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Minimizing Skin Color Differences Does Not Eliminate the Own-Race Recognition Advantage in Infants

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Abstract

An abundance of experience with own-race faces and limited to no experience with other-race faces has been associated with better recognition memory for own-race faces in infants, children, and adults. This study investigated the developmental origins of this other-race effect (ORE) by examining the role of a salient perceptual property of faces—that of skin color. Six- and 9-month-olds' recognition memory for own- and other-race faces was examined using infant-controlled habituation and visual-paired comparison at test. Infants were shown own- or other-race faces in color or with skin color cues minimized in grayscale images. Results for the color stimuli replicated previous findings that infants show an ORE in face recognition memory. Results for the grayscale stimuli showed that even when a salient perceptual cue to race, such as skin color information, is minimized, 6- to 9-month-olds, nonetheless, show an ORE in their face recognition memory. Infants' use of shape-based and configural cues for face recognition is discussed.

Relative to other features, such as the eyes, nose, mouth, ears, and hair, skin color is rated as the most important feature that adults use in their racial categorization of others (Brown, Dane, & Durham, 1998). This initial racial categorization may perhaps influence how one processes a given face, and thus may partially contribute to the widely replicated other-race effect (ORE) in face recognition memory. This recognition advantage for own-race faces has been found among adults (see Meissner & Brigham, 2001) and children (Chance, Turner, & Goldstein, 1982; Feinman & Entwisle, 1976; Goodman et al., 2007; Pezdek, Blandon-Gitlin, & Moore, 2003; Sangrigoli & de Schonen, 2004a; Walker & Hewstone, 2006), and begins its development during infancy (see Lee, Anzures, Quinn, Pascalis, & Slater, in press).

Early differential behavior toward own- and other-race individuals has been demonstrated by 3-month-olds' visual preference for own-race over other-race faces (Kelly et al., 2005;

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Kelly, Liu et al., 2007). This early preference is likely the result of differential experience with individuals from different racial backgrounds, such that equal experience with own-race individuals and individuals from another racial category leads to no such visual preference (Bar-Haim, Ziv, Lamy, & Hodes, 2006). However, given continued experience with own-race individuals and limited to no experience with other-race individuals, infants develop an own-race advantage in their face recognition memory that becomes evident between 3 and 9 months of age (Anzures, Quinn, Pascalis, Slater, & Lee, 2010; Hayden, Bhatt, Joseph, & Tanaka, 2007; Kelly, Quinn et al., 2007; Kelly et al., 2009; Sangrigoli & de Schonen, 2004b).

Although differential experience with own- and other-race faces has been widely accepted as a precursor to the ORE, researchers are still trying to uncover the specific ways in which own- and other-race faces are differentially processed. In adults, it appears that training or learning sessions during which other-race faces must be individuated result in an immediate reduction of the ORE (Goldstein & Chance, 1985; Hills & Lewis, 2006; Rhodes, Locke, Ewing, & Evangelista, 2009; Tanaka & Pierce, 2009). In addition, several training sessions across 2–3 weeks appear to have long-lasting effects of up to at least 5 months (Goldstein & Chance, 1985).

Similarly, training or learning sessions with infants have shown improvements in later recognition memory. Six-month-olds who received daily exposure to different monkey faces for 3 months showed above chance recognition memory for novel monkey faces at 9 months as long as the monkeys during the pretest exposure were labeled at the individual level (e.g., “Carlos,” “Flora,” etc.), rather than at the basic category level (i.e., “monkey”) or not labeled at all (Scott & Monesson, 2009). Thus, relative to when exposure is more passive in nature, it appears that learning faces from a previously unfamiliar category at the individual level leads to a more sophisticated processing of new faces from that same category.

