A developmental investigation of the other-race categorization advantage in a multiracial population: Contrasting social categorization and perceptual expertise accounts

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Acknowledgements: The authors wish to thank Yvonne Choo, Kerryn Lum, and Melissa Nuah for their assistance in conducting the study. This research has been partially supported by a Sunway University Internal Grant (INT-FST-PSY-0312-01).

Declarations of interest: none

Word Count: 4359

Abstract

Most prior studies of the other-race categorization advantage have been conducted in predominantly monoracial societies. This limitation has left open the question of whether tendencies to more rapidly and accurately categorize other-race faces is an effect based on social categorization (own- versus other-race) or perceptual expertise (frequent or infrequent exposure). To address this question, we tested Malay and Malaysian Chinese children (9- to 10-year-olds) and adults on (1) own-race faces (i.e., Malay faces for Malay participants and Chinese faces for Malaysian Chinese participants), (2) high frequency other-race faces (i.e., Chinese faces for Malay participants, and Malay faces for Malaysian Chinese participants), and (3) low frequency other-race faces (i.e., Caucasian faces). While the other-race categorization advantage was in evidence in the accuracy data of Malay adults, other aspects of performance were supportive of either the social categorization or perceptual expertise accounts, and were dependent on the race (Malay vs. Chinese) or age (child vs. adult) of the participants. Of particular significance is the finding that Malaysian Chinese children and adults categorized own-race Chinese faces more rapidly than high frequency other-race Malay faces. The overall pattern of outcomes indicates that experience with different class of faces tunes the face recognition system towards the majority class of faces present in a multiracial society. Moreover, in accord with a perceptual expertise account, the other-race categorization advantage is more an advantage for racial categories of lesser experience, regardless of whether these face categories are own or other race.

Keywords: face categorization; other-race categorization advantage; multiracial; ingroup-outgroup

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The ability to recognize and categorize different faces proficiently may have social and evolutionary advantages, allowing us to identify different individuals, remember the behavior of specific individuals in social situations, detect emotions, and recognize ingroup and outgroup members (Pascalis et al., 2014). Thus, investigating how people learn and process information about faces is of particular interest for understanding human social behavior.

The Other-Race Effect (Own-Race Recognition Advantage)

Past empirical studies have confirmed that individuals process own- and other-race faces differently. One well established effect, the other-race effect, also known as the own-race recognition advantage, indicates that individuals recognize faces of their own race more accurately and faster relative to faces of other races (Ge et al., 2009; Rhodes, Locke, Ewing, & Evangelista, 2009; Slone, Brigham, & Meissner, 2000; Walker & Tanaka, 2003). This effect has been studied extensively in infants, children, and adults from various populations (for reviews, see Hugenberg, Young, Bernstein, & Sacco, 2010; Lee, Anzures, Quinn, Pascalis, & Slater, 2011; Meissner & Brigham, 2001). For example, the effect has been demonstrated in infants between 6 and 9 months of age (Anzures et al., 2014; Kelly et al., 2007; Kelly et al., 2009) as well as in children aged 3 years old and above (Sangrigoli & de Schonen, 2004).

The other-race effect has also been shown to be moderated by other-race contact and can be reversed if sufficient exposure to the other-race contact is achieved. For instance, training studies (Anzures et al., 2012; Lebrecht, Pierce, Tarr, & Tanaka, 2009; Tanaka & Pierce, 2009) have found that the other-race effect can be reduced if infants, children, and adults are provided with video, picture book, or image-based experience with other-race faces. In addition, children who are adopted into an other-race family have been found to have similar recognition of own- and other-race faces (de Heering, de Liedekerke, Deboni, & Rossion, 2010), while a reversal of the other-race effect was found in adults who were adopted into an other-race family when they were young (Sangrioli, Pallier, Argenti, Ventureyra, & de Schonen, 2005). Thus, the other-race effect is a phenomenon that seems to be developed through perceptual experience and is malleable given experience with other-race faces.

The other-race effect has further been linked to implicit racial bias in preschoolers (Xiao et al., 2015). Xiao and colleagues found that preschoolers as young as 4 years of age demonstrate implicit racial bias towards another race, and that perceptual individuation training with other-race faces can reduce such bias. These results indicate that processing other-race faces at a perceptual level can affect implicit bias against other-race individuals at a social level.

