Generalization of Expert Face Processing Takes Time

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Abstract

Same race faces are recognized better than other race faces, and this other-race effect (ORE) can be explained by reduced holistic processing of other-race faces. Holistic processing is defined as a tendency to process all parts of a stimulus interactively as a whole. Previous studies found that experience can mediate ORE in holistic processing. The present study investigated whether quality or quantity of experience with the other-race better predicts holistic processing of other-race faces between Caucasian and Asian individuals. Contrary to what we expected, we did not find any correlation between experience with the other-race and the ORE in holistic processing for either Caucasian or Asian participants. However, our experiment revealed a negative correlation between the ORE in holistic processing and the response time for the actual face discrimination ability of the other-race faces among Asian participants. Such a surprising result indicates that for Asian individuals, the response time at the perceptual level that actually modulates ORE in holistic processing.

Key words: other-race effect, holistic processing, experience, Asian, Caucasian

Generalization of Expert Face Processing Takes Time

Our ability to accurately remember and identify thousands of faces is noteworthy considering the fact that all faces are similar in their configurations. However, such ability varies depending on whether people are identifying faces of their own race or of other races. The other-race effect (ORE) is defined by better recognition of same-race (SR) versus other-race (OR) faces (for a recent review see Meissner & Brigham, 2001). The negative effect of ORE is worth noting. It is thought to be the reason for false identifications by witness who is of a different race from the suspect (Platz and Hosch, 1988). In daily life, it can embarrass people who inaccurately attribute anger or offense to those of another race who are not responsible for the accusation (Elfenbein & Ambady, 2002). In an emerging trend of globalization, ORE will negatively affect the social and cultural connection among different countries and races. As many negotiations, business transactions and science projects are conducted collaboratively by people from diverse racial background, ORE may impact the perceived trust and friendliness among collaborators and thus impede the outcome of collaborations and even the improvement of human welfare. The negative effects of ORE have triggered extensive research on its underlying mechanism in an attempt to develop possible strategies to reduce ORE.

One influential hypothesis about ORE is that SR faces are processed more holistically than OR faces (e.g., Tanaka Kiefer & Bukach, 2004, Hayward, Rhodes, & Schwaninger, 2008; Michel et al., 2006; Mondloch et al., 2010). Holistic processing is defined as processing of all parts of a stimulus interactively, as opposed to only attending to specific features of a stimulus (Maurer, Le Grand, & Mondloch, 2002). While it is generally acknowledged that experience with OR faces negatively predicts ORE in face recognition, *how* experience enhances the encoding mechanism for OR faces is still hotly debated, and two major issues are yet to be

clarified: 1) whether quality or quantity of experience help to better reduce ORE in holistic processing; 2) whether ORE in holistic processing is directly correlated with the ability to recognize individual faces.

Experience with OR can be measured in two ways: quantitatively or qualitatively. Quantity of experience captures the exposure (e.g. number of acquaintances) while quality of experience captures individuating experiences (e.g. mutual helping experiences). Previous studies with Caucasian and Asian participants yielded mixed results on the relative contribution of different types of experience to ORE in holistic processing. In a recent study by Hancock and Rhodes (2008), both quantitative and qualitative experiences were found to be significantly correlated to the reduced ORE in holistic processing. However, the holistic processing was indexed by face inversion effect (FIE), which is known to be an indirect measure of holistic processing because inversion also disrupts mechanisms other than holistic processing (Rhodes, Hayward, & Winkler 2006; Cheung & Gauthier, 2010). In another study with a direct measure of holistic processing using a scrambled/blurred paradigm (for details of the task, see Rhodes et al., 2009), only quantity of experience was significantly correlated with ORE in holistic processing. However, qualitative experience was found to be a better predictor for recognition of OR faces in a study by Walker and Hewstone (2006), where they found Caucasians were better at recognizing Asian faces if they had a higher qualitative experience such as mutual comforting. In an effort to organize and refine our understanding of *how* experience impacts encoding mechanisms of OR faces, this current study is going to directly examine whether qualitative or quantitative experience with OR is a better predictor of ORE in holistic processing.

Furthermore, though ORE is widely acknowledged as a consequence of reduced holistic processing of OR faces, very few studies have directly examined the relationship between ORE

in holistic processing and ORE in face discrimination. Given the fact the holistic processing is the hallmark of face expertise, and it is related to the performance of face recognition tasks (Richler, Cheung, & Gauthier, 2011), we would expect higher level of holistic processing could predict a smaller size of ORE in face discrimination tasks. However, in a previous study on the relationship of ORE and holistic processing, Michel et al. (2006) found that holistic processing is necessary for encoding OR faces, but not sufficient to overcome ORE in face recognition. The result that Asian participants simultaneously demonstrating holistic processing for OR faces and ORE in face recognition unexpectedly questions the relationship between the two. In order to clarify this unresolved issue, an independent face discrimination task will be used in the current study to empirically test the relationship between ORE in holistic processing and the ability to visually discriminate individual faces. This manipulation will significantly extend the previous studies because it will allow us to conclude a functional mechanism that is responsible for ORE in face discrimination.

