighty participants completed the blocked condition. Please note that this sample size also aligns with previous online studies employing gaze-cueing tasks (e.g., Dalmaso, Castelli, & Galfano, 2021; Dalmaso, Zhang, et al., 2021). All participants were students at the University of Padova, who took part on a voluntary basis. The study was approved by the Ethics Committee for Psychological Research at the University of Padova (protocol 4654) and conducted in accordance with the Declaration of Helsinki.

2.1.2. Stimuli, apparatus, and procedure

A single face, representing a young adult male, was extracted from the MR2 database (Strohminger et al., 2016). This face was a full-colour image of a real person. A schematic representation of this face was then created, ensuring that both the outline dimensions and the dimensions of the eye-gaze region were identical. For each face, there were three versions: One featuring a direct gaze, and two others with the gaze averted either to the left or to the right (see Fig. 1).[1]

The experiment was programmed using PsychoPy and administered online via Pavlovia. Each trial started with a central fixation cross (Arial font, 0.1 height units) displayed for 500 ms (see Fig. 1, Panel A for an illustration). Subsequently, a face with a direct gaze (measuring 500 px in width by 500 px in height) was presented centrally for 900 ms. This was followed by an image of the same face with an averted gaze, shown for 200 ms. The target was a black line (measuring 40 px in width by 12 px in height) randomly appearing either to the left or right of the centre of the screen (±0.8 normalised units). The task required to decide whether the target was a vertical or horizontal line. Participants were instructed to maintain their gaze at the centre of the screen throughout the trial and to respond as quickly and accurately as possible by pressing the 'F' or 'K' keys (counterbalanced across participants) as soon as the target was displayed. They were also told to disregard the facial stimulus since the direction of the eye gaze did not reliably indicate the target location. Indeed, on 50 % of trials, the target appeared in the same spatial location looked at by the face (i.e., a congruent trial), whereas on the other 50 % of trials, the target appeared in the opposite spatial location (i.e., an incongruent trial). The target remained onscreen until the participant responded or 2000 ms had elapsed, whichever came first. Incorrect or missed responses were indicated with a central visual feedback displaying the words 'ERROR' or 'TOO SLOW' respectively. A practice block (10 trials) was followed by two experimental blocks (64 trials each), totalling 128 experimental trials.

Participants took part in one of two conditions on a random basis: One where the schematic and real faces were interspersed within the two experimental blocks (i.e., the intermixed condition), and another where each type of stimulus was presented in separate blocks (one type in the first block and the other in the second block, i.e., the blocked condition). For the latter condition, the order of blocks (i.e., real face first, schematic face second, or the reverse) was counterbalanced across participants.

2.2. Results

Trials in which a missed response was recorded (0.35 % of trials) were discarded and not further analysed. Trials in which a wrong response was provided (5.49 % of trials) were discarded and analysed separately, for the sake of completeness. Correctly-responded trials with a latency smaller than 150 ms or >1500 ms were discarded (0.42 % of trials; also see Dalmaso, Castelli, & Galfano, 2021; Dalmaso, Zhang, et al., 2021). After that, there was a minimum of 2367 observations per experimental cell, which guaranteed adequate statistical power (Brysbaert & Stevens, 2018) for RT analyses, which were of primary interest. As experimental factors, we considered congruency (2: congruent vs. incongruent), face type (2: real vs. schematic), and condition (2: intermixed vs. blocked).

The RT data of correct trials were analysed utilising a linear mixed-effects model with the 'lme4' and 'lsmeans' R packages. We used linear mixed-effects models, as they offer several advantages over standard ANOVAs, such as accounting for between-subject variability. To maintain consistency with previous studies, we computed traditional effect sizes without including random effects. By means of the 'MuMin' R package, we compared several models with increasing complexity, ranging from the null model (i.e., the model with only a random intercept for participant) to the most saturated model. The best model fitting the data, according to the Akaike Information Criterion, included congruency, face type, condition, and their interactions, as fixed effects, and participant as random effect. The only significant result was the main effect of congruency, $F(1, 19{,}040.2) = 75.119$, $p < .001$, $\eta_p^2 = 0.289$, due to smaller RTs on congruent ($M = 597$ ms, $SE = 6.78$) than on incongruent ($M = 615$ ms, $SE = 6.78$) trials. All other results were non-significant (all $ps > 0.344$; see also Fig. 2 and Table 1 for descriptive statistics, whereas details about model parameters are reported in Supplementary Materials). The models were then compared using Bayes Factors (BF) calculated with the 'bayestestR' package, which provides a measure of the relative evidence for each model against the null model. The best model included only the congruency factor ($BF_{10} > 150$), and this model was preferable over the two models including the interaction between congruency and face type ($BF_s > 150$).

Similarly to RTs, errors were analysed through the comparison of mixed-effect logit models (which can appropriately handle the binary nature of errors) characterised by increasing complexity. The best model fitting the data included congruency, face type, and their interaction, as fixed effects, and participant as random effect. The main effect of congruency was significant, $b = 0.348$, $SE = 0.09$, $z = 3.882$, $p < .001$, $\eta_p^2 = 0.061$, due to greater accuracy on congruent ($M = 0.959$, $SE = 0.003$) than on incongruent ($M = 0.949$, $SE = 0.003$) trials, as well as the main effect of face type, $b = 0.229$, $SE = 0.091$, $z = 2.505$, $p = .012$, $\eta_p^2 = 0.018$, due to greater accuracy for real ($M = 0.957$, $SE = 0.003$) than for schematic ($M = 0.952$, $SE = 0.003$) faces. Their interaction was not significant ($p = .058$; see also Table 1). Bayesian analyses showed that the best model included only the congruency factor ($BF_{10} = 4.86$), and this model was preferable over the two models including the interaction between congruency and face type ($BF_s > 150$).

2.3. Discussion

The results of Experiment 1 clearly provide evidence for the presence of a robust gaze-cueing effect, with smaller response latencies emerging when the target appeared in the same spatial location indicated by the gaze cues, as compared to trials in which the target appeared in the opposite location (see also, e.g., McKay et al., 2021). Strikingly, gaze cueing was not modulated by the nature of the gaze stimulus (i.e., schematic, or real). The lack of differences in the strength of gaze cueing elicited by schematic and real faces was observed both in the blocked and in the intermixed condition (i.e., when the ecological relevance of real faces was rendered contextually more salient). In sum, the overall scenario emerging from this first experiment suggests that the two types of face stimuli seem to impact the social attention system to the same extent. This possibility was further investigated in the subsequent experiment.