The Other-Race Categorization Advantage

Another relevant area of face processing which is less researched is how we categorize faces. Contrary to the own-race recognition advantage, individuals categorize other-race faces faster and sometimes with greater accuracy than own-race faces (Levin, 1996; Valentine & Endo, 1992). This phenomenon is known as the other-race categorization advantage. For example, Zhao and Bentin (2008) found that Chinese and Israeli participants categorized other-race faces more quickly and accurately than own-race faces. The other-race categorization advantage has been demonstrated to be robust with various populations and research paradigms (Feng et al., 2011; Li, Tse, & Sun, 2018; Zhao & Bentin, 2011). In addition, like the own-race recognition advantage, the other-race categorization advantage has been linked to social bias. In a recent study, Setoh et al. (2019) found that children's racial categorization performance was associated with implicit racial bias in a multiracial population. In particular, children who were more accurate in categorizing other-race faces had higher implicit racial bias.

Relation between Own-Race Recognition and Other-Race Categorization

Ge et al. (2009) reported a negative relation between the own-race recognition advantage and other-race categorization advantage. Specifically, using a within-subject design, other-race faces were found to be more rapidly categorized, but recognized less accurately and more slowly compared with own-race faces. This result, in turn, suggests a negative relation between the processing of face identity and category information.

Theoretical Accounts

Perceptual expertise and social categorization frameworks have been postulated to account for the negative relation between the own-race recognition and other-race categorization advantage (Meissner & Brigham, 2001; Sporer, 2001). The perceptual expertise model has previously been applied to explaining aspects of perceptual and cognitive development (Gauthier & Nelson, 2001; Quinn, 2010), and in the case of race, the model postulates that extensive contact or experience with own-race members and a lack of contact with other-race members increases the accuracy of recognition of own-race faces due to the perceptual processes that are used (Tanaka, Kiefer, & Bukach, 2004) and how familiar and unfamiliar faces are represented in memory (Valentine, 2001). For example, Tanaka et al. (2004) reported that more holistic perceptual processes which allow for viewing a face as a whole are applied when we view familiar racial category of faces (i.e., own-race faces) compared to other-race faces. Such holistic processing of own-race faces, but not other-race faces, is in turn believed to slow down the response time of participants in racial categorization tasks (Zhao & Bentin, 2011).

Valentine (2001) in his face space model explains that other-race faces which we encounter less are densely clustered in face space as compared to own-race faces which are encountered more frequently. The densely clustered other-race faces are assumed to be more cognitively similar than own-race faces as neighboring exemplars interfere with accurate recall of a face leading to a deficit in differentiating and recognizing other-race faces. On the other hand, these densely clustered spaces would give to the other-race categorization advantage as the other-race faces are seen as more homogenous and would activate in the face space as a group due to the close proximity of the neighboring exemplars.

In accord with the perceptual expertise hypothesis, there is ample support for the idea that extensive contact influences both the own-race recognition advantage and other-race categorization advantage. In a series of studies, Walker and colleagues have reported a relationship between amount and type of other-race contact and the ability to perceptually differentiate other-race faces (Walker & Hewstone, 2006; Walker, Silvert, Hewstone, & Nobre, 2008; Walker & Tanaka, 2003). Participants with greater other-race experience were consistently more accurate at recognizing other-race faces than were participants with less other-race experience. Amount of contact with other-race faces has also been used to explain the other-race categorization advantage. Caldara, Rossion, Bovet, and Hauert (2004), using event-related potentials, found that Caucasian participants were faster at categorizing other-race faces than own-race faces. Caldara et al. concluded that lesser experience with other-race faces leads to a less rich representation (identity-specific face representation) which in turn yields faster categorization of these faces. However, this study did not measure or test the influence of face experience directly.