However, without prior individuating experience with other-race individuals, other-race faces appear to be processed at the categorical rather than at the individual level (Levin, 1996, 2000). Visual processing tasks in adults show that race is encoded as the presence or absence of other-race visual features, thereby resulting in faster detection and categorization of other-race faces compared to own-race faces (Ge et al., 2009; Levin, 1996, 2000). Such visual processing asymmetry has also been found in 9-month-olds in a visual search task (Hayden, Bhatt, Zieber, & Kangas, 2009). This recognition of own-race faces at the individual level and other-race faces at the categorical level (Ge et al., 2009; Levin, 1996, 2000; Valentine & Endo, 1992; see also Caldara, Rossion, Bovet, & Hauert, 2004) may be associated with further differential processing of own- and other-race faces.

FACE PROCESSING AND ADULTS’ USE OF SKIN COLOR

As suggested earlier, skin color may be a salient perceptual cue that influences one’s racial categorization and subsequent processing of faces. Previous research has shown that adults’ perception of skin color can be influenced by introducing faces as either “Black” or “White,” whereby a face labeled as Black appears to be darker than the same face labeled as White (Levin & Banaji, 2006). In addition, racially ambiguous composite faces created from own- and other-race faces are remembered better by adults when they are labeled as own-race than when they are labeled as other-race (Pauker & Ambady, 2009; Pauker et al., 2009), and they are processed more holistically when they are perceived as own-race rather than as other-race faces (Michel, Corneille, & Rossion, 2010). More relevant to this study, the effect of directly manipulating skin color on own- and other-race face processing has been examined in two studies with adults. It has been shown that skin color plays a role—albeit a secondary one—in adults’ face recognition (Bar-Haim, Saidel, & Yovel, 2009).

Electrophysiological evidence also shows that adult participants display differential neural responses for own-race skin color and other-race skin color that are independent of own- and other-race facial features (Balas & Nelson, 2010). Thus, skin color appears to be associated somewhat with differential processing of own- and other-race faces in adults. However, a similar examination has yet to be conducted with an infant population.

FACE PROCESSING AND INFANTS' USE OF SKIN COLOR

In this paper, we specifically examined whether skin color drives differential recognition memory for own- and other-race faces among infants. If skin color information is minimized, might infants process other-race faces similarly to own-race faces? A previous study by Sangrigoli and de Schonen (2004b) found that 3-month-olds show an ORE when black-and-white photographs were used. However, the ORE in 3-month-olds is inconsistent across studies with some studies showing an ORE (Hayden et al., 2007; Sangrigoli & de Schonen, 2004b) and other studies showing comparable recognition of own- and other-race faces (Kelly, Quinn et al., 2007; Kelly et al., 2009). Considering that the ORE and enhanced recognition memory for own-race faces is more robust among infants during the latter half of their first year (Ferguson, Kulkofsky, Cashon, & Casasola, 2009; Kelly, Quinn et al., 2007; Kelly et al., 2009), this study examined 6- and 9-month-olds' recognition memory for own- and other-race faces shown in color and with skin color information minimized in grayscale images. If skin color is sufficient to drive enhanced processing of own-race faces relative to other-race faces, then using color photographs of own and other-race faces should elicit the classic ORE in infants' face recognition memory. In contrast, using grayscale photographs of own- and other-race faces with minimized skin color cues may lead to comparable recognition memory for own- and other-race faces. Considering previous findings of developmental changes in infants' face processing abilities between 6 and 9 months of age (Anzures et al., 2010; Cashon & Cohen, 2004), the potential influence of skin color on own-and other-race face recognition might also show developmental changes across the 6- and 9-month-old age groups in this study. However, if skin color cues do not affect the ORE in infants' face recognition memory, then the ORE should be evident in both the color and grayscale stimulus conditions.

METHOD

Participants

Thirty-eight Caucasian 6-month-olds (24 males) and 40 Caucasian 9-month-olds (19 males) participated in the study. An additional three 6-month-olds and three 9-month-olds were excluded because of fussiness, crying, and/or failure to complete the task. Participants were recruited through maternity wards in local hospitals. All infants were reported to have had little to no experience with Asian individuals (i.e., interacting with an Asian individual no more than once per month).