3. Experiment 2: gaze-cueing task without apparent eye-gaze movement

In this second experiment, everything was identical to Experiment 1,

---

[1] We acknowledge that using a single facial identity introduces limitations to the generalisability of the results. This decision was made to avoid perceptual confounds, as schematic faces, by definition, exhibit less variability than real faces. We reasoned that using multiple identities for both real and schematic faces could have introduced differences in gaze cueing driven by stimulus variability rather than by the real vs. schematic condition itself. In this regard, it is also important to note that previous research (Frischen & Tipper, 2004) found no evidence that gaze cueing is influenced by whether participants repeatedly see the same face or a different face on each trial. This suggests that variations in facial identity do not play a significant role in shaping social attention.

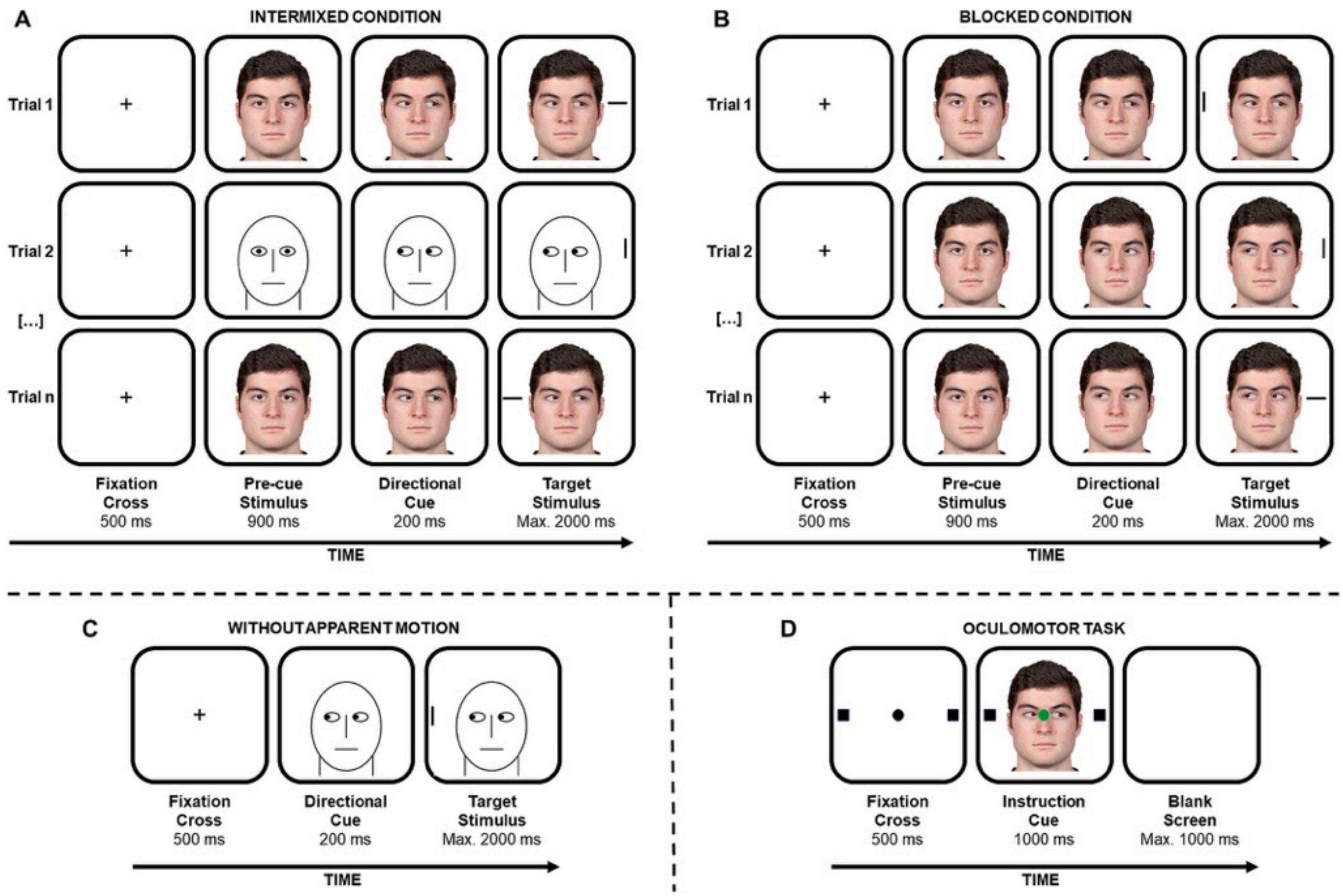


Fig. 1. Illustrations of the stimuli (not drawn to scale) and the tasks used in this study. Examples of trials used in the manual response task of Experiment 1 are depicted in Panel A (in which the intermixed condition is depicted) and in Panel B (in which the blocked condition is depicted). Panel C depicts an example of a trial used in the manual response task of Experiment 2, in which the apparent motion of the pupils was removed. In Experiments 1 and 2, participants had to discriminate the orientation (i.e., vertical or horizontal) of the target line while maintaining their eyes at the centre of the screen. Panel D depicts an example of a trial used in the oculomotor task of Experiment 3, in which an eye movement towards the left or the right placeholder (the two black squares) had to be executed according to the colour (green or blue) assumed by the central spot (for interpretation of the references to colour in this figure legend, the reader is referred to the web version of this article).