Social categorization models (e.g., Tajfel, 1970) have also been used to explain own-race recognition and other-race categorization. Sporer (2001) proposed that both effects arise from differential processing of ingroup versus outgroup members. When we encounter a face, we rapidly categorize it as belonging to our ingroup or an outgroup (Levin, 2000). This leads individuals to perceive and classify out-group members using categorization cues, resulting in superficial encoding and poorer recognition memory. By contrast, ingroup members are automatically processed in a more individuating manner, resulting in superior recognition memory (see Bernstein, Young, & Hugenberg, 2007, for supporting evidence). Moreover, Hugenberg et al. (2010), in their categorization-individuation model, suggest that one motivational factor associated with categorizing a face as in-group or out-group is the perceived relevance or importance of a face. One social categorization model that is developmental in nature is Meltzoff's (2007) "like me" model. When applied to face race, the "like me" model implies that even as early as infancy, others would be categorized as ingroup or outgroup based on their similarity to the categorizer. Consistent with such a model, Fawcett and Markson (2010) have reported that children as young as 3 years of age categorization toy dolls as being similar or dissimilar to them, and even show an evaluative preference for the similar dolls.

The Current Study

Given that most prior studies of own-race recognition and other-race categorization have been studied with predominantly monoracial populations living in racially homogeneous environments predominantly monoracial socities, there is a need for work examining the processing of face race in children and adults who have extensive experience with another race of faces. A study by Tham, Bremner, and Hay (2017) is particularly relevant in the present context. These investigators tested 5- to 6-year-old and 13- to 14-year-old British children and Malaysian Chinese children on their recognition of Chinese, Malay, Caucasian, and African faces. A typical other-race effect was observed for the British children; however, the Malaysian Chinese children displayed a recognition advantage for both frequently experienced Chinese and Malay faces relative to the less frequently experienced Caucasian faces. Tham et al. concluded that children from a multiracial environment who have experience with another race of faces early in life may be able to maintain a more malleable face representation when exposure to other-race faces is plentiful. This is further supported by recent evidence indicating that experience with other-race faces during early childhood (i.e., elementary school ages and younger) is predictive of a reduced other-race effect (McKone et al., 2019; Zhou, Elshiekh, & Mouslon, 2019), an effect that is not evident if the exposure to other-race faces happens during adolescence or adulthood.

Is the other-race categorization advantage also modifiable with ample exposure to other-race faces? A major point of the perceptual expertise hypothesis is that the other-race categorization advantage is related to the frequency of exposure to a category of faces. Hence, the other-race categorization advantage should be largest for racial groups with the least exposure to other-race faces. As noted, previous studies investigating the other-race categorization advantage have generally tested populations with near-zero contact with other races. For example, both Valentine and Endo (1992) and Levin (1996) recruited their participants from a majority pool (i.e., the race of the participants was the majority race in that country). While Valentine and Endo tested Caucasian British and Japanese Asians, Levin tested Caucasian Americans. The other-race categorization advantage has also been established in other racial groups such as Chinese Asians (Feng et al., 2011), Hispanics (Maclin & Malpass, 2001), and Israelis (Zhao & Bentin, 2008). However, all these populations lacked experience with other-race faces.

Moreover, knowledge of the development of the other-race categorization advantage is still scarce. To date, there are only two studies investigating race-based category formation for faces by infants. Anzures, Quinn, Pascalis, Slater, and Lee (2010) found that 9-month-old infants formed distinct categories for own-race Caucasian faces versus other-race Asian faces. In a more recent study, Quinn, Lee, Pascalis, and Tanaka (2016) investigated other-race category formation during infancy. Caucasian 6-month-olds responded to the perceptual differences between African and Asian face classes, whereas Caucasian 9-month-olds formed a broad other-race grouping of faces inclusive of both African and Asian faces, although exclusive of Caucasian faces. Still, in these infant studies, the other-race categories were also the categories of infrequent experience.

With regard to children, older studies have reported that children are able to categorize race from as young as 4 years of age, but such studies have not necessarily used real face images as stimuli (Clark & Clark, 1947). Moreover, Dunham, Stepanova, Dotsch, and Todorov (2014) investigated the race categorization abilities of 4- to 9-year-olds and found that it was not until 9 years of age that children were able to categorize face race without physiognomic features. This latter result fits with a study of face gender categorization in 7- to 9-year-old children in which only the 9-year-olds were above chance (Wild et al., 2000). Further, Roberts and Gelman (2015) studied categorization of face race in black and white children from 4 to 13 years of age, and found that it was not until 10 years of age that children consistently showed sensitivity to multiracial faces. All of these studies suggest that children's categorization of face race undergoes a protracted period of development.