Stimuli

Four different Caucasian male faces and four different Asian (i.e., Chinese) male faces were used as stimuli. Two versions of each face were used. In one version, skin color information was included as shown in Figure 1A. A control study with adults verified that these Caucasian and Asian faces differed in skin color. We obtained data from six Caucasian adults and six Asian (i.e., Chinese) adults (nine females). For each Caucasian and Asian face pair, participants were asked whether the faces were similar or different in skin color. After specifying whether the face pair was similar or different, participants were then asked to use a 5-point scale to indicate how similar or different the face pair appeared in terms of skin color. For "different" responses, the following scale was used: 1 = a little different, 3 =

considerably different, 5 = extremely different. For “similar” responses, the following scale was used: −1 = a little similar, −3 = considerably similar, −5 = extremely similar. Participants indicated that the Caucasian and Asian faces were different rather than similar in skin color. A one-sample *t* test was conducted which compared participants’ skin color ratings to 1 (a little different) and showed that adults’ perceived the Caucasian and Asian faces to be considerably different in skin color ($M = 3.13$, $SD = 1.38$, $p < .001$).

In the second version of the stimuli shown in Figure 1B, differential skin color information for own- and other-race faces was minimized by converting the faces into grayscale images in Adobe Photoshop (San Jose, CA). All color and grayscale faces were presented with hair cues and facial contour removed to ensure that infants would attend to the internal regions of both own- and other-race faces. Thus, results using these stimuli would be indicative of genuine face recognition rather than potential hair or external contour recognition. In addition, considering that the majority of own- and other-race face recognition studies have used Caucasian and Asian face stimuli, Asian faces were chosen as the other-race stimulus group to ascertain whether Caucasian infants’ relatively poor recognition memory for Asian faces is influenced by skin color information.

Procedure

Infants were seated in a high-chair positioned approximately 60 cm from a 42-in. television screen on which the stimuli were presented (25.81° visual angle for the horizontal dimension, 34.71° visual angle for the vertical dimension). Infants were video-taped during testing so that their direction and duration of looking could be coded.

Infants were randomly assigned to one of the following four stimulus conditions: (a) Caucasian faces in color (twelve 6-month-olds, eleven 9-month-olds), (b) Caucasian faces in grayscale (eight 6-month-olds, nine 9-month-olds), (c) Asian faces in color (ten 6-month-olds, nine 9-month-olds), or (d) Asian faces in grayscale (eight 6-month-olds, eleven 9-month-olds). Infants in each condition were familiarized with a single face using an infant-controlled habituation procedure. During the first habituation trial, a single face was presented on the screen until infants’ looking away from the face reached two consecutive seconds. The same face was repeatedly presented in the same way until infants’ looking at the face during a single habituation trial decreased to 50% or less than 50% of the average of the previous two consecutive trials. That is, the habituation criterion changed with infants’ looking. For example, a sudden increase in looking at the face during the habituation trials resulted in an increase in the habituation criterion. Thus, this habituation criterion ensures that infants were adequately familiarized with a given face by accounting for fluctuations in looking at the face.

Once this habituation criterion was reached, infants were presented with two 5-sec test trials which presented the familiar face paired with a novel face from the same-race category in a left-right arrangement. Left-right positioning of the familiar and novel test stimuli was counterbalanced across infants on the first test trial and reversed on the second test trial. If infants recognized the familiar face that was presented during the habituation portion of the task, then they should show a novelty preference as indicated by greater looking at the novel face at test. It should be noted that in addition to testing infants’ recognition memory, this infant-controlled habituation and visual-paired preference test is most likely also a test of infants’ abilities to discriminate between two different faces from the same race. However, limited evidence does suggest that infants are able to discriminate between different other-race faces (Langlois, Ritter, Roggman, & Vaughn, 1991) in addition to their ability to discriminate between own-race faces. Thus, this study is most likely specifically examining 6- and 9-month-olds’ recognition memory of own- and other-race faces rather than purely their discrimination between different same-race faces.

Coding

Videos of the infants during testing were subjected to a frame by frame analysis. Interrater reliability between two independent research assistants was assessed by having both assistants code a randomly selected set of videos. The computed Cohen's Kappa for 10% of the total number of participants (i.e., eight videos) showed that the agreement between the two coders in terms of duration and direction of looking was .91.