One important reason to examine ORE particularly in an Asian population is to help refine the method and analysis of previous studies with Asian participants. An interesting and perplexing result of several prior studies is that researchers have consistently found that Asian participants demonstrated holistic processing both for SR and OR faces (e.g., Rhodes et al., 1989; Michel et al., 2006; Tanaka et al. 2004). Such phenomenon observed may be related to the following two reasons. First, the Asian participants recruited may lack of variability of exposure/individuating experience with OR faces (e.g., in the study of Tanaka et al. 2004, all Asians recruited have resided in Western countries for very long time), thus resulting in a homogenous high level of holistic processing of OR faces. Second, previous studies all analyzed the relationship between experience and holistic processing of OR faces at a group-level

performance, while the group mean may not accurately reflect individual differences. Previous studies of Caucasian and Black participants showed that despite the result of group-analysis, examination of individual differences yielded significant negative correlation between experience with OR faces and ORE in holistic processing (Wright, Boyd, & Tredoux, 2003; Bukach et al., 2012). It is possible that the same individual differences will be present for Asian participants. Therefore, in order to clarify the relationship between experience and ORE in holistic processing among Asian participants, this study recruited participants with various experiences with OR faces, and also included an individual difference analysis.

The present study investigated the relationship between the ORE in holistic processing and different types of OR experiences. I hypothesized that qualitative experience would be a better predictor than quantitative experience for ORE in holistic processing that there would be a greater negative correlation between qualitative experience and ORE in holistic processing than quantitative experience within both groups. Moreover, I hypothesized the ORE in holistic processing would be positively correlated with ORE in face recognition. Therefore, the qualitative experience with OR faces would be able to predict the size of ORE in face recognition.

Method

Participants

28 Asians and 31 Caucasians from University of Richmond were compensated $20 for participation. 4 participants were excluded due to poor accuracy, leaving 29 Caucasians (mean age: 20.31, 3 males) and 26 Asians (mean age 19.23, 5 males). The study was approved by the local IRB.

Procedure

Overview

      Participants completed the composite task, the face-identification task, with both Asian face and Caucasian face stimuli, and a social contact and experiences questionnaire. The study lasted for a total of two sessions, each day completing a composite task and a face-discrimination task, one day with one race and the second day with the other race. Order for completion of the composite and face-discrimination tasks was counterbalanced for different participants. Completion of the questionnaire occurred at the end of the second session.
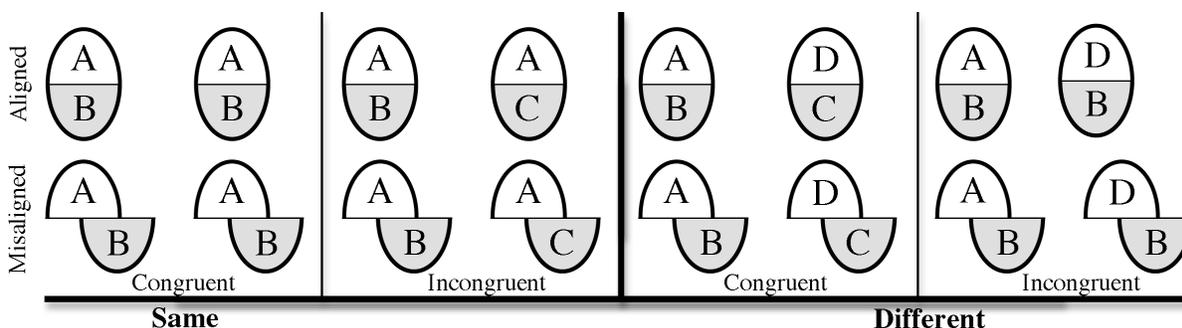
Composite Task

      Composite faces are the top of one face and the bottom of another face separated by a thin line. The task is a sequential matching task in which a composite face is shown on the screen for 1500 ms, followed by a nonsense mask and a cue indicating which half of the face the participant should pay attention to. Following the cue will be another composite face, and the participant's task is to determine whether the cued half (top or bottom) of the second face is the same as that of the first. The participants are instructed to ignore the non-cued portion of the face (See Figure 1). They will press number 1 on the keyboard to indicate the cued halves are the same or number 2 to indicate the cued halves are different, and they are instructed to do so as quickly and as accurately as possible.

      There are four randomly occurring types of trials. The trials can be congruent same (both tops and bottoms are the same), congruent different (both parts are different), incongruent same (the cued part is the same and the non-cued part is different), and incongruent different (cued parts are different, non-cued parts are the same). If participants process the faces holistically, they cannot ignore the uncued part, and therefore poorer performance will be observed in incongruent trials as the uncued halves will yield different response from the target halves and

thus interfere with the participant's same/different judgment. This is known as the congruency effect and it can be reduced when the top and bottom halves of the faces are misaligned, which disrupts holistic processing. Therefore, holistic processing can be indexed as an interaction between congruency and alignment, and ORE in holistic processing can be indexed as the difference of holistic processing for SR and OR faces. For the composite task of each race, there are 320 trials that are evenly divided among top and bottom cues, alignment (aligned, misaligned), congruency (congruent, incongruent) and matching (same, different) conditions. Figure 1 below demonstrates experiment design and shows a set of sample trials.