Given this background, there is a need to study the other-race categorization advantage during development and in a multiracial society, where children and adults have consistent exposure to a variety of faces from different races early on. Studying the other-race categorization in a multiracial environment also makes it possible to disentangle the effects of social categorization versus perceptual experience. A hypothesis based on social categorization implies that the other-race categorization advantage results from the race of a face (own versus other) determining the way we categorize faces, with the race of a face and its similarity to the categorizer being determined by its skin color, physiognomic features, or some combination. The perceptual expertise hypothesis instead predicts that the other-race categorization advantage depends on the frequency of exposure to faces in the multiracial environment.

We therefore sought to determine whether children and adults from a multiracial environment would manifest the typical other-race categorization advantage for other-race faces of minimal experience and also for other-race faces of consistent experience. The study was conducted in Malaysia, a multiracial country which consists of 68.8% Malay, 23.2% Malaysian Chinese, 7%, Malaysian Indian, and 1% other ethnic groups (Department of Statistics Malaysia, 2017).

Participants were Malays and Malaysian Chinese. In addition to categorizing Malay and Malaysian Chinese faces, participants were also asked to categorize Caucasian faces for which they had limited direct exposure. We will, therefore, use the term, "**low frequency other-race**" to refer to the Caucasian faces used in this study, "**own-race**" to refer to faces of the same race as the participants (i.e., Malay faces for Malay participants and Chinese faces for Malaysian Chinese participants), and "**high frequency other-race**" to refer to faces to which participants are exposed frequently in Malaysia but are not from their own race (i.e., Chinese faces for Malay participants, and Malay faces for Malaysian Chinese participants).

According to the perceptual expertise hypothesis (Levin, 2000), the other-race categorization advantage should decrease as exposure increases. In other words, average response time (RT) and accuracy for categorizing face race should be faster and higher for low frequency faces, and slower and less accurate for high frequency faces. Specifically, for both Malay and Chinese participants, fastest RT and highest accuracy should be observed for Caucasian faces followed by Chinese faces and then Malay faces[1]. In contrast, by the social categorization hypothesis, other-race faces of low and high frequency should yield equivalent RT and accuracy, and both should be faster and more accurate than own-race faces. This prediction implies that the findings will differ for Malay versus Chinese participants. In particular, for Malay participants, faster RT and higher accuracy should be observed for both Caucasian and Chinese faces relative to Malay faces. However, for Chinese participants, faster RT and higher accuracy should be observed for Caucasian and Malay faces relative to Chinese faces.

Method

Participants

The participants were 40 Malaysian adults from two ethnic groups (20 Malay, 20 Malaysian Chinese) with a mean age of 24 years, and 50 9- to 10-year-old children (25 Malay and 25 Malaysian Chinese) with a mean age of 9.6 years. Sixteen of the adult participants were male and twenty-four were female. Twenty-four of the child participants were male and twenty-six were female. All participants reported minimal contact with Caucasian individuals.

Stimuli and Materials

For the adult categorization task, we used 16 Malay, 16 Chinese, and 16 Caucasian adult upright faces with neutral expression, half male and half female (examples shown in Figure 1). For the child categorization task, the procedures were similar to the task used with adults, but the number of stimuli presented was reduced to 12 Malay, 12 Chinese, and 12 Caucasian adult upright faces with neutral expression (half male and half female). Adult faces for children were used to maintain consistency with the adult experiment. In addition, there are some studies (Cassia, Luo, Pisacane, Li, & Lee, 2014; Wild et al., 2000) that have reported that children are more accurate in classifying and recognising adult faces compared to child faces in certain conditions. In particular, in a recognition and sex categorization task with child and adults faces, Wild et al. (2000) reported that both adult and child classification were more accurate with adult faces than with child faces. Similarly, Cassia et al. (2014) found that children without siblings and adults were better at recognising adult faces than child faces (adult face bias). All photographs of faces were full-color images taken at a frontal position on a white background.

Figure 1. Sample stimuli used in the study. From left to right: Caucasian male, Malay male and Chinese male.