RESULTS

An examination of infants' looking during the habituation portion of the task showed that they looked at the habituation face for an average of 12.92 sec (SD = 15.05) in the first trial and an average of 2.66 sec (SD = 2.21) in the last trial. Infants' habituation was further examined to ensure that there were no differences across conditions. A preliminary analysis showed no significant main effect or interactions with participant gender, and thus the analysis was collapsed across this variable. A 2 (stimulus race: Caucasian, Asian) × 2 (stimulus color condition: color, grayscale) × 2 (participant age: 6-month-olds, 9-month-olds) analysis of variance (ANOVA) was conducted with the dependent variable as the number of trials until the habituation criterion was reached (M = 4.49, SD = 2.07). The analysis showed no significant main effects or interactions ($p > .05$). A second three-way ANOVA with the same independent variables but with the dependent variable as the total duration of looking (in seconds) across all habituation trials (M = 32.15, SD = 27.75) also showed no significant main effects or interactions ($p > .05$). Thus, 6- and 9-month-olds' looking during the habituation portion of the task did not differ across participant age or across stimulus race and stimulus color conditions.

A novelty preference score for the novel face shown after habituation was computed for each participant by obtaining an average percentage of looking at the novel face across the two test trials. A preliminary analysis showed no significant main effects or interactions with participant gender, and thus the analysis was collapsed across this variable. A 2 (stimulus race: Caucasian, Asian) × 2 (stimulus color condition: color, grayscale) × 2 (participant age: 6-month-olds, 9-month-olds) ANOVA was conducted with participants' novelty preference scores as percentages as the dependent variable. The analysis showed a significant main effect of stimulus race, $F(1, 70) = 4.50$, $p < .05$, partial $\eta^2 = .06$, so that infants showed a significantly larger novelty preference in the own-race Caucasian face conditions (M = 57.71, SD = 10.08) relative to the other-race Asian face conditions (M = 52.55, SD = 10.18). Neither the main effect of stimulus color condition (color: M = 55.77, SD = 10.26; grayscale: M = 54.53, SD = 10.64) nor the main effect of participant age (6-month-olds: M = 55.89, SD = 9.55; 9-month-olds: M = 54.54, SD = 11.21) was significant ($p > .05$). The remaining two- and three-way interactions were also not significant ($p > .05$). Thus, infants showed better recognition memory for own-race Caucasian faces relative to other-race Asian faces regardless of the stimulus color condition.

One-sample t tests were also conducted to examine whether infants' novelty preference scores in each of the four stimulus conditions were greater than chance levels (see Table 1). Results showed that 6- and 9-month-olds' novelty preference scores were significantly above chance levels only for the Caucasian faces in the color (6-month-olds: M = 59.32, SD = 11.05; 9-month-olds: M = 55.31, SD = 9.33) and grayscale (6-month-olds: M = 57.57, SD = 9.53; 9-month-olds: M = 58.62, SD = 11.22) conditions, $t(22) = 3.47$, $p < .05$, and $t(16) = 3.30$, $p < .05$, respectively. In contrast, 6- and 9-month-olds' novelty preference scores for Asian faces in the color (6-month-olds: M = 53.16, SD = 9.77; 9-month-olds: M = 54.50, SD = 11.22) and grayscale (6-month-olds: M = 52.48, SD = 5.40; 9-month-olds: M = 50.46, SD = 12.95) conditions were at chance levels ($p > .05$). Thus, infants demonstrated above chance recognition only for own-race Caucasian faces. Overall, these findings indicate that

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regardless of the salience of skin color information, infants exhibit an ORE in face recognition memory.