Figure 1: Experimental design and sample trials of Composite Tasks.

The complete composite task design was used as opposed to the partial paradigm for this study. The complete paradigm analyzes both same and different trials so as to control for response bias. There has been much debate about the benefits of each design (Gauthier & Bukach, 2007; McKone & Robbins, 2007; Richler, Mack, Palermi, & Gauthier, 2011). Most recently though the complete paradigm has been found to be a more valid measure of holistic processing. The reasons for this are that it controls for response bias and performance on it correlates with face recognition performance (Konar, Bennett, & Sekuler, 2010; Richler, Cheung, et al., 2011).

Face-Discrimination Task

The face-Discrimination task was developed based on the task used by Konar et al. (2010) and Richler et al. (2011). The study included two versions of this task, using Asian face stimuli and Caucasian face stimuli, respectively. On each of 120 trials, a target face was presented on the center of the screen for 200 ms, followed by a blank screen for 500 ms. The participant then viewed four test faces displayed simultaneously, and were instructed to determine which one of those four is the target face by pressing designated keys on keyboard. The test faces were displayed on the screen until a response was made. Among the four test faces, the face that matched the target face had a different lighting condition in order to prevent image matching. The 120 trials were split into all-male-trials and all-female-trials and the trials were randomized for each participant. See Figure 2 for a depiction of the task.
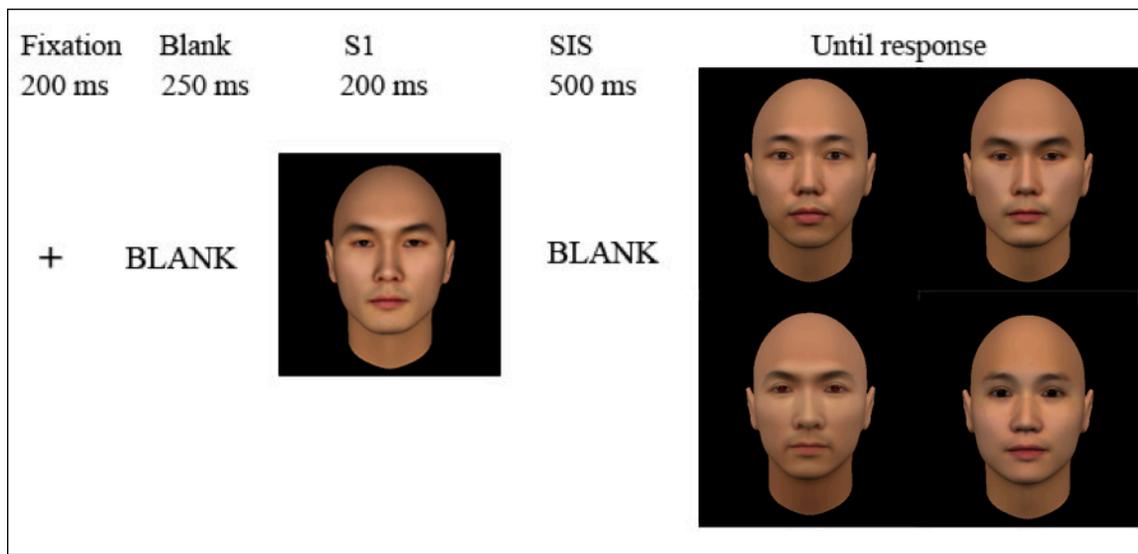
Figure 2. Example of face-discrimination task. SIS=interstimulus interval.

Questionnaire

We used a questionnaire to address the question of whether individuating experience

impacts holistic processing of OR faces. The questions that were included in the questionnaire

were taken from questionnaires used in previous studies as well as a few that we designed

ourselves. Walker and Hewstone's (2006) Individuating Experiences Scale (IES) was included as

the first part of the questionnaire used in this study. The IES was also included as the scale in

Bukach, et al. 2012, the preceding study to this one. This scale consists of five items that assess

mutual helping, comforting, and inclusion activities and uses a 5-pt scale ranging from 1 = never

to 5 = very often. In addition, questions based off of the Social Experiences Questionnaire (SEQ)

published by Brigham (1993) were also included. These questions measure the past contact of

each participants. Responses for this portion of the questionnaire are presented as either

percentages or a number choice on a scale of 1-9 or more. There are also the newly designed

questions that aimed to measure participants' current experience with the other-race. The

questions that measure quantity of contact mainly asked about the number of OR acquaintances

participants have, whereas the questions measure the quality of contact asked about participants' depth of interaction with OR people. A sample of the questionnaire is attached in the Appendix.

Result

1. Group Analyses

Mean response times for the various conditions are displayed in Figure 3. Results of the 2(Congruency) X 2 (Alignment) X 2 (Face) ANOVAs for each group are presented in Table 1. Both Asian and Caucasian participants showed a significant 2-way interaction between congruency and alignment indicative of holistic processing, however this effect did not interact with face (*ps =0.342 and 0.249 respectively*), indicating no ORE in holistic processing for either Asian or Caucasian participants.