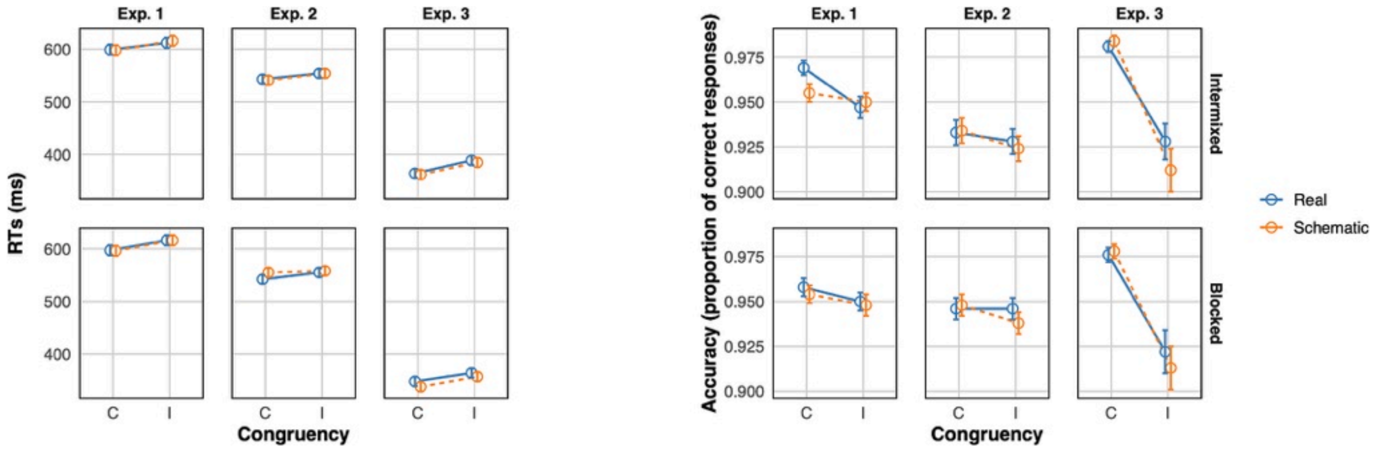


Fig. 2. Mean RTs and accuracy that were observed in all conditions of the three experiments. Error bars are standard errors.

with the sole exception that the pre-cue frame (direct-gaze face stimulus) was removed, to eliminate the apparent motion of the eyes. This adjustment was made to achieve a more conservative measure of gaze cueing, which would not be inflated by the influence of perceptual factors other than those under investigation.

3.1. *Methods*

3.1.1. *Participants*

We decided to test the same number of participants as in Experiment 1. Hence, a new group of 160 individuals (*Mean age* = 25 years, *SD* =

Table 1

Mean RTs (in ms) and accuracy (% correct) observed as a function of condition, face type, and congruency, in Experiments 1–3.

	Intermixed				Blocked			
	Real		Schematic		Real		Schematic	
	Congruent	Incongruent	Congruent	Incongruent	Congruent	Incongruent	Congruent	Incongruent
Experiment 1								
RTs	599 (9.79)	612 (9.80)	598 (9.80)	616 (9.80)	597 (9.80)	616 (9.80)	596 (9.80)	616 (9.80)
Accuracy	0.969 (0.004)	0.947 (0.006)	0.955 (0.005)	0.950 (0.005)	0.958 (0.005)	0.950 (0.005)	0.954 (0.005)	0.948 (0.006)
Experiment 2								
RTs	543 (8.45)	554 (8.45)	541 (8.45)	554 (8.46)	542 (8.44)	555 (8.44)	555(8.44)	558(8.45)
Accuracy	0.933 (0.007)	0.928 (0.007)	0.934 (0.007)	0.924 (0.007)	0.946 (0.006)	0.946 (0.006)	0.948 (0.006)	0.938 (0.006)
Experiment 3								
RTs	364 (8.61)	389 (8.62)	362 (8.61)	385 (8.62)	348 (8.61)	364 (8.62)	338 (8.61)	357 (8.62)
Accuracy	0.981 (0.003)	0.928 (0.010)	0.984 (0.003)	0.912 (0.012)	0.976 (0.004)	0.922 (0.012)	0.978 (0.004)	0.913 (0.012)

2.72, 86 males) was recruited with Prolific (https://www.prolific.com; the hourly rate was €10). The study was approved by the Ethics Committee for Psychological Research at the University of Padova (protocol 4654) and conducted in accordance with the Declaration of Helsinki.

3.1.2. *Stimuli, apparatus, and procedure*

Everything was identical to Experiment 1, the only difference being that in the present experiment, the pre-cue direct-gaze face was removed. Therefore, participants were directly presented with the averted-gaze stimulus after the initial fixation cross.

3.2. *Results*

The data were analysed as in Experiment 1. Missed responses were rare (0.18 % of trials) and were consequently discarded and excluded from further analysis. Wrong responses (7.45 % of trials) were also discarded and analysed separately, for the sake of completeness. Correctly-responded trials with RTs smaller than 150 ms or >1500 ms (0.24 % of trials) were excluded as well. Following these exclusions, each experimental condition had a minimum of 2320 observations, ensuring sufficient statistical power (Brysbaert & Stevens, 2018).

Regarding RTs, the best model fitting the data included congruency, face type, condition, and their interactions, as fixed effects, and participant as random effect. The main effect of congruency was significant, F (1, 18,703.6) $= 26.778$, $p < .001$, $\eta_p^2 = 0.163$, indicating smaller RTs on congruent ($M = 545$ ms, $SE = 5.81$) compared to incongruent ($M = 556$ ms, $SE = 5.81$) trials. All other main effects were non-significant ($ps > 0.077$). The face type × condition interaction was also significant, F(1, 18,703.4) $= 6.209$, $p = .013$, $\eta_p^2 = 0.020$. Further comparisons between schematic and real faces, as a function of condition, revealed that RTs in the blocked condition were smaller ($p = .003$) in response to real ($M = 549$ ms, $SE = 8.21$) than schematic ($M = 557$ ms, $SE = 8.21$) faces, whereas no differences ($p = .601$) emerged in the intermixed condition. The remaining interactions (all of which included the crucial factor of congruency) were non-significant ($ps > 0.126$; see also Fig. 2 and Table 1 for descriptive statistics). Bayesian analyses showed that the best model included only the congruency factor ($BF_{10} > 150$), and this model was preferable over the two models including the interaction between congruency and face type ($BF_s > 150$).