DISCUSSION

Findings from this study showed that 6- and 9-month-olds exhibit above chance recognition of own-race Caucasian faces regardless of the salience of skin color information, whereas they only showed chance-level recognition of other-race Asian faces in both the color and grayscale conditions. This study also showed that infants have significantly better recognition memory for own-race Caucasian faces relative to other-race Asian faces, again regardless of the salience of skin color information. These results are consistent with previous findings of an ORE in 6- and 9-month-olds' face recognition memory (Anzures et al., 2010; Kelly, Quinn et al., 2007; Kelly et al., 2009). More importantly, this study is the first to directly and systematically examine the influence of the salience of skin color cues on infants' recognition of own- and other-race faces. Findings from this study indicate that although skin color is a visually salient racial marker, the salience of skin color cues does not appear to drive Caucasian infants' differential identity processing of own-race Caucasian and other-race Asian faces. However, it should also be noted that although 6- and 9-month-olds' face recognition does not appear to be influenced by the salience of skin color cues, their face recognition may nonetheless still be influenced by other low-level surface visual cues (e.g., luminance).

Despite previous findings of developmental changes occurring between 6 and 9 months of age in face processing abilities (Anzures et al., 2010; Cashon & Cohen, 2004) and in the development of a more robust ORE (Kelly, Quinn et al., 2007), this study found no developmental changes in terms of the influence of the salience of skin color cues on own- and other- race face recognition. These findings show small and nonsignificant age-related differences in 6- and 9-month-olds' use of skin color information (or lack thereof) for own- and other-race face recognition memory. Thus, whatever perceptual cues are driving the ORE in infants' face recognition, they are likely functional by 6 months of age.

Results from this study are consistent with results from the adult literature which show that skin color information plays a secondary role in the ORE in face recognition relative to the information provided by the internal facial regions (Bar-Haim et al., 2009). Thus, similar to the study with adults which showed no improvement in other-race face recognition when other-race faces were altered by replacing their skin color information with own-race skin color (Bar-Haim et al., 2009), 6- and 9-month-olds in this study showed no improvement in other-race face recognition when skin color cues were minimized. Our findings are also consistent with results from a study by Hayden et al. (2009) who found that even when skin tones across own- and other-race faces were equated, Caucasian 9-month-olds still showed a visual search asymmetry in their detection of own-race faces and other-race Asian faces. Thus, infants' recognition and detection of own- and other-race faces do not appear to be influenced by the salience of skin color cues. Alternatively, infants may use different perceptual cues when processing faces from different racial backgrounds. Thus, infants' processing of faces that are generally more disparate in skin color relative to their own-race faces (e.g., Caucasian infants' processing of African faces) may be more readily influenced by the salience of skin color information. Future studies are needed to ascertain whether findings from this study generalize to infants' processing of faces from different racial backgrounds. In addition, it remains unknown whether infants' categorization of own- and other-race faces is unaffected by skin color—which is another question that should also be addressed in future studies.

Considering that the results of this study suggest that the salience of skin color cues do not play an important role in Caucasian infants' recognition of own-race faces and other-race Asian faces, one can speculate that these infants are instead differentially processing the features and configuration of own- and other-race faces. This speculation would be consistent with findings by Ferguson et al. (2009) who have already shown an ORE in infants' holistic processing of faces. In addition, racially characteristic shapes of internal facial features, and/or racially characteristic spacing among internal facial features (Hajniš, Farkas, Ngim, Lee, & Venkatadri, 1994), may act as racial markers that lead to infants' differential processing of own- and other-race faces. Such differential processing would be consistent with findings in the adult literature, which show greater holistic processing (Michel, Rossion, Han, Chung, & Caldara, 2006; Tanaka, Kiefer, & Bukach, 2004), as well as better recognition memory for individual facial features (e.g., eyes, nose, mouth, etc.) and the spacing between individual features, for own-race faces as compared to other-race faces (Hayward, Rhodes, & Schwaninger, 2008; Rhodes, Hayward, & Winkler, 2006; Rhodes, Ewing et al., 2009).

