University of Padova

Department of Developmental Psychology and Socialisation

Department of General Psychology

Ph.D. School in Psychological Sciences

XXXIV Cycle

Gaze-driven orienting of attention across cultures

Coordinator: Prof. Giovanni Galfano

Supervisor: Prof. Giovanni Galfano

Co-Supervisor: Prof. Shimin Fu

Ph.D. student : Xinyuan Zhang

CONTENT

Summary

Quickly and correctly receiving and interpreting the information transmitted from the eyes of others is an essential cognitive ability for humans. Studies have shown that observers can automatically shift their attention in the direction signalled by the averted gaze. This thesis focused on the modulatory effect of ethnicity on gaze-driven orienting of attention, particularly under a cross-cultural context.

In Chapter 1, we aim to provide a background introduction to gaze-driven orienting of attention and its social modulators. Next, in Chapter 2, the goal is to explore the modulatory effect of ethnicity on gaze-driven orienting in White and Asian individuals. In particular, five experiments are presented which have been conducted by applying the gaze-cueing paradigm to investigate the influence of faces belonging to different ethnicities on the gaze-cueing effect in Italian and Chinese participants. The results showed that White individuals exhibited a stronger gaze-cueing effect for White rather than Black faces, but they exhibited a similar gaze-cueing effect for White and Asian faces. As for the Asian individuals, they showed a stronger gaze-cueing effect for White (outgroup) rather than Asian (ingroup) faces. It is the first time that an asymmetric gaze-cueing effect was reported in Asian individuals. Thus, in Chapter 3, we report a study in which an eye-tracking technique and the oculomotor interference paradigm were adopted to further investigate this phenomenon. The results from two eye movement experiments revealed a consistent pattern, similar to what we found in the experiments illustrated in Chapter 2, suggesting that the social knowledge activated by the ethnicity of the face (e.g., perceived social status of the different ethnic groups) plays a role in modulating gaze-driven orienting. Finally, in Chapter 4, the influence of masked faces on gaze-cueing

effect in different cultural contexts was investigated through online experiments, due to the COVID-19 pandemic. The results showed that the gaze-cueing effect emerged irrespective of whether masked or unmasked faces were used, in both Italian and Chinese individuals.

Chapter 5 is dedicated to highlighting and summarizing our findings, discussing the limitations of our work, and identifying future routes by using different experimental designs and new techniques with the aim of extending upon the present results.

Chapter 1 Gaze-driven orienting of attention

General Introduction

Every day in our life, the amount of information we constantly receive is so large that it would fully overload our cognitive system if we had to process every single stimulus. Given that human beings have limited capacity in dealing with incoming information, our brain has evolved and developed measures to filter and select the input with greatest importance with respect to our current goals. These psychological and neural mechanisms for selecting and simplifying the complexity of perceptual inputs are collectively termed attention (Yantis, 2000).

In daily life, except for specific situations, we are unlikely to keep our attention on a certain object for long, and we tend to shift it from one object to another, or from one individual to another, instead. For instance, imagine you are a student attending to a course and reading the book in a classroom, suddenly a flash of lightning comes from outside the window. You quickly turn your head (and attention) to look out of the window. In this situation, you are likely to deploy your attention to the stimulus outside the window in an involuntary fashion. Now, imagine that the professor asks everyone to look at the blackboard for reading the key points of the lecture. You will look up and shift your attention from the book to the blackboard. This time, you voluntarily shift attention to your target in a voluntary manner. In the two examples above, the flash of lightning and the voice of the professor are both signals that can drive our attention. These signals trigger two modes of control over attentional orienting, one is the reflexive orienting induced by salient stimuli, the other one is voluntary orienting directed by signals whose meaning needs some degree of interpretation such as symbolic stimuli.

In this vein, orienting of attention can be distinguished as bottom-up (stimulus-driven, reflexive, or exogenous) and top-down (goal-directed, voluntary, or endogenous). Reflexive, exogenous orienting of attention refers to the response to peripherally presented cues (e.g., a brief flash), which can automatically capture attention (e.g., Yantis & Hillstrom, 1994). On the contrary, voluntary, endogenous orienting of attention was thought to be characterized by responses to centrally presented cues (e.g., arrows), which do not directly capture spatial attention but instead require interpretation of spatial information (Posner, 1980). However, attentional behaviour elicited by centrally-presented eye gaze blurred this distinction between bottom-up and top-down orienting. Next, we will introduce why eye gaze can guide attention and the characteristics of gaze-driven orienting of attention.

Face processing

The perception of a person often begins with face processing (e.g., Hugenberg & Wilson, 2013; Zebrowitz, 2017). Eye gaze is always displayed and perceived in the context of a face in the real world. Previous studies have shown that gaze and face processing are strictly interconnected (e.g., Jiang, Blanz, & Rossion, 2011). It has been shown that healthy participants can use gaze direction as a cue to allocate their attention more efficiently when full-face stimuli, rather than only the eye region, are presented (Burra, Kerzel, & Ramon, 2017). In addition, studies employing intact face stimuli have reported cultural differences in face processing. Early studies using eye-movement technique found a systematic pattern in the fixation scanpath, namely the triangular pattern, over the eyes and mouth of the face, suggesting a universal strategy for face processing (Janik, Wellens, Goldberg, & Dell'osso, 1978; Walker-Smith, Gale, & Findlay, 1977). However, this strategy appears to differ as a function of cultural context, with Western participants indeed displaying a triangular pattern, whereas East Asian participants focusing more on the central region of the face (e.g., Blais, Jack, Scheepers, Fiset, & Caldara, 2008). Similar results about cultural differences emerged with respect to other cultural groups (e.g., Chuk, Chan, & Hsiao, 2014; Kelly et al., 2011a), young children (e.g., Kelly et al., 2011b), and inverted faces (e.g., Rodger, Kelly, Blais, & Caldara, 2010). This has been interpreted to reflect the effects of either analytic vs. holistic cognitive styles, or the prevailing social norms in different cultural contexts (e.g., excessive eye contact may be considered rude in East Asian country). Beside the cultural context differences, social information conveyed by and inferred from the face can also exert an influence on face processing. For instance, people tend to look longer to attractive faces as compared to less attractive faces (e.g., Aharon et al., 2001; Leder, Tinio, Fuchs, & Bohrn, 2010). Moreover, high-status or dominant faces are privileged in face processing and more likely capture individuals' attention (e.g., Maner, Dewall, & Gailliot, 2008; Ratcliff, Hugenberg, Shriver, & Bernstein, 2011). Furthermore, face per se conveys a variety of social information, including invariant characteristics, such as identity, gender, race, as well as changeable aspects of faces, such as facial expressions and gaze direction. These two dimensions of the facial features are processed by two distinct streams, according to an influential model of face processing proposed by Bruce and Young (1986). More recently, Haxby, Hoffman, and Gobbini (2000) proposed a distributed model of face processing, suggesting that the neural mechanisms processing invariant and changeable aspects of the face may interact and be interdependent. In addition, social experience, cultural factors, and facial features can exert a complex influence on face processing, and further shape evaluation and perception of the gaze direction. We will elaborate on these influences in more detail below.

Gaze perception and gaze following

Human eyes have gradually formed some simple and obvious morphology in the long evolutionary process, which has a unique physiological significance. Compared with most terrestrial primates, the white sclera has the highest proportion of the exposed tissues of the eyes (Kobayashi & Kohshima, 1997). Because the sclera structure is horizontally stretched, it allows eyes to make the largest movement to expand the horizontal field of vision. This, coupled with the strong colour contrast between the iris and the sclera, makes it very easy to discriminate the gaze direction, not only in a face-to-face situation, but also when the observer stands at a distance from the gazer. This unique morphology of human eyes lays the physiological foundation for quickly identifying the direction of gaze, which, in turn, helps with interpersonal interaction and survival (e.g., detecting potential threats in the surroundings by exploiting spatial information provided by gaze cues).

In addition to the morphology of the eyes that enables us to quickly and easily detect the direction of the gaze, humans have also developed the ability to perceive the gaze direction by processing visual characteristic information such as the luminance, contrast, shape, and colour of the eyes (Teufel, Fletcher, & Davis, 2010). The contrast in the luminance of the various tissues of the eye is an important factor in the perception of gaze. When the contrast of the tissues is reversed (e.g., the sclera changed from white to black, while the iris and pupil changed from black to white), the perception of gaze direction would be reversed (Ricciardelli, Baylis, & Driver, 2000; Sinha, 2000; Tipples, 2005). Moreover, the geometric shape of each tissue of the eye is also an important clue to determine gaze direction. Different studies have shown that even if the differences in luminance between the sclera and the iris were artificially reduced, and only the outlines of a circle and an oval were presented, individuals could still accurately distinguish gaze direction based on the remaining geometric information (Ando, 2002, 2004).

The morphology of the eyes and the perception of gaze allows humans to both convey and receive information about emotions, mental state, focal attention and intentions. This non-verbal interaction and communication is key to social cognition in early life (Striano & Reid, 2006). Young infants show a preference for eyes and gaze stimuli with respect to other information. Researchers have demonstrated that when showing newborn infants (two to five days old) two photographs of faces, one with the eyes open and the other with the eyes closed, the time spent to look at the face with open eyes was significantly longer than that of the faces with eyes closed (Batki, Baron-Cohen, Wheelwright, Connellan, & Ahluwalia, 2000; Farroni, Csibra, Simion, & Johnson, 2002). Young infants also tend to look at faces for much longer in the eye area than in the rest of the face (Maurer, 1985) and to smile less when they notice that other individuals in their environment are not looking at them (Hains & Muir, 1996). Four-month-old infants have also been shown to be able to distinguish between direct and averted gaze, and this finding has been supported by both behavioural and electroencephalography (EEG) studies (Farroni et al., 2002; Farroni, Johnson, & Csibra, 2004a).

Not only are human sensitive to eye gaze from birth, but they also have the ability to shift their attention following the gaze direction of other individuals, for it plays a fundamental role in social cognition and communication. This ability appears very early during development. For instance, studies with newborns and young infants have consistently shown that infants exhibit a rudimentary form of gaze following (Farroni, Johnson, Brockbank, & Simion, 2000; Farroni, Massaccesi, Pividori, & Johnson, 2004b; Hood, Willen, & Driver, 1998). In addition, infants' object processing and attention can be affected by gaze cues (Hoehl, Wahl, & Pauen, 2014; Reid & Striano, 2005; Wahl, Michel, Pauen, & Hoehl, 2013).

Gaze-cueing effect

Based on the special morphological traits and the selective bias in processing the gaze of others, Friesen and Kingstone (1998) adapted the classic spatial cueing paradigm developed by Posner (1980), using schematic faces with an averted gaze as a spatial cue for attention. First, a face with blank eyes appeared in the centre of the screen, then the gaze of the face pointed either leftward or rightward, providing a spatial cue for attention. Finally, a target stimulus appeared (equiprobably) either to the left or to the right of the face. Different tasks were used, requiring participants to manually detect, localize or identify the target by pressing the appropriate response keys.

The gaze cue could be valid, invalid, or neutral. A valid cue referred to the fact that the target appeared at the gazed-at location (spatially congruent trials), while the invalid cue referred to the situation in which the target appeared at the nongazed-at location (spatially incongruent trials). A neutral cue occurred when the gaze was maintained straight. The results showed that even if the participants were instructed that the target location was selected randomly and the face stimulus was irrelevant to the task, participants responded faster on spatially congruent trials than on spatially incongruent trials. Shortly after the study by Friesen and Kingstone (1998), other independent research groups removed the neutral cue and replaced schematic faces with more ecological faces (e.g., pictures of real human faces) and reported consistent and robust gaze-cueing effects (Driver et al., 1999; Hietanen, 1999; Langton & Bruce, 1999).

It has been shown that the gaze-cueing effect can be found with relatively short cue-target Stimulus Onset Asynchrony (e.g., 105 ms, see Friesen & Kingstone, 1998). Further studies found that the gaze-cueing effect occurs independently of the subjective perception of the gaze cue. Sato, Okada, and Toichi (2007) added a mask frame after the gaze cue onset and shortened the presence of the gaze frame so that participants reported that the cue was invisible. The results showed that the gaze cueing effect emerged even in this subliminal condition (see also Xu, Zhang, & Geng, 2011).

The gaze cueing effect is considered a robust and stable phenomenon. Evidence has been reported that the cueing effect still occurred when the paradigm was designed to disentangle bottom-up from top-down mechanism by inserting a top-down goal or by manipulating the expectations of the participants. Driver et al. (1999) manipulated the probability of the target stimuli location matching the direction of gaze. In one experiment, the participants were informed that the target stimuli had an 80% probability of appearing in the location opposite to that signalled by gaze direction. Despite this manipulation, the results showed that the gaze-cueing effect emerged, at least at a short Stimulus Onset Asynchrony (i.e., when the time interval between the onset of the gaze cue and the onset of target was 300 ms). That is, participants responded quicker when the target appeared at gazed-at location, even if this was the least likely location for the target to appear. This, in turn, has been interpreted as indicating that attentional orienting triggered by gaze cues is automatic and difficult to suppress (see also Langton & Bruce, 2000). This pattern has been later replicated using different types of gaze cues (video clips of a person making saccadic gaze shift), in line with the view that gaze can exert attentional cueing effects even when they are counterpredictive with respect to the target location (Langton, Mcintyre, Hancock, & Leder, 2017).

From the abovementioned studies, one would be tempted to conclude that the gaze-cueing effect is to a great extent an automatic phenomenon in that it occurs regardless of the expectations of the participants. Another important criterion for automaticity states that the process under investigation can be considered automatic to the extent that it is not hindered by increasing concurrent information load (Santangelo & Spence, 2008). Following this criterion (also known as the capacity criterion of automaticity), some researchers conducted studies using a dual-task paradigm to investigate the impact of attentional resources allocation on the gaze-cueing effect under different working memory load. The results showed that overloading either verbal working memory or visuospatial working memory did not modulate gaze cueing (Hayward & Ristic, 2013; Law, Langton, & Logie, 2010). Another study used a different demanding task by adopting the Rapid Serial Visual Presentation (RSVP) paradigm. The gaze cueing effect was found even under conditions of high perceptual load, supporting the automaticity and reflexivity of gaze-induced attentional orienting (Xu et al., 2011).

Although attentional shifting triggered by gaze is seen as highly reflexive in nature, some studies argued that there might be a top-down component involved in this process. Ristic and Kingstone (2005) found that only when participants were instructed to perceive an ambiguous stimulus as depicting the gaze of a face, participants showed the gaze-cueing effect. Additional, though indirect, evidence has been reported in neuropsychological studies in which patients with frontal-lobe damage showed an impairment in that the magnitude of attentional orienting induced by gaze cue (Vecera & Rizzo, 2004, 2006). In sharp contrast, these patients had no deficits in orienting attention in response to peripheral uninformative cues. Because this latter type of orienting is often taken as the signature of reflexive orienting and because frontal lesions are known to produce impairments in voluntary action, Vecera and Rizzo (2004, 2006) argued that gaze-cueing reflected voluntary orienting of attention rather than reflexive processing.

The most important issue pointing to the relevance of top-down processing in the gaze-cueing effect, however, is that in classic studies only very impoverished faces stimuli were used. This is very different from what happens in daily life, in which faces are complex stimuli, conveying different types of information. By using more realistic stimuli, researchers have started realizing that gaze-driven orienting of attention cannot be a purely reflexive phenomenon and have focused on different possible modulators of gaze cueing effect (see Dalmaso, Castelli, & Galfano, 2020c for a review). In this regard, some of the most relevant factors are related to the social domain. It is worth noting that three important elements participate in potentially modulating the gaze-cueing effect: the first one is the face providing the gaze cue, the second one is the participant taking part in the experiment, and the third one is the relationship between the first and the second elements.

As for the face providing gaze, we can extract a multitude of social information from fine variations across face, such as age, gender, ethnicity, and emotion (Haxby et al., 2000). These rapid extracted characteristics of a face in turn influence face processing (e.g., Chen, 2014; Ebner, He, Fichtenholtz, McCarthy, & Johnson, 2011). This raises the possibility that the characteristics of the face play a role in modulating the gaze-cueing effect (Emery, 2000). For instance, it has been shown that dominant (masculinized) faces seem to elicit greater gaze cueing than subordinate (femininized) faces (Jones et al., 2010), trustworthy faces elicit greater gaze cueing than untrustworthy faces (Süßenbach & Schönbrodt, 2014), and high-status faces elicit greater gaze cueing effect than low-status faces (Dalmaso, Galfano, Coricelli, & Castelli, 2014; Dalmaso, Pavan, Castelli, & Galfano, 2012). In addition, faces bearing various facial expressions of emotions also exert a modulatory effect on gaze cueing (see Dalmaso et al., 2020c for a review).

As for the participant taking part in the gaze-cueing experiment, individual differences can have a substantial impact on the gaze cueing effect. For instance, females typically show greater gaze cueing effects than males (e.g., Alwall, Johansson, & Hansen, 2010; Cooney, Brady, & Ryan, 2017; Feng et al., 2011), and younger adults show greater gaze cueing effect than older adults (e.g., Slessor et al., 2016). Internal states such as perceived social power or political temperament can modulate gaze cueing effect (e.g., Carraro, Dalmaso, Castelli, & Galfano, 2015; Cui, Zhang, & Geng, 2014; Dodd, Hibbing, & Smith, 2011)

As for the relationship between the face stimulus and the participant, several studies have suggested that whether the participants and the faces providing averted gazes belong to in- or out-groups, plays a role in this modulatory effect. For instance, self-similar faces elicit a larger gaze-cueing effect (e.g., Hungr & Hunt, 2012; Porciello et al., 2014), familiar faces elicit stronger gaze cueing when compared to unfamiliar faces (e.g., Deaner, Shepherd, & Platt, 2007; Frischen & Tipper, 2007). Gaze cueing is also influenced by group membership based on age (e.g., Ciardo, Marino, Actis-Grosso, Rossetti, & Ricciardelli, 2014), political affiliation (e.g., Liuzza et al., 2013), and ethnicity (e.g., Pavan, Dalmaso, Galfano, & Castelli, 2011).

In summary, the social features of face stimuli, participants, and the relationship between the first two can shape gaze-driven orienting of attention. Among these social features, ethnicity is an important one, as it is a relevant characteristic shared by both the face stimuli and the participants. Pavan et al. (2011) conducted a series of experiments using the gaze-cueing paradigm by presenting White and Black faces intermixed across trials. The study reported different patterns of results for White and Black participants. Black participants exhibited a typical gaze cueing effect of similar magnitude for both White and Black faces. In contrast, White participants only exhibited the gaze cueing effect in response to White rather than Black faces. Similar experiments and consistent results were reported in the work of another research group (Weisbuch, Pauker, Adams, Lamer, & Ambady, 2017), revealing that White participants did not exhibit gaze following in response to Black faces. The asymmetric gaze-cueing effect that emerged in White participants remained stable in an eye-tracking study using the oculomotor interference paradigm (Dalmaso, Galfano, & Castelli, 2015b). When the comparison of the face stimuli called into play White vs. Asian faces, White individuals showed typical and similar gaze cueing effect for both groups of faces in a recent study (Strachan, Kirkham, Manssuer, Over, & Tipper, 2017). As far as we know, no such investigation on gaze-driven orienting of attention has been conducted including Asian participants. Additionally, considering the findings in above-mentioned literature, the direction of the modulation on gaze-cueing effect come out differently depending on how the participants perceived the face stimuli belonging to different ethnic group memberships. Thus, we were interested in examining the extent to which ethnicity-based knowledge can modulate gaze-driven orienting of attention in Asian participants. In Chapter 2, we report a series of experiments performed to address this question.

In addition to the gaze-cueing paradigm, which is well acknowledged to assess covert attentional orienting, oculomotor evidence testing overt attentional orienting is also an important side to further understanding gaze cueing and gaze following in different tasks (Ricciardelli, Bricolo, Aglioti, & Chelazzi, 2002). In Chapter 3, we report two eye tracking experiments combined with an oculomotor interference paradigm which were carried out to gain insight about the features and the robustness of the data emerged in the experiments employing a covert orienting paradigm.

As mentioned above, internal states can shape the gaze-cueing effect. On the other hand, internal states can be influenced by the characteristics of the face, not only the characteristics of the face itself but also other features. From 2020, the world witnesses the COVID-19 pandemic, which has brought great changes to our daily life. People have now become familiar with the need of wearing masks to protect themselves from viruses. However, a face wearing a mask may convey different meanings. On the one hand, it could be interpreted as a safety signal (i.e., a person wearing a mask cares about herself/himself but also about others, and is someone that we can safely interact with). On the other hand, a person wearing a facemask may revealing that he or she is sick (and risky to interact with). In Chapter 4, we report a set of online experiments (considering the lockdowns following the pandemic and the obvious safety measures that forced universities to close their laboratories) conducted to investigate how the gaze-cueing effect would be influenced by masked faces in different cultural contexts (i.e., Italy vs. China).

Chapter 2 Covert gaze-driven orienting across cultures

Parts of this chapter have been published in the following article:

Zhang, X., Dalmaso, M., Castelli, L., Fiorese, A., Lan, Y., Sun, B., Fu, S., & 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, 741-762. DOI: 10.1111/BJOP.12476

2.1 Introduction

Humans are sensitive to the eyes of others since birth (Farroni et al., 2002). The eyes are not only a privileged mean for communicating during interaction, but can also convey information about the surrounding environment, such as potential threats or resources (Emery, 2000; Frischen, Bayliss, & Tipper, 2007). Hence, the ability to process information conveyed by the eyes plays an important role in the early stages of individual development and contributes greatly to build up mental maps about our social world (Striano & Reid, 2006). The central role of the eyes for humans is also reflected in the ability to attend and follow the gaze of others, which can also play a role in promoting inferences about the intentions and mental states of others (Capozzi & Ristic, 2018). This perspective is also supported by evidence suggesting that individuals diagnosed with psychopathologies known to be associated to impairments in the social cognition domain can exhibit alterations in their attentional response to gaze stimuli (Akiyama et al., 2008; Caruana et al., 2018; Dalmaso, Galfano, Tarqui, Forti, & Castelli, 2013; Dalmaso et al., 2015a; Dawson, Meltzoff, Osterling, Rinaldi, & Brown, 1998; Kuhn et al., 2010; Langdon, Corner, McLaren, Coltheart, & Ward, 2006; Marotta et al., 2014, 2018).

Since the end of the past millennium, researchers have attempted to explore the attentional orienting response elicited by averted gaze stimuli and developed the so-called gaze-cueing paradigm (see Driver et al., 1999; Friesen & Kingstone, 1998; Hietanen, 1999; Langton & Bruce, 1999). This has proved as an extremely popular paradigm largely because of its flexibility and potential for providing insightful answers in many different fields within psychological science, including social, developmental, and comparative psychology (e.g., Bayliss, Pellegrino, & Tipper., 2005; Carraro et al., 2017; Chen & Zhao, 2015; Ciardo, Ricciardelli, Lugli, Rubichi, & Iani, 2015; Dalmaso, Alessi, Castelli, & Galfano, 2020a; Deaner et al., 2007; Farroni et al., 2004b; Marotta et al., 2014, 2018; Pickron, Fava, & Scott, 2017; Shepherd, 2010).

In this paradigm, the participants are usually asked to manually respond to a target stimulus appearing either leftwards or rightwards with respect to a central face gazing either to the left or to the right. Usually, the target stimulus has the same probability to appear in the location gazed by the face or in the opposite location, leading to spatially congruent and incongruent trials, respectively. Thus, eye gaze can be thought as a task-irrelevant spatial cue. The typical finding emerging from this paradigm is that, irrespective of the specific type of task (e.g., Friesen & Kingstone, 1998), reaction times (RTs) are lower for congruent than for incongruent trials. This pattern, known as gaze-cueing effect, has been interpreted as suggesting that viewing an averted gaze can elicit spontaneous shifts of attention in the same direction. The gaze-cueing effect has been shown to emerge using very short (e.g., 100 ms) stimulus-onset asynchronies (SOAs) between cue and target onset and appears to be relatively long-lasting as compared to the effect exerted by other types of attentional cues (Chica, Martín-Arévalo, Botta, & Lupiáñez, 2014). This has led researchers to conceptualize the gaze-cueing effect as potentially reflecting both stimulus-driven (typically characterized as early rising) and goal-directed (typically characterized as late occurring; see Müller & Rabbitt, 1989) processes. Moreover, there is evidence that the gaze-cueing effect can be observed even under conditions aimed to render eye gaze processing detrimental for the task at hand (e.g., Galfano et al., 2012; Kuhn & Benson, 2007). Although these studies indicate that the gaze-cueing effect is difficult to suppress and hence point to a strong automaticity, evidence is accumulating to suggest that it is also sensitive to social information conveyed by individuals (for a review see Dalmaso et al., 2020c). For instance, Jones et al. (2010) showed that the gaze of dominant (masculinised) faces elicit a stronger gaze-cueing effect than the gaze of subordinate (femininised) faces. Other researchers have focused on the characteristics of the participants such as their age (e.g., Slessor, Phillips, & Bull, 2008), and political temperament (Carraro et al., 2015; Dodd et al., 2011). For instance, Dodd et al. (2011) have shown that liberals exhibit a more pronounced gaze-cueing effect with respect to conservatives.

More interestingly, modulatory effects can be due to the interaction between the characteristics of the face providing the gaze cue and those of the participants. In this regard, the respective membership of the face stimulus and the participant can profoundly shape the gaze-cueing effect depending on whether the face stimulus belongs to an ingroup or an outgroup member. For instance , Liuzza et al. (2011) have shown that the gaze of a political leader can either enhance or reduce gaze cueing in ingroup and outgroup voters respectively (also see Cazzato, Liuzza, Caprara, Macaluso, & Aglioti, 2015; Liuzza et al., 2013; Porciello, Liuzza, Minio-Paluello, Caprara, & Aglioti, 2016).

Another important avenue to investigate the role of ingroup-outgroup dynamics on the gaze-cueing effect is based on ethnicity-defined group membership. In this regard, Pavan et al. (2011) adopted a gaze-cueing paradigm in which White and Black faces were presented to both White and Black participants recruited in Italy. Interestingly, White participants exhibited a gaze-cueing effect only in response to White faces. In contrast, Black participants showed a significant gaze-cueing effect regardless of the ethnicity of the cueing face. A similar pattern has been reported in participants based in the U.S.A. (Weisbuch et al., 2017). This modulatory effect has been observed using short SOAs (i.e., 100-300 ms), whereas it disappeared at a longer SOA (1200 ms), thus suggesting that the ethnicity-based modulation is early rising and short lasting (see also Dalmaso et al., 2015b). Pavan et al. (2011; Experiment 3) also provided evidence showing that this modulation genuinely involved social rather than merely perceptual processes. Indeed, White participants showed a different pattern in response to White and Black faces only when these stimuli were intermixed within the same block of trials rather than blocked. This pattern is consistent with the view that the modulation only occurs when the category membership of the face stimuli is made contextually salient through social comparison. Intriguingly, in both Pavan et al. (2011) and Weisbuch et al. (2017), Black participants exhibited a gaze-cueing effect regardless of the ethnicity of the cueing face. Since the observed modulations did not follow a simple ingroup-bias dynamic, ethnic membership was considered to play a role because of the different social status associated to different ethnic groups (e.g., Miller, Olson, & Fazio, 2004) namely a higher status associated to White rather than Black individuals. Direct evidence supporting this view has been provided by Weisbuch et al. (2017; Experiment 2), who reported that participants primed with a high-status condition were sensitive to the social status of the cueing faces, showing a reliable gaze cueing effect only in response to faces belonging to a high-status group. In contrast, participants primed with a low-status condition were not selective in their attentional response and exhibited a gaze cueing effect to faces belonging to both high- and low-status groups.