Regarding errors, the best model fitting the data included congruency and condition, as fixed effects, and participant as a random effect. The main effect of congruency was not significant ($p = .051$), whereas the main effect of condition was significant, $b = 0.252$, $SE = 0.121$, $z = 2.090$, $p = .037$, $\eta_p^2 = 0.031$, indicating greater accuracy for the blocked ($M = 0.945$, $SE = 0.005$) than for the intermixed ($M = 0.930$, $SE = 0.006$) condition (see also Table 1). Bayesian analyses showed that the null model was preferable over all other models. Specifically, the model including only congruency ($BF1_{10} = 0.045$), as well as the two models including the interaction between congruency and face type ($BF_{10s} < 6.05e^{-6}$), were less plausible than the null model.

3.3. *Discussion*

The results of Experiment 2 align with those observed in Experiment 1, as a reliable gaze-cueing effect emerged without being further qualified by the nature of the face (i.e., schematic or real), regardless of condition (i.e., blocked vs. intermixed). Hence, the presence of apparent movement is unlikely to account for the similar gaze-cueing effect for schematic and real faces observed in Experiment 1 (this is also supported by exploratory analyses combining data from Experiments 1 and 2; see Supplementary Materials). To shed further light on the scenario that has emerged so far, in the third experiment, we focused on overt attentional responses to eye-gaze stimuli.

4. Experiment 3: oculomotor task without apparent eye-gaze movement

In this final experiment, we slightly modified the task used in the previous experiments to adapt it for an oculomotor paradigm, in which participants performed leftward and rightward saccades following a central instruction cue (see, e.g., Ciardo et al., 2014; Dalmaso, Alessi, et al., 2020; Kuhn & Benson, 2007; Ricciardelli et al., 2002). This approach was aimed to collect more direct and ecologically-valid measures of visual attention, as represented by saccadic dynamics (Malienko et al., 2018; also see Pereira et al., 2022), with a specific focus on saccadic latencies and directions.[2] No pre-cue direct-gaze face preceded the averted-gaze frame, as in Experiment 2.

4.1. *Methods*

4.1.1. *Participants*

The minimum number of participants was established as in the previous experiments (see also Brysbaert & Stevens, 2018). Given that in our oculomotor task we collected 64 data points for each cell of the experimental design, the minimum number of participants was 25 for each of the two conditions (i.e., intermixed vs. blocked). As in the previous experiments, in order to increase power, we decided to collect a larger number of participants. The final sample size was therefore

---

[2] Eye movement recording allows for the collection of various measures related to spatial attention in social contexts, such as saccadic curvature (e.g., Dalmaso, 2022) and microsaccades (e.g., Yokoyama et al., 2012). In this context, we focused solely on saccadic latency and direction (used to compute correct and wrong responses) to ensure a more direct comparison with the previous two experiments involving manual responses.

composed of 80 individuals (*Mean age* = 20 years, $SD = 2.14$, 26 males), recruited within the student population of the University of Padova. Forty participants completed the intermixed condition, the remaining 40 participants completed the blocked condition. They took part on a voluntary basis. The study was approved by the Ethics Committee for Psychological Research at the University of Padova (protocol 4654) and conducted in accordance with the Declaration of Helsinki.

4.1.2. Stimuli, apparatus, and procedure

The facial stimuli were the same used in Experiments 1 and 2. Eye movement data were collected using an EyeLink 1000 Plus (SR Research) at a 1000-Hz sampling rate, and the stimuli were presented on a 24-in. monitor (1280 × 1024 pixels, 120 Hz). A chinrest placed about 70 cm away from the monitor was used to stabilise the head. The entire experimental procedure was managed by Experiment Builder software (SR Research). The screen background was set to grey.

First, all participants underwent a calibration/validation procedure. Then, the experiment started. Each trial began with a black fixation spot (diameter: 0.5°), positioned centrally, flanked by two black squares serving as placeholders (side: 0.9°), located 9.7° to the left and right of the fixation spot. A 500-Hz tone, lasting 100 ms, was played to signal the start of the trial. Participants fixated the central spot, and the trial proceeded only if they maintained their gaze on this spot for a variable duration (ranging from 800 to 1300 ms, in 100 ms increments), as monitored by a gaze-contingent trigger (invisible boundary diameter: 4°). If, within a 10-s period, participants failed to maintain fixation, then a visual feedback (the word 'RECALIBRATION') was presented for 2000 ms, the trial was aborted and recycled at the end of the block, and a new calibration/validation procedure was conducted. If fixation was successful, then a face (500 px wide by 500 px high), with gaze directed either leftwards or rightwards, appeared in the centre of the screen. Simultaneously, the central spot became either green or blue. This instruction cue informed participants about the spatial vector of the to-be-executed saccade and served as 'go' signal. Participants were required to execute a saccade to either the left or right placeholder as soon as they detected the colour change. Half of the participants were instructed to associate the green colour with a leftwards saccade and the blue colour with a rightwards saccade, while for the other half, the association was reversed. Participants were also informed that eye-gaze direction was not informative concerning the direction of the requested saccade (i.e., congruent and incongruent trials occurred with the same frequency) and therefore they were invited to ignore facial stimuli. Participants were given a maximum of 1000 ms to execute the saccade. Finally, a blank screen appeared for another 1000 ms, during which participants were instructed to shift their eyes back to the centre of the screen, and then the next trial started.

Participants first completed a practice block consisting of 10 trials, followed by four experimental blocks including 64 trials each, yielding a total of 256 experimental trials. Similar to the previous experiments, participants took part in one of the two conditions (i.e., intermixed vs. blocked) on a random basis. As in previous experiments, for the blocked condition, the order of blocks was counterbalanced across participants.

4.2. Results

Because oculomotor rather than manual responses were collected, data cleaning followed a slightly different approach, while data analyses were conceptually identical to those used in the previous two experiments. First, we extracted the first blink-free saccade with a minimum amplitude of 2°, executed after the onset of the instruction cue. A saccade was defined as an eye movement exceeding 30°/s in velocity and $8000°/s^2$ in acceleration, respectively. Erroneous saccades (6.40 % of trials), classified as eye movements made in the opposite direction to that associated with the instruction cue, were discarded and analysed separately, for the sake of completeness. Correctly executed saccades were further treated by eliminating those with a RT shorter than 80 ms or longer than 800 ms (0.609 % of trials; also see Dalmaso et al., 2023). Following these exclusions, each experimental condition had a minimum of 2228 observations, ensuring sufficient statistical power (Brysbaert & Stevens, 2018) for the analysis of RTs, which was of primary interest.