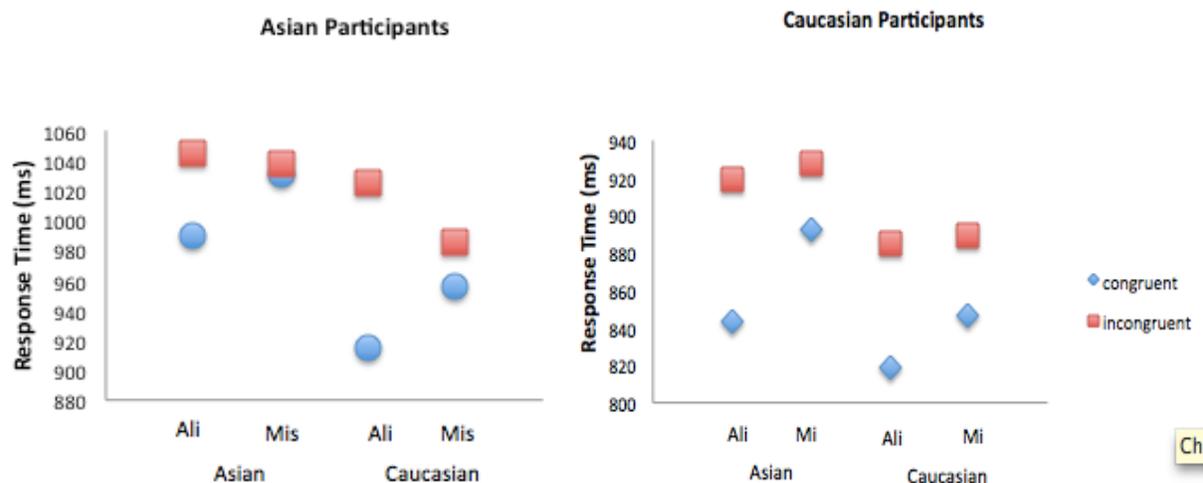
Figure 3:Mean response time as a function of face (same, other), and alignment (aligned, misaligned) and congruency (congruent, incongruent) for Asian and Caucasian participants.

2. Correlations with Quantity and Quality of Experience

No correlation was found between either quantity or quality of experience and ORE in holistic processing for both Caucasian and Asian participants (*ps> .05*).

Source	F(1,25)	p	η2
Asian Participants			
Face (F)	0.983	0.331	0.038
Alignment (A)	2.370	0.136	0.087
Congruency (C)	18.464	<0.001	0.425
F X A	0.659	0.425	0.026
F X C	3.517	0.072	0.123
A X C	8.026	0.009	0.243
F X A X C	0.940	0.342	0.036
Caucasian Participants	F(1,28)		
Face (F)	0.702	0.409	0.024
Alignment (A)	11.167	0.002	0.285
Congruency (C)	57.768	<0.001	0.674
F X A	0.769	0.388	0.027
F X C	0.003	0.177	0.677
A X C	5.219	0.030	0.157
F X A X C	0.653	0.426	0.023

Table 1: *Analysis of Variance of Response Times for Asian and Caucasian Participants*

3. Correlations between ORE in holistic processing and response time for OR face discrimination

A significant negative correlation was found between ORE in holistic processing (measured by response time) and the response time for OR face discrimination among Asian participants (r (25)= 0.427, p = 0.030) as shown in Figure 4 below. In addition, a marginally

significant result was found between ORE in holistic processing (measured by sensitivity) and

ORE in response time for face discrimination task among Asian participants (r(25)= -.363, p=

.069) as displayed in Figure 5 below However, the same pattern did not hold for
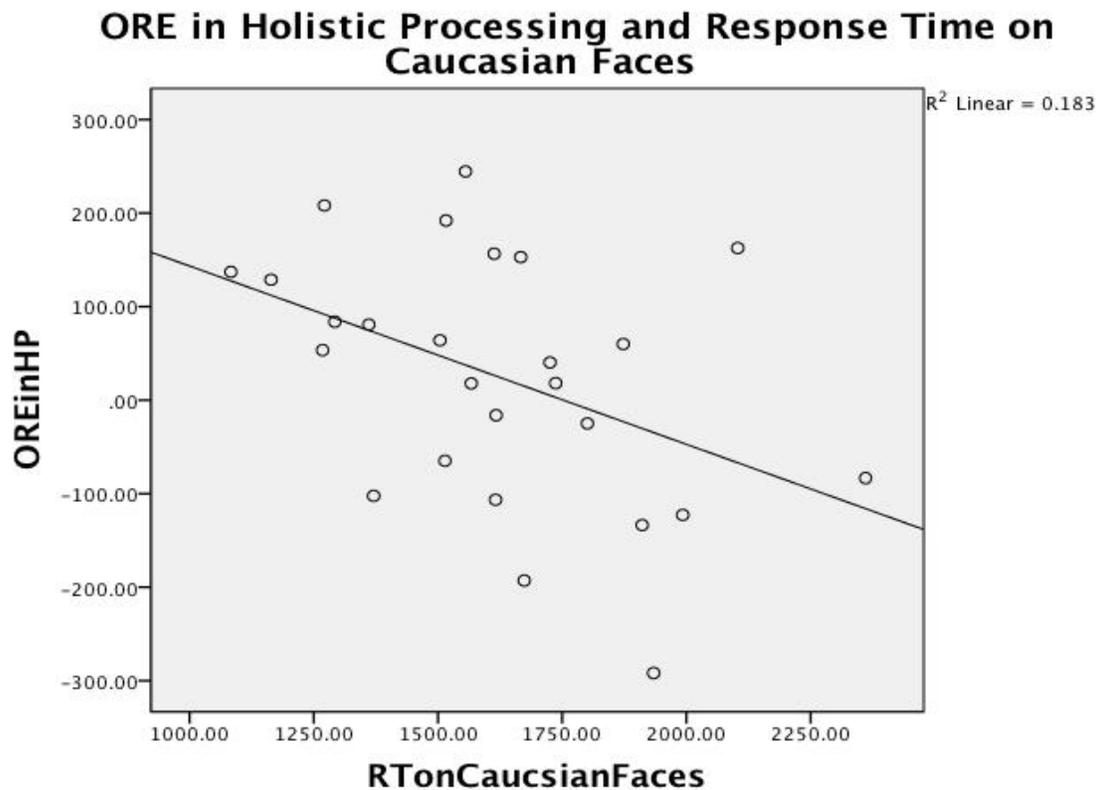
Caucasian participants (p>0.05).

