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Social attention across borders: A cross-cultural investigation of gaze cueing elicited by same- and other-ethnicity faces

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The gaze-cueing effect is a robust phenomenon which illustrates how attention can be shaped by social factors. In four experiments, the present study explored the interaction between the ethnic membership of the participant and that of the face providing the gaze cue. Firstly, we aimed to further investigate the differential impact of White, Black, and Asian faces on the gaze-cueing effect in White individuals. Secondly, we aimed to explore, for the first time, the impact of faces belonging to different ethnicities on gaze cueing in Chinese participants. The results allowed to rule out alternative accounts and showed that White participants exhibit a gaze-cueing effect for White and Asian faces, but not for Black faces, consistent with previous studies. As regards Chinese participants, the overall findings suggested a stronger gaze-cueing effect for White faces than for Asian faces. The results are discussed with reference to differences in the perceived social status of the various groups, pointing to the need of taking into account different cultural contexts.

Humans are sensitive to the eyes of others since birth (Farroni, Csibra, Simion, & Johnson, 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 *et al*., 2015a; Dalmaso, Galfano, Tarqui, Forti, & Castelli, 2013; Dawson, Meltzoff, Osterling, Rinaldi, & Brown, 1998; Kuhn *et al*., 2010; Langdon, Corner, McLaren, Coltheart, & Ward, 2006; Marotta *et al*., 2014, 2018).

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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 & Tipper, 2005; Carraro *et al*., 2017; Chen & Zhao, 2015; Ciardo, Ricciardelli, Lugli, Rubichi, & Iani, 2015; Dalmaso, Alessi, Castelli, & Galfano, 2020a; Deaner, Shepherd, & Platt, 2006; Farroni, Massaccesi, Pividori, & Johnson, 2004; 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, Castelli, & Galfano, 2020b). For instance, Jones *et al*. (2010) showed that the gaze of dominant (masculinized) faces elicits a stronger gaze-cueing effect than the gaze of subordinate (feminized) 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, Dalmaso, Castelli, & Galfano, 2015; Dodd, Hibbing, & Smith, 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, Dalmaso, Galfano, and Castelli (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, Pauker, Adams, Lamer, & Ambady, 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, Galfano, & Castelli, 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, Kirkham, Manssuer, Over, and Tipper (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 towards 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. Moreover, 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, Galfano, Coricelli, & Castelli, 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).

EXPERIMENT 1

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.

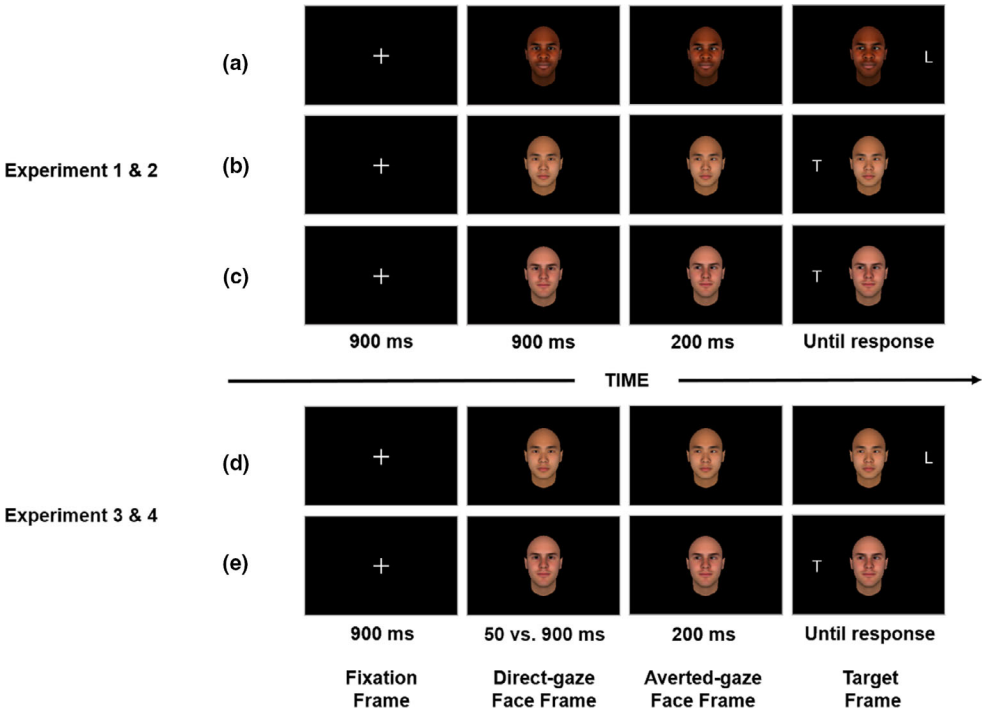

Figure 1. Illustration of experimental procedure and stimuli (not drawn to scale) used in the experiments. The three upper panels refer to Experiments 1 and 2, in which the direct-gaze face frame lasted 900 ms. Examples of an incongruent trial with a Black face (a), a congruent trial with an Asian face (b), and a congruent trial with a White face (c) are shown. The two lower panels refer to Experiments 3 and 4, 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.