Regarding RTs, the best model fitting the data included congruency, face type, condition, and their interactions, as fixed effects, and participant as random effect. The main effect of congruency was significant, $F(1, 18{,}712) = 359.800$, $p < .001$, $\eta_p^2 = 0.682$, indicating smaller RTs on congruent ($M = 353$ ms, $SE = 6.04$) compared to incongruent ($M = 374$ ms, $SE = 6.04$) trials, as well as the main effect of face type, $F(1, 18{,}674) = 30.799$, $p < .001$, $\eta_p^2 = 0.111$, due to smaller RTs for schematic ($M = 360$ ms, $SE = 6.04$) than for real ($M = 366$ ms, $SE = 6.04$) faces. The main effect of condition was non-significant ($p = .059$). The face type × condition interaction was also significant, $F(1, 18{,}672) = 5.689$, $p = .017$, $\eta_p^2 = 0.021$. Further comparisons revealed that the difference between schematic and real faces was significant in both conditions ($ps < 0.026$), but it was greater in the blocked (9 ms) than in the random (4 ms) condition.[3] The congruency × condition interaction was also significant, $F(1, 18{,}673) = 8.197$, $p = .004$, $\eta_p^2 = 0.051$. Further comparisons revealed that the difference between congruent and incongruent trials was significant in both conditions ($ps < 0.001$), but it was greater in the intermixed (24 ms) than in the blocked (18 ms) condition. The other two interactions were non-significant ($ps > 0.213$; see also Fig. 2 and Table 1 for descriptive statistics). Bayesian analyses showed that the best model included the factors congruency and face type without their interaction ($BF_{10} > 150$), and this model was preferable over the two models including the interaction between congruency and face type ($BF_s > 121$).

Regarding errors, the best model fitting the data included congruency and face type, and their interaction, as fixed effects, and participant as a random effect. The main effect of congruency was significant, $b = 1.313$, $SE = 0.098$, $z = 13.370$, $p < .001$, $\eta_p^2 = 0.522$, due to greater accuracy on congruent ($M = 0.98$, $SE = 0.002$) than on incongruent ($M = 0.919$, $SE = 0.007$) trials, whereas the main effect of face type was non-significant ($p = .379$). The interaction was significant, $b = 0.278$, $SE = 0.141$, $z = 1.977$, $p = .048$, $\eta_p^2 = 0.070$. Further comparisons revealed that the difference between congruent and incongruent trials was significant for both face types ($ps < 0.001$), but it was slightly greater for schematic (0.068) than for real (0.054) faces (see also Table 1). Bayesian analyses showed that the best model included only the factor congruency ($BF_{10} > 150$), and this model was preferable over the two models including the interaction between congruency and face type ($BF_s > 150$).

4.3. Discussion

The results of Experiment 3 did not reveal any clear differences in the capability of gaze belonging to schematic and real faces of biasing overt orienting of attention. This was evident in the analysis of RTs, where the main effect of congruency was robust and, more importantly, was not further influenced by the nature of the gaze stimulus (i.e., real or schematic), irrespective of condition (i.e., blocked or intermixed). It is worth noting that the analysis of erroneous saccades suggested that participants tended to be more influenced by the gaze direction of schematic faces, as indicated by the interaction between congruency and face type. Despite this statistically-significant difference, it is crucial to acknowledge that the percentage of overall errors was relatively small,

---

[3] The same interaction also emerged in Experiment 2, although with an opposite pattern (i.e., smaller RTs for real compared to schematic faces in the blocked condition). This discrepancy between Experiments 2 and 3, together with the absence of the interaction in Experiment 1, invites caution when interpreting this result and prevents us from drawing firm conclusions. Moreover, given that the 'congruency' factor was not involved, this two-way interaction has limited theoretical relevance regarding our primary research goal.

and the difference in how schematic and real faces influenced gaze-mediated orienting was minimal. Therefore, this result should be interpreted with caution, especially because it is not consistent not only with RT data but also with the coherent pattern of findings emerging from the accuracy data of the previous experiments. Moreover, Bayesian analyses provided strong evidence for the model including the congruency factor only. Finally, it is worth noting that gaze-mediated responses appeared more pronounced for saccades than for manual responses in both Experiments 1 and 2. This may be due to differences in the potential conflict between the spatial nature of gaze cues and the type of response. Supporting this view, Bonmassar et al. (2019)—who recorded both manual and oculomotor measures in a spatial cueing task with gaze (and non-social) stimuli—suggested that the conflict between gaze cues and eye movements (which both share a clear spatial dimension, i.e., left vs. right) might be stronger than that measured through manual responses, which are often based on target identity discrimination. In addition, in light of its nature, the oculomotor task may be more prone to imitative responses and, therefore, leading to rely more on social cues.

5. General discussion

In the present work, we explored how gaze-mediated orienting of attention is influenced by schematic and real faces. In Experiment 1, we collected manual responses in a gaze-cueing paradigm (see, e.g., Friesen & Kingstone, 1998) wherein a central face, either schematic or real, initially directed its gaze towards the participant and subsequently shifted its eyes to the same (vs. opposite) spatial location of the upcoming target. Schematic and real faces were presented either in an intermixed or in a blocked fashion. Experiment 2 replicated Experiment 1, the only exception being that the face appeared directly with averted gaze to avoid the apparent motion of the pupils. Experiment 3 replicated Experiment 2, but the task was adapted to collect oculomotor measures (see, e.g., Ricciardelli et al., 2002).

Across all experiments, a clear and robust pattern of results emerged: Gaze-mediated orienting of attention was reliable for both types of facial stimuli, and of comparable magnitude. The main findings emerging from this work underscore the relevance of eye-gaze stimuli for the human attention system. Despite the stark differences between schematic and real faces in terms of complexity and ecological validity, our set of experiments consistently revealed that both types of stimuli effectively shape orienting of attention in similar ways. Overall, these results suggest that the mechanisms underlying social attention may be influenced regardless of whether the face providing eye-gaze stimuli is highly detailed, as in the case of a real face, or minimally sketched, as in the case of a schematic face.