So far, research addressing the effects of ethnicity on gaze cueing has almost invariably focused on the White vs. Black comparison. To the best of our knowledge, the only exception is represented by Strachan et al. (2017), who compared responses to White and Asian faces in a gaze-cueing paradigm administered to White participants recruited in the U.K.. Interestingly, White participants exhibited a gaze-cueing effect irrespective of the ethnicity of the faces. Considering the whole picture emerging from the available literature, it seems that White participants exhibit a comparable gaze-cueing effect for White and Asian faces (Strachan et al., 2017), but do not shift their attention following the gaze of Black faces (Dalmaso et al., 2015b; Pavan et al., 2011; Weisbuch et al., 2017)

It is worth noting that Strachan et al. (2017) were not primarily interested in addressing the impact of ethnic group membership on gaze cueing per se, but rather focused on the modulatory effects due to the trustworthiness of the face stimuli. This led them to employ a procedure in which participants were repeatedly exposed to the face stimuli before entering the gaze cueing experiment, with the idea that greater familiarity could also lead to increased perceived trustworthiness. While this manipulation is extremely valuable with respect to the major goal of the study by Strachan et al. (2017), it might be less than ideal for investigating responses toward members of different social groups. Indeed, the manipulation might result in participants' social perception to shift from a category-based mode to an exemplar-based mode. In addition, only White participants were tested, thus preventing the possibility to explore the impact of cultural differences, if any. Finally, Strachan et al. (2017) used a relatively long SOA (500 ms). Hence, one possibility is that the ethnicity of the faces did not affect the gaze-cueing effect in their study, because the activation of ethnicity-related attitudes had decayed by the time the target appeared on screen, given that it was irrelevant for the task at hand. Indeed, there is evidence showing that the modulatory effects of social variables on gaze cueing tend to be short-lasting and are detectable using brief SOAs such as 200 ms (e.g., Dalmaso et al., 2014; Jones et al., 2010) In addition, Strachan et al. (2017) employed a rather demanding task, likely leading to higher RTs which, in turn, might have further contributed to mask the eventual effects (if any) of ethnicity.

The main aim of the present study was to investigate possible modulations driven by ethnicity in White and Asian participants more thoroughly. For this purpose, White and Asian participants were recruited and tested in Italy and China (i.e., in their own countries), respectively. Importantly, the gaze cueing paradigm incorporated in our study included a short SOA and the task was administered in a very different fashion with respect to Strachan et al. (2017) to overcome issues related to shifts, if any, from a category-based mode to an exemplar-based mode when processing faces belonging to different ethnicities. Finally, we also aimed to address gaze-cueing effects driven by Black faces. In Experiment 1, White Italian participants were tested. Finding the same pattern as reported by Strachan et al. (2017) would rule out the possibility that the lack of ethnicity-driven modulation of the gaze-cueing effect for White vs. Asian faces was simply due to procedural rather than social aspects. As for Black faces, our goal was to ascertain the robustness of the pattern reported by (Pavan et al., 2011; Experiment 1), who observed no gaze cueing effect when using Black faces. In Experiment 2, Asian Chinese participants were tested. To the best of our knowledge, no research has so far been conducted comparing gaze-cueing effects elicited by White vs. Asian faces on the one hand, and Black vs. Asian faces on the other hand.

As concerns the White vs. Asian faces comparison, two possibilities are open. The first is that an ingroup bias and the greater familiarity with ingroup individuals drive towards a larger gaze-cueing effect for Asian faces; the other possibility is that, because White people in China are usually represented in a positive way, and are associated to high-status roles (Qian et al., 2016), White faces might trigger an equal or even stronger gaze-cueing effect with respect to that elicited by Asian faces. Finding a diminished (or even null) gaze-cueing effect for Black faces would be consistent with the data reported for White participants, likely reflecting a lower perceived status associated to Black individuals in both cultural contexts. A similar (and significant) gaze-cueing effect for Asian and Black faces, instead, would lend support to the view that ethnicity-based inferences are less central in modulating visual attention in Chinese participants. This latter pattern might reflect an overall tendency in collectivistic cultures to more strongly focus on others' needs and goals (e.g., Cohen, Sasaki, German, & Kim, 2017; Wu & Keysar, 2007).

2.2 Study 1

Experiment 1a

Method

Participants

Forty White Italian participants (28 females, M = 24 years, age range = 21-30 years) from the University of Padova took part in this experiment. Sample size in this and all subsequent experiments was predetermined based on the available studies reporting significant modulations of gaze cueing as a function of ethnicity (Pavan et al., 2011; Weisbuch et al., 2017). All participants had normal or corrected-to-normal vision and received course credits. All of them provided a signed informed consent. The study was approved by the Ethics Committee for psychological research at the University of Padova.

Apparatus and stimuli

The experiment was controlled by E-Prime on a PC equipped with a 17-inch monitor (1024×768 px; 60 Hz) and a standard keyboard. Stimuli were presented on a black background. Twenty-four 3D full-colour faces created with FaceGen 3.1 software were used, sixteen of which (4 Black females, 4 Black males, 4 White females, and 4 White males) were the same as used by Pavan et al. (2011). The other eight faces (4 Asian females and 4 Asian males) were newly created. All faces had the same dimensions (14.4° wide × 16.8° high). Hair and clothes were absent (see Figure 1 for examples). Three different copies were created for each face (i.e., one displaying direct gaze, one displaying gaze averted leftwards, and the other displaying gaze averted rightwards). A pre-test with an independent sample of respondents (21 Chinese and 21 Italian), who did not take part in the main study, showed that both Chinese and Italian observers could perfectly classify gender and ethnicity of all facial stimuli.

Design and procedure

Each experimental session lasted approximately 30 minutes and all participants were tested by a White Italian experimenter. Participants were seated 57cm away from the monitor. Participants completed 2 blocks, one in which White faces appeared intermixed with Black faces, and the other in which White faces were intermixed with Asian faces. Block order was counterbalanced across participants. In both blocks, each trial began with a 900-ms white fixation cross, replaced by a direct-gaze face remaining on the screen for 900 ms. Then, the image of the same face with gaze averted either leftwards or rightwards was presented. Two-hundred ms after the onset of the averted gaze cue, a peripheral target letter (L or T; 24-point Arial Bold font) appeared either 11° leftwards or rightwards with respect to the centre of the screen (see Figure 1). The target remained on screen until a manual response was provided. The participants were instructed to press the “d” key with their left index finger and “k” key with their right index finger depending on the identity of the target letter. Both speed and accuracy were emphasized. Spatially congruent trials refer to the condition in which the target appeared in the location gazed by the face. Spatially incongruent trials refer to the condition in which the target appeared in the opposite location. Congruent and incongruent trials occurred with the same frequency. In total, each participant was administered 256 trials (128 trials in each block), resulting from the combination of gaze direction (left, right) and target location (left, right), presented in random order within each block. Prior to the experiment, participants were warned that gaze direction was not informative as regards the upcoming target location. Participants were instructed to maintain fixation at the centre of the screen throughout a trial.

Results

On average, the participants provided a correct response on 96.89% of trials.

Accuracy has been analysed separately. RTs for correct responses more than three standard deviations above or below the mean of each participant, for each experimental condition, were removed (1.24% of trials). We analysed the data from the two blocks of trials separately. To test the influence of ethnicity on the gaze-cueing effect, we conducted 2 (congruency: congruent vs. incongruent) × 2 (ethnicity: White vs. outgroup) repeated measures ANOVAs on mean RTs for correct responses.

As for the White vs. Black condition, neither congruency nor ethnicity showed significant main effects (congruency: F (1,39) = 1.56, p = .219, η^2_p = .04; ethnicity: F (1,39) = 2.01, p = .156, η^2_p = .05). However, importantly, the interaction between congruency and ethnicity was significant, F (1,39) = 4.45, p = .041, η^2_p = .10. T-test analysis showed a significant gaze-cueing effect in response to White faces, t (1,39) = 2.43, p =.02, d = .55, but not Black faces, t (1,39) = .66, p = .52, d = .15. This pattern mirrors the one emerged in previous research (Pavan et al., 2011), in which White participants shifted attention and covertly followed the gaze of White faces but not Black faces.

As for the White vs. Asian condition, there was a significant main effect of congruency, F (1,39) = 9.32, p = .004, η^2_p = .19, indicating shorter RTs on congruent trials (M = 555 ms, SE = 9) than on incongruent trials (M = 564 ms, SE = 9). Ethnicity led to a non-significant main effect, F (1,39) = 0.06, p = .801, η^2_p = .00. In contrast with the previous condition, the interaction between congruency and ethnicity was not significant, F (1,39) = 0.16, p = .687, η^2_p = .00, suggesting that participants exhibited a similar gaze-cueing effect for both White and Asian faces (see Figure 2).

The same ANOVA was also applied on the percentage of correct responses. In the White vs. Black condition, there were neither significant main effects (congruency: F (1,39) = 0.42, p = .522, η^2_p = .01; ethnicity: F (1,39) = 2.54, p = .119, η^2_p = .06) nor a significant interaction, F (1,39) = 2.74, p = .106, η^2_p = .01. Similarly, in the White vs. Asian condition, there were neither significant main effects (congruency: F (1,39) = 3.34, p = .075, η^2_p = .08; ethnicity: F (1,39) = 2.07, p = .159, η^2_p = .05) nor a significant interaction, F (1,39) = 0.09, p = .770, η^2_p = .00. Thus, the data were unlikely to be affected by any speed-accuracy trade-off.

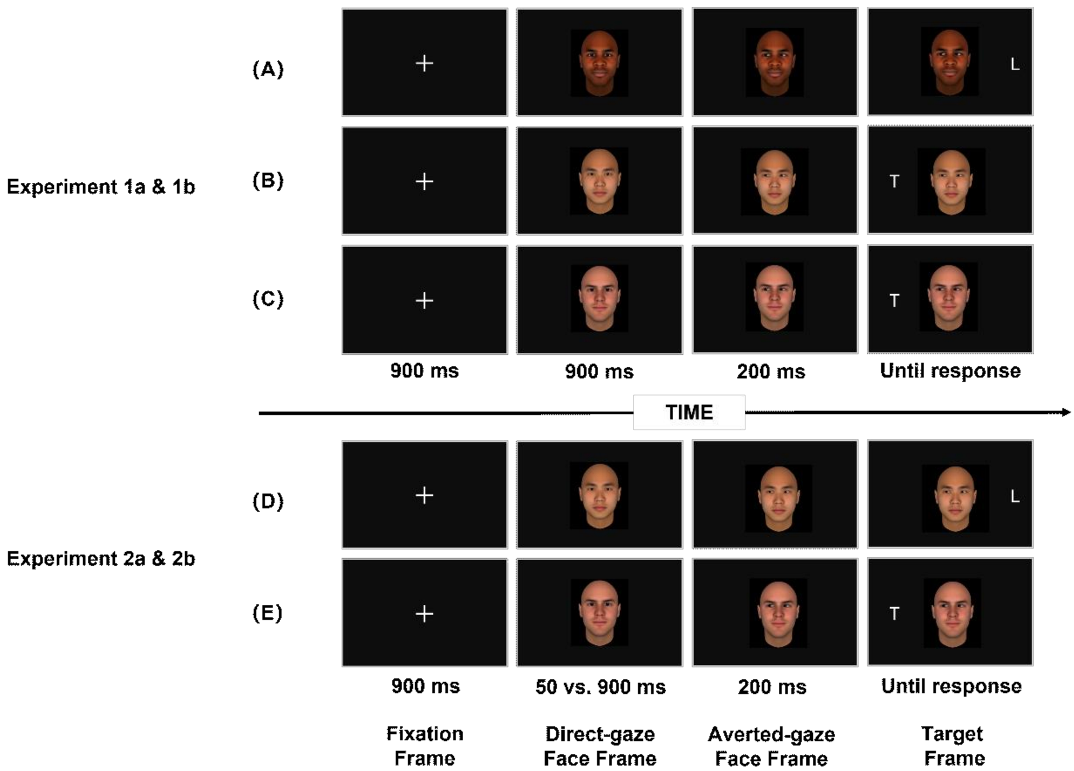

Figure 1. Illustration of experimental procedure and stimuli (not drawn to scale) used in the experiments. The three upper panels refer to Experiments 1a and 1b, in which the direct-gaze face frame lasted 900 ms. Examples of an incongruent trial with a Black face (A), a congruent trial with a White face (B), and a congruent trial with an Asian face (C) are shown. The two lower panels refer to Experiments 2a and 2b, in which the direct-gaze frame lasted either 50 or 900 ms. Examples of an incongruent trial with an Asian face (D), and a congruent trial with a White face (E) are shown.

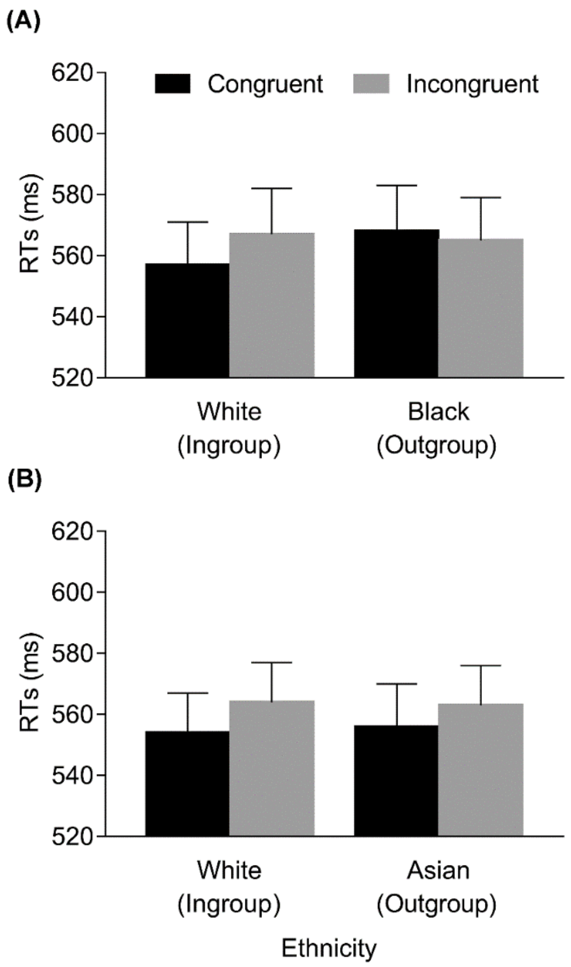

Figure 2. RTs for correct responses as a function of spatial congruency and ethnicity of the faces in Experiment 1a (White participants). Error bars represent standard errors.

Discussion

A robust asymmetrical gaze-cueing effect between White and Black faces emerged among White participants. This pattern is fully consistent with previous studies with White participants conducted in Italy (Dalmaso et al., 2015b; Pavan et al., 2011) and in the United States (Weisbuch et al., 2017). As regards the condition in which the participants were presented with White and Asian faces, no such asymmetry emerged, in line with the results reported by Strachan et al. (2017) in a study involving White British participants. Together, the patterns of gaze cueing-effect that emerged among White individuals, namely, an asymmetrical one in the case of White and Black faces, and a symmetrical one in the case of White and Asian faces, are persistent across different samples from different Western countries.

Experiment 1b

Method

Participants

Forty Chinese participants (34 females, *M* = 20 years, age range = 17-25 years) from Guangzhou University took part in this experiment. All participants had normal or corrected-to-normal vision and received either course credits or 10 RMB. All of them provided a signed informed consent. The study was approved by the Institutional Review Board of the Educational School, Guangzhou University.

Apparatus and stimuli

An apparatus with the same technical features as the one used in Experiment 1a was adopted. Face stimuli were the same as in Experiment 1a (see Figure 1).

Design and procedure

Everything was the same as in Experiment 1a except that one of the experimental blocks consisted of the intermixed presentation of Asian and Black faces, whereas the other consisted of the intermixed presentation of Asian and White faces. Participants were tested by an Asian Chinese experimenter.

Results

Due to an error in the administration of the experiment that emerged after data collection was completed, only data from 34 participants were actually available for the analyses. Data were analysed as in Experiment 1a. On average, the participants provided a correct response on 96.10% of trials. The application of the algorithm for outlier detection resulted in the removal of 1.63% of trials. The data from the two blocks of trials were analysed separately. We conducted 2 (congruency: congruent vs. incongruent) × 2 (ethnicity: Asian vs. outgroup) repeated measures ANOVAs on mean RTs for correct responses.

Both the Asian vs. Black and Asian vs. White conditions only revealed a significant main effect of congruency (Asian vs. Black condition: F (1,33) = 5.25, p = .029, η^2_p = .14; Asian vs. White condition: F (1,33) = 7.44, p = .010, η^2_p = .18), in line with a reliable gaze-cueing effect. The main effect of Ethnicity was not significant (Asian vs. Black condition: F (1,33) = 1.24, p = .274, η^2_p = .04; Asian vs. White condition: F (1,33) = 0.11, p = .746, η^2_p = .00). Importantly, the lack of significant interactions between congruency and ethnicity in both conditions (Asian vs. Black condition: F (1,33) = 0.16, p = .691, η^2_p = .01; Asian vs. White condition: F (1,33) = 1.04, p = .315, η^2_p = .03) suggests that Chinese participants covertly follow the gaze of both ingroup (Asian) and outgroup (White and Black) members (see Figure 3).

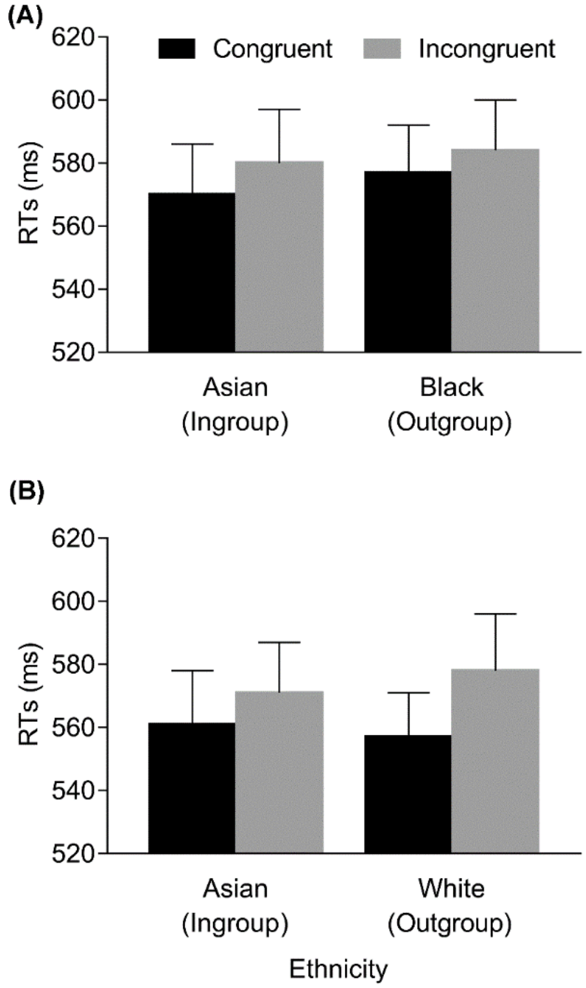

Figure 3. RTs for correct responses as a function of spatial congruency and ethnicity of the faces in Experiment 1b (Asian participants). Error bars represent standard errors.

The same ANOVA was also conducted on the percentage of correct responses. In the Asian vs. Black condition, there were neither significant main effects (Congruency: F (1,33) = 2.13, p = .154, η^2_p = .06; Ethnicity: F (1,33) = 0.39, p = .536, η^2_p = .01) nor a significant interaction, F (1,33) = 0.02, p = .892, η^2_p = .00. In the same vein, in the Asian vs. White condition, there were neither significant main effects (Congruency: F (1,33) = 1.02, p = .320, η^2_p = .03; Ethnicity: F (1,33) = 1.78, p = .192, η^2_p = .05) nor a significant interaction, F (1,33) = 2.36, p = .134, η^2_p = .07. Hence, the data were unlikely to be affected by any speed-accuracy trade-off.

Discussion

Asian participants exhibited a reliable gaze-cueing effect. However, this phenomenon was not further modulated depending on the ethnicity of the faces providing the gaze cue. Because this represents the first evidence stemming from data collected in an Asian country, further empirical work is needed before trying to provide a suitable explanation for the observed pattern of results. In this regard, it is also worth noting that the modulatory effects of social variables on the gaze-cueing effect are known to be extremely sensitive to temporal parameters (e.g., Dalmaso et al., 2014; Jones et al., 2010). Indeed, it has been shown that social modulations decay with time, likely because the knowledge conveyed by the identity and group membership of the face is not task-relevant when a standard gaze-cueing paradigm is used (Dalmaso et al., 2014). Hence, one may hypothesise that participants might activate social knowledge associated to the specific identity and group membership of the face but then this knowledge quickly fades away from working memory. In Experiments 1a and 1b, the participants were presented with a direct gaze frame for 900 ms, and an averted gaze frame for 200 ms, meaning that 1100 ms elapsed before target onset. It is worth noting that the direct gaze frame duration was very long (1000/1500 ms) also in Strachan et al. (2017; Experiment 1). One possibility is that, when considering Asian vs. Black faces, social information is indeed processed by Chinese participants, but this knowledge vanishes earlier with respect to Italian participants. The same might also occur with reference to White vs. Asian faces. To address this issue, Italian (Experiment 2a) and Chinese (Experiment 2b) participants were administered a gaze-cueing paradigm in which presentation time for the direct-gaze face frame was manipulated in order to create a condition in which the same duration used in Experiment 1a and 1b was present (i.e., 900 ms) and a much shorter (50 ms) duration was also included (see Dalmaso et al., 2014 for a similar approach).

Experiment 2a

It is well known that people can categorize faces within milliseconds, and this is assumed to occur with little or no effort (e.g., Bargh, 1997). However, it is likely that activation of stereotypic knowledge associated to ethnicity is subjected to spontaneous decay, when irrelevant for the task at hand (Macrae, Bodenhausen, Milne, Thorn, & Castelli, 1997; Tomelleri & Castelli, 2012). If this is the case, then, this might account for the lack of modulation observed in the previous experiment for Asian faces. Indeed, the use of a long direct gaze frame might have resulted in missing the ethnicity-driven modulation of gaze cueing, in that by the time the target appeared, activation of stereotypic knowledge had vanished. Hence, the inclusion of a short (50 ms) direct gaze frame in the present experiment had the purpose of exploring whether short presentations might result in uncovering modulations as a function of ethnicity. In order to increase the number of observations per participant for each facial ethnicity without increasing the overall length of the experimental session, only Asian and White faces were used.

Method

Participants

A new sample of 40 White Italian participants (35 females, *M* = 23 years, age range = 18-39 years) from the University of Padova took part in this experiment for course credits. All had normal or corrected-to-normal vision and provided a signed informed consent. The study was approved by the Ethics Committee for psychological research at the University of Padova.

Apparatus and stimuli

The apparatus was identical to that used in Experiment 1a. Face stimuli were the same as Experiment 1a, except that Black faces were removed.

Design and procedure

The gaze-cueing paradigm was the same as in Experiment 1a with two exceptions. First, only White and Asian faces were used in each of the two blocks. Second, the direct gaze frame was equally likely to last either 50 ms or 900 ms (see Figure 1). Both ethnicity and direct-gaze frame duration were randomly intermixed within blocks. There were 256 trials in total, resulting from the factorial combination of gaze direction (left, right), direct-gaze frame duration (50 ms, 900 ms), and target location (left, right). Participants were tested by a White Italian experimenter.

Results

On average, the participants provided a correct response on 97.29% of trials. The application of the same algorithm for RT outliers detection used in the previous experiments resulted in the removal of 1.42% of trials. Mean RT data for correct responses were submitted to a 2 (congruency: congruent vs. incongruent) × 2 (ethnicity: White vs. Asian) × 2 (direct-gaze frame duration: 50 vs. 900 ms) repeated measures ANOVA.

A significant gaze-cueing effect emerged, F (1,39) = 19.39, p < .001, η^2_p = .33, with shorter RTs on congruent trials (M = 579 ms, SE = 8) than on incongruent trials (M = 590 ms, SE = 7). Ethnicity also yielded a significant main effect, F (1,39) = 5.13, p = .029, η^2_p = .12, reflecting longer RTs for Asian (M = 589 ms, SE = 8) than for White faces (M = 581 ms, SE = 7). A significant main effect emerged also for Direct-gaze frame duration, F (1,39) = 6.37, p = .016, η^2_p = .14, reflecting longer RTs for the short (M = 589 ms, SE = 7) than for the long duration (M = 580 ms, SE = 8) direct-gaze frame. No significant interactions emerged (congruency × ethnicity, F (1,39) = 2.67, p = .110, η^2_p = .07; congruency × duration interaction, F (1,39) = 1.07, p = .306, η^2_p = .03; ethnicity × duration interaction F (1,39) = 0.01, p = .937, η^2_p = .00; congruency × ethnicity × duration interaction, F (1,39) = 1.18, p = .283, η^2_p = .03; see also Figure 4).

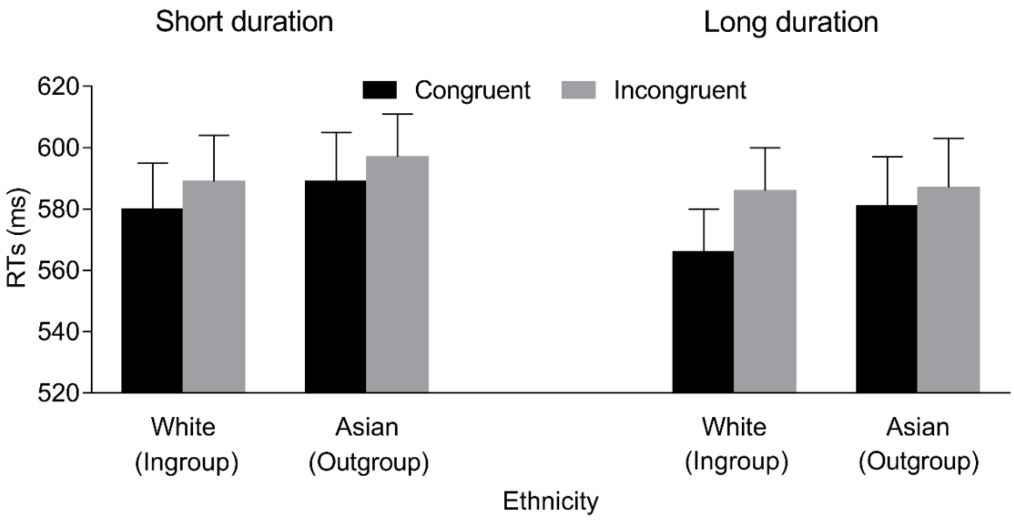

Figure 4. RTs for correct responses as a function of spatial congruency, ethnicity of the faces and duration of the direct-gaze face frame in Experiment 2a (White participants). Error bars represent standard errors.

The same ANOVA was also conducted on the percentage of correct responses. Congruency, F (1,39) = 0.21, p = .651, η^2_p = .01, ethnicity, F (1,39) = 1.48, p = .232, η^2_p =.04, and duration, F (1,39) = 2.22, p = .145, η^2_p = .05 did not yield significant effects. The same held true for the interactions (congruency × ethnicity interaction, F (1,39) = 0.71, p = .404, η^2_p = .02; congruency × duration interaction, F (1,39) = 0.62, p = .436, η^2_p = .02; ethnicity × duration interaction F (1,39) = 0.11, p = .741, η^2_p = .00; congruency × ethnicity × duration interaction, F (1,39) = 3.07, p = .088, η^2_p = .07). Hence, the data were unlikely to be affected by any speed-accuracy trade-off.