Design and procedure

Each experimental session lasted approximately 30 minutes and all participants were tested by a White Italian experimenter. Participants were seated 57 cm 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_p^2 = .04; ethnicity: F (1,39) = 2.09, p = .156, η_p^2 = .05). However, importantly, the interaction between congruency and ethnicity was significant, F (1,39) = 4.45, p = .041, η_p^2 = .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_p^2 = .19, indicating shorter RTs on congruent trials (M = 555 ms, SE = 13) than on incongruent trials (M = 564 ms, SE = 13). Ethnicity led to a non-significant main effect, F (1,39) = 0.06, p = .801, η_p^2 = .00. In contrast with the previous condition, the interaction between congruency and

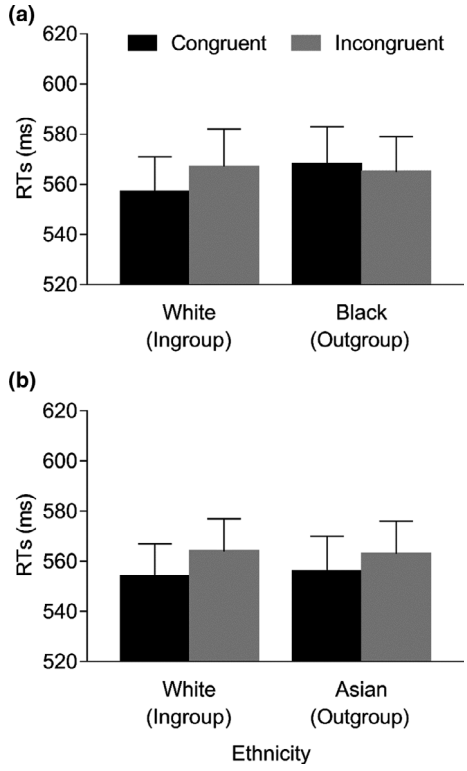

Figure 2. RTs for correct responses as a function of spatial congruency and ethnicity of the faces in Experiment 1 (White participants). Error bars represent standard errors.

ethnicity was not significant, F (1,39) = 0.16, p = .687, η_p^2 = .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_p^2 = .01; ethnicity: F(1,39) = 2.54, p = .119, η_p^2 = .06) nor a significant interaction, F (1,39) = 2.74, p = .106, η_p^2 = .07. Similarly, in the White vs. Asian condition, there were neither significant main effects (congruency: F(1,39) = 3.34, p = .075, η_p^2 = .08; ethnicity: F (1,39) = 2.07, p = .159, η_p^2 = .05) nor a significant interaction, F (1,39) = 0.09, p = .770, η_p^2 = .00. Thus, the data were unlikely to be affected by any speed-accuracy trade-off.

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). 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.

EXPERIMENT 2

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 1 was adopted. Face stimuli were the same as in Experiment 1 (see Figure 1).

Design and procedure

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

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: $F(1,33) = 2.13, p = .154, \eta_p^2 = .06$; ethnicity: $F(1,33) = 0.39, p = .536, \eta_p^2 = .01$) nor a significant interaction, $F(1,33) = 0.02, p = .892, \eta_p^2 = .00$. In the same vein, in the Asian vs. White condition, there were neither significant main effects (congruency: $F(1,33) = 1.02, p = .320, \eta_p^2 = .03$; ethnicity: $F(1,33) = 1.78, p = .192, \eta_p^2 = .05$) nor a significant interaction, $F(1,33) = 2.36, p = .134, \eta_p^2 = .07$. Hence, the data were unlikely to be affected by any speed-accuracy trade-off.