Procedure

All participants were given a practice session before the start of the face categorization task to familiarize themselves with the procedure of the task. They were asked to categorize 16 toy and animal pictures. To ensure that children understood the different ethnic group faces presented in the study, the children were also shown examples of Malay, Chinese, and Caucasian faces, prior to the start of the study. The categorization task was administered in three blocks. In each block, participants were asked to categorize two races of faces (i.e., Block 1: Malay vs. Caucasian faces, Block 2: Malay vs. Chinese faces, Block 3: Chinese vs. Caucasian faces) with a total of 32 trials per block for adults and 24 trials per block for children. Each face was presented one at a time and participants were instructed to respond as quickly and as accurately as possible by pressing one of two keys to indicate which race they had seen. Instruction for all the blocks were the same with the exception that the particular face race contrast to be responded to was stated at the beginning of each block. Order of presentation of the blocks was counterbalanced across participants. In each block, the order of presentation of the face stimuli was randomized. Stimuli were presented with E-Prime (Psychology Software Testing, Pittsburgh, PA). Each face was presented for up to 5 s depending on the latency of the key press response with an interstimulus interval of 500 ms between each face. A fixation cross-hair appeared during each interstimulus interval.

Accuracy and response time of face categorization were entered as the dependent variables in the statistical analysis. The calculation of mean response time included only correct responses.

Results

The full design of the experiment was a 3 Face Race x 2 Face Gender x 2 Participant Age Group x 2 Participant Race x 2 Participant Gender mixed design, with Face Race (Caucasian, Chinese, Malay) and Face Gender (female, male) as within-subject factors. Participant Age Group (9- to 10-year-olds, adults), Participant Race (Malay, Malaysian Chinese) and Participant Gender (female, memale) were between-subjects factors.

Face Race was nested within blocks. For each participant, we averaged the results from the different blocks to obtain a mean accuracy (percentage correct) and mean response time for each face race (Caucasian, Chinese, Malay). In doing so we canceled out the effect of Block which was not significant in a preliminary analysis ($F_{2,492} = 1.939$, $p = 0.145$). In the same analysis including all factors we found an effect of Participant Gender ($F_{1,492} = 6.98$, p = 0.008) and an interaction between Participant Gender and Age Group ($F_{1,492} = 14.56$, p < 0.001). Adult women had smaller RT than men. This difference was not observed in infants (boys, M = 1206 s, SD = 384; girls, M = 1242 s, SD = 423). Because this effect was not relevant for the current study, we discarded the Participant Gender factor in the final analysis. The final dataset comprised 270 observations (90 participants x 3 Face Race) for each dependent variable (accuracy and response time). Each participant thus contributed 3 percentage correct responses and 3 correct response times. The final model included Face Race, Age Group, and Participant Race.

Mixed-design ANOVA analyses were conducted using R (R Core Team, 2014) and the library udsAnova (Roulin, 2015). Due to the bounded nature of percentage correct data, we applied the arc-sinus transformation $x_t = asin((x/100)^{0.5})$ on the data before analysis. In addition, because preliminary inspection of the data indicated a positive skew of the distributions of response time, we applied a logarithmic transformation to the data $x_t = ln(x)$ before analysis. Accuracy and correct response time reported below are the back-transformed values. Accordingly, we used confidence intervals (95% CI) to represent the variability of the mean dependent variables.

Accuracy

Mean percentage of correct scores are presented in the top row of Figure 2. We examined individual percentage correct scores for each Face Race according to Age Group and Participant Race. Accuracy was dependent on face race, $F(2, 172) = 41.03$, $p < .001$, $\mu_p^2 = .32$). The Caucasian faces were categorized more accurately (*M* = 98.1%, 95% *CI* = 97.1-98.9) than the more frequent Chinese and Malay faces (*Ms* = 94.9%, and 90.5%, respectively, 95% *CIs* = 93.2-96.4 and 88.6-92.4). Post-hoc comparison using Fisher's LSD indicated that the three means were different from each other (all $ps < .001$). Mean accuracy also increased with age $F(1, 86) = 34.8$, $p < .001$, $\mu_p^2 = .29$, rising from 91.8% (*CI* = 90.0-93.6) in 9- to 10-year-olds to 97.4% (*CI* = 96.7-98.0) in adults.