Figure 4. Scatter plot (with the best fitting regression line) showing correlations between ORE in

HP (measured by response time, y-axis) and Response Time on Caucasian face discrimination
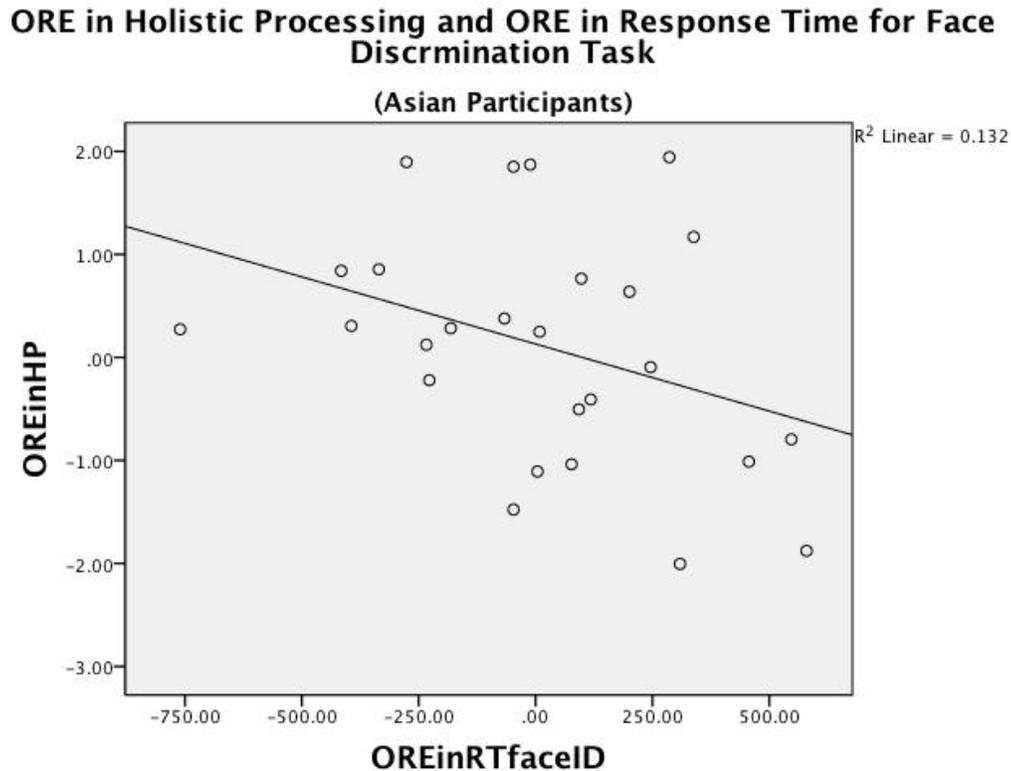
(x-axis) among Asian participants.

Figure 5. Scatter plot (with the best fitting regression line) showing correlations between ORE in HP (measured by sensitivity, y-axis) and ORE in face discrimination task (x-axis) among Asian participants.

Discussion

Holistic processing is one of the perceptual mechanisms that are thought to make face processing qualitatively different from basic object recognition (Farah et al., 1998). Past research with object recognition suggests that holistic processing is experience dependent (Gauthier & Tarr, 20002), and the quality of experience matters instead of mere exposure (Tanaka et al., 2005; Wong, Palmeri, & Gauthier, 2009). Similarly, in a previous study on ORE that recruited Black and Caucasian participants, it was found that individuating experience predicts ORE in holistic processing (Bukach et al., 2012). Contrary to what we may expect, the same pattern did

not hold for Caucasian participants viewing Asian faces or for Asian participants viewing Caucasian faces. The current study found that Asians and Caucasian individuals process both their own race faces and other-race faces holistically. This indicates that the holistic processing that is necessary for expert face recognition generalized from own-race to the other-race for Caucasian and Asian participants. Interestingly, neither quality nor quantity of experience with the other-race was significantly correlated with the ORE in holistic processing, indicating the generalization is not experience dependent.