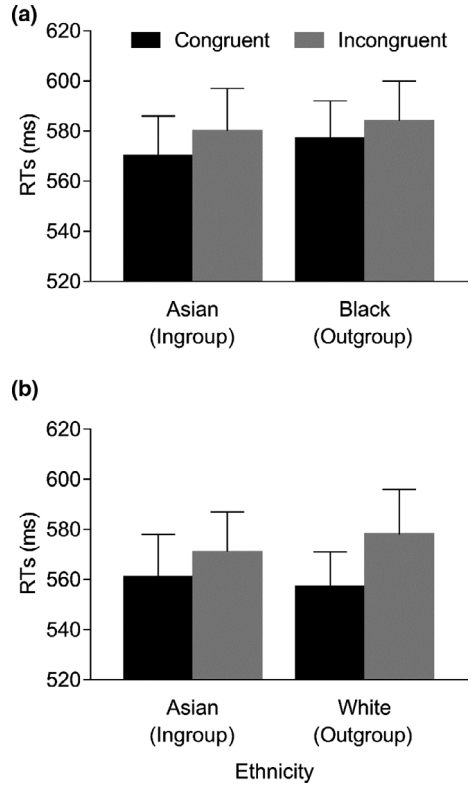

Figure 3. RTs for correct responses as a function of spatial congruency and ethnicity of the faces in Experiment 2 (Asian participants). Error bars represent standard errors.

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 (e.g., Dalmaso *et al.*, 2014). Hence, one may hypothesize 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 1 and 2, 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 3) and Chinese (Experiment 4) 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 1 and 2 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 3

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 1. Face stimuli were the same as Experiment 1, except that Black faces were removed.

Design and procedure

The gaze-cueing paradigm was the same as in Experiment 1 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, $F(1,39) = 19.39$, $p < .001$, $\eta_p^2 = .33$, with shorter RTs on congruent trials ($M = 579$ ms, $SE = 15$) than on incongruent trials ($M = 590$ ms, $SE = 14$). Ethnicity also yielded a significant main effect, $F(1,39) = 5.13$, $p = .029$, $\eta_p^2 = .12$, reflecting longer RTs for Asian ($M = 589$ ms, $SE = 15$) than for White faces ($M = 581$ ms, $SE = 14$). A significant main effect emerged also for Direct-gaze frame duration, $F(1,39) = 6.37$, $p = .016$, $\eta_p^2 = .14$, reflecting longer RTs for the short ($M = 589$ ms, $SE = 15$) than for the long duration ($M = 580$ ms, $SE = 15$) direct-gaze frame. No significant interactions emerged (congruency × ethnicity, $F(1,39) = 2.67$, $p = .110$, $\eta_p^2 = .07$; congruency × duration interaction, $F(1,39) = 1.07$, $p = .306$, $\eta_p^2 = .03$; ethnicity × duration interaction $F(1,39) = 0.01$, $p = .937$, $\eta_p^2 = .00$; congruency × ethnicity × duration interaction, $F(1,39) = 1.18$, $p = .283$, $\eta_p^2 = .03$; see also Figure 4).

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

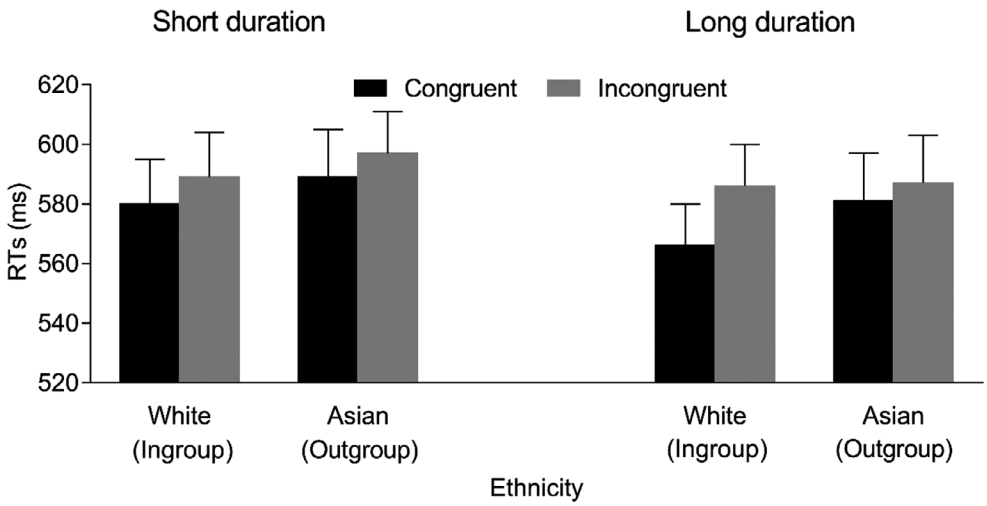

Figure 4. RTs for correct responses as a function of spatial congruency, ethnicity of the faces, and duration of the direct-gaze face frame in Experiment 3 (White participants). Error bars represent standard errors.

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 1.