Differential processing of own- and other-race facial features has also been supported by an eye-tracking study by Liu et al. (2011) that indeed showed differences in infants' scanning of own- and other-race faces. Liu et al. found that Chinese infants show differential scanning of the nose, with an age-related decrease in fixation for the nose of other-race Caucasian faces, but a maintenance of fixation duration on this feature for own-race Chinese faces. In addition, Chinese infants' total fixation duration for other-race internal facial features (i.e., eyes, nose, and mouth) declined with age, but remained the same with age for own-race internal facial features (Liu et al., 2011). Thus, future studies should investigate whether such early differential scanning of own- and other-race facial features can account for the ORE in infants.

It should be noted that this study has three main limitations. One limitation pertains to our use of a particular habituation procedure. Although our habituation criterion ensured that infants were adequately familiarized with a given face by accounting for fluctuations in looking at the face, a different habituation criterion may lead to different results. A second limitation is our use of only male stimulus faces. Although previous studies have found comparable OREs for male and female faces (Kelly, Quinn et al., 2007; Kelly et al., 2009), future studies are needed to examine infants' use of skin color for own- and other-race female faces to verify the generalizability of these results with male faces. A third limitation is our recruitment of Caucasian infants, rather than Caucasian as well as Asian infants. Further research should examine whether findings from this study also generalize to infants from Asian backgrounds. This would verify that these findings of an own-race recognition advantage regardless of the salience of skin color cues is because of differential experience with own- and other-race faces, and that Caucasian faces are not simply easier to discriminate relative to Asian faces (see Kelly et al., 2009). These three limitations suggest caution when interpreting these findings in relation to other studies that use a different habituation criterion, female faces, and non-Caucasian infant participants.

Despite these findings showing that an own-race recognition advantage is maintained in 6- to 9-month-old Caucasian infants even when skin color differences between races are minimized, our results coupled with previous findings from adults are also consistent with the idea that there are important developmental changes in the use of skin color in face recognition. Bar-Haim et al. (2009) showed that Caucasian adults showed better recognition of own-race Caucasian faces with white skin color relative to their recognition of own-race Caucasian faces with black skin color. Thus, although minimizing skin color differences does not appear to affect own- and other-race face recognition in infants, the use of color information for own-race face processing may increase with age so that the replacement of

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the skin color of own-race faces with that of other-race faces leads to a significant decrement in adults' own-race face recognition performance. Perhaps adults' representation of own-race faces includes skin color, whereas infants' relatively less mature representation of own-race faces has yet to integrate such skin color information so that the salience of skin color cues does not affect their own- and other-race face recognition.

It remains to be investigated when this use of skin color for own-race face processing first emerges. Consistent with findings from this study, Sangrigoli and de Schonen (2004a) found an ORE in 5-year-olds' recognition of black- and- white photographs of own- and other-race faces. However, although the ORE in children is well replicated (Chance et al., 1982; Feinman & Entwisle, 1976; Goodman et al., 2007; Pezdek et al., 2003; Sangrigoli & de Schonen, 2004a; Walker & Hewstone, 2006), further systematic investigation is needed to examine the role of skin color and other racial markers in children's face recognition. Such studies on the perceptual roots of the ORE will not only reveal developmental changes in own- and other-race face recognition and categorization, but may also lead to a greater understanding of the development of social preferences for in-group and potential prejudice against out-group individuals.

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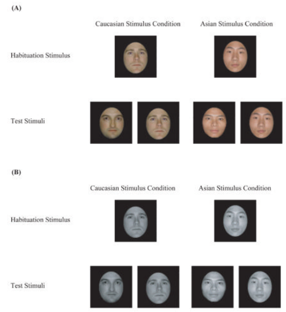

FIGURE 1.
Example of Caucasian and Asian stimuli in the color (A) and grayscale (B) conditions.

TABLE 1

Six- and 9-Month-Olds' Mean Novelty Preference Score and Standard Deviation for Own-Race Caucasian Faces and Other-Race Asian Faces in the Color and Grayscale Stimulus Conditions

Stimulus race	Stimulus color condition	Mean novelty preference (%)	SD
Caucasian	Color	57.40*	10.24
	Grayscale	58.13*	10.15
Asian	Color	53.79	10.21
	Grayscale	51.31	10.27

Note:

* indicates above chance-level performance at $p < .05$.