We additionally found a significant interaction between Age Group and Face Race, $F(2, 172) = 10.71$, $p < .001$, $\mu_p^2 = .11$). Adults were more accurate for both Caucasian (*M* = 99.3%, *CI* = 98.7-99.8) and Chinese faces (*M* = 98.6%, *CI* = 97.6-99.3) relative to Malay faces (*M* = 91.7%, *CI* = 89.1-93.9, Fisher's LSD, all $ps < .001$). No difference was found between Caucasian and Chinese Face Race (Fisher's LSD, $p = .27$). In contrast, 9- to 10-year-old children were more accurate for Caucasian faces (*M* = 96.3%, *CI* = 94.1-97.9) than for both Chinese (*M* = 89.0%, *CI* = 86.1-91.6, Fisher LSD $p < .001$) and Malay faces (*M* = 89.2, *CI* = 86.5-91.7, Fisher's LSD, $p < .001$). The difference between Chinese and Malay faces was not significant (Fisher's LSD, $p = .90$).

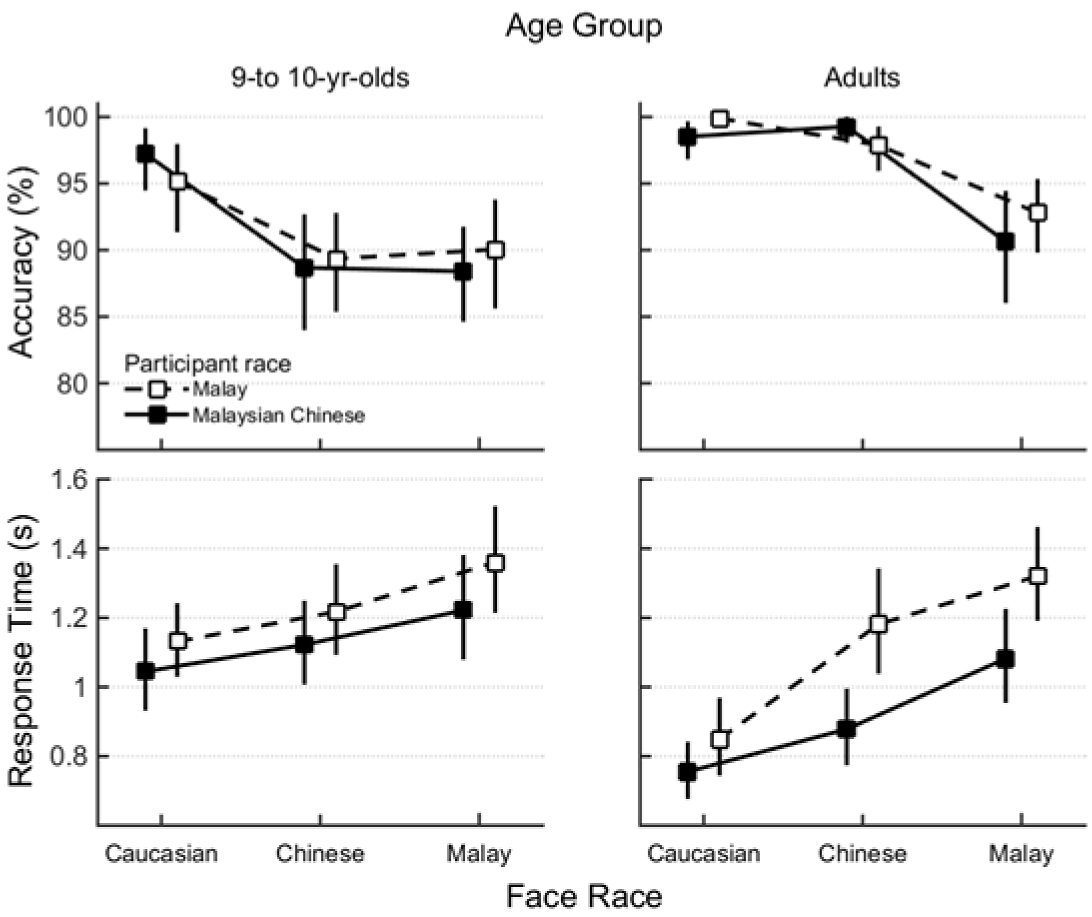

Figure 2. Mean accuracy (top row) and correct response time (bottom row) according to face race, age group, and participant race. Bars give the upper and lower limit of the 95% *CI* for the mean.