Discussion

In this experiment, the ethnicity of the face providing the gaze cue did not affect the gaze-cueing effect. Indeed, the gaze-cueing effect emerged both in the case of

White and Asian faces, and this was true both at the short and at the long direct-gaze frame duration. Overall, these findings confirm those emerged in Experiment 1a.

Experiment 2b

Method

Participants

A new sample of 40 Chinese participants (29 females, M = 20 years, age range = 18-24 years) from Guangzhou University took part in this experiment. They either received course credits or 10 RMB for their participation. All had normal or corrected-to-normal vision and provided a signed informed consent. The study was approved by the Institutional Review Board of the Educational School, Guangzhou University.

Apparatus, stimuli, design, and procedure

Everything was identical to Experiment 2a, except that the participants were tested by an Asian Chinese experimenter.

Results

Due to a problem in the administration of the experiment, that emerged after data collection was completed, only data from 38 participants were available for the analyses. On average, the participants provided a correct response on 96.65% of trials. The application of the same algorithm for RT outliers detection used in the previous experiments resulted in the removal of 1.58% of trials. Mean RT data for correct responses were submitted to a 2 (congruency: congruent vs. incongruent) × 2 (ethnicity: White vs. Asian) × 2 (direct-gaze frame duration: 50 vs. 900 ms) repeated measures ANOVA.

A significant gaze cueing effect emerged, F (1,37) = 20.26, $p < .001$, $\eta^2_p = .35$, with shorter RTs on congruent trials (M = 562 ms, SE = 12) than on incongruent trials (M = 576 ms, SE = 12). Importantly, a significant interaction between congruency and ethnicity was found, F (1,37) = 5.01, $p = .031$, $\eta^2_p = .12$, indicating that participants showed a gaze-cueing effect toward White faces, t (1,37) = 4.67, $p < .001$, d =.82, but not toward Asian faces, t (1,37)=1.22, $p = .230$, d =.22 (see also Figure 5). No other significant results emerged (congruency × duration interaction, F (1,37) = 1.09, $p = .304$, $\eta^2_p = .03$; ethnicity × duration interaction, F (1,37) = 0.45, $p = .506$, $\eta^2_p = .01$; congruency × ethnicity × duration interaction, F (1,37) = 0.84, $p = .367$, $\eta^2_p = .02$).

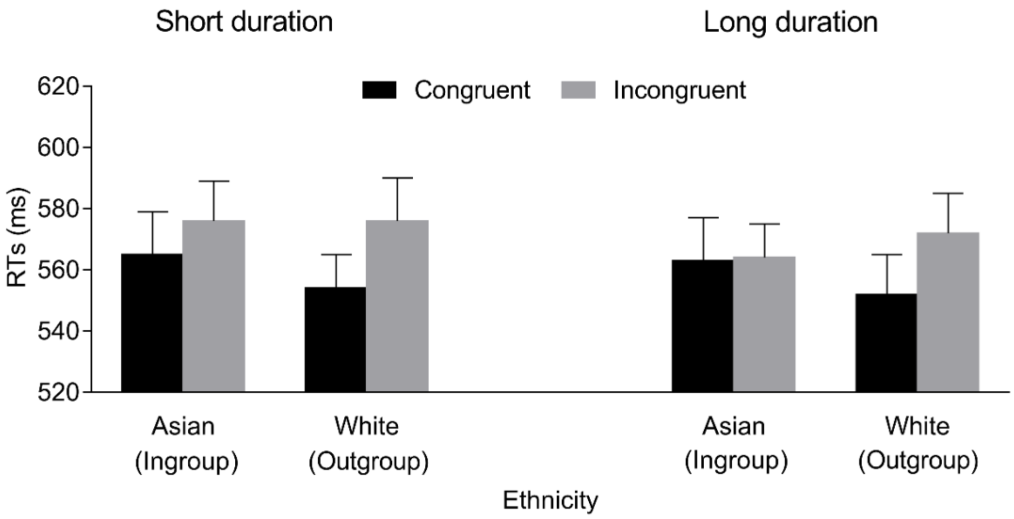

Figure 5. RTs for correct responses as a function of spatial congruency, ethnicity of the faces and duration of the direct-gaze face frame in Experiment 2b (Asian participants). Error bars represent standard errors.

The same ANOVA was also conducted on the percentage of correct responses. Congruency, F (1,37) = 0.10, p = .750, η^2_p = .00, ethnicity: F (1,37) = 3.48, p = .070, η^2_p =.09, and duration, F (1,37) = 0.01, p = .942, η^2_p = .00, did not yield significant effects. The same held true for the interactions (congruency × ethnicity interaction, F (1,37) = 0.63, p = .432, η^2_p = .02; congruency × duration interaction, F (1,37) = 0.58, p = .453, η^2_p = .02; ethnicity × duration interaction, F (1,37) = 0.25, p = .624, η^2_p = .01; congruency × ethnicity × duration interaction, F (1,37) = 0.16, p = .696, η^2_p = .00). Hence, the data were unlikely to be affected by any speed-accuracy trade-off.

Combined analysis of Experiment 1b and 2b

In order to provide a measure of the robustness of the patterns emerged in Experiment 1b and 2b concerning the comparison between White and Asian faces, further analyses were performed. First, even though in Experiment 1b the congruency × ethnicity interaction was not significant, the gaze-cueing effect appeared to be somehow larger in the case of White faces than Asian faces. This was confirmed by a statistical analysis showing that the gaze-cueing effect was significant for White, t (1,33) = 2.21, p = .034, d = .63, but not for Asian faces, t (1,33) = 1.84, p = .074, d = .31. In addition, an exploratory analysis combining the White vs. Asian faces data of Experiment 1b with the long direct-gaze frame duration data of Experiment 2b was conducted. Congruency (congruent vs. incongruent) and ethnicity (White vs. Asian) of the face were included as within-participant factors, whereas experiment (1b vs. 2b) was entered as a between-participant factor in a mixed-design ANOVA. Experiment did not yield a significant main effect nor was involved in any significant interactions (all ps > .432). Intriguingly, there was a main effect of congruency, F (1,70) = 11.78, p

= .001, η^2_p = .144, further qualified by a significant congruency × ethnicity interaction, *F* (1,70) = 5.94, *p* = .017, η^2_p = .08. More specifically, Chinese participants exhibited a significant gaze-cueing effect for White faces, *t* (1,70) = 3.61, $p < .001$, *d* = .65, but not for Asian faces, *t* (1,70) = 1.27, *p* = .209, *d* = .16.

Discussion

The results of Experiment 2b show evidence for a robust gaze-cueing effect for White faces in Chinese participants, and this pattern, namely the fact that outgroup faces (i.e., White faces) elicited a stronger gaze-cueing effect, has been found to be consistent across Experiment 1b and 2b. Moreover, even if the gaze-cueing effect was not statistically significant for Asian faces, mean RTs for congruent and incongruent trials were in the expected direction.

Experiment 3

For what we have found above, Chinese individuals tended to exhibit a stronger gaze-cueing effect in response to the gaze of the White but not the Asian faces. However, this finding holds true under the condition when the comparison of these two ethnic groups were salient (i.e., White and Asian faces were presented in a mixed order). In other words, when faces are presented in an ethnic-blocked condition, the modulatory effect of ethnicity will be expected to disappear (see Pavan et al., 2011). Since there is no possibility to make comparisons among different ethnicities in such context, the manipulated variable, ethnicity, of the face stimuli is no longer salient and hence should not influence gaze-driven orienting. Thus, we assumed that White and

Asian faces presented in separate blocks would elicit a regular and similar gaze-cueing effect in Chinese participants, just as one would expect with schematic faces, in which ethnicity is not manipulated. In this regard, we conducted another experiment recruiting Chinese participants to address the effectiveness of ethnicity on gaze-mediated attentional orientating. Crucially, Asian and White faces were presented in different blocks of trials.

Method

Participants

Forty Chinese participants (32 females, M = 20 years, age range = 17-23 years) from the Guangzhou University. All participants had normal or corrected-to-normal vision and received either course credits or 10 yuan for participating. All of them provided a signed informed consent. The study was approved by the Institutional Review Board of the Educational School, Guangzhou University.

Apparatus and stimuli

An apparatus with the same technical features as the one used in Experiment 2b was adopted. Face stimuli were the same as in Experiment 2b (see Figure 1).

Design and procedure

The gaze-cueing paradigm was the same as in Experiment 2b, except that White and Asian faces were assigned to different two blocks and kept constant within a block. Block order and response keys were counterbalanced across participants.

Results

Data were analysed as in Experiment 2b. On average, the participants provided a correct response on 94.99% of trials. Accuracy data have been analysed separately. The application of the same algorithm for RT outliers detection used in the previous experiments resulted in the removal of 1.39% of trials. The data of mean RT were submitted to a 2 (congruency: congruent vs. incongruent) × 2 (ethnicity: White vs. Asian) × 2 (direct-gaze frame duration: 50 vs. 900 ms) repeated measures ANOVA.

A significant gaze-cueing effect emerged, F (1,39) = 33.67, p < .001, η^2_p = .46, with shorter RTs on congruent trials (M = 608 ms, SE = 15) than on incongruent trials (M = 621 ms, SE = 15). Ethnicity also yielded a significant main effect, F (1,39) = 4.15, p = .048, η^2_p = .10, reflecting an overall quicker response to White (M = 606 ms, SE = 15) than to Asian faces (M = 623 ms, SE = 16). In addition, a significant main effect of Direct-frame duration also emerged, F (1,39) = 4.86, p =.033, η^2_p = .11, reflecting longer RTs for the short (M = 620 ms, SE = 14) than for the long duration (M = 609 ms, SE = 15) direct-gaze frame. As predicted, the interaction between congruency and ethnicity was not significant, F (1,39) = .70, p = .407, η^2_p = .02, indicating that the modulatory effect of ethnicity only emerges when the comparison between different ethnic faces was made salient for participants to recognize the hierarchy behind ethnic memberships (i.e., when the faces were presented intermixed within each block). No other significant effect emerged (Fs < .80, ps > .377; see Figure 6).

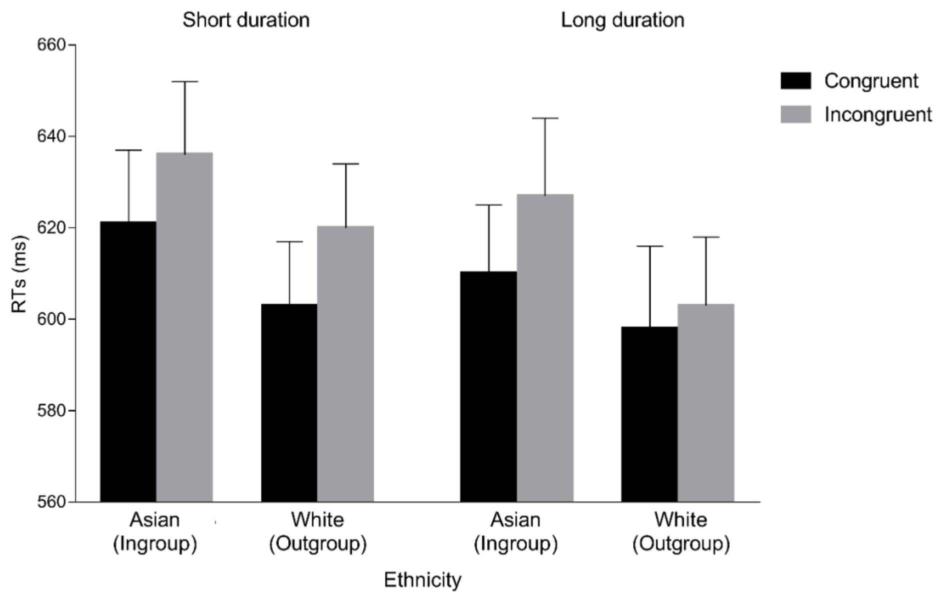

Figure 6. RTs for correct responses as a function of spatial congruency, ethnicity of the faces and duration of the direct-gaze face frame in Experiment 3 (Asian participants). Error bars represent standard errors.

The same ANOVA was applied on the percentage of correct response. A significant main effect of duration emerged, F (1,39) = 5.87, p = .020, η^2_p = .13, reflecting a tendency for the percentage of correct response to be lower at the long duration (M = 94.6%, SE = .56) than at the short duration (M = 95.4%, SE = .39). Congruency, F (1,39) = .37, p = .545, η^2_p = .01, and ethnicity, F (1,39) = .34, p = .562, η^2_p = .01, did not yield significant effects. The same held true for the interactions (congruency × ethnicity interaction, F (1,39) = 3.23, p = .080, η^2_p = .08; congruency × duration, F (1,39) = .00, p = .963, η^2_p = .00; ethnicity × duration, F (1,39) = .34, p = .564, η^2_p = .01; congruency × ethnicity × duration, F (1,39) = .01, p = .914, η^2_p = .00).

Discussion

In line with the study carried out by Pavan et al. (2011), our data here showed that when the contrast between ethnic faces was not salient (because the faces of different ethnicities were presented in different blocks of trials), ethnic membership did not influence the gaze-cueing effect. Thus, the modulatory role of ethnicity on the gaze-cueing effect is linked to perceived or activated social and stereotypic knowledge of the ethnic faces, rather than low-level perceptual features of the face stimuli.

2.3 Discussion

Previous studies have shown that human beings and even other animal species have developed a specific sensitivity to eye signals provided by other individuals for maximizing the benefits of social life (for reviews, see Frischen et al., 2007; Shepherd, 2010). This is well exemplified in the gaze-cueing effect (Driver et al., 1999), a phenomenon which has been interpreted as reflecting an attentional prioritization of gaze stimuli. In recent years, it has been shown that gaze cueing can be further modulated as a function of different social factors related to both the participants and the face stimuli providing the gaze (see Dalmaso et al., 2020c for a review). In this regard, different studies have provided evidence that the gaze-cueing effect can be affected by the interaction between the ethnic membership of the participant and that of the face providing the gaze cue (e.g., Pavan et al., 2011). The present study had three main goals. Firstly, we aimed to replicate the available evidence concerning the differential impact of White and Black faces on the attentional gaze-driven responses of White individuals (Pavan et al., 2011; Weisbuch et al., 2017). Secondly, we aimed to investigate gaze-cueing elicited by Asian faces in White individuals more thoroughly, given the limited available evidence in the literature (Strachan et al., 2017). Third, we aimed to explore for the first time, the impact of faces belonging to different ethnicities (i.e., Asian, Black, and White) on gaze cueing in Asian participants.

As concerns the first goal, Pavan et al. (2011) and Weisbuch et al. (2017)showed that White participants recruited in both Italy and the U.S.A. exhibited a significant gaze-cueing effect when presented with White faces but not with Black faces (also see Dalmaso et al., 2015b for oculomotor evidence). The present data from Experiment 1a further confirm this pattern, showing that White participants tend to selectively shift their covert attention following the gaze of faces depicting White but not Black individuals. As discussed in the introduction section, this effect may reflect the different social status that is associated to White and Black individuals in Western countries. In order to ascertain whether this was indeed the case in the specific social context where the present studies have been conducted, we administered a questionnaire aimed at assessing perceived group status to a new sample of participants extracted from the same student population who participated in the experimental studies. The questionnaire closely followed the one employed by Qian et al. (2016; see Appendix I for details). The results confirmed the presence of a robust difference in the perceived social status of White and Black people, irrespective of whether participants were asked to report their personal beliefs or the expected responses of Italian people in general.

As concerns the second goal, Strachan et al. (2017) have reported no significant modulations of gaze cueing when White participants were presented with White and Asian faces. Based on the idea that activation of social knowledge underlying modulations of gaze cueing can be short-lasting when irrelevant for the task at hand

(Dalmaso et al., 2014; Jones et al., 2010), in Experiment 1a we used an experimental paradigm including a much shorter SOA (200 ms) with respect to the one (500 ms) adopted by Strachan et al. (2017). Yet, the results mirrored those reported by Strachan et al. (2017), further suggesting that the null modulation emerged in their study is unlikely to reflect the effects of the specific procedural aspects adopted in their paradigm. Experiment 1a was conducted to explore the issue of the impact, if any, of temporal parameters in more detail. As anticipated earlier, activation of social knowledge tends to be short-lasting (e.g., Hermans, De Houwer, & Eelen, 2001), and a different way to address this issue is manipulating the duration of the direct-gaze face frame. Experiment 2a was based on this specific approach. The results confirmed the lack of modulation of the gaze cueing effect as a function of ethnicity (Asian vs. White) among White participants, irrespective of the duration of the direct-gaze face frame. This pattern aligns with recent evidence showing that White individuals had similar performance on a working memory task involving White vs. Asian faces (Gregory, Langton, Yoshikawa, & Jackson, 2020). Importantly, responses to the questionnaire aimed at assessing personal beliefs about status differences (see Appendix I) showed no reliable difference when White and Asian people were compared.

As concerns the third goal, when the comparison focused on White vs. Asian faces, Chinese participants displayed a strong and significant gaze-cueing effect only for the outgroup, namely faces belonging to White individuals. This latter pattern was rather consistent across Experiment 1b and 2b. These findings are in line with the scenario according to which this specific asymmetry might reflect the relatively high status associated to White people in China (see also Cheng & Tracy, 2014; Qian et al., 2016). Importantly, Qian et al. (2016) have shown that, in China, White people are perceived as having a higher status as compared to Chinese people. Similar findings emerged from the questionnaire we administered to a sample of Chinese students from the same population who took part in the experimental studies. Indeed, both personal beliefs and the expected responses of Chinese people in general strongly indicated that the outgroup represented by White people is perceived as associated to a higher status than the ingroup (see Appendix I). Although this is an indirect evidence, it suggests that status differences may have played a role in the observed pattern of cueing effects when White and Chinese faces were presented.

Interestingly, Qian et al. (2016) also showed that Chinese people considered their own group as having a higher status with respect to Black people, and this finding was replicated in the data we collected through the questionnaire (see Appendix I). Accordingly, in Experiment 1b, we might have expected Chinese participants to exhibit asymmetries in their gaze cueing response to Black and Asian faces. However, the interaction between ethnicity and congruency was not statistically significant. The presence of a significant gaze cueing effect also for Black faces in Chinese participants might result from the peculiar overall tendency in collectivistic cultures to more strongly focus on others' needs, goals, and internal states (e.g., Cohen et al., 2017). Intriguingly, it can also be the case that a high social economic status leads to different outcomes in different cultures. For instance, a recent study has shown that in East Asian countries a high social economic status is associated to a stronger other-orientation, namely an attention to the interdependence with other individuals (Miyamoto et al., 2018), which, in turn, might affect gaze-cueing effects also in the case of faces belonging to lower status groups. Future research will have to address the robustness of this pattern and more closely focus on the potential impact of perceived social status on gaze cueing in different cultural contexts. The results of the present study suggest that there are indeed context-specific influences in the gaze-cueing effect for faces belonging to different ethnicities, likely due to the structure and meaning of the social hierarchy in that specific cultural context. Overall, it appears that people spontaneously prioritize and more likely follow the gaze of high-status individuals as compared to low-status individuals, either because of their idiosyncratic social role (Dalmaso et al., 2012, 2014) or because of their group membership (Dalmaso et al., 2015b; Pavan et al., 2011; Weisbuch et al., 2017).

The observed sensitivity of gaze cueing to social variables can be interpreted as reflecting a beneficial attentional mechanism. In other words, gaze cueing would be more likely triggered under conditions that can maximize a situational gain (see Dalmaso et al., 2020c). In this sense, the averted gaze of high-status individuals, who are typically more likely to be in leadership positions, might be considered as more informative about potentially interesting objects in the environment. This, in turn, adds to a growing body of evidence showing that gaze cueing is not entirely automatic, in that it does not invariably occur, but can be heavily modulated by social variables (Cohen et al., 2017; Dalmaso et al., 2020c). This influence, however, tends to be particularly strong when social variables are made salient by the specific experimental context (see e.g., Dalmaso et al., 2020a; Pavan et al., 2011; Weisbuch et al., 2017).

In conclusion, the present study consisted of a cross-cultural investigation of gaze cueing of attention elicited by faces belonging to different ethnicities. Our study provides evidence that ethnic group membership modulates gaze cueing of attention in both Western and Eastern countries. More specifically, we document the first evidence of asymmetries driven by group membership among Chinese participants. However, the nature of the modulation was different in the two countries, likely reflecting how the various ethnic groups are perceived in the different cultural contexts. The present findings can stimulate novel insights concerning the interplay between basic attentional mechanisms and social perception processes in a cross-cultural perspective.

Chapter 3 Overt gaze-driven orienting across cultures

Parts of this chapter have been included in the following article:

Zhang, X., Dalmaso, M., Castelli, L., Fu, S., & Galfano, G. (2021). Cross-cultural asymmetries in oculomotor interference elicited by gaze distractors belonging to Asian and White faces. Scientific Reports, 11, 20410. DOI: 10.1038/s41598-021-99954-x.

3.1 Introduction

The averted gaze of another individual is known to provide humans critical information about the environment, such as the presence of potential threats or rewards, and prompt them to react appropriately (Emery, 2000; Frischen et al., 2007). The ability to process eye gaze can also have a crucial role to help deciphering intentions and mental states of others (Capozzi & Ristic, 2018; Colombatto, Chen, & Scholl, 2020). Consistent with this view, a wealth of data has suggested that gaze deviations of others trigger a reflexive orienting of attention in the same direction (Driver et al., 1999; Friesen & Kingstone, 1998; Galfano et al., 2012). This finding has been consistently reported using the so-called gaze-cueing paradigm, in which a face with direct gaze suddenly shifts the eyes either leftwards or rightwards and is followed by a target stimulus randomly appearing either at the gazed-at location or at the opposite location. Irrespective of the specific task, manual performance is typically better when the target appears at the gazed-at location (spatially-congruent trials) than at the nongazed-at location (spatially-incongruent trials), likely as a consequence of the fact that the averted gaze caused a shift of attention in the corresponding direction (e.g., Friesen & Kingstone, 1998). In recent years, evidence has accumulated suggesting that the pushing of attention exerted by an averted gaze is not entirely automatic, in that it is sensitive to different social variables characterizing both the face stimulus and the participants (see Dalmaso et al., 2020c for a review). For instance, a larger gaze-cueing effect has been reported for faces more similar to those of the participants (Hungr & Hunt, 2012; Porciello et al., 2014), for familiar over unfamiliar faces (Deaner et al., 2007), for the faces of politicians of one's own political affiliation (Liuzza et al., 2013), as well as for faces depicting either dominant (Jones et al., 2010) or high-status individuals (Dalmaso et al., 2012, 2014).

In general, the effects of social factors call into play a complex interaction between variables related to the face stimulus and the participants (Ciardo, De Angelis, Marino, Actis-Grosso, & Ricciardelli, 2020; Ciardo et al., 2015). This is particularly evident in the context of ethnic membership, in which basic intergroup dynamics can interact with other social variables such as perceived social status. In this regard, Pavan et al. (2011) tested White and Black participants in a gaze cueing paradigm which included faces of both White and Black individuals. The results showed that Black participants exhibited a similar gaze-cueing effect in response to both White and Black faces, whereas White participants displayed no gaze-cueing effect when exposed to Black faces. This pattern has been later replicated by Weisbuch et al., (2017), who also provided direct evidence that this asymmetry was likely to reflect differences in the social status associated with different ethnic groups, as shown in previous studies (Miller et al., 2004). In this regard, it is worth noting that ethnicity-based status differences may change as a function of the social context in which they are assessed. Indeed, there is evidence that, in China, White individuals are associated with a higher social status as compared to Chinese individuals (Qian et al., 2016; Zhang et al., 2021). On the other hand, in a sample of Italian respondents, no significant differences in perceived status were observed while judging White and

Chinese people (Zhang et al., 2021; see also Appendix I)

Additional evidence supporting the view that the influence of ethnicity on gaze-cueing does not follow a simple ingroup-bias dynamic were well introduced in Chapter 2, in which Italian and Chinese participants were tested in a manual response task, with faces depicting both White and Asian individuals (i.e., faces that could be unambiguously perceived as either Italian or Chinese). In the case of the Italian sample, a reliable gaze-cueing effect was observed irrespective of face ethnicity, and its magnitude was similar for both White and Asian faces. Interestingly, in the case of Chinese participants, the results showed an outgroup-like bias, in that a reliable gaze-cueing effect emerged for White faces, whereas the data suggested the presence of an overall null gaze-cueing effect for Asian faces. This latter result was unexpected in that, in so far, no study addressing the specific effect of ethnicity on gaze cueing has reported such a pattern for faces belonging to one's ingroup (Dalmaso et al., 2020c; Pavan et al., 2011; Weisbuch et al., 2017).

The aim of the present study was to investigate this the peculiar pattern of findings reported in Chapter 2 in more detail, using richer and more sensitive measures of spatial attention, i.e., eye movements, which can provide novel insights underlying eye-gaze processing (e.g., Dalmaso, Castelli, & Galfano, 2017a; Dalmaso, Castelli, Scatturin, & Galfano, 2017b). Importantly, evidence has accumulated indicating that saccadic selection represents a more sensitive measure than manual selection in several visual tasks which directly involve attentional control (Bompas, Hedge, & Sumner, 2017), including spatial cueing paradigms (e.g., Briand, Larrison, & Sereno, 2000; Malienko, Harrar, & Khan, 2018). In recent years, it has been shown that the gaze-cueing effect can be effectively captured by means of experimental paradigms that focus on eye movement dynamics, i.e., more direct, online measures of attentional orienting with respect to manual responses (e.g., Macdonald & Tatler, 2013; Ricciardelli et al., 2002; for a review, see Pfeiffer, Vogeley, & Schilbach, 2013).

Thus, in the present study, we relied on eye movements measures of social attention and adopted the oculomotor interference paradigm developed by Ricciardelli et al. (2002), which has proved to be both robust (e.g., Dalmaso, Castelli, & Galfano, 2020b; Kuhn & Benson, 2007; Kuhn & Kingstone, 2009), and well-suited to uncover social modulations of the gaze-cueing effect (e.g., Ciardo et al., 2014; Dalmaso et al., 2020a; Porciello et al., 2016). In this paradigm, individuals are asked to perform a saccadic eye movement either to the left or to the right according to an instruction cue provided at fixation on every trial. A task-irrelevant central face is presented displaying an averted gaze either looking to the same (spatially-congruent trials) or the opposite location (spatially-incongruent trials) as the instructed saccadic direction. Given that spatially congruent and incongruent trials occur with the same probability, eye gaze direction of the central face represents a distractor stimulus that participants are explicitly instructed to ignore. Notwithstanding, the results typically show that performance is better (in terms of both saccadic latency and accuracy) for spatially-congruent trials than for spatially-incongruent trials. This suggests that, when the instructed saccade has the same spatial vector as the averted gaze, the task is easier with respect to when the instructed saccade and the averted gaze have opposite spatial vectors. Thus, participants seem to be unable to ignore the direction of the task-irrelevant gaze stimulus, which, in turn, gives rise to oculomotor interference (Kuhn & Benson, 2007; Ricciardelli et al., 2002). Interestingly, this paradigm also enables to conduct complementary analyses that provide hints about both the voluntary and reflexive components underlying saccadic programming (Dalmaso et al., 2020a; Kuhn & Benson, 2007; Kuhn & Kingstone, 2009).