In addition, it is worth noting that schematic and real faces had the same impact on visual orienting regardless of the context in which the two stimuli were presented (intermixed vs. blocked). This can be taken as further proof of the similar, strong influence the two stimuli exert on our social attention system. In this regard, previous literature suggests that, when facial stimuli belonging to different categories are presented separately, pervasive gaze-mediated orienting of attention can be observed for stimuli belonging to each single category. In contrast, however, when the same stimuli are presented intermixed, different attentional prioritisation effects have been reported. For instance, a diminished/abolished gaze-mediated orienting of attention has been documented for Black (vs. White) faces in White participants, but only when the salience of the ethnicity was enhanced by presenting faces in an intermixed (vs. blocked) fashion (see, e.g., Pavan et al., 2011; for related results with different ethnicities see also Zhang et al., 2023). This reflects the tendency of observers to favour one social category over another, but only when they are immersed in a context in which social comparison is most likely to occur (see also Macrae & Cloutier, 2009). In the current set of experiments, it is possible to hypothesize that schematic and real faces did not evoke any distinction in terms of categorisation and were therefore treated as expressions of the same entity (i.e., an individual looking leftwards or rightwards). This might result from our tendency to process schematic faces prioritising their meaning as ‘faces’ rather than their meaning as ‘schematic stimuli’. Evidence supporting this argument can be found in the well-known sensitivity to eye-gaze stimuli provided by simple geometrical shapes in newborns and even foetuses (e.g., Gliga & Csibra, 2007; Reid et al., 2017), as well in the widespread diffusion of schematic faces in our modern societies (e.g., Bai et al., 2019). Overall, the present findings are also consistent with the eyeTUNE framework (Dalmaso, Castelli, & Galfano, 2020a) according to which, in the absence of clear modulatory variables (such as the affiliation with a specific social group), gaze-mediated orienting would represent the default response for the human attention system.

To the best of our knowledge, the current set of experiments represents the first attempt to directly compare schematic and real face stimuli in relation to gaze-mediated orienting of attention, given that previous studies addressed this issue only indirectly and using a between-participant approach (e.g., Hietanen & Leppänen, 2003; Tipples, 2005; Zhang et al., 2019; see also McKay et al., 2021, for a review). Our research opens new avenues for exploring how simplified social signals can be utilized in environments where realistic human interaction is limited or impractical. For instance, in the context of virtual reality, social robotics, and online communication platforms, employing schematic faces could offer a viable alternative to more complex, real-life representations without significantly diminishing the social attention effects (see, e.g., Krebs et al., 2019). Additionally, this insight has potential applications in the development of therapeutic tools for populations with social cognition impairments, where simplified cues might be as effective as real ones. This is the case, for instance, with autism spectrum disorder (ASD), in which it is known that social interactions between children with ASD and social robots (equipped with schematic faces) can lead to improvements in social skills (see, e.g., Cabibihan et al., 2013).

Future studies, using paradigms similar to those employed here, might also explore how different brain regions respond to schematic versus real eye-gaze stimuli when these stimuli are directly compared. In this regard, we cannot rule out the possibility that neural measures, other than manual or oculomotor indexes, may be more sensitive in detecting differences between the two types of stimuli (cf., Rossi et al., 2015; Sagiv & Bentin, 2001; Zhang et al., 2019). In a different vein, other potentially interesting research perspectives might involve cross-cultural examinations, aimed at testing the generalisability of these findings. On the one hand, one could assess whether cultural differences in visual literacy or exposure to media influence the processing of schematic versus real eye-gaze stimuli. On the other hand, one could address the issue of whether social features, such as ethnicity, increasingly used in the stylised face stimuli (e.g., emoticons) populating our daily life, exert their effects on social attention mechanisms similarly to what reported, so far, with more ecological stimuli (e.g., Pavan et al., 2011; Weisbuch et al., 2017). Additionally, future studies could also increase the number of facial identities to further improve the generalisability of the results by minimising the potential influence of specific individual facial characteristics.

In conclusion, this study broadens our understanding of social attention and highlights the adaptability of such a mechanism to different forms of social information. This work invites further research into the cognitive and neural mechanisms that enable such flexibility, with significant implications for both theoretical frameworks in cognitive psychology and practical applications in technology and clinical interventions.

CRediT authorship contribution statement

Mario Dalmaso: Writing – review & editing, Writing – original draft, Visualization, Validation, Supervision, Software, Resources, Project administration, Methodology, Investigation, Funding acquisition, Formal analysis, Data curation, Conceptualization. **Giovanni Galfano:**

Writing – review & editing, Writing – original draft, Visualization, Validation, Supervision, Resources, Project administration, Methodology, Conceptualization. **Alessandra Baratella:** Writing – review & editing, Investigation, Data curation. **Luigi Castelli:** Writing – review & editing, Writing – original draft, Visualization, Validation, Supervision, Resources, Project administration, Methodology, Conceptualization.

Funding

This research was financially supported by a grant from the Italian Ministry of University and Research (MUR) to Mario Dalmaso (n° [Prin 2022 PNRR, P2022TPX8E]).

Declaration of competing interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

Appendix A. Supplementary data

Supplementary data to this article can be found online at https://doi.org/10.1016/j.actpsy.2025.104934.