Experiment 4

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 3, except that 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, η_p^2 = .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, η_p^2 = .12, indicating that participants showed a gaze-cueing effect towards White faces, t (1,37) = 4.67, p < .001, d =.82, but not towards 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, η_p^2 = .03; ethnicity × duration interaction, F (1,37) = 0.45, p = .506, η_p^2 = .01; congruency × ethnicity × duration interaction, F (1,37) = 0.84, p = .367, η_p^2 = .02).

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

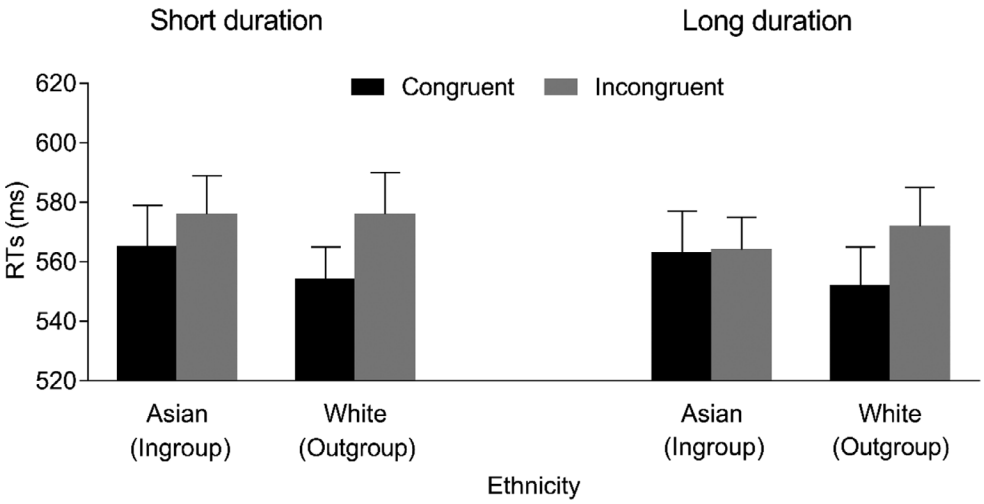

Figure 5. RTs for correct responses as a function of spatial congruency, ethnicity of the faces, and duration of the direct-gaze face frame in Experiment 4 (Asian participants). Error bars represent standard errors.

Combined analysis of Experiment 2 and 4

In order to provide a measure of the robustness of the patterns emerged in Experiment 2 and 4 concerning the comparison between White and Asian faces, further analyses were performed. First, even though in Experiment 2 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 2 with the long direct-gaze frame duration data of Experiment 4 was conducted. Congruency (congruent vs. incongruent) and ethnicity (White vs. Asian) of the face were included as within-participant factors, whereas experiment (2 vs. 4) 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, $p = .001$, $\eta_p^2 = .144$, further qualified by a significant congruency × ethnicity interaction, F (1,70) = 5.94, $p = .017$, $\eta_p^2 = .08$. 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 4 show evidence for a robust gaze-cueing effect for White faces in Chinese participants. 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.

GENERAL 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 (e.g., 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.*, 2020b 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 1 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 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 1 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 3 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 3 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) 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 2 and 4. 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; e.g., 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). 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). Accordingly, in Experiment 2, 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 socio-economic status leads to different outcomes in different cultures. For instance, a recent study has shown that in East Asian countries a high socio-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.*, 2014; Dalmaso, Pavan, Castelli, & Galfano, 2012) 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.*, 2020b). 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.*, 2020b). 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.

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Conflict of interest

All authors declare no conflict of interest.

Author's contribution

Xinyuan Zhang (Conceptualization; Data curation; Formal analysis; Supervision; Writing – original draft; Writing – review & editing) Mario Dalmaso (Conceptualization; Supervision; Writing – review & editing) Luigi Castelli (Conceptualization; Resources; Supervision; Writing – review & editing) Alberto Fiorese (Project administration) Yonglong Lan (Project administration) Bo Sun (Project administration) Shimin Fu (Resources; Supervision) Giovanni Galfano (Conceptualization; Resources; Supervision; Writing – review & editing).

Data availability statement

The data sets generated and analysed during the current study are available from the corresponding author on reasonable request.

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Appendix :

Perceived social status differences between different ethnic groups in Italian and Chinese adults

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 *et al.*, 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.

Italian sample

Method

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

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 ($M = 4.68$, $SE = .13$), $t(25) = 5.07$, $p < .001$, $d = 1.00$. 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, $t(25) = 5.97$, $p < .001$, $d = 1.17$.

Chinese sample

Method

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

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.