Here, the oculomotor interference paradigm was used with faces belonging to different ethnicities, i.e., White and Asian. The first goal was to further investigate the hypothesis that the gaze-cueing effect is stronger in response to White vs. Asian faces in a Chinese sample. As a second major goal, we aimed to more deeply explore whether Chinese participants do not exhibit a gaze-cueing effect when presented with Asian faces (i.e., ingroup faces). Here, using eye-tracking techniques and focusing on eye movement measures, we expected to find some evidence in favour of the idea that also ingroup faces can actually orient spatial attention in a sample of Chinese participants, as evidenced by a significant oculomotor interference effect. In other words, Chinese respondents were expected to exhibit faster saccadic responses on spatially-congruent trials than on spatially-incongruent trials also for ingroup faces.

In addition, in keeping with previous studies (e.g., Dalmaso et al., 2020b; Ricciardelli et al., 2002), we manipulated the Stimulus Onset Asynchrony (SOA) between the onset of the averted gaze and the onset of the instruction cue. At the short SOA, the instruction cue was synchronous to the onset of the averted gaze (i.e., SOA = 0 ms), while at the long SOA, the instruction cue appeared 900 ms after presentation of the averted-gaze face (see Figure 7). This manipulation was aimed at addressing the time-course of oculomotor interference and its possible modulations as a function of the ethnicity of the faces. In this regards, Dalmaso et al. (2015b), who were interested in comparing White and Black faces with White participants, have shown that the gaze of White faces elicits a larger oculomotor interference than that belonging to Black faces, but this difference is only detectable with a short SOA, i.e., when it is likely that social information automatically extracted from faces is still activated and has not decayed yet. To sum up, we expected Asian participants to exhibit an oculomotor interference in response to both White and Asian faces, even though, based on the results reported in Chapter 2, the effect might turn up to be stronger in the former case, likely as a consequence of differences in the perceived social status associated to the two groups. We predicted that this pattern might be specifically present at the short SOA, because at the long SOA social information extracted from the face may be subjected to decay, being irrelevant for the task at hand. A further goal of the present study, addressed in Experiment 4a was to assess whether, in a sample of European individuals, oculomotor interference is present irrespective of the White vs. Asian category membership of the faces, in line with previous studies using manual response paradigms (Strachan et al., 2017; Zhang et al., 2021). In other words, the magnitude of oculomotor interference was expected to be similar regardless of the ethnicity of the face used as stimulus.

3.2 Study 2

Experiment 4a

Method

Participants

Sample size was determined based on previous studies using oculomotor measures that investigated possible modulators of social attention, which used 25-32 participants (e.g., Ciardo et al., 2020, 2014; Dalmaso et al., 2015b; Liuzza et al., 2011). Data collection was stopped at $N = 30$ (*Mean age* = 19.33, *SD* = 1.49, 22 females) for convenience. White Italian students from the University of Padova took part in the experiment. All participants had normal or corrected-to-normal vision and were naïve to the purpose of the experiment. Moreover, eight of them completed the experiment wearing glasses and other three wearing contact lenses. All of them provided a written, signed informed consent. The study was approved by the Ethics Committee for Psychological Research at the University of Padova and was conducted in accordance to the Declaration of Helsinki.

Apparatus and stimuli

Because there is evidence that changes in the experimental setting can differentially affect eye-tracking data as a function of the ethnicity of the participants (Blignaut & Wium, 2014), I supervised data collection in both countries, thus ensuring consistency across experiments. Moreover, both apparatus and stimuli were identical for both Chinese and Italian participants. Specifically, eye movements were recorded monocularly at 1000 Hz with an EyeLink 1000 Plus (SR Research Ltd. Ottawa, Canada) within a room illuminated with neon ceiling lights. Stimuli were presented on a 24-inch monitor with a resolution of 1280 × 1024 pixels and refresh rate of 120 Hz. Participants sat 70 cm from the monitor and their heads were stabled with a chinrest. The experiment was programmed and run in Experiment Builder (SR Research Ltd. Ottawa, Canada). Before the beginning of each experimental session, a five-point (HV5) calibration/validation procedure was completed. The validation procedure was accepted only when the worst point error was smaller than 1.5° and the average error smaller than 1°. The mean worst point and the mean average error in Chinese participants were .72° (SD = .28) and .44° (SD = .23), respectively, while, for Italian participants, they were .71° (SD = .30) and .40 (SD = .19), respectively. Two-tailed independent t-test analyses showed that neither the mean worst point error, $t(58) = .124$, $p = .902$, $d = .032$, nor the mean average error, $t(58) = .819$, $p = .416$, $d = .211$, differed between the two samples, thus indicating that the calibration/validation procedure led to similar outputs in both experiments.

Face stimuli consisted of sixteen 3D full-coloured faces created with FaceGen 3.1 software (4 White females, 4 White males, 4 Asian females, 4 Asian males). For each face, there were three different versions: one with direct gaze, one with left-averted gaze, and one with right-averted gaze. Each face subtended about 14.4° in width and 16.8° in height and was presented over a grey background (RGB = 180, 180, 180).

Design and procedure

Data collection was performed by a White Italian experimenter. Before each trial, participants were required to fixate on a black central dot (0.45° in diameter) for a drift checking procedure. This consisted in the experimenter pressing the spacebar when the participant's fixation was exactly on the central dot. Then, a trial started with a central black fixation dot (0.45° in diameter) flanked by two black placeholders (0.85° of side). The two placeholders were placed 10° leftwards and rightwards, respectively, from the central fixation dot (i.e., the centre of the screen), and at the same height as the fixation dot. Then, a directed-gaze face appeared at the centre of the screen, with the two eyes vertically aligned with the fixation dot. After 1000 ms, the directed-gaze face was replaced by the same face with the gaze averted either leftwards or rightwards. After either a SOA of 0 ms (i.e., simultaneously) or 900 ms, the fixation dot changed to either a "+" or a "×" (0.45° height × 0.45° width), namely the same symbol rotated, or not, by 45°. Participants were instructed to make a saccade towards either the left or the right placeholder as fast and accurate as possible and to ignore the gaze direction of the face since it was task irrelevant. Half of the participants performed a leftwards saccade in response to the "+" symbol and a rightwards in response to the "×" symbol. For the other half of the participants, the directional instructions were reversed. Participants were provided with 1000 ms to perform the requested saccade. Finally, a blank screen appeared for 1500 ms before the next drift checking procedure (see Figure 7). Participants were instructed to perform the task as quickly and correctly as they can and to ignore the central task-irrelevant faces. All participants completed a practice block of 10 trials, followed by two experimental blocks of 128 trials each (i.e., 256 experimental trials in total). The whole experimental session lasted about 45 minutes.

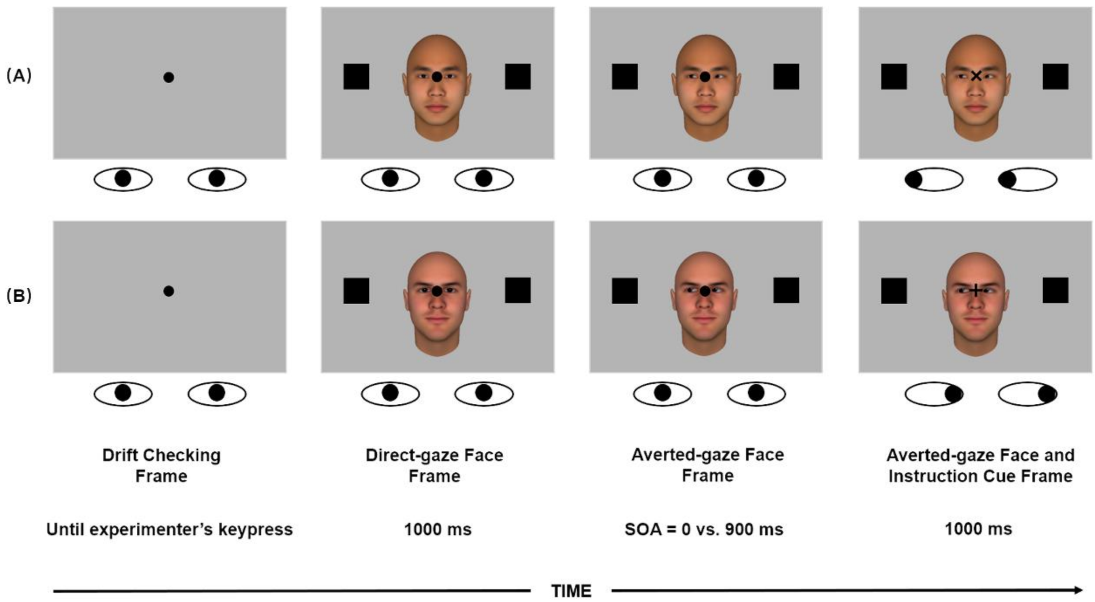

Figure 7. Trial sequence and examples of stimuli: (A) An Asian face distractor in the congruent condition where an "x" indicating a leftward saccade and the central gaze averted to the left; (B) A White face distractor in the incongruent condition where a "+" indicating a rightward saccade and the central gaze averted to the left. Schematic eyes below depict the correct gaze behaviour that participants were instructed to execute.

Results

In order to test the key hypotheses laid down in the introduction, data from the two experiments were first analysed separately. In a second step, given that the experiments relied on the same procedure, a combined analysis was also conducted.

Data handling

Saccades were defined as eye movements exceeding 30°/s in velocity and 8000°/s in acceleration and with a minimum amplitude of 2°. On each trial, the first saccade detected after the onset of the instruction cue was extracted. Then, only saccades which did not contain a blink[1] were analysed, to avoid any potential impact of blinks on the subsequent analyses of saccadic parameters. Saccades made towards the opposite spatial location as that indicated by the instruction cue (i.e., saccadic directional errors) were analysed separately (6.19% of trials). Correct saccades with a

[1] Two types of blinks have been identified, namely blinks performed during a saccadic eye movement and blinks executed prior to a saccadic eye movement. Trials including either type of blinks have been excluded from the analyses. On average, the mean percentage of blinks made within the extracted saccades was 4.62% (SD = 5.68) in the Chinese sample, and 1.30% (SD = 3.12) in the Italian sample. Despite these low percentages, in order to confirm that blinks were not associated with specific experimental conditions, exploratory 2 × 2 × 2 repeated-measures ANOVAs with congruency (spatially congruent vs. incongruent), ethnicity (Asian vs. White), and SOA (0 vs. 900 ms) as within-participant factors was conducted on the mean percentage of blinks in both samples. In Chinese participants, all results were not significant, (Fs < 3.301, ps > .080), including the theoretically-relevant congruency × ethnicity interaction (F = 1.465, p = .236), and the three-way interaction (F < 1, p = .572). The same pattern emerged also in Italian participants, since all results were not significant, (Fs < 2.724, ps > .110), including the theoretically-relevant congruency × ethnicity interaction (F < 1, p = .684), and the three-way interaction (F < 1, p = .549). In addition, a further exploratory ANOVA was performed with the between-participants group factor (Chinese vs. Italian), confirming that none of the interactions including congruency and ethnicity were significant (Fs < 1.629, ps > .207), as well as the four-way interaction (F < 1, p = .755). The only significant result involving the group factor was its main effect, $F(1, 58) = 7.953$, $p = .007$, $\eta^2_p = .002$, indicating that blinks were overall more frequent among Chinese than Italian participants. As for the blinks executed prior to a saccadic eye movement, this kind of trials – in which a blink occurred after the onset of the instruction cue and prior to a correct saccade, these were very rare in both Chinese (0.45% of total trials) and Italian participants (0.22% of total trials), and importantly, were not significantly different across the two groups ($t(58) = -1.45$, p = .15).

latency falling outside the 80-1000ms range, were discarded from the analysis (.04% of trials). Trials in which the instruction cue and the averted gaze of the facial stimulus conveyed the same spatial locations (i.e., right-right or left-left) was classified as congruent trials, the others as incongruent trials. Trials with missing data (i.e., trials in which no saccades were detected) were very rare in both Chinese (1.08% of total trials) and Italian participants (0.07% of total trials) and were not analysed further.

Saccadic latencies

Median saccadic latencies were analysed using the same ANOVA design implemented for Chinese participants. Congruency yielded a significant main effect, $F(1, 29) = 24.453$, $p < .001$, $\eta^2_p = .457$, with shorter latencies on congruent trials (M = 344 ms, SE = 9.56) than on incongruent trials (M = 354 ms, SE = 9.03). The main effect of SOA was also significant, $F(1, 29) = 115.511$, $p < .001$, $\eta^2_p = .799$, with shorter latencies at the 900-ms SOA (M = 329 ms, SE = 8.75) than at the 0-ms SOA (M = 369 ms, SE = 10.04). Ethnicity also yielded a significant main effect, $F(1, 29) = 7.571$, $p = .010$, $\eta^2_p = .207$, with shorter latencies for Asian faces (M = 346 ms, SE = 8.91) than White faces (M = 352 ms, SE = 9.68). The congruency × SOA interaction was significant, $F(1, 29) = 9.687$, $p = .004$, $\eta^2_p = .250$, indicating that the difference between congruent and incongruent trials was greater at the 0-ms SOA, $t(29) = 5.71$, $p < .001$, $d = .980$, than at the 900-ms SOA, $t(29) = 1.78$, $p = .086$, $d = .297$. All the other interactions were non-significant (Fs < 1.836, ps > .186), including the theoretically-relevant congruency × SOA × ethnicity interaction ($F < 1$, $p = .498$). For completeness, two additional ANOVAs, namely one for each level of SOA and with congruency and ethnicity as within-participants factors, were performed. In both ANOVAs, the congruency × ethnicity interaction was not significant (*F*s < 1.99, *p*s >. 169; see also Figure 8 and Table 1).

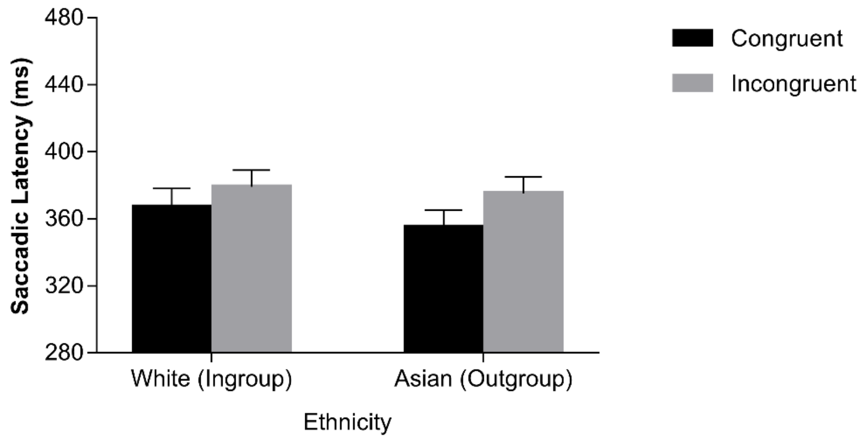

Figure 8. Median saccadic latencies as a function of spatial congruency and face ethnicity in the sample of Italian participants at the 0-ms SOA. Error bars represent Standard Errors.

Saccadic directional errors

An ANOVA with the same factors as that conducted on saccadic latencies was also run on errors. The results showed that, only congruency yielded a significant main effect, $F(1, 29) = 26.678$, $p = .001$, $\eta^2_p = .479$, with fewer errors on congruent trials (*M* = 4.13 %, *SE* = .64) than on incongruent trials (*M* = 8.22 %, *SE* = 1.01). The congruency × SOA interaction was also significant, $F(1, 29) = 10.156$, $p = .003$, $\eta^2_p = .259$, indicating that the difference between congruent and incongruent trials was greater at 0-ms SOA, $t(29) = 5.307$, $p < .001$, $d = .969$, than at 900-ms SOA, $t(29) = 1.684$, $p = .103$, $d = .307$. No other significant results emerged (*F*s < 1.977, *p*s > .170), including the theoretically-relevant congruency × SOA × ethnicity interaction ($F < 1$, $p = .837$; see also Table 1).

Table 1. Median saccadic latencies (sRT), in milliseconds, for correct responses and percentage of errors (%E), for all experimental cells in Italian participants. Standard errors are in brackets. C = congruent trials; I = incongruent trials.

	Italian participants							
	0-ms SOA				**900-ms SOA**			
	White faces		**Asian faces**		**White faces**		**Asian faces**	
	C	**I**	**C**	**I**	**C**	**I**	**C**	**I**
sRT	367	379	355	375	329	333	325	330
	(11)	(10)	(10)	(10)	(10)	(9)	(8)	(9)
%E	3.70	10.38	3.14	9.55	4.56	6.11	5.15	6.83
	(0.80)	(1.41)	(0.74)	(1.32)	(1.10)	(1.06)	(0.83)	(1.46)

Reflexive nature of saccades

Previous studies exploring gaze following behaviour in the oculomotor interference paradigm have shown that saccades performed on spatially incongruent trials have shorter latencies when they are executed erroneously, i.e., following the direction conveyed by the averted-gaze stimulus (i.e., reflexive saccades) as compared to when they are executed correctly, i.e. following the direction conveyed by the instruction cue (i.e., voluntary saccades; see e.g., Dalmaso et al., 2020a; Kuhn & Benson, 2007). A similar pattern of results was expected also in the present context. Moreover, we also explored whether reflexive vs. voluntary saccades were furtherly shaped by the ethnicity of the distracting face. Only 18 Italian participants showed both voluntary and reflexive saccades in all of the experimental conditions. Median latencies of reflexive and voluntary saccadic eye movements executed on incongruent trials were therefore analyzed through a repeated-measures ANOVA with saccade type (reflexive vs. voluntary), SOA (0 vs. 900 ms) and ethnicity (White vs. Asian) as within-participant factors. The main effect of saccade type was significant, $F(1, 17) = 7.496$, $p = .014$, $\eta^2_p = .306$, with shorter latencies associated with reflexive ($M = 325$ ms, $SE = 17.81$) than voluntary ($M = 344$ ms, $SE = 13.10$) saccades. SOA also yielded a significant main effect, $F(1, 17) = 36.548$, $p < .001$, $\eta^2_p = .683$, with shorter latencies at the 900-ms SOA ($M = 310$ ms, $SE = 12.33$), than at the 0-ms SOA ($M = 359$ ms, $SE = 18.60$). Although the saccade type × ethnicity interaction was not statistically significant, $F(1, 17) = 3.146$, $p = .094$, $\eta^2_p = .156$, we further explored each ethnicity through two tailed paired t-tests between reflexive and voluntary conditions. The results indicated that latencies of reflexive saccades were shorter than latencies of voluntary saccades for White faces, $t(17) = 4.600$, $p < .001$, $d = .746$, but not for Asian faces, $t(17) = .580$, $p = .570$, $d = .167$ (see Figure 9). All the other results were non-significant, (Fs < 1.919, ps $> .184$), including the theoretically-relevant three-way interaction ($F = 1.789$, $p = .199$; see also Figure 9 and Table 2).

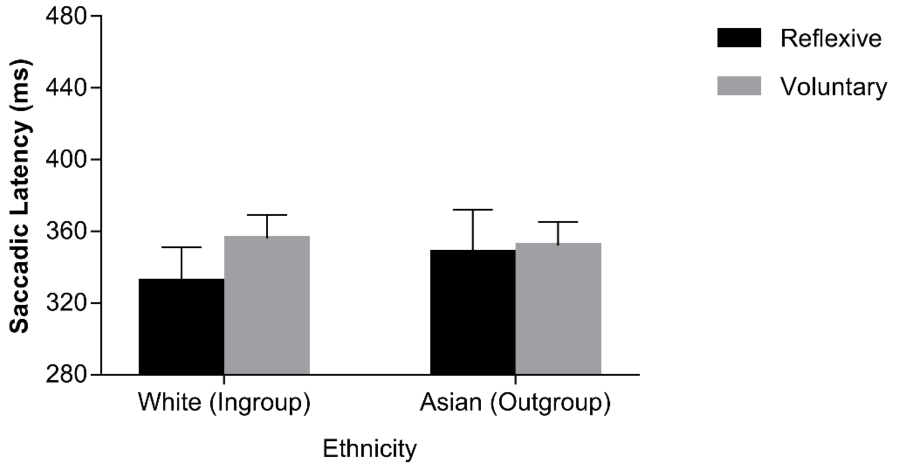

Figure 9. Median saccadic latencies as a function of saccadic type and face ethnicity in the sample of Italian participants. Error bars represent Standard Errors.

Table 2. Median saccadic latencies (sRT), in milliseconds, for reflexive (re) and voluntary (vo) saccades in all experimental cells in Italian participants. Standard errors are in brackets.

	Italian participants							
	0-ms SOA				**900-ms SOA**			
	White faces		**Asian faces**		**White faces**		**Asian faces**	
	re	**vo**	**re**	**vo**	**re**	**vo**	**re**	**vo**
sRT	358	379	376	375	301	333	313	330
	(22)	(13)	(27)	(12)	(12)	(11)	(17)	(12)

Discussion

The distractive gaze of White and Asian faces elicited a comparable oculomotor interference effect in Italian individuals, as reflected in both saccadic latency and accuracy. This evidence from an overt attention task fits well with the findings from the covert attention task reported in Chapter 2, showing that Italian participants exhibit a similar response to the gaze of both ingroup (i.e., White) and outgroup (i.e., Asian) faces. Furthermore, the distracting gaze elicited greater interference when gaze direction and the instruction cue changed simultaneously (i.e., SOA = 0 ms), in line with previous studies (Dalmaso et al., 2015b).

Experiment 4b

In the present experiment, everything was identical to Experiment 4a with the only exception that the sample was composed of Asian Chinese individuals living in China, as well as the experimenter. Overall, we expected to observe 1) a gaze following behaviour and 2) a modulatory effect of racial group membership on gaze following, in line with the results we found reported in Chapter 2. In particular, we expected that the magnitude of gaze following was greater for White than Asian faces, and this was expected in particular at the 0-ms SOA, in line with previous studies indicating that the influence of social variables on social orienting is early rising and then decays with time (e.g., Dalmaso et al., 2015b; Dalmaso et al., 2014; Jones et al., 2010).

Method

Participants

We aimed to recruit the same number of participants as in Experiment 4a. The sample consisted of 30 Chinese participants (*Mean age* = 22.13, *SD* = 3.43, 22 females) from Guangzhou University. All participants had normal or corrected-to-normal vision and were naïve to the purpose of the experiment. Moreover, twenty of them completed the experiment wearing glasses and other four wearing contact lenses. All of them provided a written, signed informed consent. The study was approved by the Ethics Committee for Psychological Research at Guangzhou University.

Apparatus, stimuli, design and procedure

All the things are identical to Experiment 4a.

Results

Data handling

We used an identical measure to handle data as in Experiment 4a. In particular, saccadic directional errors were analysed separately (8.27 % of trials) and correct saccades with a latency falling outside the 80-1000 ms range were discarded from the analyses (.54 % of trials).

Saccadic latencies

A 2 × 2 × 2 repeated-measures ANOVA with congruency (spatially congruent vs. incongruent), ethnicity (Asian vs. White), and SOA (0 vs. 900 ms) as within-participant factors was also conducted on median saccadic latencies. The main effect of congruency was significant, $F(1, 29) = 10.078$, $p = .004$, $\eta^2_p = .258$, with shorter latencies on congruent trials ($M = 402$ ms, $SE = 11.75$) than on incongruent trials ($M = 411$ ms, $SE = 12.13$). SOA also yielded a significant main effect, $F(1, 29) = 151.589$,

$p < .001$, $\eta^2_p = .839$, with shorter latencies at the 900-ms SOA (M = 383 ms, SE = 12.79) than at the 0-ms SOA (M = 430 ms, SE = 11.20). The congruency × SOA interaction was significant, $F(1, 29) = 12.309$, $p = .001$, $\eta^2_p = .298$, indicating that the difference between congruent and incongruent trials was greater at the 0-ms SOA, $t(29) = 4.940$, $p < .001$, $d = 1.017$, than at the 900-ms SOA, $t(29) = .877$, $p = .388$, $d = .198$. Importantly, the congruency × SOA × ethnicity interaction was also significant, $F(1, 29) = 5.631$, $p = .024$, $\eta^2_p = .163$. No other significant results emerged (Fs < 1.345, ps > .256). The three-way interaction was further explored through two additional ANOVAs, one for each level of SOA, with congruency and ethnicity as within-participants factors. As for the 0-ms SOA, the main effect of congruency was significant, $F(1, 29) = 24.399$, $p < .001$, $\eta^2_p = .457$, with shorter latencies on congruent trials (M = 420 ms, SE = 10.78) than on incongruent trials (M = 441 ms, SE = 12.01), while the main effect of ethnicity was non-significant, $F(1, 29) = .035$, $p = .853$, $\eta^2_p = .001$. Importantly, the congruency × ethnicity interaction was significant, $F(1, 29) = 5.392$, $p = .027$, $\eta^2_p = .157$, since the difference between congruent vs. incongruent trials was significant for both White, $t(29) = 5.937$, $p < .001$, $d = 1.211$, and Asian faces, $t(29) = 2.401$, $p = .023$, $d = .593$, but the difference was larger in the former case (29 ms vs. 14 ms). As for the 900-ms SOA, no significant results emerged (Fs < .770, ps > .387; see also Figure 10 and Table 3).

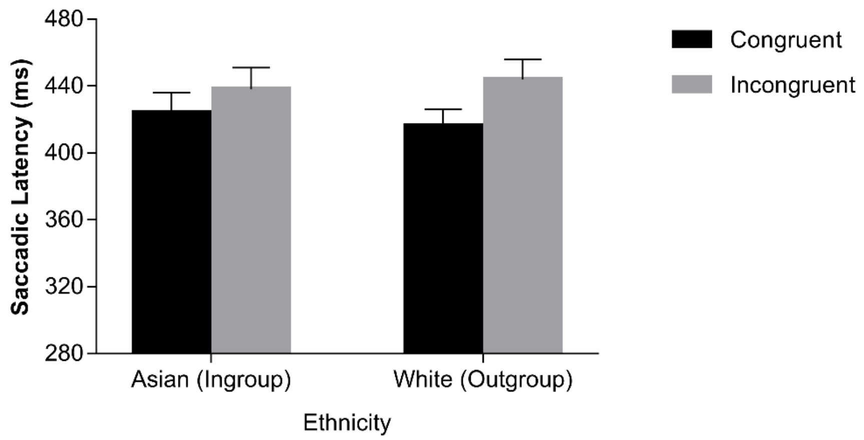

Figure 10. Median saccadic latencies as a function of spatial congruency and face ethnicity in the sample of Chinese participants at the 0-ms SOA. Error bars represent Standard Errors.

Saccadic directional errors

Data were analyzed through the same ANOVA design used in latencies analysis. The results showed that, the main effect of Congruency was significant, $F(1, 29) = 20.313$, $p < .001$, $\eta^2_p = .412$, with fewer errors on congruent trials ($M = 5.54$ %, $SE = .90$) than on incongruent trials ($M = 10.84$ %, $SE = 1.54$). SOA was also yielded a significant main effect, $F(1, 29) = 11.580$, $p = .002$, $\eta^2_p = .285$, with fewer errors at the 900-ms SOA ($M = 6.79$ %, $SE = 1.04$) than at the 0-ms SOA ($M = 9.59$ %, $SE = 1.33$). The congruency × SOA interaction was significant, $F(1, 29) = 29.212$, $p = .003$, $\eta^2_p = .502$, indicating that the difference in accuracy between congruent vs. incongruent trials was greater at 0-ms SOA, $t(29) = 5.286$, $p < .001$, $d = .965$, than at 900-ms SOA, $t(29) = .209$, $p = .836$, $d = .038$. No other significant results emerged (Fs < 1, ps > .392), including the theoretically-relevant congruency × SOA × ethnicity interaction ($F < 1$, $p = .599$; see also Table 3).