Response Time

Mean correct response times (RTs) are presented in the bottom row of Figure 2. The outcomes of the ANOVA yielded a main effect of Face Race, $F(2, 172) = 90.56$, $p < .001$, $\mu_p^2 = .51$, a main effect of Age Group, $F(1, 86) = 11.55$, $p < 0.01$, $\mu_p^2 = .11$, and a main effect of Participant Race, $F(1, 86) = 8.86$, $p < 0.01$, $\mu_p^2 = .09$. Caucasian faces ($M = 0.93$ s, *CI* = 0.87-0.99) were categorized faster than Chinese faces (M = 1.09 s, *CI* = 1.03-1.1.16). Malay faces yielded the longest response time ($M = 1.24$ s, *CI* = 1.17-1.31). Post-hoc comparison using

Fisher's LSD indicated that the three means were different from each other (all *ps* < .001). Adults were faster than 9- to 10-year-olds (*M* = 0.99 s, *CI* = 0.92 – 1.07, *vs*. *M* = 1.18 s, *CI* = 1.10 – 1.26, $p < .01$) and Malaysian Chinese were faster than Malay participants (*M* = 1.00 s, *CI* = 0.94 – 1.07, *vs*. *M* = 1.16 s, *CI* = 1.10 – 1.23, $p < .01$).

Finally, the ANOVA indicated a significant interaction between Age Group and Face Race, $F(2, 172) = 15.65$, $p < .001$, $\mu_p^2 = .15$. In the 9- to 10-year-olds, the effect of Face Race was best described by a linear increase in RT. Caucasian faces led to shorter RT (*M* = 1.08 s, *CI* = 1.01-1.16) than the more frequent Chinese faces (*M* = 1.17 s, *CI* = 1.09-1.26, Fisher's LSD, $p = .027$) and Chinese faces led to shorter RT than Malay faces (*M* = 1.29, *CI* = 1.19-1.4, Fisher's LSD, $p = .003$). The same trend was found in adults, Caucasian faces led to shorter RT (*M* = 0.8 s, *CI* = 0.73-0.87 s) than Chinese faces (*M* = 1.01 s, *CI* = 0.92-1.12, Fisher's LSD, $p < .001$) and Chinese faces led to shorter RT than Malay faces (*M* = 1.19 s, *CI* = 1.1-1.3, Fisher's LSD, $p < .001$). However, as suggested by the difference in RTs, the slope for the main effect of Face Race, which represent the increase of RTs with change in the Face Race frequency from 0 (Caucasian) to 1 (Chinese) and then 2 (Malay), was larger for adults than for children leading to the observed interaction. All interactions involving the Participant Race were non-significant.

Discussion

In the present study, we examined how the other-race categorization advantage was manifested in children and adults who were born and raised in a multiracial environment. We also investigated how the other-race categorization advantage was affected by participant and face race. Two hypotheses were proposed: the perceptual expertise hypothesis and the social categorization hypothesis. Based on the perceptual expertise hypothesis, the other-race categorization advantage should decrease as exposure increases. In contrast, by the social categorization hypothesis, other-race faces of low and high frequency should result in equivalent correct response times and accuracies, and both should be faster and more accurate than own-race faces.

The correct response time data are entirely consistent with the perceptual expertise hypothesis given that both Malay and Chinese children and adults responded fastest for Caucasian faces followed by Chinese and then Malay faces. Of particular significance is the finding that Chinese children and adults responded to own-race Chinese faces as intermediate between other-race Caucasian and Malay faces. Here then is an instance where a classic other-race categorization advantage is not observed in that the two classes of other-race faces were not responded to more rapidly than the own-race Chinese faces.

One other aspect of the reaction time results that deserves further comment is the overall faster responding to all classes of faces by Chinese participants relative to Malay participants. We would speculate that such a result could reflect the minority status of the Chinese in Malaysia. In particular, it could be argued that a minority population presented with different races of faces responds with more categorization than recognition responses. Such a suggestion would also slower responding overall for recognition of faces of different races, a proposal that would need to be confirmed with further research.