One possible explanation of this unexpected null result is that previous studies on ORE between Caucasian and Asian individuals that found significant correlations between social contact with the other-race and ORE in holistic processing all used different measures for holistic processing. As mentioned in introduction, none of those studies used the standard composite task that is developed recently and is thought to be a more reliable measure of holistic processing. Thus, it is very possible that their result will not hold true if they used a different measure for holistic processing. The current study employed an existing measure of holistic processing that was found to be significantly correlated with experience within Black and Caucasian participants. Therefore, the result of this experiment is more valid than the previous ones because a replication ensures that the holistic processing measured here indeed has the same theoretical construct with the holistic processing measured in the study that is replicated and that has yielded a significant correlation as expected.

Another possible explanation for the fact that generalization of face processing between Caucasian and Asian individuals does not depend on experience is that Caucasians and Asians consider each other less as an out-group but more as an in-group (Lee & Fiske, 2006). A research on intergroup perception of immigrants found that the initial negative stereotypes associated with

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Asians has been significantly reduced. Instead, Asians are perceived as shy but successful (Sue & Kitano, 1973; Wong et al., 1998). One determining factor of outgroup perception is that people in the outgroup are usually perceived as low in competence and low in warmth. However, high-competence is uniquely associated with Asian as a group, making them less an outgroup than other racial minorities (Lee & Fiske, 2006). As a result, more individuating instead of categorizing takes place between Caucasians and Asians.

Contrary to what we have predicted, we found a marginally negative instead of a positive correlation between ORE in holistic processing and ORE in face discrimination task among Asian participants. Since the ORE in face discrimination task is calculated as the difference between the response time for OR faces and the response time for SR face, a larger ORE in face discrimination indicates that the participants spent more time on OR faces. Therefore, the negative correlation suggests that the more time Asian participants spent on discriminating Caucasian faces, the less ORE they demonstrated in holistic processing of Caucasian faces. This pattern is further confirmed by a significant negative correlation between the ORE in holistic processing and the response time on Caucasian face discrimination task. This result, together with the fact that experience with Caucasian individuals doesn't modulate ORE in holistic processing, suggests that the generalization of expertise was attempted despite less experience with other races, and this is because of the social assessment of the other race as less of an outgroup.

However, the same pattern did not hold for Caucasian participants. No correlation was found for ORE in holistic processing and ORE in face discrimination task. This result suggests that compared to Asian participants, the generalization of holistic processing from Caucasian faces to Asian faces is less effortful, as no extra response time is needed for the generalization to

take place. One possible explanation for the different patterns of generalization of holistic processing is that Caucasians and Asians employ different visual strategies to recognize faces. A recent study on how different culture shapes the way people visually extract information from faces showed that Caucasian individuals tend to use an analytical way to process faces, whereas Asians are more likely to engage holistic processing during face recognition (Nisbett & Miyamoto, 2005). This is largely due to the culture difference that it is often time considered rude to directly look at a person's eyes in Eastern Asian cultures. As a result, Asians tend to look at the center of the face and process the faces more interactively (Blais et al., 2008). Therefore, when distinguishing facial features such as different hairstyles or skin colors are removed, it is less effortful to generalize expert face processing if the original strategy is to focus on a single facial feature with a bias toward eyes. On the other hand, the fact that Asians usually engage more holistic processing and they meanwhile spend more time on discriminating Caucasian faces suggests that generalization of holistic processing indeed takes time to occur. Another possible explanation was speculated because of some participants' comments on the experiment. Several participants commented that the Asian version is harder because the facial features for Caucasian faces are more variable than that of Asian faces. For example, the variability of eye colors are greater among Caucasian faces than Asian faces. Also, Caucasian faces all tend to have larger eyes, longer eye lashes, higher nose bridge, which make them more easily to be distinguished from each other. As a result, generalization from a more variable feature space (Caucasian) to a less variable feature space (Asian) may be less effortful than the other way around. However, this hypothesis needs to be further tested as no current research has looked at how different physical features contribute to the other-race effect.

The current study directly showed that experience with the other race did not modulate ORE in holistic processing for either Caucasian or Asian individuals. Instead, it is the response time at the perceptual level that helps the generalization of holistic processing from Asian faces to Caucasian faces. Such a result is promising to reveal an entirely new model for the ORE by teasing apart experience at the social attitude level and visual perception at the basic perceptual level. Future research should try to dig into this new possible explanation of ORE by answering the following two questions: 1. Why doesn't experience modulate holistic processing between Asian and Caucasian individuals? 2. Why is the generalization process less effortful for Caucasian individuals? Although face recognition is largely affected by top down processing, such as motivation, attitude and attention (Meissner & Brigham, 2001), understanding the basic perceptual mechanism of ORE will help researchers to develop strategies that directly modulate the perception of OR faces and therefore reduce ORE in a relative short time by utilizing certain perceptual training strategies. The experiment and its follow up studies will be beneficial for people in certain professions, such as airport security and screening, which require accurate identification of faces of different races.