Table 3. Median saccadic latencies (sRT), in milliseconds, for correct responses and percentage of errors (%E), for all experimental cells in Chinese participants. Standard errors are in brackets. C = congruent trials; I = incongruent trials.

	Chinese participants							
	0-ms SOA				**900-ms SOA**			
	White faces		**Asian faces**		**White faces**		**Asian faces**	
	C	**I**	**C**	**I**	**C**	**I**	**C**	**I**
sRT	416	444	424	438	386	380	383	382
	(10)	(12)	(12)	(13)	(13)	(12)	(14)	(13)
%E	4.51	14.74	4.24	14.89	7.14	6.45	6.26	7.29
	(0.99)	(2.14)	(0.10)	(2.40)	(1.28)	(1.25)	(1.29)	(1.28)

Reflexive nature of saccades

Similar to the sample of Italian participants, only 18 participants showed both voluntary and reflexive saccade in all of the experimental conditions. Median latencies of reflexive and voluntary saccadic eye movements executed on incongruent trials were therefore analyzed through a repeated-measures ANOVA with saccade type (reflexive vs. voluntary), SOA (0 vs. 900 ms) and ethnicity (Asian vs. White) as within-participant factors. As for the main effects, only ethnicity approached the conventional level of statistical significance, $F(1, 17) = 3.747$, $p = .070$, $\eta^2_p = .181$, reflecting a tendency towards shorter latencies for White faces ($M = 392$ ms, $SE = 16.51$) than for Asian faces ($M = 421$ ms, $SE = 21.02$). Importantly, the saccade type × ethnicity interaction was significant, $F(1, 17) = 5.590$, $p = .030$, $\eta^2_p = .247$, as latencies of reflexive saccades were shorter than latencies of voluntary saccades for White faces, $t(17) = 3.110$, $p = .006$, $d = .603$, but not for Asian faces, $t(17) = -.901$, p

= .380, d = -.263 (see Figure 11). No other sources of variance were significant, (Fs < 3.038, ps > .099), including the theoretically-relevant three-way interaction (F < 1, p = .370; see also Figure 11 and Table 4).

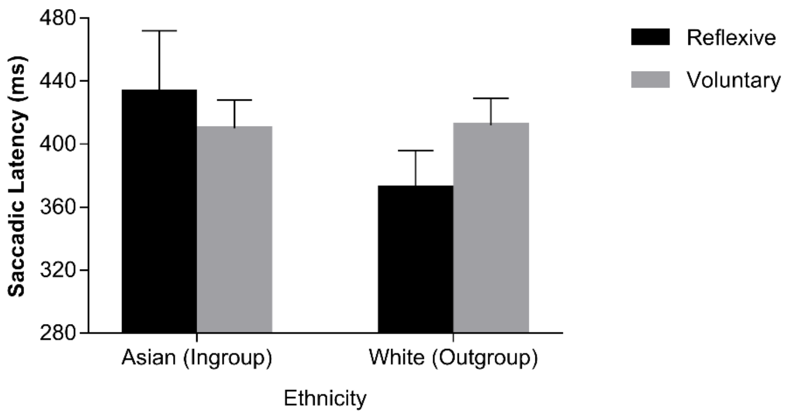

Figure 11. Median saccadic latencies as a function of saccadic type and face ethnicity in the sample of Chinese participants. Error bars represent Standard Errors.

Table 4. Median saccadic latencies (sRT), in milliseconds, for reflexive (re) and voluntary (vo) saccades in all experimental cells in Chinese participants. Standard errors are in brackets.

	Chinese participants							
	0-ms SOA				**900-ms SOA**			
	White faces		**Asian faces**		**White faces**		**Asian faces**	
	re	**vo**	**re**	**vo**	**re**	**vo**	**Re**	**vo**
sRT	393	444	422	438	346	380	446	382
	(23)	(15)	(24)	(17)	(24)	(16)	(51)	(17)

Comparison between Chinese and Italian participants

For completeness, additional analyses were also performed combining the data from the two experiments, in which the between-participants factor group (Chinese vs. Italian) was added to the ANOVAs addressing saccadic latencies, directional errors, and the reflexive nature of saccades. As for saccadic latencies, the main effects of congruency and SOA, and their interaction, were all significant (Fs > 20.461, ps < .001). Moreover, the only significant results involving the group factor were the main effect, $F(1, 58) = 14.65$, $p < .001$, $\eta^2_p = .202$, indicating that Italians were overall faster than Chinese and, more importantly, the congruency × ethnicity × SOA × group interaction, $F(1, 58) = 4.711$, $p = .034$, $\eta^2_p = .075$. In order to better understand the latter pattern, two further ANOVAs were conducted separately for the two SOAs. For the 900-ms SOA, the congruency × ethnicity × group interaction was not significant, $F(1, 58) = .163$, $p = .688$, $\eta^2_p = .003$. In contrast, for the 0-ms SOA, the congruency × ethnicity × group interaction yielded a significant effect, $F(1, 58) = 7.267$, $p = .009$, $\eta^2_p = .111$. Crucially, this latter finding confirmed that at the short SOA, oculomotor interference was modulated by ethnicity in a different way in the two experiments.

As for saccadic directional errors, the main effects of congruency and SOA, and their interaction, were all significant (Fs > 12.108, ps < .001). Moreover, the only significant result involving the group factor was the congruency × SOA × group interaction, $F(1, 58) = 4.748$, $p = .033$, $\eta^2_p = .076$. This reflected a stronger oculomotor interference for Chinese participants at the 0-ms SOA, although this finding was not further qualified by the ethnicity of the faces.

As for the reflexive nature of saccades, the main effects of saccade type, SOA, ethnicity, and the saccade type × ethnicity interaction, were all significant (Fs > 4.811, ps < .035). Moreover, the only significant results involving the group factor were the main effect, $F(1, 34) = 9.81$, $p = .004$, $\eta^2_p = .224$, indicating that Italians were overall faster than Chinese, and the SOA × ethnicity × group interaction, $F(1, 34) = 4.213$, $p = .048$, $\eta^2_p = .110$. The lack of significance for the saccade type × ethnicity × group interaction, $F(1, 34) = 1.864$, $p = .181$, $\eta^2_p = .052$,, suggests the presence of a similar pattern in the two experiments, consisting of lower latencies for reflexive than voluntary saccades for White faces, but not for Asian faces.

Discussion

As for the Chinese participants, the greater interference observed for the gaze of outgroup (i.e., White) than ingroup (i.e., Asian) faces decayed over time, emerging only at the short SOA. This scenario is similar to the pattern reported in an oculomotor study employing Black vs. White faces in Italian participants (Dalmaso et al., 2015b). In general, these findings are consistent with what we have previously reported in Chapter 2, in which the experiments were based on manual responses.

3.3 Discussion

The general goal of the present study was to investigate social attention dynamics in different cross-cultural contexts. By using an oculomotor interference paradigm, we aimed at providing a more refined and robust test of the nature of attentional processing undergone by social cues such as eye gaze of others. According to the picture stemming from studies using covert attention paradigms and manual response tasks, we expected that processing of spatial information conveyed by the gaze of others would result in a different pattern of findings depending on complex interactions related to ethnic membership of both the participants and the face stimulus (Pavan et al., 2011; Weisbuch et al., 2017; Zhang et al., 2021). In particular, we have provided evidence in Chapter 2 that, in Chinese participants, the gaze of ingroup members does not seem to undergo privileged processing leading to enhanced social attention responses. Indeed, the overall pattern picture stemming from the data reported in Chapter 2 seems to suggest a weak-to-null gaze-cueing effect for Asian faces, despite a significant social attention response for averted gaze provided by White faces. Here, we addressed this issue further by using oculomotor measures, that are known to provide a more stable and robust pattern of spatial attention behaviour with respect to manual responses (e.g., Bompas et al., 2017).

Interestingly, oculomotor measures revealed the presence of a significant social attention response in Chinses participants when eye gaze belonged to Asian faces. Moreover, as predicted, Chinese individuals exhibited a greater gaze following behaviour for White faces, as testified by a more pronounced oculomotor interference reflected in both saccadic latencies and reflexive saccades. On the contrary, Italian individuals displayed an overall comparable oculomotor interference effect behaviour for both White and Asian faces. These latter findings are in line with those reported by previous studies (Strachan et al., 2017; Zhang et al., 2021), and extend and confirm this pattern with more direct attentional measures in an oculomotor context. Furthermore, the overall magnitude of oculomotor interference was larger for the 0-ms SOA, i.e., when the instruction cue simultaneously changed with the averted gaze. This result is consistent with previous oculomotor interference studies (e.g., Dalmaso et al., 2015b; Kuhn & Kingstone, 2009) and is likely to reflect that, with a long SOA, participants have more time to process the instruction cue and disregard the task-irrelevant distractor stimulus. In a related vein, at increasing SOAs, modulations as a function of social variables are expected to decrease, as shown in previous studies (Dalmaso et al., 2020c; Dalmaso et al., 2015b; Dalmaso et al., 2014; Jones et al., 2010), since the activated social knowledge is also task-irrelevant, and hence is likely to either spontaneously decay or to be subjected to top-down suppression. Importantly, these outcomes have been also corroborated by additional analyses directly comparing the two experiments.

In sum, the present findings show that Chinese individuals display an outgroup-like bias in gaze following behaviour so that oculomotor interference is stronger for White than for Asian faces. This pattern is not shown by Italian individuals, who seem to exhibit a similar social attention response to White and Asian faces. One possibility is that this asymmetry reflects differences in perceived social status. In particular, there is evidence suggesting that, in China, White people are perceived as having a relatively higher social status (Qian et al., 2016; Zhang et al., 2021). The stronger oculomotor interference elicited by White faces in Chinese participants would then indicate a more robust attentional response to eye-gaze signals conveyed by faces belonging to individuals with a relatively higher social status.

Importantly, the lack of difference in oculomotor interference displayed by Italian participants in response to White and Asian faces is unlikely to reflect insensitivity to the ethnic membership. Indeed, previous data showed that ethnicity modulates social attention when the focus is on a White vs. Black face comparison. Notably, this finding has been demonstrated both in studies using covert attention paradigms (Pavan et al., 2011; Zhang et al., 2021) and in studies using the oculomotor interference paradigm (Dalmaso et al., 2015b). The present results are in line with previous studies confirming that Western individuals exhibit a similar social attention behaviour to White and Asian faces (Strachan et al., 2017; Zhang et al., 2021). This, in turn, may suggest that Asian and White individuals may be associated with a rather similar social status at least in the Western countries where the few available studies have been carried out. Alternative predictions based on different factors such as low-level perceptual properties of the face stimuli (i.e., generalized stronger oculomotor interference for faces belonging to a specific ethnicity) or perceptual familiarity (i.e., stronger oculomotor interference for ingroup faces) would not be consistent with the observed pattern of findings. Indeed, as concerns low-level factors (differences in the perceptual features of the faces belonging to the two ethnic groups), these were also safely ruled out based on the consideration that, if present, these factors should predict symmetric effects. For instance, if White (or Asian) faces have some specific and unique perceptual features, then a stronger oculomotor interference for White (or Asian) faces should be expected irrespective of the respondents' group membership. Our data are not consistent with this possibility since they evidence a stronger oculomotor interference for one face type but only in a specific group of respondents (i.e., we found an asymmetric effect). As concerns familiarity, it has been shown using a manual response task, that gaze cueing is stronger for familiar faces (Deaner et al., 2007). Given that facial familiarity develops with repeated experience (e.g., Clutterbuck & Johnston, 2002; Osborne & Stevenage, 2007), studies on face familiarity generally used photos of friends, family members, or colleagues, or through a large number of repetitive presentations of a face identity to increase familiarity. In the current study, the face stimuli were generated by using the FaceGen software and they were reasonably all unknown to the participants. Furthermore, the number of times each face identity was presented in the experiment was the same. In this vein, we can assume that in-group faces should be more familiar to participants. Hence, if familiarity were involved, this should result, if anything, in a stronger oculomotor interference for Asian faces in Chinese participants. This was clearly not the case. Hence, the social meaning of ethnicity in a given cultural context is likely to be one key factor modulating the oculomotor interference effect in the present study.

Ethnicity is a powerful determinant of how members of societies perceive others and perceived social status is one of its manifestations (Dupree, Torrez, Obioha, & Fiske, 2021). Individuals make relatively stable evaluations of the social status of one's own and other ethnic groups. Thus, when viewing a face belonging to a specific ethnicity, perceived social status is likely to be quickly activated (Mattan, Kubota, & Cloutier, 2017). Sensitivity to the social status of individuals seems to be a relevant trait in human nature that appears early during development (Mandalaywala, Tai, & Rhodes, 2020). As regards social attention, it has been shown that observers tend to be more sensitive to the gaze of faces belonging to individuals being higher in the social hierarchy (Capozzi & Ristic, 2018; Dalmaso et al., 2014, 2012). Thus, one possibility is that perceived social status acted as a major determinant in shaping the present pattern of findings (Cheng & Tracy, 2014; Qian et al., 2016; Zhang et al., 2021). This interpretation, however, needs to be taken with caution in that perceived group status differences were not assessed in the current study and status is also a multifaceted notion with several antecedents (e.g., dominance, prestige) and correlates (Mattan et al., 2017). Future studies will possibly assess and/or manipulate social status perception to further clarify its possible role in shaping the oculomotor interference effect.

An emerging literature has addressed the role of cultural differences in visuo-spatial attentional mechanisms involved in face processing (Caldara, 2017). In this regard, previous studies have consistently shown that Western and Eastern individuals tend to explore faces in a different manner. More specifically, Western individuals are more focused on the mouth region, whereas Eastern individuals tend to look more over the eyes and central parts of the face (Haensel et al., 2020a; Senju et al., 2013). Interestingly, however, a recent study (Haensel, Ishikawa, Itakura, Smith, & Senju, 2020b) employing a free-viewing paradigm with faces of different ethnicity reported no significant interactions of face ethnicity (Asian vs. White) with ethnicity of the participants (Japanese vs. British). This, in turn, does not favor the view according to which the present findings simply reflect basic differences in face scanning between Eastern and Western individuals. More in general, differences in overall performance in attentional tasks between Asian and Western participants have been documented in previous studies. In particular, Asian participants have been reported to respond more slowly than Western participants. This finding, however, has been interpreted as reflecting response biases rather than attentional differences driven by cultures (Boduroglu, Shah, & Nisbett, 2009; Lawrence, Edwards, Chan, Cox, & Goodhew, 2019). In our data we observed a similar pattern, but this can hardly be interpreted as the driving factor underlying how individuals belonging to the two cultural groups differently respond to White and Asian faces. In sum, although cultural differences in visual exploration are robust and important as a general factor, the available evidence does not seem to support a specific role in influencing the modulation of gaze-driven attentional and oculomotor responses as a function of the ethnicity of face stimuli.

In conclusion, our study provides support for the view that social attention can be influenced by social variables and that major differences can arise depending on the socio-cultural context. The current results both corroborate and enrich previous evidence, confirming that the oculomotor interference paradigm employed here is a well-suited instrument to reveal social modulations of social attention behaviour.

Chapter 4 Gaze cueing and face masks across cultures

Parts of this chapter have been included in the following article:

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, 1-16. DOI: 10.1177/20416695211058480

4.1 Introduction

From the COVID-19 outbreak onwards, face mask has been introduced by governments worldwide as a protective gear to stop the spread of the virus (e.g., Cheng et al., 2020; Eikenberry et al., 2020). From a practical perspective, wearing a face mask is aimed at preventing salivary particles from being transmitted by air from one individual to another, thus reducing the possibility of a potential contagion (e.g., Liang et al., 2020; van der Sande, Teunis, & Sabel, 2008). However, despite the fundamental role of face masks in promoting public health, it is undoubted that they can also interfere with interpersonal relations to a large extent. In particular, by occluding a relatively large part of the face, the presence of a face mask prevents an observer from properly perceiving and processing a number of information coming from others.

From a psychological perspective, faces have a profound impact on a variety of cognitive mechanisms supporting social interaction. For instance, from the unchangeable features of others' face we can acquire information concerning their age, gender, and, more in general, identity (Haxby et al., 2000). Similarly, facial expressions can be used to infer others' feelings and mental states (Adams, Ambady, Macrae, & Kleck, 2006). Moreover, eye gaze direction of others allows us to infer where they are attending to, thus allowing us to orient our own attention towards the same spatial location (for reviews, see Capozzi & Ristic, 2018; Dalmaso et al., 2020c; Frischen et al., 2007). For these reasons, it is highly likely that wearing a face mask during social interactions could reasonably interfere with specific mechanisms involved in face processing. Supporting evidence to this notion comes from a few recent studies showing reduction in both identity recognition (e.g., Freud, Stajduhar, Rosenbaum, Avidan, & Ganel, 2020; Noyes, Davis, Petrov, Gray, & Ritchie, 2021; for other related evidence see also Giovanelli, Valzolgher, Gessa, Todeschini, & Pavani, 2021) and emotion recognition (Carbon, 2020; Marini, Ansani, Paglieri, Caruana, & Viola, 2021; Nestor, Fischer, & Arnold, 2020; Parada-Fernández, Herrero-Fernández, Jorge, & Comesaña, 2022) of faces wearing a face mask. However – to the best of our knowledge – so far, no studies investigated the potential impact of face masks on social attention. The present work aims at filling this gap.

As well introduced in the previous chapters, social attention has been widely studied by adopting the so-called gaze cueing paradigm (e.g., Driver et al., 1999; Friesen & Kingstone, 1998). Depending on different aims, the faces in the paradigm can be real person's faces, schematic faces, or emotional faces. Here, a gaze cueing task was adopted in which the face providing the gaze cue belonged to an individual who could either wear a face mask or not, in order to reveal the potential impact of this protective gear on social attention abilities. In this regard, it is worth noting that some previous studies (e.g., Akiyama et al., 2008; Hayward & Ristic, 2015; Kingstone, Friesen, & Gazzaniga, 2000; Slessor et al., 2016) reported a reliable gaze cueing effect even when participants were presented with just two eye gaze stimuli in isolation, rather than embedded within a whole face stimulus – an approach that closely resembles the perceptual condition associated with a face wearing a mask, for which the eyes are the only visible part. Furthermore, Quadflieg, Mason, and Macrae (2004) reported a reliable gaze cueing effect also when eye gaze stimuli were embedded in schematic animal faces (e.g., a tiger or a monkey) or in inanimate schematic non facial stimuli (i.e., an apple or a glove). Importantly, this effect was similar in magnitude to the gaze cueing effect emerging from a schematic human face. Taken together, these results seem to suggest that gaze cueing of attention can be elicited without necessarily presenting participants with a whole human face and therefore a reliable gaze cueing effect should reasonably emerge even for faces wearing a face mask. Nevertheless, it is also important to note that all the above studies either used artificial, schematic stimuli (i.e., drawings) or stimuli extracted from pictures of real faces (i.e., the eye region) that, however, were presented in highly impoverished contexts that do not resemble real life situations. In addition, it is worth remarking that, in recent years, a great bulk of studies clearly showed that both individual characteristics and contextual factors can deeply shape social attention when more ecological stimuli are used instead (Dalmaso et al., 2020c). Of particular relevance for the present work, individual levels of fearfulness (Tipples, 2006), threatening contexts (Ohlsen, van Zoest, & van Vugt, 2013) or faces associated with or communicating a potential threat (Chen & Zhao, 2015; Kuhn, Pickering, & Cole, 2015; Kuhn & Tipples, 2011) are all known to potentiate the gaze cueing effect, likely reflecting an increased monitoring of the surrounding environment possibly aimed at implementing defensive behaviours. For this reason, on the one hand, in a context characterised by an aggressive and dangerous airborne disease – such as the COVID-19 – an enhanced gaze cueing could be expected in response to individuals not wearing a face mask, since these could be perceived as a possible source of contagion. Importantly, the fear of contagion can be triggered also by using pictorial stimuli presented on a computer monitor (e.g., Schaller, Miller, Gervais, Yager, & Chen, 2010). However, on the other hand, a recent study (Olivera-La Rosa, Chuquichambi, & Ingram, 2020) has also shown that individuals wearing a face mask can be perceived as more likely to be sick – but also more trustworthy, a characteristic that can boost gaze cueing (see, e.g., Süßenbach & Schönbrodt, 2014) – and therefore it cannot be excluded that an enhanced gaze cueing could instead emerge for faces wearing a face mask. These two competing hypotheses were tested in the present study. Self-reported measures of objective habits and subjective viewpoints towards face mask usage and the perception of infection risk were also collected, in order to explore any potential link between individual attitudes and gaze cueing. In addition, we also assessed whether the impact of face mask on gaze cueing may vary in different cultural backgrounds. More specifically, the gaze cueing task we devised was delivered to both a sample of European individuals (i.e., Italians) living in a European country (i.e., Italy) and to a sample of Asian individuals (i.e., Chinese) living in an Asian country (i.e., China). Indeed, while in Western countries, before the COVID-19 emergency, the use of face masks in everyday life was extremely uncommon, this cannot be said for several Eastern countries – and especially for China – in which, after the SARS outbreak of 2003, individuals are more generally inclined to wear a mask for a variety of reasons related to health, such as reducing the spread of common cold in public places (e.g., Meng et al., 2021; Nie, Duan, Wang, Zhao, & Huang, 2015; see also Sin, 2016). On this basis, we also explored whether the possible difference in gaze cueing magnitude elicited by faces wearing a mask or not – if any – could be further shaped by cultural context.

To sum up, in the present study, we conducted two experiments based on a gaze cueing task in which averted gaze faces, either wearing a face mask or not, were employed as cueing stimuli. The gaze cueing task was delivered to a sample of Italian individuals living in Italy (Experiment 5a) and to a sample of Chinese individuals living in China (Experiment 5b). Because ethnic membership can deeply shape gaze cueing (e.g., Dalmaso et al., 2015b; Weisbuch et al., 2017; Zhang et al., 2021), in both Experiments participants were presented with faces belonging to their own ethnic group. Self-reported measures assessing COVID-related habits and perceptions were also collected. In so doing, we explored the potential impact of face mask on social attention under different perspectives.

4.2 Study 3

Experiment 5a

Methods

Participants

Data were collected from October 23rd, 2020 until November 7th, 2020, during the second wave of the pandemic in Italy, which took place in the fall period. In particular, during the time window in which data were collected, the new daily cases of COVID-19 in Italy increased from 19.143 to 39.809, according to the COVID-19 data repository by Dong, Du and Gardner (2020).

The sample was composed of 46 Italian students at the University of Padova, Italy, who took part on a voluntary basis. Based on previous studies in which a whole face vs. eyes were visible (e.g., Hayward & Ristic, 2015; Quadflieg et al., 2004; Slessor et al., 2016), we aimed at collecting data from about 40 participants. Data collection was stopped, for convenience, at N = 46 (*Mean age* = 21.35 years, *SD* =

6.12, 11 males). Before the experiment, participants were asked to read an informed consent, which was provided by pressing a specific keyboard key. The project was conducted in line with the Declaration of Helsinki, and it was approved by the Ethics Committee for Psychological Research at the University of Padova.

Stimuli and procedure

Facial stimuli consisted of high resolution faces (300 px width × 450 px height), depicting two White males and two White females with neutral expression, extracted from the MR2 database (Strohminger et al., 2016). For each identity, there was the original stimulus with direct gaze and two new stimuli of the same face with gaze averted both leftwards and rightwards. Moreover, we also created, for each of these three stimuli, three additional new faces wearing a face mask. Hence, for each facial identity, there were six different versions in total. All stimuli were presented in full colour against a white background. The experiment was created with PsychoPy software and administered online by using Pavlovia, which allow to collect precise and reliable behavioural data across different operating systems and web browsers (see also Bridges, Pitiot, MacAskill, & Peirce, 2020). At the beginning of the experiment, the software randomly selected which individuals (one male and one female), among the four different identities, would be systematically presented to a given participant as either wearing a mask or not.

In the gaze cueing task (please see Figure 12), each trial started with a black fixation cross (0.1 normalized units) presented at the centre of the screen for 500 ms. Then, a central face with the gaze directed to the participant appeared for 900 ms. The image was then replaced by a frame with the same face presenting leftward or rightward averted gaze. After either 200 ms or 700 ms (SOA), a black target line (40 px width × 12 px height) appeared either leftwards or rightwards (± 0.8 normalized units with respect to the centre of the screen) until a manual response was provided, or until timeout (2000 ms). Two different SOAs were employed in order to explore the time-course of any possible modulations of gaze cueing as a function of the mask condition. The target line could be oriented either horizontally or vertically. Participants were asked to look at the centre of the screen for the whole duration of the trial and to discriminate, as fast and accurate as possible, the orientation of the target line by using two response keys (“f” or “k” key) on the keyboard. The response mapping between line orientation and keys was randomly selected across participants. Participants were also instructed to ignore gaze direction of the facial stimulus since it was not informative about the location of the upcoming target (i.e., the target had the same probability to occur at either the gazed or the non-gazed at location). Trials associated with either a wrong or a missed response were signalled through a visual feedback (i.e., the words “NO” or “TOO SLOW”, respectively; Arial font, 0.1 normalized units) provided at the centre of the screen for 500 ms, and they were not replaced by additional trials.

There was a practice block, composed of 10 trials, followed by two experimental blocks, each composed of 128 trials. In so doing, each participant completed 256 experimental trials in total. Within each of the two experimental blocks, each experimental condition was selected in a random order and presented for an equal number of times. Therefore, trials presenting faces with either a face mask or not were intermixed within each block. The gaze cueing task was then followed by a short questionnaire aimed at collecting self-reported measures assessing COVID-related habits and attitudes (please see Appendix II). Before both the gaze cueing experiment and the questionnaire, a specific text screen appeared containing the instructions to successfully complete the requested task.

Figure 12. Examples of faces (not drawn to scale) and trials composing the gaze cueing task. A female Asian individual (panels A and B) and a male White individual (panels C and D) are depicted, both wearing a face mask or not. Congruent trials are those in which the face looks towards the spatial location in which the target line appears (panels A and C), whereas incongruent trials are those in which the face looks toward the opposite spatial location with respect to the targe line (panels B and D).

Results

Data of all participants who completed the experiment were analysed. Partial data provided by participants who aborted the task before its ending were not stored by the Pavlovia platform. Data analyses were performed through JAMOVI software (http://www.jamovi.org).

Gaze cueing task

Missing responses (0.34 % of trials) were rare and therefore not further analysed. Wrong responses (4.70 % of trials) were analysed separately. Outliers, namely correct trials with a latency smaller than 150 ms or greater than 1500 ms (0.31 % of trials), were discarded from RT analyses. Data were analysed both using a frequentist approach and a Bayesian framework, in order to establish the best model fitting the available data.