Data availability

Data and experiment codes can be found here: https://doi.org/10.17605/OSF.IO/GWQBJ

References

Akiyama, T., Kato, M., Muramatsu, T., Maeda, T., Hara, T., & Kashima, H. (2008). Gaze-triggered orienting is reduced in chronic schizophrenia. *Psychiatry Research, 158*(3), 287–296. https://doi.org/10.1016/j.psychres.2006.12.004

Bai, Q., Dan, Q., Mu, Z., & Yang, M. (2019). A systematic review of emoji: Current research and future perspectives. *Frontiers in Psychology, 10*, Article 476737. https://doi.org/10.3389/fpsyg.2019.02221

Bonmassar, C., Pavani, F., & van Zoest, W. (2019). The role of eye movements in manual responses to social and nonsocial cues. *Attention, Perception, & Psychophysics, 81*(4), 1236–1252. https://doi.org/10.3758/s13414-019-01669-9

Brysbaert, M. (2019). How many participants do we have to include in properly powered experiments? A tutorial of power analysis with some simple guidelines. *Journal of. Cognition, 2(1), 16*, 1–38. https://doi.org/10.5334/joc.72

Brysbaert, M., & Stevens, M. (2018). Power analysis and effect size in mixed effects models: A tutorial. *Journal of Cognition, 1*(1), 1–20. https://doi.org/10.5334/joc.10

Cabibihan, J. J., Javed, H., Ang, M., & Aljunied, S. M. (2013). Why robots? A survey on the roles and benefits of social robots in the therapy of children with autism. *International Journal of Social Robotics, 5*, 593–618. https://doi.org/10.1007/s12369-013-0202-2

Capozzi, F., & Ristic, J. (2018). How attention gates social interactions. *Annals of the New York Academy of Sciences, 1426*(1), 179–198. https://doi.org/10.1111/nyas.13854

Capozzi, F., & Ristic, J. (2020). Attention AND mentalizing? Reframing a debate on social orienting of attention. *Visual Cognition, 28*(2), 97–105. https://doi.org/10.1080/13506285.2020.1725206

Chevalier, P., Kompatsiari, K., Ciardo, F., & Wykowska, A. (2020). Examining joint attention with the use of humanoid robots-a new approach to study fundamental mechanisms of social cognition. *Psychonomic Bulletin & Review, 27*(2), 217–236. https://doi.org/10.3758/s13423-019-01689-4

Ciardo, F., Marino, B. F., Actis-Grosso, R., Rossetti, A., & Ricciardelli, P. (2014). Face age modulates gaze following in young adults. *Scientific Reports, 4*, 4746. https://doi.org/10.1038/srep04746

Csibra, G., & Volein, A. (2008). Infants can infer the presence of hidden objects from referential gaze information. *British Journal of Developmental Psychology, 26*, 1–11. https://doi.org/10.1348/026151007X185987

Dalmaso, M. (2022). Exploring the social environment with the eyes: A review of the impact of facial stimuli on saccadic trajectories. *International Journal of Environmental Research and Public Health, 19*(24), 16615. https://doi.org/10.3390/ijerph192416615

Dalmaso, M., Alessi, G., Castelli, L., & Galfano, G. (2020). Eye contact boosts the reflexive component of overt gaze following. *Scientific Reports, 10*, 4777. https://doi.org/10.1038/s41598-020-61619-6

Dalmaso, M., Castelli, L., Bernardini, C., & Galfano, G. (2023). Can masked gaze and arrow stimuli elicit overt orienting of attention? *A registered report. Consciousness and Cognition, 109*, Article 103476. https://doi.org/10.1016/j.concog.2023.103476

Dalmaso, M., Castelli, L., & Galfano, G. (2020a). Social modulators of gaze-mediated orienting of attention: A review. *Psychonomic Bulletin & Review, 27*(5), 833–855. https://doi.org/10.3758/s13423-020-01730-x

Dalmaso, M., Castelli, L., & Galfano, G. (2020b). Early saccade planning cannot override oculomotor interference elicited by gaze and arrow distractors. *Psychonomic Bulletin & Review, 27*(5), 990–997. https://doi.org/10.3758/s13423-020-01768-x

Dalmaso, M., Castelli, L., & Galfano, G. (2021). Increased gaze cueing of attention during COVID-19 lockdown. *iScience, 24*(11), Article 103283. https://doi.org/10.1016/j.isci.2021.103283

Dalmaso, M., Galfano, G., & Castelli, L. (2024). Testing the effects of gaze distractors with invariant spatial direction on attention cueing. *Quarterly Journal of Experimental Psychology, 77*, 1544–1554. https://doi.org/10.1177/17470218231203963

Dalmaso, M., Zhang, X., Galfano, G., & Castelli, L. (2021). Face masks do not alter gaze cueing of attention: Evidence from the COVID-19 pandemic. *i-Perception, 12*(6). https://doi.org/10.1177/20416695211058480, 20416695211058480.

Driver, J., Davis, G., Ricciardelli, P., Kidd, P., Maxwell, E., & Baron-Cohen, S. (1999). Gaze perception triggers reflexive visuospatial orienting. *Visual Cognition, 6*(5), 509–540. https://doi.org/10.1080/135062899394920

Emery, N. J. (2000). The eyes have it: The neuroethology, function and evolution of social gaze. *Neuroscience & Biobehavioral Reviews, 24*(6), 581–604. https://doi.org/10.1016/S0149-7634(00)00025-7

Friesen, C. K., & Kingstone, A. (1998). The eyes have it! Reflexive orienting is triggered by nonpredictive gaze. *Psychonomic Bulletin & Review, 5*(3), 490–495. https://doi.org/10.3758/BF03208827

Frischen, A., & Tipper, S. P. (2004). Orienting attention via observed gaze shift evokes longer term inhibitory effects: Implications for social interactions, attention, and memory. *Journal of Experimental Psychology: General, 133*(4), 516–533. https://doi.org/10.1037/0096-3445.133.4.516

Gliga, T., & Csibra, G. (2007). Seeing the face through the eyes: A developmental perspective on face expertise. *Progress in Brain Research, 164*, 323–339. https://doi.org/10.1016/S0079-6123(07)64018-7

Hietanen, J., & Yrttimaa, K. (2005). Where a person with a squint is actually looking: Gaze-cued orienting in crossed eyes. *Visual Cognition, 12*, 117–126. https://doi.org/10.1080/13506280444000184

Hietanen, J. K. (1999). Does your gaze direction and head orientation shift my visual attention? *Neuroreport, 10*(16), 3443–3447. https://doi.org/10.1097/00001756-199911080-00033

Hietanen, J. K. (2018). Affective eye contact: An integrative review. *Frontiers in Psychology, 9*, 1587. https://doi.org/10.3389/fpsyg.2018.01587

Hietanen, J. K., & Leppänen, J. M. (2003). Does facial expression affect attention orienting by gaze direction cues? *Journal of Experimental Psychology: Human Perception and Performance, 29*(6), 1228–1243. https://doi.org/10.1037/0096-1523.29.6.1228