Appendix

Quality and Quantity of Experience Questionnaire (for Caucasian individuals)

Please complete the following questionnaire. In the questionnaire, we are going to ask you about

your personal experiences with Asian individuals. For each question below, please choose an

appropriate answer (e.g. a number, a percentage or a frequency, etc.) that best describes your

experiences. For the questions regarding your interactions with Asian individuals, we are

interested in face-to-face interactions in which you have exchanged greetings, conversed,

conducted business, asked for, gave, or received information or services, or in some other way

responded to each other. For example, merely attending a class with an Asian individual is not an

interaction unless you had a conversation, made direct eye contact, etc. Take as much time as

you need to answer the questions thoroughly and accurately and get the experimenter once you

are finished. Please remember too that all answers are coded and your responses will be kept

confidential. Thank you again for your cooperation!

Approximately what percentage of the students in the elementary school you attended were Asian?

	0	50	100
0-100%			

How many Asian friends did you have in elementary school?

	None	>10
0		

Approximately what percentage of the students in the middle school or junior high school you attended were Asian?

	0	50	100
0-100%			

How many Asian friends did you have in middle school or junior high?

	None	>10
0		

Approximately what percentage of the students in the high school you attended were Asian?

	0		50		100

0-100%

How many Asian friends did you have in high school?

None   >10

0

Approximately what percentage of the people in the neighborhood in which you grew up were Asian?

	0		50		100

0-100%

Of all the Asian individuals you know personally how many would fit into each of the following categories? Please estimate a number of individuals.

Casual Acquaintance

Moderately Well

Very Close Relationship

How many Asian people do you know very well?

0   >12

0-12 or more

I often spend time with Asian people.

Strongly Disagree	Sort of Disagree	Not Sure	Sort of Agree	Strongly Agree
○	○	○	○	○

I spend a lot of free time doing things with Asian people.

Strongly Disagree	Sort of Disagree	Not Sure	Sort of Agree	Strongly Agree
○	○	○	○	○

I often go round to the houses of Asian people.

Strongly Disagree	Sort of Disagree	Not Sure	Sort of Agree	Strongly Agree
○	○	○	○	○

Asian people often come around to my house.

Strongly Disagree	Sort of Disagree	Not Sure	Sort of Agree	Strongly Agree
○	○	○	○	○

I have looked after or helped an Asian friend when someone was causing them trouble or being mean to them.

Never	Hardly Ever	Sometimes	Quite Often	Very Often
○	○	○	○	○

An Asian person has looked after me or helped me when someone was causing me trouble or being mean to me.

Never	Hardly Ever	Sometimes	Quite Often	Very Often
○	○	○	○	○

I have comforted an Asian friend when they were feeling sad.

Never	Hardly Ever	Sometimes	Quite Often	Very Often
○	○	○	○	○

An Asian person has comforted me when I have been feeling sad.

Never	Hardly Ever	Sometimes	Quite Often	Very Often
○	○	○	○	○

I have asked an Asian person to be on my team or in my group during sports or activities.

Never	Hardly Ever	Sometimes	Quite Often	Very Often
○	○	○	○	○

How many times have you gone on a date with an Asian individual?

0	>5

0-5 or more	

If you have ever held a job, how many of your coworkers have been Asian?

0   >12

0-12 or more │

Of your 9 closest friends at college, how many are Asian?

0   >9

0 │

I often spend time in conversation with Asian individuals.

Never	Hardly Ever	Sometimes	Quite Often	Very Often
○	○	○	○	○

I share meals with an Asian individual at the same table while eating on campus.

Never	Hardly Ever	Sometimes	Quite Often	Very Often
○	○	○	○	○

I discuss my personal life with an Asian individual.

Never	Hardly Ever	Sometimes	Quite Often	Very Often
○	○	○	○	○

I discuss school work with an Asian individual.

Never	Hardly Ever	Sometimes	Quite Often	Very Often
○	○	○	○	○

What percentage of your friends belong to each group? Total should equal 100%

Asian	0	%
Black	0	%
Caucasian	0	%
Other	0	%
Total	0	%

That is the end of the questionnaire. Please press the finish button below and get the experimenter. Thank you for your participation!

Reference

Blais, C., Jack, R. E., Scheepers, C., Fiset, D., & Caldara, R. (2008). Culture shapes how we look at faces. *PLoS One*, *3*(8), e3022.

Bukach, C. M., Bub, D. N., Gauthier, I., & Tarr, M. J. (2006). Perceptual expertise effects are NOT all or none: Spatially limited perceptual expertise for faces in a case of prosopagnosia. *Journal of Cognitive Neuroscience, 18*, 48-63.

Bukach, C. M., Cottle, J., Ubiwa, J., & Miller, J. (2011). Individuation experience predicts other-race effects in holistic processing for both Caucasian and black participants. *Cognition, 123(2):*319-24.

Bukach, C. M., Phillips, W. S., & Gauthier, I. (2010). Limits of generalization between categories and implications for theories of category specificity. *Attention, Perception, & Psychophysics, 72*, 1865-1874.

Cheung, O. S., & Gauthier, I. (2010). Selective interference on the holistic processing of faces in working memory. *Journal of Experimental Psychology: Human Perception and Performance, 36*, 448-461.