RTs for correct trials were analysed through a repeated measures ANOVA, with spatial congruency (2: congruent vs. incongruent), SOA (2: 200 vs. 700 ms), and mask (2: mask vs. no mask) as within-participants factors. The main effect of spatial congruency was significant, $F(1, 45) = 12.378$, $p < .001$, $\eta^2_p = .216$, due to smaller RTs on congruent (M = 588 ms, SE = 12.03) than on incongruent (M = 598 ms, SE = 12.53) trials, as well as the main effect of SOA, $F(1, 45) = 125.698$, $p < .001$, $\eta^2_p = .736$, due to smaller RTs at the longer (M = 575 ms , SE = 12.71) than at the shorter (M = 610 ms, SE = 11.89) SOA, consistent with a foreperiod effect. No other results were significant (Fs < 2.334, ps > .134), including the two theoretically relevant spatial congruency × mask, and spatial congruency × SOA × mask interactions (Fs < 1, ps > .760; see also Figure 13). The repeated measures Bayesian ANOVA, performed through the default JAMOVI priors (i.e., r scale fixed effect: .5; r scale fixed effect: 1; r scale covariates: .345), including the same factors as those reported for the frequentist approach. Model comparison included all possible models (i.e., from the null model to the most saturated one), which were compared against the best one. This ANOVA indicated that the best model fitting the data included only the main effects of spatial congruency and SOA. According to Lee and Wagenmakers (2013), this model received extreme evidence ($BF_{10} > 100$) for being preferable over the null model, and strong evidence ($BF_{10} = 19.835$) for being preferable over the first best model including the theoretically relevant interaction between spatial congruency and mask (i.e., a model with the main effects of spatial congruency, SOA, and mask, and the spatial congruency × mask interaction).

Wrong responses were analysed through an identical ANOVA as that used for RT analyses. The main effect of SOA was significant, $F(1, 45) = 5.041$, $p = .030$, $\eta^2_p = .101$, with fewer errors at the longer ($M = 4.21$ %, $SE = .43$) than at the shorter ($M = 5.2$ %, $SE = .48$) SOA. No other results were significant (Fs < 2.512, ps > .120). The Bayesian ANOVA, performed identically as that used for RTs analyses, confirmed that the model including only the main effect of SOA was the best one fitting the data. This model received anecdotal evidence ($BF_{10} = 2.228$) for being preferable over the null model, and extreme evidence ($BF_{10} > 100$) for being preferable over the first best model including the theoretically relevant interaction between spatial congruency and mask (i.e., a model with the main effects of spatial congruency, SOA, and mask, and the spatial congruency × mask interaction).

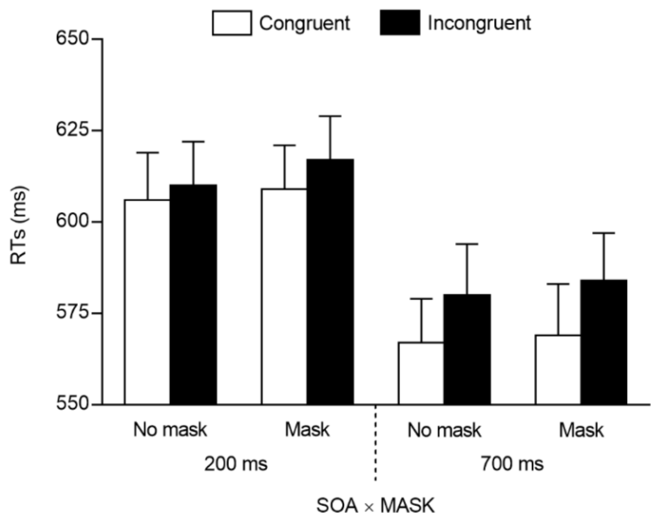

Figure 13. Mean RTs observed in Experiment 5a (Western participants) as a function of spatial congruency, SOA, and mask. Error bars are SEM.

Relationship between gaze cueing and self-reported measures

The mean scores observed for each item of the questionnaire (see Appendix II) are reported, separately for each experiment, in Table 5. In order to assess the presence of a potential relationship between gaze cueing and the self-reported measures, a new index expressing the magnitude of the gaze cueing effect (i.e., mean RTs on incongruent trials – mean RTs on congruent trials) was calculated separately for each mask condition. This index was then correlated with the mean score obtained for both objective and subjective measures. Both classical and Bayesian correlations (Pearson's coefficient) were performed. In particular, since responses to the three items concerning objective measures (Section 1 of the questionnaire) were not intercorrelated (α = -.12), they were kept separated; responses to the items concerning the subjective measures (Section 2 of the questionnaire) were intercorrelated (α = .74), and therefore they were averaged, thus obtaining a single score. Nevertheless, no significant correlations emerged for both the objective (ps > .087, BF_{10}s < 1) and the subjective (*p*s > .224, BF_{10}s < 1) measures. For completeness, correlations were also performed with an overall index of gaze cueing (calculated by collapsing the data for both the mask and the no mask condition) and non-significant results emerged for both the objective (*p*s > .187, BF_{10}s < 1) and the subjective (p = .481, BF_{10} < 1) measures.

Table 5. Mean values (and SEM, in parentheses) obtained from the five-point response scales, for all the questionnaire items (see also Appendix II).

	Section 1			Section 2		
	A1	**B1**	**C1**	**A2**	**B2**	**C2**
Experiment 1	4.02 (.17)	4.50 (.09)	4.30 (.11)	4.63 (.08)	3.28 (.15)	3.22 (.18)
Experiment 2	3.54 (.20)	2.96 (.15)	3.39 (.17)	4.15 (.14)	2.54 (.15)	2.52 (.18)

Experiment 5b

Methods

Participants

Data were collected from November 11th, 2020, until November 13th, 2020. During the time window in which data were collected, the new daily cases of COVID-19 in China were extremely rare and changed from 15 to 18, according to the COVID-19 data repository (Dong et al., 2020).

We aimed to collect a similar number of participants as in Experiment 5a. The sample was composed of 46 Asian students at the University of Guangzhou, China, who took part of a voluntary basis. Data collection was stopped at N = 46 (*Mean age* = 19.13 years, *SD* =.86, 14 males). The informed consent was provided by participants as in Experiment 5a.

Stimuli and procedure

Everything was identical to Experiment 5a, with only one exception: Faces belonged to Asian individuals. Indeed, because ethnic membership can deeply shape gaze cueing (e.g., Dalmaso et al, 2015b; Weisbuch et al., 2017; Zhang et al., 2021) in both Experiments participants were presented with faces belonging to their own ethnic group. Importantly, since the MR2 database (Strohminger et al., 2016) provides rating scores for some social dimensions that can be also involved in shaping gaze cueing of attention (i.e., age, masculinity, mood and trust; see Dalmaso et al., 2020c), Asian faces were therefore selected in order to match White faces along all these four dimensions (all ps > .27).

Results

Data of all participants who completed the experiment were analysed. Partial data provided by participants who aborted the task before its ending were not stored by the Pavlovia platform. Data were analysed as in Experiment 5a.

Gaze cueing task

Missing responses (1.51 % of trials) were rare and therefore not further analysed.

Wrong responses (7.86 % of trials) were analysed separately. Outliers (0.76 % of trials) were discarded from RT analyses.

RTs of correct trials were analysed through a repeated measures ANOVA, with congruency (2: congruent vs. incongruent), SOA (2: 200 vs. 700 ms), and mask (2: mask vs. no mask) as within-participants factors. The main effect of spatial congruency was significant, $F(1, 45) = 55.335$, $p < .001$, $\eta^2 p = .552$, due to smaller RTs on congruent ($M = 593$ ms, $SE = 11.264$) than on incongruent ($M = 615$ ms, $SE = 11.272$) trials, as well as the main effect of SOA, $F(1, 45) = 83.247$, $p < .001$, $\eta^2_p = .649$, due to smaller RTs at the longer ($M = 585$ ms, $SE = 10.65$) than at the shorter ($M = 623$ ms, $SE = 12.03$) SOA. The spatial congruency × SOA interaction was also significant, $F(1, 45) = 6.047$, $p = .018$, $\eta^2_p = .118$, and it was further explored, for each SOA, through two tailed paired t-tests between congruent and incongruent trials. These indicated that the gaze cueing effect emerged both at the 200-ms SOA, $t(45) = 3.342$, $p = .002$, $d = .493$, and at the 700-ms SOA, $t(45) = 6.610$, $p < .001$, $d = .975$, but it was greater in the latter case (14 vs. 30 ms). No other results were significant (Fs < 1, ps > .389), including the two theoretically relevant spatial congruency × mask, and spatial congruency × SOA × mask interactions (Fs < 1, ps > .643; see also Figure 14). The Bayesian ANOVA, including the same factors as those reported for the frequentist approach, was also conducted. This indicated that the best model fitting the data included the main effects of congruency and SOA and their interaction. This model received extreme evidence ($BF_{10} > 100$) for being preferable over the null model, and very strong evidence ($BF_{10} = 40.087$) for being preferable over the first best model including the theoretically relevant interaction between spatial congruency and mask (i.e., a model with the main effects of spatial congruency, SOA, and mask, and the spatial congruency × SOA and spatial congruency × mask interactions).

Wrong responses were analysed through an identical ANOVA as that used for RTs analyses. The main effect of SOA was significant, $F(1, 45) = 16.955$, $p < .001$, $\eta^2_p = .274$, with fewer errors at the longer ($M = 6.44$ %, $SE = .76$) than at the shorter ($M = 9.29$ %, $SE = 1.14$) SOA. No other results were significant (Fs < 1, ps > .520). Bayesian analyses confirmed that the model including only the main effect of SOA was the best one fitting the data, and it was also preferable over any other model including any interaction between spatial congruency and mask (BF_{10}s > 150). The Bayesian ANOVA confirmed that the model including only the main effect of SOA was the best one fitting the data. This model received extreme evidence ($BF_{10} > 100$) for being preferable over the null model, and extreme evidence ($BF_{10} > 100$) for being preferable over the first best model including the theoretically relevant interaction between spatial congruency and mask (i.e., a model with the main effects of spatial congruency, SOA, and mask, and the spatial congruency × mask interaction).

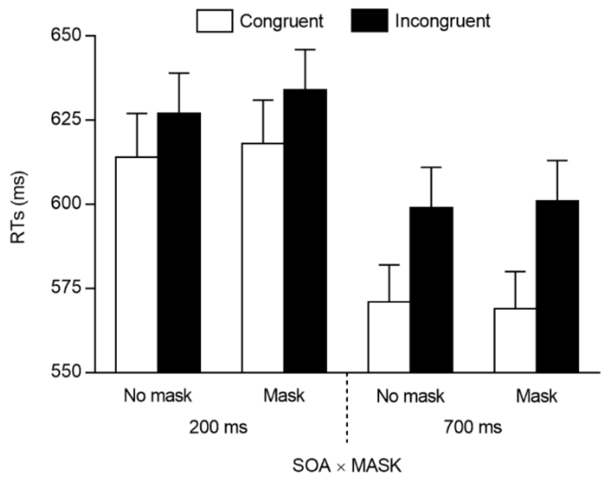

Figure 14. Mean RTs observed in Experiment 5b (Asian participants) as a function of spatial congruency, SOA, and mask. Error bars are SEM.

Relationship between gaze cueing and self-reported measures

Mean scores collected through the questionnaire are reported in Table 5. As in Experiment 5a, correlational analyses between the index of gaze cueing magnitude for faces with or without mask and the scores for the three objective measures (which were only weakly intercorrelated, α = .46) and the average index for subjective measures (α = .76) did not show any significant result (*p*s > .106, BF_{10}s < 1). This held true also for the overall index of gaze cueing (*p*s > .117, BF_{10}s < 1).

Comparison between Experiment 5a (Western participants) and 5b (Eastern participants)

In order to explore whether the gaze cueing effect was different between the two samples, we conducted a mixed design ANOVA, with the same within-participants factors used in previous analyses (i.e., spatial congruency, SOA, and mask), and with experiment (2: Experiment 5a vs. Experiment 5b) as an additional between-participants factor. Both the main effects of spatial congruency and SOA were significant (*F*s > 61.508, *p*s < .001), as well as the spatial congruency × SOA interaction, $F(1, 90) = 7.758$, $p = .007$, $\eta^2_p = .079$, reflecting that the gaze cueing effect, albeit significant at both SOAs (*t*s > 3.366, *p*s < .001), was greater at the longer one. Moreover, the main effect of experiment was not significant, $F(1, 90) = .461$, $p = .499$, $\eta^2_p = .005$, but the experiment × congruency interaction was significant, $F(1, 90) = 9.301$, $p = .003$, $\eta^2_p = .094$, reflecting that the gaze cueing effect, albeit significant in both samples (*t*s > 3.518, *p*s < .001), was greater among Asian than European participants (i.e., 22 vs. 10 ms). More importantly, experiment was not involved in any interaction including both spatial congruency and mask (*F*s < .027, *p*s > .870), thus indicating a similar gaze cueing effect in response to faces irrespective of whether wearing a mask or not, in both samples. The Bayesian ANOVA, including the same factors as those reported for the frequentist approach indicated that the best model fitting the data included the main effects of spatial congruency, SOA, and experiment, and the spatial congruency × SOA and spatial congruency × experiment interactions. This model received extreme evidence ($BF_{10} > 100$) for being preferable over the null model, and extreme evidence ($BF_{10} > 100$) for being preferable over the first best model including the theoretically relevant interaction between spatial congruency and mask (i.e., a model with the main effects of spatial congruency, SOA, and mask, experiment, and the spatial congruency × SOA, spatial congruency × mask, spatial congruency × experiment, mask × experiment, and spatial congruency × mask × experiment interactions).

As a final note, the effect size of the difference between the magnitude of gaze cueing in the mask and the no mask condition (Cohen's $d = 0.058$) suggests that regardless of the statistical significance, the difference, if any, would reflect a practically-irrelevant effect.

4.3 Discussion

The aim of this work was to assess the possible impact of face mask on social attention. In two experiments, we employed a gaze cueing task in which a task irrelevant face, which could either wear a face mask or not, looked either leftwards or rightwards while the participant provided a manual response to a peripheral target. This task was delivered to both a sample of Western and Eastern individuals, for whom the everyday use of face mask before COVID-19 emergency was either extremely uncommon or far more diffused (Meng et al. 2021; Nie et al., 2015; see also Sin, 2016), respectively. Overall, a reliable gaze cueing effect emerged and, interestingly, its magnitude was not modulated by mask condition, and it was not linked to self-reported measures related to both personal habits and attitudes towards facemask usage and possible infection risk. Moreover, these patterns of results were virtually identical in both the Italian and the Chinese sample, thus suggesting that participants' cultural background was not involved in shaping the social orienting response investigated here. Importantly, these results found support not only within a frequentist approach, but also within a Bayesian framework, which suggested that the face mask might not have an impact on social attention, given that neither main effect of face mask nor any interactions including face mask were significant.

Although it has been shown that the gaze cueing effect can be obtained also by presenting eye gaze stimuli in isolation (e.g., Akiyama et al., 2008; Hayward & Ristic, 2015), it is worth remarking that previous studies invariably used either artificial or heavily impoverished stimuli. In addition, the presence of gaze cueing in those studies does not rule out the possibility that gaze cueing might be either magnified or decreased as compared to a condition in which full access to facial information is enabled. Importantly, in our study, stimuli with and without the mask were presented intermixed within the same block of trials, rather than in separate blocks. This manipulation was aimed to maximize the perceptual saliency of the distinctive features of the two sets of stimuli (i.e., with or without the face mask; see also Dalmaso et al., 2020c). Therefore, the lack of modulation of gaze cueing as a function of mask condition can be interpreted as a rather straightforward evidence that, at least in some condition, the gaze cueing effect is not affected by whether or not participants are prevented from seeing the whole face. It should be noted that this reasoning is related to the lack of an overall effect of face masks, although it cannot be excluded that face masks affect gaze cueing in opposite ways in different participants. It would thus be important to explore the eventual role of individual differences as possible intervening factors that either magnify or reduce the attentional response to gaze stimuli embedded in faces wearing a mask.

Interestingly, in a recent study (published after our data collection was ended), Cartaud, Quesque, and Coello (2020) explored some aspects regulating social interactions at the time of COVID-19, reporting that the preferred interpersonal distance declared by participants towards a virtual character presented on the screen was smaller when the character wore a face mask rather than when it was presented without a face mask. Furthermore, the declared interpersonal distance was also reduced among individuals who had contracted the virus or who came from areas with a low risk of contagion. Taken together, these results seem to suggest that the willingness to establish a potential social interaction with others at the time of COVID-19 can be influenced by whether they are wearing a face mask or not, and this would be further affected by some individual characteristics that have not been considered here and that could also influence the way we process facial stimuli (Federico, Ferrante, Marcatto, & Brandimonte, 2021). Indeed, in our study, participants were not asked to report if they contracted COVID-19 nor we collected information about the risk of contagion within the area they were living in at the time of testing, namely two variables that could have also played a role in shaping social attention. This is something future studies could address.

From a purely methodological point of view, social attention abilities have been widely explored by adopting gaze cueing tasks based on manual responses, such as the one employed here. However, in every day social interactions, we tend to explore the surrounding environment around us through eye movements, which can be considered as a more direct and ecological index of visuo-spatial orienting of attention (e.g., Malienko et al., 2018), and can also provide a more fine-grained picture concerning the possible role of social stimuli on social attention (e.g., Dalmaso et al., 2017a, 2017b). In this regard, to the best of our knowledge, only Frank et al. (2021) analyzed fixations when participants were presented with faces of individuals either wearing face mask or not. In particular, they showed that face scanning behaviour was influenced by this protective gear, since the participants spent more time in examining the periorbital region of mask wearers with respect to faces without the face mask. In a similar vein, it will be important to explore whether faces wearing a mask or not can actually impact on social attention to a different extent by applying specific oculomotor tasks (e.g., Dalmaso et al., 2020b; Ricciardelli et al., 2002).

One of the main concerns regarding face mask use is related to the impact that such protective gear can have on interpersonal communication (e.g., Mheidly, Fares, Zalzale, & Fares, 2020). Indeed, face masks can interfere with identity (e.g., Noyes et al., 2021), and emotion (e.g., Carbon, 2020) recognition. In addition, face masks can hamper the intelligibility of vocal messages (Cohn, Pycha, & Zellou, 2021; Giovanelli et al., 2021). The gaze cueing effect addressed in the present study has been shown to imply the extraction of high-level information about the intentions of the interaction partner and therefore it represents one of the building blocks of social communication (e.g., Colombatto et al., 2020; wee also Schmidtmann, Logan, Carbon, Loong, & Gold, 2020). The present data indicate that the attentional response to a nonverbal spatial cue conveyed by gaze direction can be observed irrespective of face mask, and hence suggest that this micro-level component of social interaction is preserved. Interestingly, a recent study (Carbon & Serrano, 2021; see also Ruba & Pollak, 2020) has reported that children are not strongly affected by face masks in emotional reading.

This, in turn, provides further evidence for the notion that face masks do not necessarily impair face processing mechanisms. To sum up, in two experiments we observed that the tendency to orient our attentional resources towards the spatial location gazed at by others is not affected by whether the face providing the gaze cue is wearing a mask or not, and this emerged among individuals of both a Western and an Eastern country. Even if face masks usage during COVID-19 pandemic is a widely debated topic, and in particular in some contexts (e.g., schools; Spitzer, 2020), we believe that our results, alongside other recent evidence (e.g., Carbon & Serrano, 2021), might be seen as a further incentive to wear face masks in case of airborne diseases (see also Carbon, 2021).

Chapter 5 General discussion

General Discussion

Eyes fascinate us from the day we are born. On the one hand, eye gaze of others provides essential information to indicate both the presence and the location of potential resources or threats, and facilitates our social communication and interaction. On the other hand, the ability to shift our attention following the gaze of others potentiates the early development of language-related abilities and theory of mind (Emery, 2000; Frischen et al., 2007; Shepherd, 2010). Thus, researchers have devoted a lot of efforts to investigate gaze-driven orienting of attention, suggesting that this process is automatic and reflexive. However, in the past decades, several studies highlighted the role of top-down factors in gaze cueing, and demonstrated the influence of different manipulations of the features of face stimuli or the relationship between the observers and the faces in different contexts (Dalmaso et al., 2020c). In this regard, the present thesis aimed at investigating the possible factors (e.g., ethnicity and face mask) that could exert an influence on gaze-driven orienting of attention, as well as external contexts, namely, cultural differences and the particular COVID-19 pandemic period.

Over the past decade, some studies have addressed the issue of social factors that modulate gaze-driven orienting of attention, but few studies have focused on cultural comparisons in general and more specifically on Asian individuals. In Chapter 2, we reported different experiments conducted using the gaze cueing paradigm with manual responses, which measured the covert attention of the participants, to investigate the gaze cueing patterns in different socio-cultural contexts (i.e., Italy and

China) toward faces belonging to either the ingroup or the outgroup. As for the White participants, we replicated the asymmetric gaze-cueing effect in response to Black and White faces, implying that White participants tended to ignore the gaze direction of Black faces with respect to faces of their own-ethnic group. Moreover, we also confirmed the pattern reported by Strachan et al. (2017), namely that White individuals exhibited a comparable gaze-cueing effect in response to Asian and White faces. Novel findings were observed in Chinese participants who tended to follow the gaze of both Black and Asian faces. However, importantly and intriguingly, they showed a stronger gaze cueing effect toward White faces as compared to faces belonging to their own-ethnic group. However, this outgroup-like bias only emerged when the ethnic membership was made salient, i.e., when faces belonging to different ethnicities were presented intermixed in the block of trials. In Chapter 3, we reported eye tracking experiments in which an oculomotor interference task was employed to further investigate the different patterns shown in White and Asian participants. We found that the gaze of White and Asian faces elicited similar oculomotor interference effects in White individuals. On the contrary, the gaze of White faces elicited a stronger interference effect than that of Asian faces in Asian individuals. These findings are consistent with the results reported in Chapter 2 with manual responses, likely indicating a link between personal attitude toward an ethnic group and gaze-driven orienting of attention.

In addition to ethnicity-related issues, we also investigated whether face masks influence gaze-driven orienting of attention in different socio-cultural contexts during this particular period, given that the COVID-19 pandemic changed our behaviour in daily life. Because the outbreak of the COVID-19 caused a great problem on data collection, due to the strict lockdowns adopted to counteract spreading of the disease, we decided to conduct online experiments to collect data from participants in both Italy and China. The findings were reported in Chapter 4, and showed no differences in gaze-driven orienting as a function of whether faces appeared with or without the face mask. Moreover, the self-reported questionnaires on personal habits and attitudes towards facemask use and potential infection risk were tested. The results of the questionnaire did not reveal any specific association with the gaze-cueing effect. Interestingly, the findings in manual responses and questionnaires were consistent among Chinese and Italian participants.

A large number of studies have been conducted to demonstrate the automatic nature of this effect. However, there has been a debate about this nature of automaticity, as many researchers have provided evidence that social factors play various roles in modulating this gaze cueing effect, suggesting the phenomenon that people reflexively shift their attention triggered by other individuals' gaze is not ballistic (for a review, see Dalmaso et al., 2020c). Our data contribute to this debate. On the one hand, the results of Chapter 4 showed that the gaze cueing effect was robust regardless of whether the faces were intact or wearing a mask, and regardless of different cultural contexts during COVID-19 pandemic. In this regard, we confirmed the automaticity of gaze cueing effect, even when individuals were not processing the whole face. On the other hand, the different patterns observed in White and Asian individuals in the experiments reported in Chapters 2 and 3 suggest that the interplay between ethnicity of the faces and of the observers does indeed influence the gaze-driven orienting of attention. In this perspective, the present thesis corroborates the notion that the gaze cueing effect is sensitive, at least to a certain extent, to top-down control. Furthermore, our results suggest that ethnicity is the driving factor underlying the modulation because when ethnic faces were presented in different blocks of trials (i.e., when ethnicity was made less salient), the modulatory effect disappeared. This implies that the underlying mechanism modulating gaze-driven attention can be attributed to higher-level processing of extracted social knowledge.

From an evolutionary perspective, the ability to quickly process the most relevant cue from the surrounding environment is crucial for individual survival. There may be a series of mental processes behind the modulatory effect of social variables on gaze-driven attention. In addition to the ability to detecting the attentional focus of others by processing their gaze (e.g., Itier & Batty, 2009), social information about the face, such as social status, facial expression, dominance, trustworthiness, and familiarity, might also help people making assumptions about the mental states of others (Shamay-Tsoory, Tibi-Elhanany, & Aharon-Peretz, 2007). Then, based on these inferences, one can evaluate for instance objects in the environment (Bayliss, Frischen, Fenske, & Tipper, 2007), potential threats and rewards (Bayless, Glover, Taylor, & Itier, 2011; Graham, Friesen, Fichtenholtz, & Labar, 2010), and adjust one's social behaviour. If this perspective, it is likely that implicit evaluation processes may underlie responses to both ethnic faces and faces wearing masks, which in turn is reflected in different sensitivities to the gaze of others.

In this work, we have focused on the role of perceived social status, the factor which, in our prediction, as one of the most likely candidates to influence the observed modulation of gaze-driven attention as a function of ethnic group memberships. As discussed in the previous chapters, the direction of the modulation exerted by ethnicity on gaze-driven orienting did not emerge in a uniform template. More specifically, White individuals showed an ingroup-like bias on the gaze-cueing effect when shown with White and Black faces, while they exhibited a similar cueing effect when the outgroup faces turned to be Asian (i.e., no ingroup-like bias was present). In contrast, Asian individuals displayed a stronger gaze-cueing effect for outgroup (i.e., White) rather than ingroup faces. Taken together, neither low-level features (i.e., skin colour) nor straightforward in- or out-group biases can explain the pattern emerged in the different ethnic groups in our experiments. In this perspective, we assumed that the activated stereotypic knowledge from the ethnic faces might play a key role in the different modulations exhibited by the different ethnic groups. Social hierarchy is ubiquitous in the society and essential for survival, as people with higher social status occupy and can provide more resources (e.g., Fiske, 1992; Magee & Galinsky, 2008). It is well known that individuals allocate and pay more attention to people with higher social status than to those with medium or low status (Foulsham, Cheng, Tracy, Henrich, & Kingstone, 2010). Moreover, previous findings suggested that social power or dominance can be relevant modulators on gaze-driven attention in both non-human and human primates (e.g., Jones et al., 2010; Shepherd, Deaner, & Platt, 2006). Thus, it is reasonable that social status, which is pervasive and quickly perceived by humans, can influence social attention. The novel findings reported in Chapters 2 and 3, that Chinese participants exhibited a pro-White bias with a larger attentional response to gazes of faces belonging to the outgroup, together with the findings from the perceived social status questionnaires, seem to support our hypothesis. In addition, Eurocentric beauty standards have been assimilated into Asian countries (e.g., China, Japan, and South Korea). Asian people, especially females, chase European-seeming features, such as pale skin and wide double-eyelid (Chen, 2021; Chen, Lian, Lorenzana, Shahzad, & Wong, 2020). Behind this aesthetic pursuit, some researchers believe that it is a pursuit of social power that drives non-white populations desire to physically mimic those who are in power (Yeung, 2015).

Limitations and future directions.

Firstly, although we identified social status, an attribute that can be processed rapidly and spontaneously, even when faces are shown very a briefly, as one of the main factors impacting on gaze-driven orienting of attention, we did not directly test the perceived social status of participants after the gaze-cueing task, neither embodied this variable in the paradigm (e.g., by manipulating the social status of the face stimuli). This limitation suggests caution in the interpretation of the asymmetric patterns across cultures. Future studies will need to further investigate the potential impact of perceived social status on gaze cueing using more direct experimental paradigms.

Secondly, social features associated to the faces such as attractiveness, or trustworthiness are also known to influence social attention (see Dalmaso et al., 2020c, for a review). In the present thesis, we only considered the ethnicity and gender of the faces but did not match attractiveness and trustworthiness of the ethnic faces, nor we did employ a questionnaire to test these attributes. Although a recent study found no evidence that facial attractiveness can affect gaze cueing (Roth, Du, Samara, & Kret, 2021), future studies could still control or test these features, in combination with ethnicity and cultural context.