The accuracy data were more nuanced because of the age by face race interaction. For children, accuracy was greater for Caucasian faces relative to Chinese and Malay faces which were not different from each other. In the case of Malay children, the Chinese faces were responded to more as own- than other-race faces, a finding that is consistent with a version of the perceptual expertise hypothesis in which other-race faces need to surpass some threshold of experience in order to be responded to as own-race faces. In other words, a minority group of faces, even though lesser experienced, can be responded to like own-race faces it is passes some threshold amount of experience. Thus, given the population statistic of 23.2% Malaysian Chinese, it could be that any experience value above 20% allows an other-race face to be responded to like an own-race face (see Liu et al., 2015, for an analogous proposal in how infants may respond to male versus female faces). In the case of Chinese children, the same pattern of accuracy outcomes suggests that high frequency other-race faces (i.e., Malay faces) are treated like own-race faces, a finding that is again consistent with a version of the perceptual expertise hypothesis in which some threshold amount of experience can be surpassed in order for other-race faces to be responded to as own-race faces.

For adults, accuracy was greater for Caucasian and Chinese faces relative to Malay faces. As with the child accuracy data, this outcome carries different meaning for Malay and Chinese participants. For Malay adults, the results are in accord with the classic form of the other-race categorization advantage in which own-race faces differ from different classes of other-race faces, which are not different from each other. These findings are consistent with the social categorization hypothesis. For Chinese adults, own-race Chinese faces are responded to more as low frequency other-race Caucasian faces than as high frequency own-race faces. Here then is another aspect of the data that is inconsistent with the typical format of the other-race categorization advantage.

The overall pattern of findings accords well with what Tham et al. (2017) reported for the own-race recognition advantage, where Malaysian Chinese children were found to display a recognition advantage for both frequently experienced Chinese and Malay faces relative to the less frequently experienced Caucasian faces. Similarly, the finding of a lack of an own-race face recognition advantage in Japanese descent children born and living in Brazil (Fioravanti-Bastos, Filgueiras, & Landeira-Fernandez, 2014) provides additional evidence that experience with faces within one’s local environment shapes the face-processing system during development. The current data indicate that the effects of other-race face experience extend to the other-race categorization advantage. Most broadly, our data imply that the other-race categorization advantage is an appropriate term to describe performance only when the other-race categories are categories of minimal experience.

Of interest in the accuracy data is the developmental transition in how Chinese participants respond to other-race categories of low and high frequency (i.e., Caucasian and Malay faces, respectively) relative to their own-race category. That is, in children, it is the high frequency other-race category (i.e., Malay) that is responded to like the own-race category, whereas in adults, it is the low frequency other-race category (i.e., Caucasian) that is responded to like the own-race category. A possible account is that with increased age, there is increasing experience with majority group Malay faces, and they become responded to as if they were the own-race category with the true own-race, but lower frequency Chinese faces becoming more like an other-race category. This account would predict that if one were to test even younger Chinese participants, then the own-race Chinese faces would be categorized less accurately relative to both Caucasian and Malay faces.

A limitation of our study is that we did not measure interracial experience directly. Amount of contact with other-race faces has been found in some studies to moderate different aspects of responding to face race (McKone et al., 2019; Roberts & Gelman 2015; Zhao et al., 2019). Future work using contact measures may provide further information about individual variation with other-race contact and how it influences the development of other-race categorization advantage. We also did not test participants younger than 9 years of age, given prior studies indicating either chance or partial responding to the social category attributes of both race and gender earlier in development (Dunham, Stepanova, Dotsch, & Todorov, 2015; Roberts & Gelman, 2015; Wild et al. 2000). Nevertheless, it is possible that further insight into the ontogeny of the other-race categorization advantage could be gained by investigating the other-race advantage in younger children.

To our knowledge, the current study is the first to examine the other-race categorization advantage in children and adults in a multiracial environment. The significance of the work derives from being able to contrast how participants responded to own-faces and different classes of other-race faces that varied by how prominent they are in the population. This composition in turn allowed us to test competing predictions from perceptual expertise and social categorization hypothesis. Notably, in the case of the correct response time measure, Chinese participants responded to own-race Chinese faces as intermediate between other-race Caucasian (fastest) and Malay faces (slowest). Here then is an instance where a classic other-race categorization is not observed, and the findings follow the perceptual expertise account of the advantage rather than the social categorization account. Future studies with different age groups and samples of participants, and with different classes of other-race faces, are needed to evaluate the generalizability of these novel findings. A similar study with biracial children and adults with multiracial experience both within the local family and broader neighborhood environments would provide further information on how categorical responses to face race are influenced by frequency of exposure.

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Footnote

[1]We acknowledge that the differences suggested in this prediction may be moderated particularly in Chinese children where the home environment would be weighted toward Chinese faces.