Elfenbein, H. A., & Ambady, N. (2002). On the universality and cultural specificity of emotion recognition: A meta-analysis. *Psychological Bulletin, 128*(2), 203-235. doi:10.1037/0033-2909.128.2.203

Farah, M. J., Wilson, K. D., Drain, M., & Tanaka, J. N. (1998). What is" special" about face perception? *Psychological Review, 105*, 482-498. doi: 10.1037/0033-295X. 105.3.482

Gauthier, I., & Tarr, M. J. (2002). Unraveling mechanisms for expert object recognition: Bridging brain activity and behavior. *Journal of Experimental Psychology: Human Perception and Performance, 28*, 431-446. doi:10.1037/0096-1523.28.2.431

Hancock, K. J., & Rhodes, G. (2008). Contact, configural coding and the other-race effect in face recognition. *British Journal of Psychology, 99*, 45-56.

Hayward, W. G., Rhodes, G., & Schwaninger, A. (2008). An own-race advantage for components as well as configurations in face recognition. *Cognition, 106,* 1017-1027.

Sue, S., & Kitano, H. H. (1973). Stereotypes as a measure of success. *Journal of Social Issues*, *29*(2), 83-98.

Konar, Y., Bennett, P. J., & Sekuler, A. B. (2010). Holistic processing is not correlated with face-identification accuracy. *Psychological Science*, *21*, 38-43. Do10.1177/0956797609356508.

Lee, T. L., & Fiske, S. T. (2006). Not an outgroup, but not yet an ingroup: Immigrants in the stereotype content model. *International Journal of Intercultural Relations, 30,* 751-768.

Maurer, D., Le Grand, R., & Mondloch, C. J. (2002). The many faces of configural processing. *Trends in Cognitive Sciences, 6*, 255-260.

McKone, E., & Robbins, R. (2007). The evidence rejects the expertise hypothesis: Reply to Guathier & Bukach. *Cognition, 103*, 331-336. doi: 10.1016/j.cognition.2006.05.014.

Meissner, Christian A., and John C. Brigham. "Thirty Years of Investigating the Own-race Bias in Memory for Faces: A Meta-analytic Review." *Psychology, Public Policy, and Law 7.1 (2001):* 3-35. Print

Michel, C., Caldara, R., & Rossion, B. (2006). Same-race faces are perceived more holistically than other-race faces. *Visual Cognition, 14*, 55-73.

Mondloch, C. J., Elms, N., Maurer, D., Rhode, G., Haywad, W. G., Tanaka, J. W., & Zho, G. (2010). Processes underlying the cross-race effect: An investigation of holistic, featural, and relational processing of own-race versus other-race faces. *Perception, 39*, 1065-1085.

Nisbett RE, Miyamoto Y (2005) The influence of culture: holistic versus analytic perception. Trends Cogn Sci 9: 467–473

Platz, S. J. and Hosch, H. M. (1988), Cross-Racial/Ethnic Eyewitness Identification: A Field Study. *Journal of Applied Social Psychology, 18:* 972–984.

Richler, J. J., Cheung, O. S., & Gauthier, I. (2011). Holistic processing predicts face recognition. *Psychological Science: Advanced Online Publication, 22*, 464-471.

Richler, J.J, Mack, M.L., Palermi, T.J., & Gauthier, I. (2011). Inverted faces are (eventually) processed holistically. *Vision Research, 51,* 333-342. doi: 10.1016/j.visres.2012.11.014.

Rhodes, G., Brake, S., Taylor, K., & Tan, S. (1989). Expertise and configural coding in face recognition. *British Journal of Psychology, 80*, 313-331.

Rhodes, G., Hayward, W. G., & Winkler, C. (2006). Expert face coding: Configural and component coding of own-race and other-race faces. *Psychonomic Bulletin and Review, 13*, 499-505.

Rhodes, G., Ewing, L., Hayward, W. G., Maurer, D., Mondloch, C. J., & Tanaka, J. W. (2009). Contact and other-race effects in configural and component processing of faces. *British Journal of Psychology, 100*, 717-728.

Tanaka, J. W., Curran, T., & Sheinberg, D. L. (2005). The training and transfer of real-world perceptual expertise. *Psychological Science, 16*, 145-151. doi:10.1111/j.0956-7976.2005.00795.x

Tanaka, J. W., Kiefer, M., & Bukach, C. M. (2004). A holistic account of the own-race effect in face recognition: Evidence from a cross-cultural study. *Cognition, 93*, B1-9.

Walker, P. M., & Hewstone, M. (2006). A perceptual discrimination investigation of the own-race effect and intergroup experience. *Applied Cognitive Psychology, 20*, 461-475.

Wong, P., Lai, C. F., Nagasawa, R., & Lin, T. (1998). Asian Americans as a model minority: Self-

   perceptions and perceptions by other racial groups. *Sociological Perspectives*, 95-118.

Wong, A. C., Palmeri, T. J., & Gauthier, I. (2009). Conditions for facelike expertise with objects:

   Becoming a ziggerin expert--but which type? *Psychological Science, 20*, 1108-1117.

   doi:10.1111/j.1467-9280.2009.02430.x

Wright, D. B., Boyd, C. E., & Tredoux, C. G. (2003). Inter-racial contact and the own-race bias for

   face recognition in South Africa and England. *Applied Cognitive Psychology, 17*, 365-373.