Krebs, M. C., Schüler, A., & Scheiter, K. (2019). Just follow my eyes: The influence of model-observer similarity on eye movement modeling examples. *Learning and Instruction, 61*, 126–137. https://doi.org/10.1016/j.learninstruc.2018.10.005

Kuhn, G., & Benson, V. (2007). The influence of eye-gaze and arrow pointing distractor cues on voluntary eye movements. *Perception & Psychophysics, 69*, 966–971. https://doi.org/10.3758/BF03193934

Kuhn, G., Pickering, A., & Cole, G. G. (2016). "Rare" emotive faces and attentional orienting. *Emotion, 16*(1), 1–5. https://doi.org/10.1037/emo0000050

Macrae, C. N., & Cloutier, J. (2009). A matter of design: Priming context and person perception. *Journal of Experimental Social Psychology, 45*(4), 1012–1015. https://doi.org/10.1016/j.jesp.2009.04.021

Malienko, A., Harrar, V., & Khan, A. Z. (2018). Contrasting effects of exogenous cueing on saccades and reaches. *Journal of Vision, 18*(9), 4. https://doi.org/10.1167/18.9.4

McKay, K. T., Grainger, S. A., Coundouris, S. P., Skorich, D. P., Phillips, L. H., & Henry, J. D. (2021). Visual attentional orienting by eye gaze: A meta-analytic review of the gaze-cueing effect. *Psychological Bulletin, 147*(12), 1269–1289. https://doi.org/10.1037/bul0000353

Morillo-Mendez, L., Stower, R., Sleat, A., Schreiter, T., Leite, I., Mozos, O. M., & Schrooten, M. G. (2023). Can the robot "see" what I see? Robot gaze drives attention depending on mental state attribution. *Frontiers in Psychology, 14*, 1215771. https://doi.org/10.3389/fpsyg.2023.1215771

Pavan, G., Dalmaso, M., Galfano, G., & Castelli, L. (2011). Racial group membership is associated to gaze-mediated orienting in Italy. *PLoS One, 6*(10), Article e25608. https://doi.org/10.1371/journal.pone.0025608

Pereira, E. J., Birmingham, E., & Ristic, J. (2022). Infrequent faces bias social attention differently in manual and oculomotor measures. *Attention, Perception, & Psychophysics, 84*(3), 829–842.

Quadflieg, S., Mason, M. F., & Macrae, C. N. (2004). The owl and the pussycat: Gaze cues and visuospatial orienting. *Psychonomic Bulletin & Review, 11*, 826–831. https://doi.org/10.3758/BF03196708

Reid, V. M., Dunn, K., Young, R. J., Amu, J., Donovan, T., & Reissland, N. (2017). The human fetus preferentially engages with face-like visual stimuli. *Current Biology, 27*(12), 1825–1828. https://doi.org/10.1016/j.cub.2017.06.036

Ricciardelli, P., Bricolo, E., Aglioti, S. M., & Chelazzi, L. (2002). My eyes want to look where your eyes are looking: Exploring the tendency to imitate another individuals' gaze. *Neuroreport, 13*, 2259–2264. https://doi.org/10.1097/00001756-200212030-00018

Risko, E. F., Laidlaw, K. E., Freeth, M., Foulsham, T., & Kingstone, A. (2012). Social attention with real versus reel stimuli: Toward an empirical approach to concerns about ecological validity. *Frontiers in Human Neuroscience, 6*, 143. https://doi.org/10.3389/fnhum.2012.00143

Ristic, J., & Kingstone, A. (2005). Taking control of reflexive social attention. *Cognition, 94*(3), B55–B65. https://doi.org/10.1016/j.cognition.2004.04.005

Rossi, A., Parada, F. J., Latinus, M., & Puce, A. (2015). Photographic but not line-drawn faces show early perceptual neural sensitivity to eye gaze direction. *Frontiers in Human Neuroscience, 9*, 185. https://doi.org/10.3389/fnhum.2015.00185

Sagiv, N., & Bentin, S. (2001). Structural encoding of human and schematic faces: Holistic and part-based processes. *Journal of Cognitive Neuroscience, 13*(7), 937–951. https://doi.org/10.1162/089892901753165854

Strohminger, N., Gray, K., Chituc, V., Heffner, J., Schein, C., & Heagins, T. B. (2016). The MR2: A multi-racial, mega-resolution database of facial stimuli. *Behavior Research Methods, 48*(3), 1197–1204. https://doi.org/10.3758/s13428-015-0641-9

Tipples, J. (2005). Orienting to eye gaze and face processing. *Journal of Experimental Psychology: Human Perception and Performance, 31*(5), 843–856. https://doi.org/10.1037/0096-1523.31.5.843

Weisbuch, M., Pauker, K., Adams, R. B., Jr., Lamer, S. A., & Ambady, N. (2017). Race, power, and reflexive gaze following. *Social Cognition, 35*(6), 619–638. https://doi.org/10.1521/soco.2017.35.6.619

Yokoyama, T., Noguchi, Y., & Kita, S. (2012). Attentional shifts by gaze direction in voluntary orienting: Evidence from a microsaccade study. *Experimental Brain Research, 223*, 291–300. https://doi.org/10.1007/s00221-012-3260-z

Zhang, X., Dalmaso, M., Castelli, L., Fiorese, A., Lan, Y., Sun, B., & Galfano, G. (2021). Social attention across borders: A cross-cultural investigation of gaze cueing elicited by same-and other-ethnicity faces. *British Journal of Psychology, 112*(3), 741–762. https://doi.org/10.1111/bjop.12476

Zhang, X., Dalmaso, M., Galfano, G., & Castelli, L. (2023). Tuning social modulations of gaze cueing via contextual factors. *Psychonomic Bulletin & Review, 30*(3), 1004–1010. https://doi.org/10.3758/s13423-022-02211-z

Zhang, X., Zhang, Z., Zhang, Z., Tang, Y., & Liu, W. (2019). The role of the motion cue in the dynamic gaze-cueing effect: A study of the lateralized ERPs. *Neuropsychologia, 124*, 151–160. https://doi.org/10.1016/j.neuropsychologia.2018.12.016