Thirdly, we did not consider the impact, if any, of motivational factors in our experiments. For instance, the studies on face masks reported in Chapter 4 did not take into consideration whether or not participants were infected or were based in high-risk areas. Future studies may focus on the role of these motivational and goal-directed processes.

Finally, only experiments relying on laboratory-based methods and approaches were reported in this thesis. Although the typical laboratory task has the advantage to allow for controlling for confounding variables and preserving internal validity, these procedures often sacrifice ecological validity, at least to some extent. Many researchers have recommended a “real world approach” to better understand human behaviour and cognition in a real environment (Kingstone, Smilek, Ristic, Friesen, & Eastwood, 2003; Osborne-Crowley, 2020; Shamay-Tsoory & Mendelsohn, 2019). Considering that our research focused on gaze-driven attention, i.e., a behaviour that is highly correlated with social interactions, ecological validity becomes particularly important. Thus, future studies will need to exploit technological advances, such as portable eye trackers and virtual reality and examine whether the patterns that we observed in using strict laboratory approaches can also be replicated when using more ecological settings.

Conclusion

When referring to the role of ethnicity in gaze cueing, previous research has almost invariably focused on the comparison between White and Black individuals, but much less is known about the comparison between White and Asian, on the one hand, and Black and Asian ethnic groups on the other. In the present thesis, we extended the literature on gaze-driven orienting of attention by involving Asian individuals using faces belonging to different ethnicities. For the first time, to the best of our knowledge, we found different gaze-cueing patterns with respect to those exhibited by White individuals. The consistency of the pattern, emerged with both manual and oculomotor paradigms, suggests that this difference among cultures reflects a robust phenomenon deserving to be further explored in future studies. As concerns the experiments reported in Chapter 4, no differences among cultures were observed. Even if face masks usage during COVID-19 pandemic is a highly debated topic, we believe that our findings, might be seen as a further incentive to wear face masks in case of airborne diseases (see also Carbon, 2021), given that social attention does not seem to be hampered by this behaviour.

Acknowledgements

First, I would like to express my gratitude to Prof. Giovanni Galfano, Prof. Luigi Castelli and Prof. Mario Dalmaso for their professional and patient instructions, as well as all the precious suggestions. I am thankful to Prof. Shimin Fu for the opportunities he offered me.

Also, I would like to thank the postgraduate students who assisted me with the data collections.

Finally, I would like to thank my parents and friends for their unconditional support and love.

References

Adams, R. B., Ambady, N., Macrae, C. N., & Kleck, R. E. (2006). Emotional expressions forecast approach-avoidance behavior. *Motivation and Emotion*, *30*(2), 179–188. https://doi.org/10.1007/s11031-006-9020-2

Aharon, I., Etcoff, N., Ariely, D., Chabris, C. F., O'connor, E., & Breiter, H. C. (2001). Beautiful faces have variable reward value: fMRI and behavioral evidence. *Neuron*, *32*(3), 537–551. https://doi.org/10.1016/S0896-6273(01)00491-3

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

Alwall, N., Johansson, D., & Hansen, S. (2010). The gender difference in gaze-cueing: Associations with empathizing and systemizing. *Personality and Individual Differences*, *49*(7), 729–732. https://doi.org/10.1016/j.paid.2010.06.016

Ando, S. (2002). Luminance-induced shift in the apparent direction of gaze. *Perception*, *31*(6), 657–674. https://doi.org/10.1068/p3332

Ando, S. (2004). Perception of gaze direction based on luminance ratio. *Perception*, *33*(10), 1173–1184. https://doi.org/10.1068/p5297

Bargh, J. A. (1997). Automaticity of everyday life. In R. S. Wyer (Ed.), *Advances in Social Cognition* (pp. 1–61). Mahwah, NJ: Erlbaum.

Batki, A., Baron-Cohen, S., Wheelwright, S., Connellan, J., & Ahluwalia, J. (2000). Is there an innate gaze module? Evidence from human neonates. *Infant Behavior and Development*, *23*(2), 223–229. https://doi.org/10.1016/S0163-6383(01)00037-6

Bayless, S. J., Glover, M., Taylor, M. J., & Itier, R. J. (2011). Is it in the eyes? Dissociating the role of emotion and perceptual features of emotionally expressive faces in modulating orienting to eye gaze. *Visual Cognition*, *19*(4), 483–510. https://doi.org/10.1080/13506285.2011.552895

Bayliss, A. P., Frischen, A., Fenske, M. J., & Tipper, S. P. (2007). Affective evaluations of objects are influenced by observed gaze direction and emotional expression. *Cognition*, *104*(3), 644–653. https://doi.org/10.1016/J.COGNITION.2006.07.012

Bayliss, A. P., Pellegrino, G. Di, & Tipper, S. P. (2005). Sex differences in eye gaze and symbolic cueing of attention. *Quarterly Journal of Experimental Psychology Section A: Human Experimental Psychology*, *58*(4), 631–650. https://doi.org/10.1080/02724980443000124

Blais, C., Jack, R. E., Scheepers, C., Fiset, D., & Caldara, R. (2008). Culture shapes how we look at faces. *PLoS ONE*, *3*(8). https://doi.org/10.1371/journal.pone.0003022

Blignaut, P., & Wium, D. (2014). Eye-tracking data quality as affected by ethnicity and experimental design. *Behavior Research*, *46*(1), 67–80. https://doi.org/10.3758/s13428-013-0343-0

Boduroglu, A., Shah, P., & Nisbett, R. E. (2009). Cultural differences in allocation of

attention in visual information processing. *Journal of Cross-Cultural Psychology*, *40*(3), 349–360. https://doi.org/10.1177/0022022108331005
Bompas, A., Hedge, C., & Sumner, P. (2017). Speeded saccadic and manual visuo-motor decisions: Distinct processes but same principles. *Cognitive Psychology*, *94*, 26–52. https://doi.org/10.1016/j.cogpsych.2017.02.002
Briand, K. A., Larrison, A. L., & Sereno, A. B. (2000). Inhibition of return in manual and saccadic response systems. *Perception and Psychophysics*, *62*(8), 1512–1524. https://doi.org/10.3758/BF03212152
Bridges, D., Pitiot, A., MacAskill, M. R., & Peirce, J. W. (2020). The timing mega-study: Comparing a range of experiment generators, both lab-based and online. *PeerJ*, *8*, e9414. https://doi.org/10.7717/peerj.9414
Bruce, V., & Young, A. (1986). Understanding face recognition. *British Journal of Psychology*, *77*(3), 305–327. https://doi.org/10.1111/j.2044-8295.1986.tb02199.x
Burra, N., Kerzel, D., & Ramon, M. (2017). Gaze-cueing requires intact face processing – Insights from acquired prosopagnosia. *Brain and Cognition*, *113*, 125–132. https://doi.org/10.1016/j.bandc.2017.01.008
Caldara, R. (2017). Culture reveals a flexible system for face processing. *Current Directions in Psychological Science*, *26*(3), 249–255. https://doi.org/10.1177/0963721417710036
Capozzi, F., & Ristic, J. (2018). How attention gates social interactions. *Annals of the New York Academy of Sciences*, *1426*, 179–198. https://doi.org/10.1111/nyas.13854
Carbon, C. C. (2020). Wearing face masks strongly confuses counterparts in reading emotions. *Frontiers in Psychology*, *11*, 2526. https://doi.org/10.3389/fpsyg.2020.566886
Carbon, C. C. (2021). About the acceptance of wearing face masks in times of a pandemic. *I-Perception*, *12*(3), 1–14. https://doi.org/10.1177/20416695211021114
Carbon, C. C., & Serrano, M. (2021). The impact of face masks on the emotional reading abilities of children—A lesson from a joint school–university project. *I-Perception*, *12*(4), 1–17. https://doi.org/10.1177/20416695211038265
Carraro, L., Dalmaso, M., Castelli, L., & Galfano, G. (2015). The politics of attention contextualized: Gaze but not arrow cuing of attention is moderated by political temperament. *Cognitive Processing*, *16*(3), 309–314. https://doi.org/10.1007/s10339-015-0661-5
Carraro, L., Dalmaso, M., Castelli, L., Galfano, G., Bobbio, A., Mantovani, G., … Berlin, S.-V. (2017). The appeal of the devil's eye: Social evaluation affects social attention. *Cognitive Processing*, *18*(1), 97–103. https://doi.org/10.1007/s10339-016-0785-2
Cartaud, A., Quesque, F., & Coello, Y. (2020). Wearing a face mask against Covid-19 results in a reduction of social distancing. *PLoS ONE*, *15*(12), e0243023. https://doi.org/10.1371/journal.pone.0243023
Caruana, N., Stieglitz Ham, H., Brock, J., Woolgar, A., Kloth, N., Palermo, R., &

McArthur, G. (2018). Joint attention difficulties in autistic adults: An interactive eye-tracking study. *Autism*, *22*(4), 502–512. https://doi.org/10.1177/1362361316676204

Cazzato, V., Liuzza, M. T., Caprara, G. V., Macaluso, E., & Aglioti, S. M. (2015). The attracting power of the gaze of politicians is modulated by the personality and ideological attitude of their voters: A functional magnetic resonance imaging study. *European Journal of Neuroscience*, *42*(8), 2534–2545. https://doi.org/10.1111/ejn.13038

Chen, J. (2014). Face recognition as a predictor of social cognitive ability: Effects of emotion and race on face processing. *Asian Journal of Social Psychology*, *17*(1), 61–69. https://doi.org/10.1111/ajsp.12041

Chen, M. (2021). The racializing of beauty: The rise of Western beauty norms and self-esteem among Asian women. *NU Writing*, 1–16. Retrieved from https://openjournals.neu.edu/nuwriting/home/article/view/217

Chen, T., Lian, K., Lorenzana, D., Shahzad, N., & Wong, R. (2020). Occidentalisation of beauty standards: Eurocentrism in Asia. *Across The Spectrum of Socioeconomics*, *1*(2), 1–11. https://doi.org/10.5281/zenodo.4325856

Chen, Y., & Zhao, Y. (2015). Intergroup threat gates social attention in humans. *Biology Letters*, *11*(2), 20141055. https://doi.org/10.1098/rsbl.2014.1055

Cheng, J. T., & Tracy, J. L. (2014). Toward a unified science of hierarchy: Dominance and prestige are two fundamental pathways to human social rank. In J. T. Cheng, J. L. Tracy, & C. Anderson (Eds.), *The psychology of social status* (pp. 3–27). New York, NY: New York, NY: Springer.

Cheng, V. C. C., Wong, S. C., Chuang, V. W. M., So, S. Y. C., Chen, J. H. K., Sridhar, S., … Yuen, K. Y. (2020). The role of community-wide wearing of face mask for control of coronavirus disease 2019 (COVID-19) epidemic due to SARS-CoV-2. *Journal of Infection*, *81*(1), 107–114. https://doi.org/10.1016/j.jinf.2020.04.024

Chica, A. B., Martín-Arévalo, E., Botta, F., & Lupiáñez, J. (2014). The spatial orienting paradigm: How to design and interpret spatial attention experiments. *Neuroscience and Biobehavioral Reviews*, *40*, 35–51. https://doi.org/10.1016/j.neubiorev.2014.01.002

Chuk, T., Chan, A. B., & Hsiao, J. H. (2014). Understanding eye movements in face recognition using hidden Markov models. *Journal of Vision*, *14*(11), 1–14. https://doi.org/10.1167/14.11.8

Ciardo, F., De Angelis, J., Marino, B. F. M., Actis-Grosso, R., & Ricciardelli, P. (2020). Social categorization and joint attention: Interacting effects of age, sex, and social status. *Acta Psychologica*, *212*, 103223. https://doi.org/10.1016/j.actpsy.2020.103223

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

Ciardo, F., Ricciardelli, P., Lugli, L., Rubichi, S., & Iani, C. (2015). Eyes keep watch

over you! Competition enhances joint attention in females. *Acta Psychologica*, *160*, 170–177. https://doi.org/10.1016/j.actpsy.2015.07.013
Clutterbuck, R., & Johnston, R. A. (2002). Exploring levels of face familiarity by using an indirect face-matching measure. *Perception*, *31*(8), 985–994. https://doi.org/10.1068/p3335
Cohen, A. S., Sasaki, J. Y., German, T. C., & Kim, H. S. (2017). Automatic mechanisms for social attention are culturally penetrable. *Cognitive Science*, *41*(1), 242–258. https://doi.org/10.1111/cogs.12329
Cohn, M., Pycha, A., & Zellou, G. (2021). Intelligibility of face-masked speech depends on speaking style: Comparing casual, clear, and emotional speech. *Cognition*, *210*, 104570. https://doi.org/10.1016/j.cognition.2020.104570
Colombatto, C., Chen, Y. C., & Scholl, B. J. (2020). Gaze deflection reveals how gaze cueing is tuned to extract the mind behind the eyes. *Proceedings of the National Academy of Sciences of the United States of America*, *117*(33), 19825–19829. https://doi.org/10.1073/pnas.2010841117
Cooney, S., Brady, N., & Ryan, K. (2017). Spatial orienting of attention to social cues is modulated by cue type and gender of viewer. *Experimental Brain Research*, *235*(5), 1481–1490. https://doi.org/10.1007/S00221-017-4909-4
Cui, G., Zhang, S., & Geng, H. (2014). The impact of perceived social power and dangerous context on social attention. *PLOS ONE*, *9*(12), e114077. https://doi.org/10.1371/journal.pone.0114077
Dalmaso, M., Alessi, G., Castelli, L., & Galfano, G. (2020a). Eye contact boosts the reflexive component of overt gaze following. *Scientific Reports*, *10*(1), 1–10. https://doi.org/10.1038/s41598-020-61619-6
Dalmaso, M., Castelli, L., Franchetti, L., Carli, L., Todisco, P., Palomba, D., & Galfano, G. (2015a). Altered orienting of attention in anorexia nervosa. *Psychiatry Research*, *229*(1–2), 318–325. https://doi.org/10.1016/j.psychres.2015.06.044
Dalmaso, M., Castelli, L., & Galfano, G. (2017a). Attention holding elicited by direct-gaze faces is reflected in saccadic peak velocity. *Experimental Brain Research*, *235*(11), 3319–3332. https://doi.org/10.1007/s00221-017-5059-4
Dalmaso, M., Castelli, L., & Galfano, G. (2020b). Early saccade planning cannot override oculomotor interference elicited by gaze and arrow distractors. *Psychonomic Bulletin and Review*, 1–8. https://doi.org/10.3758/s13423-020-01768-x
Dalmaso, M., Castelli, L., & Galfano, G. (2020c). 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., Scatturin, P., & Galfano, G. (2017b). Trajectories of social vision: Eye contact increases saccadic curvature. *Visual Cognition*, *25*(1–3), 358–365. https://doi.org/10.1080/13506285.2017.1290727
Dalmaso, M., Galfano, G., & Castelli, L. (2015b). The impact of same- and other-race gaze distractors on the control of saccadic eye movements. *Perception*, *44*(8–9), 1020–1028. https://doi.org/10.1177/0301006615594936

Dalmaso, M., Galfano, G., Coricelli, C., & Castelli, L. (2014). Temporal dynamics underlying the modulation of social status on social attention. *PLoS ONE*, *9*(3), e93139. https://doi.org/10.1371/journal.pone.0093139

Dalmaso, M., Galfano, G., Tarqui, L., Forti, B., & Castelli, L. (2013). Is social attention impaired in schizophrenia? Gaze, but not pointing gestures, is associated with spatial attention deficits. *Neuropsychology*, *27*(5), 608–613. https://doi.org/10.1037/a0033518

Dalmaso, M., Pavan, G., Castelli, L., & Galfano, G. (2012). Social status gates social attention in humans. *Biology Letters*, *8*(3), 450–452. https://doi.org/10.1098/rsbl.2011.0881

Dawson, G., Meltzoff, A. N., Osterling, J., Rinaldi, J., & Brown, E. (1998). Children with autism fail to orient to naturally occurring social stimuli. *Journal of Autism and Developmental Disorders*, *28*(6), 479–485. https://doi.org/10.1023/A:1026043926488

Deaner, R. O., Shepherd, S. V., & Platt, M. L. (2007). Familiarity accentuates gaze cuing in women but not men. *Biology Letters*, *3*(1), 64–67. https://doi.org/10.1098/rsbl.2006.0564

Dodd, M. D., Hibbing, J. R., & Smith, K. B. (2011). The politics of attention: Gaze-cuing effects are moderated by political temperament. *Attention, Perception, and Psychophysics*, *73*(1), 24–29. https://doi.org/10.3758/s13414-010-0001-x

Dong, E., Du, H., & Gardner, L. (2020). An interactive web-based dashboard to track COVID-19 in real time. *The Lancet Infectious Diseases*, *20*(5), 533–534. https://doi.org/10.1016/S1473-3099(20)30120-1

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

Dupree, C. H., Torrez, B., Obioha, O., & Fiske, S. T. (2021). Race–status associations: Distinct effects of three novel measures among White and Black perceivers. *Journal of Personality and Social Psychology*, *120*(3), 601–625. https://doi.org/10.1037/pspa0000257

Ebner, N. C., He, Y., Fichtenholtz, H. M., McCarthy, G., & Johnson, M. K. (2011). Electrophysiological correlates of processing faces of younger and older individuals. *Social Cognitive and Affective Neuroscience*, *6*(4), 526–535. https://doi.org/10.1093/scan/nsq074

Eikenberry, S. E., Mancuso, M., Iboi, E., Phan, T., Eikenberry, K., Kuang, Y., … Gumel, A. B. (2020). To mask or not to mask: Modeling the potential for face mask use by the general public to curtail the COVID-19 pandemic. *Infectious Disease Modelling*, *5*, 293–308. https://doi.org/10.1016/j.idm.2020.04.001

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

Farroni, T., Csibra, G., Simion, F., & Johnson, M. H. (2002). Eye contact detection in humans from birth. *Proceedings of the National Academy of Sciences*, *99*(14), 9602–9605. https://doi.org/10.1073/pnas.152159999

Farroni, T., Johnson, M. H., Brockbank, M., & Simion, F. (2000). Infants' use of gaze direction to cue attention: The importance of perceived motion. *Visual Cognition*, *7*, 705–718. https://doi.org/10.1080/13506280050144399

Farroni, T., Johnson, M. H., & Csibra, G. (2004). Mechanisms of eye gaze perception during infancy. *Journal of Cognitive Neuroscience*, *16*(8), 1320–1326. https://doi.org/10.1162/0898929042304787

Farroni, T., Massaccesi, S., Pividori, D., & Johnson, M. H. (2004). Gaze following in newborns. *Infancy*, *5*(1), 39–60. https://doi.org/10.1207/s15327078in0501_2

Federico, G., Ferrante, D., Marcatto, F., & Brandimonte, M. A. (2021). How the fear of COVID-19 changed the way we look at human faces. *PeerJ*, *9*, e11380. https://doi.org/10.7717/peerj.11380

Feng, Q., Zheng, Y., Zhang, X., Song, Y., Luo, Y. J., Li, Y., & Talhelm, T. (2011). Gender differences in visual reflexive attention shifting: Evidence from an ERP study. *Brain Research*, *1401*, 59–65. https://doi.org/10.1016/j.brainres.2011.05.041

Fiske, A. P. (1992). The four elementary forms of sociality: Framework for a unified theory of social relations. *Psychological Review*, *99*(4), 689–723. https://doi.org/doi.org/10.1037/0033-295X.99.4.689

Foulsham, T., Cheng, J. T., Tracy, J. L., Henrich, J., & Kingstone, A. (2010). Gaze allocation in a dynamic situation: Effects of social status and speaking. *Cognition*, *117*(3), 319–331. https://doi.org/10.1016/j.cognition.2010.09.003

Frank, K., Schuster, L., Alfertshofer, M., Baumbach, S. F., Herterich, V., Giunta, R. E., … Cotofana, S. (2021). How does wearing a facecover influence the eye movement pattern in times of COVID-19? *Aesthetic Surgery Journal*, *41*(8), NP1118–NP1124. https://doi.org/10.1093/asj/sjab121

Freud, E., Stajduhar, A., Rosenbaum, R. S., Avidan, G., & Ganel, T. (2020). The COVID-19 pandemic masks the way people perceive faces. *Scientific Reports*, *10*, 22344. https://doi.org/10.1038/s41598-020-78986-9

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

Frischen, A., Bayliss, A. P., & Tipper, S. P. (2007). Gaze cueing of attention: Visual attention, social cognition, and individual differences. *Psychological Bulletin*, (133), 694–724. https://doi.org/10.1037/0033-2909.133.4.694

Frischen, A., & Tipper, S. P. (2007). Long-term gaze cueing effects: Evidence for retrieval of prior states of attention from memory. *Visual Cognition*, *14*(3), 351–364. https://doi.org/10.1080/13506280544000192

Galfano, G., Dalmaso, M., Marzoli, D., Pavan, G., Coricelli, C., & Castelli, L. (2012). Eye gaze cannot be ignored (but neither can arrows). *Quarterly Journal of Experimental Psychology*, *65*(10), 1895–1910. https://doi.org/10.1080/17470218.2012.663765

Giovanelli, E., Valzolgher, C., Gessa, E., Todeschini, M., & Pavani, F. (2021). Unmasking the difficulty of listening to talkers with masks: Lessons from the COVID-19 pandemic. *I-Perception*. https://doi.org/10.1177/2041669521998393

Graham, R., Friesen, C. K., Fichtenholtz, H. M., & Labar, K. S. (2010). Modulation of reflexive orienting to gaze direction by facial expressions. *Visual Cognition*, *18*(3), 331–368. https://doi.org/10.1080/13506280802689281

Gregory, S. E. A., Langton, S. R. H., Yoshikawa, S., & Jackson, M. C. (2020). A cross-cultural investigation into the influence of eye gaze on working memory for happy and angry faces. *Cognition and Emotion*, *34*(8), 1561–1572. https://doi.org/10.1080/02699931.2020.1782353

Haensel, J. X., Danvers, M., Ishikawa, M., Itakura, S., Tucciarelli, R., Smith, T. J., & Senju, A. (2020a). Culture modulates face scanning during dyadic social interactions. *Scientific Reports*, *10*, 1958. https://doi.org/10.1038/s41598-020-58802-0

Haensel, J. X., Ishikawa, M., Itakura, S., Smith, T. J., & Senju, A. (2020b). Cultural influences on face scanning are consistent across infancy and adulthood. *Infant Behavior and Development*, *61*, 101503. https://doi.org/10.1016/j.infbeh.2020.101503

Hains, S. M. J., & Muir, D. W. (1996). Infant sensitivity to adult eye direction. *Child Development*, *67*(5), 1940–1951. https://doi.org/10.1111/j.1467-8624.1996.tb01836.x

Haxby, J., Hoffman, E., & Gobbini, M. (2000). The distributed human neural system for face perception. *Trends in Cognitive Sciences*, *4*(6), 223–233. https://doi.org/10.1016/S1364-6613(00)01482-0

Hayward, D. A., & Ristic, J. (2013). The uniqueness of social attention revisited: Working memory load interferes with endogenous but not social orienting. *Experimental Brain Research*, *231*(4), 405–414. https://doi.org/10.1007/S00221-013-3705-Z

Hayward, D. A., & Ristic, J. (2015). Exposing the cuing task: the case of gaze and arrow cues. *Attention, Perception, & Psychophysics*, *77*, 1088–1104. https://doi.org/10.3758/s13414-015-0877-6

Hermans, D., De Houwer, J., & Eelen, P. (2001). A time course analysis of the affective priming effect. *Cognition and Emotion*, *15*(2), 143–165. https://doi.org/10.1080/02699930125768

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

Hoehl, S., Wahl, S., & Pauen, S. (2014). Disentangling the effects of an adult model's eye gaze and head orientation on young infants' processing of a previously attended object. *Infancy*, *19*(1), 53–64. https://doi.org/10.1111/infa.12035

Hood, B. M., Willen, J. D., & Driver, J. (1998). Adult's eyes trigger shifts of visual attention in human infants. *Psychological Science*, *9*(2), 131–134. https://doi.org/10.1111/1467-9280.00024

Hugenberg, K., & Wilson, J. P. (2013). Faces are central to social cognition. In D. E. Carl (Ed.), *The Oxford handbook of social cognition* (pp. 167–193). Oxford University Press.

Hungr, C. J., & Hunt, A. R. (2012). Physical self-similarity enhances the gaze-cueing effect. *Quarterly Journal of Experimental Psychology*, *65*(7), 1250–1259. https://doi.org/10.1080/17470218.2012.690769

Itier, R. J., & Batty, M. (2009). Neural bases of eye and gaze processing: The core of social cognition. *Neuroscience & Biobehavioral Reviews*, *33*(6), 843–863. https://doi.org/10.1016/j.neubiorev.2009.02.004

Janik, S. W., Wellens, A. R., Goldberg, M. L., & Dell'osso, L. F. (1978). Eyes as the center of focus in the visual examination of human faces. *Perceptual and Motor Skills*, *47*(3), 857–858. https://doi.org/10.2466/pms.1978.47.3.857

Jiang, F., Blanz, V., & Rossion, B. (2011). Holistic processing of shape cues in face identification: Evidence from face inversion, composite faces, and acquired prosopagnosia. *Visual Cognition*, *19*(8), 1003–1034. https://doi.org/10.1080/13506285.2011.604360

Jones, B. C., Debruine, L. M., Main, J. C., Little, A. C., Welling, L. L. M. M., Feinberg, D. R., & Tiddeman, B. P. R. (2010). Facial cues of dominance modulate the short-term gaze-cuing effect in human observers. *Proceedings of the Royal Society B: Biological Sciences*, *277*(1681), 617–624. https://doi.org/10.1098/rspb.2009.1575

Kelly, D. J., Jack, R. R., Miellet, S., De, E. L., Foreman, K., & Caldara, R. (2011a). Social experience does not abolish cultural diversity in eye movements. *Frontiers in Psychology*, *2*, 95. https://doi.org/10.3389/fpsyg.2011.00095

Kelly, D. J., Liu, S., Rodger, H., Miellet, S., Ge, L., & Caldara, R. (2011b). Developing cultural differences in face processing. *Developmental Science*, *14*(5), 1176–1184. https://doi.org/10.1111/j.1467-7687.2011.01067.x

Kingstone, A., Friesen, C. K., & Gazzaniga, M. S. (2000). Reflexive joint attention depends on lateralized cortical connections. *Psychological Science*, *11*(2), 159–166. https://doi.org/10.1111/1467-9280.00232

Kingstone, A., Smilek, D., Ristic, J., Friesen, C. K., & Eastwood, J. D. (2003). Attention, researchers! It is time to take a look at the real world. *Current Directions in Psychological Science*, *12*(5), 176–180. https://doi.org/10.1111/1467-8721.01255

Kobayashi, H., & Kohshima, S. (1997). Unique morphology of the human eye. *Nature*, *387*(6635), 767–768. https://doi.org/10.1038/42842

Kuhn, G., & Benson, V. (2007). The influence of eye-gaze and arrow pointing distractor cues on voluntary eye movements. *Perception and Psychophysics*, *69*(6), 966–971. https://doi.org/10.3758/BF03193934

Kuhn, G., Benson, V., Fletcher-Watson, S., Kovshov, H., Mccormick, C. A., Kirkby, J., & Leekam, S. R. (2010). Eye movements affirm: Automatic overt gaze and arrow cueing for typical adults and adults with autism spectrum disorder. *Experimental Brain Research*, *201*, 155–165. https://doi.org/10.1007/s00221-009-2019-7

Kuhn, G., & Kingstone, A. (2009). Look away! Eyes and arrows engage oculomotor responses automatically. *Attention, Perception, and Psychophysics*, *71*(2), 314–327. https://doi.org/10.3758/APP.71.2.314

Kuhn, G., Pickering, A., & Cole, G. G. (2015). "Rare" emotive faces and attentional

orienting. *Emotion*, *15*(4). https://doi.org/10.1037/emo0000050
Kuhn, G., & Tipples, J. (2011). Increased gaze following for fearful faces. It depends on what you're looking for! *Psychonomic Bulletin & Review*, *18*(1), 89–95. https://doi.org/10.3758/s13423-010-0033-1
Langdon, R., Corner, T., McLaren, J., Coltheart, M., & Ward, P. B. (2006). Attentional orienting triggered by gaze in schizophrenia. *Neuropsychologia*, *44*(3), 417–429. https://doi.org/10.1016/j.neuropsychologia.2005.05.020
Langton, S., & Bruce, V. (1999). Reflexive visual orienting in response to the social attention of others. *Visual Cognition*, *6*(5), 541–567. https://doi.org/10.1080/135062899394939
Langton, S., & Bruce, V. (2000). You must see the point: Automatic processing of cues to the direction of social attention. *Journal of Experimental Psychology: Human Perception and Performance*, *26*(2), 747–757. https://doi.org/10.1037/0096-1523.26.2.747
Langton, S., Mcintyre, A., Hancock, P., & Leder, H. (2017). Saccades and smooth pursuit eye movements trigger equivalent gaze-cued orienting effects. *The Quarterly Journal of Experimental Psychology*, *71*(9), 1860–1872. https://doi.org/10.1080/17470218.2017.1362703
Law, A. S., Langton, S. R. H., & Logie, R. H. (2010). Assessing the impact of verbal and visuospatial working memory load on eye-gaze cueing. *Visual Cognition*, *18*(10), 1420–1438. https://doi.org/10.1080/13506285.2010.496579
Lawrence, R. K., Edwards, M., Chan, G. W. C., Cox, J. A., & Goodhew, S. C. (2019). Does cultural background predict the spatial distribution of attention? *Culture and Brain 2019 8:2*, *8*(2), 137–165. https://doi.org/10.1007/S40167-019-00086-X
Leder, H., Tinio, P. P. L., Fuchs, I. M., & Bohrn, I. (2010). When attractiveness demands longer looks: The effects of situation and gender. *Sage*, *63*(9), 1858–1871. https://doi.org/10.1080/17470211003605142
Lee, M., & Wagenmakers, E.-J. (2013). *Bayesian cognitive modeling: A practical course*. Cambridge University Press. https://doi.org/10.1017/CBO9781139087759
Liang, M., Gao, L., Cheng, C., Zhou, Q., Uy, J. P., Heiner, K., & Sun, C. (2020). Efficacy of face mask in preventing respiratory virus transmission: A systematic review and meta-analysis. *Travel Medicine and Infectious Disease*, *36*, 101751. https://doi.org/10.1016/j.tmaid.2020.101751
Liuzza, M. T., Cazzato, V., Vecchione, M., Crostella, F., Caprara, G. V., & Aglioti, S. M. (2011). Follow my eyes: The gaze of politicians reflexively captures the gaze of ingroup voters. *PLoS ONE*, *6*(9), e25117. https://doi.org/10.1371/journal.pone.0025117
Liuzza, M. T., Vecchione, M., Dentale, F., Crostella, F., Barbaranelli, C., Caprara, G. V., & Aglioti, S. M. (2013). A look into the ballot box: Gaze following conveys information about implicit attitudes toward politicians. *Quarterly Journal of Experimental Psychology*, *66*(2), 209–216. https://doi.org/10.1080/17470218.2012.754909

Macdonald, R. G., & Tatler, B. W. (2013). Do as eye say: Gaze cueing and language in a real-world social interaction. *Journal of Vision*, *13*(4), 6–6. https://doi.org/10.1167/13.4.6

Macrae, C. N., Bodenhausen, G. V., Milne, A. B., Thorn, T. M. J., & Castelli, L. (1997). On the activation of social stereotypes: The moderating role of processing objectives. *Journal of Experimental Social Psychology*, *33*(5), 471–489. https://doi.org/10.1006/jesp.1997.1328

Magee, J. C., & Galinsky, A. D. (2008). Social hierarchy: the self-reinforcing nature of power and status. *Academy of Management Annals*, *2*(1), 351–398. https://doi.org/10.5465/19416520802211628

Malienko, A., Harrar, V., & Khan, A. Z. (2018). Contrasting effects of exogenous cueing on saccades and reaches. *Journal of Vision*, *18*(9), 1–16. https://doi.org/10.1167/18.9.4

Mandalaywala, T. M., Tai, C., & Rhodes, M. (2020). Children's use of race and gender as cues to social status. *PLOS ONE*, *15*(6), e0234398. https://doi.org/10.1371/journal.pone.0234398

Maner, J. K., Dewall, C. N., & Gailliot, M. T. (2008). Selective attention to signs of success: Social dominance and early stage interpersonal perception. *Personality and Social Psychology Bulletin*, *34*(4), 488–501. https://doi.org/10.1177/0146167207311910

Marini, M., Ansani, A., Paglieri, F., Caruana, F., & Viola, M. (2021). The impact of facemasks on emotion recognition, trust attribution and re-identification. *Scientific Reports*, *11*, 5577. https://doi.org/10.1038/s41598-021-84806-5

Marotta, A., Casagrande, M., Rosa, C., Maccari, L., Berloco, B., & Pasini, A. (2014). Impaired reflexive orienting to social cues in attention deficit hyperactivity disorder. *European Child and Adolescent Psychiatry*, *23*(8), 649–657. https://doi.org/10.1007/s00787-013-0505-8

Marotta, A., Chiaie, R. D., Bernabei, L., Grasso, R., Biondi, M., & Casagrande, M. (2018). Investigating gaze processing in euthymic bipolar disorder: Impaired ability to infer mental state and intention, but preservation of social attentional orienting. *Quarterly Journal of Experimental Psychology*, *71*(10), 2041–2051. https://doi.org/10.1177/1747021817737769

Mattan, B. D., Kubota, J. T., & Cloutier, J. (2017). How social status shapes person perception and evaluation: A social neuroscience perspective. *Perspectives on Psychological Science*, *12*(3), 468–507. https://doi.org/10.1177/1745691616677828

Maurer, D. (1985). Infants' perception of facedness. In T. M. Field & N. A. Fox (Eds.), *Social Perception in Infants* (pp. 73–100). Norwood, NJ: Ablex.

Meng, H., Zhong, R., Huang, Q., He, G., Liu, T., Xiao, J., … Ma, W. (2021). Analysis on the use of face masks and basic protection awareness of the public during the COVID-19 epidemic. *South China Journal of Preventive Medicine*, *47*, 188–192. https://doi.org/10.12183/j.scjpm.2021.0188

Mheidly, N., Fares, M. Y., Zalzale, H., & Fares, J. (2020). Effect of face masks on interpersonal communication during the COVID-19 pandemic. *Frontiers in*

Public Health, *8*, 898. https://doi.org/10.3389/fpubh.2020.582191
Miller, S. C., Olson, M. A., & Fazio, R. H. (2004). Perceived reactions to interracial romantic relationships: When race is ssed as a cue to status. *Group Processes and Intergroup Relations*, *7*(4), 354–369. https://doi.org/10.1177/1368430204046143
Miyamoto, Y., Yoo, J., Levine, C. S., Park, J., Boylan, J. M., Sims, T., … Ryff, C. D. (2018). Culture and social hierarchy: Self- and other-oriented correlates of socioeconomic status across cultures. *Journal of Personality and Social Psychology*, *115*(3), 427–445. https://doi.org/10.1037/pspi0000133
Müller, H. J., & Rabbitt, P. M. A. (1989). Reflexive and voluntary orienting of visual attention: Time course of activation and resistance to interruption. *Journal of Experimental Psychology: Human Perception and Performance*, *15*(2), 315–330. https://doi.org/10.1037/0096-1523.15.2.315
Nestor, M. S., Fischer, D., & Arnold, D. (2020). “Masking” our emotions: Botulinum toxin, facial expression, and well-being in the age of COVID-19. *Journal of Cosmetic Dermatology*, *19*(9), 2154–2160. https://doi.org/10.1111/jocd.13569
Nie, J., Duan, X., Wang, B., Zhao, X., & Huang, N. (2015). Survey of environmental exposure-related wearing masks behavior patterns in Chinese adults. *Ournal of Environment and Health*, *32*(3), 234–236. https://doi.org/10.16241/j.cnki.1001-5914.2015.03.013
Noyes, E., Davis, J. P., Petrov, N., Gray, K. L. H., & Ritchie, K. L. (2021). The effect of face masks and sunglasses on identity and expression recognition with super-recognizers and typical observers. *Royal Society Open Science*, *8*, 201169. https://doi.org/10.1098/rsos.201169
Ohlsen, G., van Zoest, W., & van Vugt, M. (2013). Gender and facial dominance in gaze cuing: emotional context natters in the eyes that we gollow. *PLoS ONE*, *8*(4), e59471. https://doi.org/10.1371/journal.pone.0059471
Olivera-La Rosa, A., Chuquichambi, E. G., & Ingram, G. P. D. (2020). Keep your (social) distance: Pathogen concerns and social perception in the time of COVID-19. *Personality and Individual Differences*, *166*, 110200. https://doi.org/10.1016/j.paid.2020.110200
Osborne-Crowley, K. (2020). Social cognition in the real world: Reconnecting the study of social cognition with social reality. *Review of General Psychology*, *24*(2), 144–158. https://doi.org/10.1177/1089268020906483
Osborne, C. D., & Stevenage, S. V. (2007). Internal feature saliency as a marker of familiarity and configural processing. *Visual Cognition*, *16*(1), 23–43. https://doi.org/10.1080/13506280701238073
Parada-Fernández, P., Herrero-Fernández, D., Jorge, R., & Comesaña, P. (2022). Wearing mask hinders emotion recognition, but enhances perception of attractiveness. *Personality and Individual Differences*, *184*, 111195. https://doi.org/10.1016/J.PAID.2021.111195
Pavan, G., Dalmaso, M., Galfano, G., & Castelli, L. (2011). Racial group membership ss associated to gaze-mediated orienting in Italy. *PLoS ONE*, *6*(10), e25608. https://doi.org/10.1371/journal.pone.0025608

Pfeiffer, U. J., Vogeley, K., & Schilbach, L. (2013). From gaze cueing to dual eye-tracking: Novel approaches to investigate the neural correlates of gaze in social interaction. *Neuroscience and Biobehavioral Reviews*, *37*(10), 2516–2528. https://doi.org/10.1016/j.neubiorev.2013.07.017

Pickron, C. B., Fava, E., & Scott, L. S. (2017). Follow my gaze: Face race and sex influence gaze-cued attention in infancy. *Infancy*, *22*(5), 626–644. https://doi.org/10.1111/infa.12180

Porciello, G., Holmes, B. S., Liuzza, M. T., Crostella, F., Aglioti, S. M., & Bufalari, I. (2014). Interpersonal multisensory stimulation reduces the overwhelming distracting power of self-gaze: Psychophysical evidence for "engazement." *Scientific Reports*, *4*, 1–7. https://doi.org/10.1038/srep06669

Porciello, G., Liuzza, M. T., Minio-Paluello, I., Caprara, G. V., & Aglioti, S. M. (2016). Fortunes and misfortunes of political leaders reflected in the eyes of their electors. *Experimental Brain Research*, *234*, 733–740. https://doi.org/10.1007/s00221-015-4496-1

Posner, M. I. (1980). Orienting of attention. *Quarterly Journal of Experimental Psychology*, *32*(1), 3–25. https://doi.org/10.1080/00335558008248231

Qian, M. K., Heyman, G. D., Quinn, P. C., Messi, F. A., Fu, G., & Lee, K. (2016). Implicit racial biases in preschool children and adults from Asia and Africa. *Child Development*, *87*(1), 285–296. https://doi.org/10.1111/cdev.12442

Quadflieg, S., Mason, M. F., & Macrae, C. N. (2004). The owl and the pussycat: Gaze cues and visuospatial orienting. *Psychonomic Bulletin and Review*, *11*(5), 826–831. https://doi.org/10.3758/BF03196708

Ratcliff, N. J., Hugenberg, K., Shriver, E. R., & Bernstein, M. J. (2011). The allure of status: High-status targets are privileged in face processing and memory. *Personality and Social Psychology Bulletin*, *37*(8), 1003–1015. https://doi.org/10.1177/0146167211407210

Reid, V. M., & Striano, T. (2005). Adult gaze influences infant attention and object processing: Implications for cognitive neuroscience. *European Journal of Neuroscience*, *21*(6), 1763–1766. https://doi.org/10.1111/J.1460-9568.2005.03986.X

Ricciardelli, P., Baylis, G., & Driver, J. (2000). The positive and negative of human expertise in gaze perception. *Cognition*, *77*(1), B1–B14. https://doi.org/10.1016/S0010-0277(00)00092-5

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 individual's gaze. *Neuroreport*, *13*(17), 2259–2264. https://doi.org/10.1097/01.wnr.0000044227

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

Rodger, H., Kelly, D. J., Blais, C., & Caldara, R. (2010). Inverting faces does not abolish cultural diversity in eye movements. *Perception*, *39*(11), 1491–1503. https://doi.org/10.1068/p6750

Roth, T. S., Du, X., Samara, I., & Kret, M. E. (2021). Attractiveness modulates attention, but does not enhance gaze cueing. *Evolutionary Behavioral Sciences*, Advance online publication. https://doi.org/10.1037/ebs0000265

Ruba, A. L., & Pollak, S. D. (2020). Children's emotion inferences from masked faces: Implications for social interactions during COVID-19. *PLOS ONE*, *15*(12), e0243708. https://doi.org/10.1371/journal.pone.0243708

Santangelo, V., & Spence, C. (2008). Is the exogenous orienting of spatial attention truly automatic? Evidence from unimodal and multisensory studies. *Consciousness and Cognition*, *17*(3), 989–1015. https://doi.org/10.1016/j.concog.2008.02.006

Sato, W., Okada, T., & Toichi, M. (2007). Attentional shift by gaze is triggered without awareness. *Experimental Brain Research*, *183*(1), 87–94. https://doi.org/10.1007/s00221-007-1025-x

Schaller, M., Miller, G. E., Gervais, W. M., Yager, S., & Chen, E. (2010). Mere visual perception of other people's disease symptoms facilitates a more aggressive immune response. *Psychological Science*, *21*(5), 649–652. https://doi.org/10.1177/0956797610368064

Schmidtmann, G., Logan, A. J., Carbon, C.-C., Loong, J. T., & Gold, I. (2020). In the blink of an eye: Reading mental states from briefly presented eye regions. *I-Perception*, *11*(5), 1–17. https://doi.org/10.1177/2041669520961116

Senju, A., Vernetti, A., Kikuchi, Y., Akechi, H., Hasegawa, T., & Johnson, M. H. (2013). Cultural background modulates how we look at other persons' gaze. *International Journal of Behavioral Development*, *37*(2), 131–136. https://doi.org/10.1177/0165025412465360

Shamay-Tsoory, S. G., & Mendelsohn, A. (2019). Real-life neuroscience: An ecological approach to brain and behavior research. *Perspectives on Psychological Science*, *14*(5), 841–859. https://doi.org/10.1177/1745691619856350

Shamay-Tsoory, S. G., Tibi-Elhanany, Y., & Aharon-Peretz, J. (2007). The green-eyed monster and malicious joy: the neuroanatomical bases of envy and gloating (schadenfreude). *Brain*, *130*(6), 1663–1678. https://doi.org/10.1093/brain/awm093

Shepherd, S. V. (2010). Following gaze: Gaze-following behavior as a window into social cognition. *Frontiers in Integrative Neuroscience*, *4*(1). https://doi.org/10.3389/fnint.2010.00005

Shepherd, S. V., Deaner, R. O., & Platt, M. L. (2006). Social status gates social attention in monkeys. *Current Biology*, *16*(4), 1–7. https://doi.org/10.1016/j.cub.2006.02.013

Sin, M. S. Y. (2016). Masking fears: SARS and the politics of public health in China. *Critical Public Health*, *26*(1), 88–98. https://doi.org/10.1080/09581596.2014.923815

Sinha, P. (2000). Last but not least. *Perception*, *29*(8), 1005–1008. https://doi.org/10.1068/p2908no

Slessor, G., Phillips, L. H., & Bull, R. (2008). Age-related declines in basic social perception: Evidence from tasks assessing eye-gaze processing. *Psychology and*

Aging, *23*(4), 812–822. https://doi.org/10.1037/a0014348
Slessor, G., Venturini, C., Bonny, E. J., Insch, P. M., Rokaszewicz, A., & Finnerty, A. N. (2016). Specificity of age-related differences in eye-gaze following: Evidence from social and nonsocial stimuli. *Journals of Gerontology - Series B Psychological Sciences and Social Sciences*, *71*(1), 11–22. https://doi.org/10.1093/geronb/gbu088
Spitzer, M. (2020). Masked education? The benefits and burdens of wearing face masks in schools during the current Corona pandemic. *Trends in Neuroscience and Education*, *20*(June), 100138. https://doi.org/10.1016/j.tine.2020.100138
Strachan, J. W. A., Kirkham, A. J., Manssuer, L. R., Over, H., & Tipper, S. P. (2017). Incidental learning of trust from eye-gaze: Effects of race and facial trustworthiness. *Visual Cognition*, *25*(7–8), 802–814. https://doi.org/10.1080/13506285.2017.1338321
Striano, T., & Reid, V. M. (2006). Social cognition in the first year. *Trends in Cognitive Sciences*, (10), 471–476. https://doi.org/10.1016/j.tics.2006.08.006
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
Süßenbach, F., & Schönbrodt, F. (2014). Not afraid to trust you: Trustworthiness moderates gaze cueing but not in highly anxious participants. *Journal of Cognitive Psychology*, *26*(6), 670–678. https://doi.org/10.1080/20445911.2014.945457
Teufel, C., Fletcher, P. C., & Davis, G. (2010). Seeing other minds: Attributed mental states influence perception. *Trends in Cognitive Sciences*, *14*(8), 376–382. https://doi.org/10.1016/j.tics.2010.05.005
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
Tipples, J. (2006). Fear and fearfulness potentiate automatic orienting to eye gaze. *Cognition & Emotion*, *20*(2), 309–320. https://doi.org/10.1080/02699930500405550
Tomelleri, S., & Castelli, L. (2012). On the nature of gender categorization: Pervasive but flexible. *Social Psychology*, (43), 14–27. https://doi.org/10.1027/1864-9335/a000076
van der Sande, M., Teunis, P., & Sabel, R. (2008). Professional and home-made face masks reduce exposure to respiratory infections among the general population. *PLoS ONE*, *3*(7), e2618. https://doi.org/10.1371/journal.pone.0002618
Vecera, S. P., & Rizzo, M. (2004). What are you looking at?: Impaired 'social attention' following frontal-lobe damage. *Neuropsychologia*, *42*(12), 1657–1665. https://doi.org/10.1016/j.neuropsychologia.2004.04.009
Vecera, S. P., & Rizzo, M. (2006). Eye gaze does not produce reflexive shifts of attention: Evidence from frontal-lobe damage. *Neuropsychologia*, *44*(1), 150–159. https://doi.org/10.1016/j.neuropsychologia.2005.04.010

Wahl, S., Michel, C., Pauen, S., & Hoehl, S. (2013). Head and eye movements affect object processing in 4-month-old infants more than an artificial orientation cue. *British Journal of Developmental Psychology*, *31*(2), 212–230. https://doi.org/10.1111/bjdp.12001

Walker-Smith, G. J., Gale, A. G., & Findlay, J. M. (1977). Eye movement strategies involved in face perception. *Perception*, *6*(3), 313–326. https://doi.org/10.1068/p060313

Weisbuch, M., Pauker, K., Adams, R. B., 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

Wu, S., & Keysar, B. (2007). The effect of culture on perspective taking. *Psychological Science*, *18*(7), 600–606. https://doi.org/10.1111/j.1467-9280.2007.01946.x

Xu, S., Zhang, S., & Geng, H. (2011). Gaze-induced joint attention persists under high perceptual load and does not depend on awareness. *Vision Research*, *51*(18), 2048–2056. https://doi.org/10.1016/j.visres.2011.07.023

Yantis, S. (2000). Goal-directed and stimulus-driven determinants of attentional control. In S. Monsell & J. Driver (Eds.), *Attention and performance* (pp. 73–103). Cambridge: Cambridge, MA; MIT Press.

Yantis, S., & Hillstrom, A. P. (1994). Stimulus-Driven Attentional Capture: Evidence From Equiluminant Visual Objects. *Journal of Experimental Psychology: Human Perception and Performance*, *20*(1), 95–107. https://doi.org/10.1037/0096-1523.20.1.95

Yeung, E. (2015). White and beautiful: An examination of skin whitening practices and female empowerment in China. *On Our Terms: The Undergraduate Journal of the Athena Center for Leadership Studies at Barnard College*, *3*(1), 35–47. https://doi.org/10.7916/D8125S64

Zebrowitz, L. A. (2017). First impressions from faces. *Current Directions in Psychological Science*, *26*(3), 237. https://doi.org/10.1177/0963721416683996

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*, 741–762. https://doi.org/10.1111/bjop.12476

Appendix I

Perceived social status questionnaire

We adapted the questionnaire developed by Qian and colleagues (2016) with the aim to assess the perceived relative social status of White, Asian, and Black people in two different samples, namely Italian and Chinese adult students. The questionnaire was structured into two sections. In the first section, we investigated personal beliefs, whereas in the second section we investigated the perceived beliefs of other ingroup members in general, irrespective of personal attitudes. Following Qian et al. (2016), both sections asked about issues of wealth, education, and job status which are considered to be key determinants of social status (see Axt et al., 2014; Bigler, 2001; Newheiser & Olson, 2012; Olson et al., 2012). In the first section of the questionnaire, participants were asked to make straightforward comparisons between two groups (e.g., as for job status: "How likely is that White people have higher status jobs as compared to Black people?") and responses were provided on a 7-point Likert scale (from "extremely unlikely" to "extremely likely"). In the second section of the questionnaire, participants were asked to report, from the perspective of their ingroup members, the percentage of White/Asian/Black people that could be considered as having specific characteristics related to the three dimensions mentioned above (e.g., as for wealth "What percentage of White people have enough money to own a nice car and travel for fun?").

We separately present findings stemming from the Italian and Chinese sample.

Method for Italian sample

Participants

The sample consisted of 26 White Italian participants (21 females, *mean age* =

31 years, age range = 19-50) from the same population who took part in the experimental studies.

Procedure

Participants completed two sections. The first section included nine items asking about the relative wealth, education, and job status of White, Asian, and Black people in pairwise comparisons (i.e., White versus Asian, Asian versus Black, and White versus Black). The second section included nine items asking again about wealth, education, and job status. In this case, however, participants were asked to respond from the perspective of their ingroup members, namely how Italian people in general could have responded to each question. Participants were asked to provide separate ratings for White, Asian, and Black people. Ratings had to be made in terms of percentages, from 0% to 100% with 5% increments.

Results for Italian sample

As for the first section of the questionnaire, we averaged the responses along the three dimensions and performed one-sample *t*-tests for group comparison. More specifically, it was tested whether each score was significantly different from 4 (i.e., the mean point of the response scale indicating equal social status). Results showed that Italian adults perceived White people to have a higher status than Black people (M = 5.19, SE = .12), $t(25)$ = 10.17, p < .001, d = 2.00, and Asian people to have a higher status than Black people (M = 4.68, SE = 1.34), $t(25)$ = 5.07, p < .001, d =1.00. In contrast, the social status of White people was not perceived to be significantly different from the social status of Asian people (M = 4.24, SE = .15), $t(25)$ = 1.68, p

=.106, *d* =.33.

As for the second section of the questionnaire, we again averaged the responses along the three dimensions thus obtaining one score for each target group. A series of paired-sample t-tests was then performed. Results showed that White people (M = 52.69, SE = 3.58) were perceived to have a higher status than Black people (M = 23.01, SE = 2.78), $t(25) = 10.54$, $p < .001$, $d = 2.07$, Asian people (M = 41.44, SE = 4.06) to have a higher status than Black people, $t(25) = 5.97$, $p < .001$, $d = 1.17$, and White people to have a higher status than Asian people, $t(25) = 3.84$, $p < .001$, $d = .07$. Notably, however, the difference in perceived social status between White and Black people, on the one hand, and White and Asian people, on the other, was far larger in the former case, $t(25) = 5.97$, $p < .001$, $d = 1.17$.

Method for Chinese sample

Participants

The sample consisted of 30 Chinese students (21 females, *mean age* = 20 years, age range = 18-21) from the same population who took part in the experimental studies.

Procedure

The same procedure described above was adopted, the only difference being that a Chinese version of the questionnaire was used.

Results for Chinese sample

Data were analysed as detailed above for the Italian sample. Results showed that Chinese adults perceived White people to have a higher status than Black people ($M = 5.79$, $SE = .12$), $t(29) = 14.392$, $p < .001$, $d = 2.63$,and Asian people to have a higher status than Black people ($M = 5.12$, $SE = .12$), $t(29) = 9.513$, $p < .001$, $d = 1.74$. In addition, Chinese adults perceived White people to have a higher status than Asian people ($M = 4.78$, $SE = .12$), $t(29) = 6.792$, $p < .001$, $d = 1.24$.

As for the second section of the questionnaire, results showed that White people ($M = 46.79$, $SE = 3.08$) were perceived to have a higher status than Black people ($M = 20.83$, $SE = 2.75$), $t(29) = 9.01$, $p < .001$, $d = 1.65$, Asian people ($M = 38.89$, $SE = 3.08$) to have a higher status than Black people, $t(29) = 8.26$, $p < .001$, $d = 1.51$, and White people to have a higher status than Asian people, $t(29) = 2.89$, $p = .007$, $d = 0.53$. Still, Chinese adults perceived White people to have a higher social status than Asian people.

Appendix II

Questionnaire items in Study 3

Section 1: Personal habits

A1) In this period of coronavirus-related restrictive measures, on average, how often do you leave your house?

1. Never
2. Less than three times a week
3. Three times a week
4. Four to six times a week
5. Every day

B1) In this period of coronavirus-related restrictive measures, when you are away from your house, how often – on average – do you wear face mask when you are outdoors?

1. Never
2. Hardly ever
3. Once in two (50% of the time I am outdoors)
4. Almost always
5. Always

C1) In this period of coronavirus-related restrictive measures, when you are away from your house, how often – on average – do you wear face mask when you are indoors?

1. Never
2. Hardly ever

3. Once in two (50% of the time I am outdoors)

4. Almost always

5. Always

Section 2: Concerns about potential infection risk

A2) In this period of coronavirus-related restrictive measures, how much important do you consider wearing face mask when you are indoors?

1. Not important at all

2. Not very important

3. I don't know

4. Quite important

5. Extremely important

B2) In this period of coronavirus-related restrictive measures, how worried do you feel about a possible coronavirus contagion?

1. Not important at all

2. Not very important

3. I don't know

4. Quite important

5. Extremely important

C2) In this period of coronavirus-related restrictive measures, if you are away from your house and you notice a person without a mask coming towards you, how worried do you feel?

1. Not worried at all

2. Little worried

3. I don't know

4. Quite worried

5. Extremely worried