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Here's Looking at You Kid: Preferential Attention to Same and Other Race Infant Faces Does Not Overcome the Other Race Effect

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Here's Looking at You Kid: Preferential Attention to Same and Other Race Infant Faces Does Not Overcome the Other Race Effect

By

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Accepted in Partial Completion
of the Requirements for the Degree
Masters of Science

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MASTER'S THESIS

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Sarah L. Martinez
May 26, 2017

Here's Looking at You Kid: Preferential Attention to Same and Other Race Infant Faces Does Not Overcome the Other Race Effect

A Thesis
Presented to
The faculty of
Western Washington University

In Partial Fulfillment
Of the Requirements for the Degree
Master of Science

by
Sarah L. Martinez
May 2017

Abstract

Given the attentional and motivational saliency of infant faces, triggered by a set of perceptual

baby schema features, other-race infants may overcome the processing limitations associated

with the Other Race Effect (ORE). Using an attentional bias paradigm, I found that while there

was a same-race attentional bias for adult faces, there was no difference in attention bias between

same- and other-race infants suggesting that other-race infants have the ability to overcome the

attentional limitations associated with processing other-race faces. To directly measure the ORE,

I used a recognition memory test to measure encoding differences between same- and other-race

infant and adult faces. Regardless of age, same-race faces were better remembered than other-

race faces. Further, regardless of race, adult faces were better remembered than infant faces, a

finding consistent with an Other Age Effect. Results from the recognition task were validated

with differences in Event Related Potentials which found that infant faces may not have been

configurally processed as indexed by changes in the N170 and P2 components. However,

evidence of infants' saliency was marked by an increased response of the Late Positive

Component (LPC), which supports the findings from the attention experiment. Taken together,

these experiments suggest that the saliency of baby schema does not fully overcome the

processing limitations of the ORE.

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Introduction

The expression "they all look alike to me," although having some racial undertones, illustrates that people process faces of other races differently than faces of their own race. Decades of research supports this anecdotal observation, showing that people are better at recognizing same-race faces compared to faces of another race (Meissner & Brigham, 2001; Schweinberger & Tanaka, 2010; Walker & Tanaka, 2003). This phenomenon, known as the Other Race Effect (ORE), emphasizes that although recognizing the faces of people we have seen before seems relatively automatic, the process is in fact very complex and may be influenced by several factors. In their review of the literature, Meissner and Brigham (2001) found that one possible mechanism to understand the ORE is a lack of attentional resources needed to successfully process other-race faces.

More recent work extends research on the ORE to the perception of infant faces by asking whether same-race infant faces are processed differently than other-race infant faces. This question is of particular interest because infant faces preferentially draw attention over adult faces (see Hahn & Perret, 2014 for review) and therefore may receive enhanced processing sufficient to negate effects of the ORE. Although recent studies have investigated whether same- and other-race infant faces receive similar attentional prioritization (Hodsoll, Quinn, & Hodsoll, 2010), results are mixed (Proverbio, De Gabriele, Manfredi, & Adorni, 2011). Moreover, these attention studies do not directly address the discrimination performance underlying the ORE. This thesis consists of three studies that seek to clarify and extend existing research by 1) further addressing whether same- and other-race infant faces receive similar attentional prioritization, 2) investigating whether an ORE is present when viewing same- and other-race infant faces, and 3) measuring neural differences when perceiving same- and other-race infant faces.

The Other Race Effect

The ORE is measured by comparing recognition memory for other-race faces to same-race faces, with memory failures for other-race faces attributed to processing differences during perception and encoding (Meissner & Brigham, 2001). Several theoretical approaches have been forwarded to account for the influence of social categorization, motivation, and perceptual experience on the ORE (see Hugenberg, Young, Bernstein, & Sacco, 2010 for a review and unifying model). Among several mechanisms that attempt to explain the ORE, the Contact hypothesis and the Sociocognitive approach are the most widely adopted. The Contact hypothesis is perceptually-based and proposes that other-race faces are processed differently depending on the experience one has with viewing faces of a specific race (Meissner & Brigham, 2001; Michel, Caldara, & Rossion, 2006; Tanaka, Kiefer, & Bukach, 2004; Walker & Tanaka, 2003). In contrast, the Sociocognitive approach proposes that the ORE arises from a classification process wherein social and cultural factors influence how people process the faces of out-group members (Levin, 1996; Sporer, 2001; Valentine & Endo, 1992). This approach stresses a *motivational* component in attending to other-race faces as opposed to the Contact hypothesis which places an emphasis on one's *frequency* with viewing other-race faces. Though the hypotheses describe different mechanisms of the ORE, the may not be mutually exclusive. For example, one's interracial experience may require them to re-categorize other-race faces as part of an in-group, thereby improving both attentional and encoding processes when viewing other-race faces.

The Contact/Expertise Hypothesis

According to the Contact hypothesis, interracial experience may enhance the perceptual encoding of an other-race face, which leads to successful discrimination (Meissner & Brigham,

2001; Michel et al., 2006; Tanaka et al., 2004; Walker & Tanaka, 2003). Experiences with viewing other-race faces, as well as the quality of those experiences, optimally shapes the perceptual processing of other-race faces due, in part, to a reliance on configural processing. Configural, or holistic, processing considers the face as a single percept by evaluating the higher order relationships between facial features (Rossion & Michel, 2011, Tanaka & Gordon, 2011). Evidence suggests that configural processing allows for the successful individuation of faces that leads to recognition (Tanaka & Farah, 1993; Tanaka & Gordon, 2011). Consequently, when faces are not processed configurally, faces are not easily discriminated and recognition memory suffers. This has been demonstrated using face manipulation paradigms that disrupt facial configural information, resulting in impairments when discriminating such faces (Freire, Lee, & Symons, 2000; Hahn, Jantzen, & Symons, 2012; Tanaka & Gordon, 2011).

As suggested by the Contact hypothesis, an individual with interracial experience tends to process faces configurally when viewing other-race faces (Michel et al., 2006; Walker & Tanaka, 2003). In the absence of substantial experience viewing other-race faces, one processes other-race faces featurally (Michel et al., 2006; Tanaka et al., 2004), by placing emphasis on individual facial features instead of a whole face (Rossion & Michel, 2011). Further evidence for the direct correlation between interracial experience and a reduced ORE is illustrated by the effects of perceptual learning experiments (Tanaka & Pierce, 2009). In these paradigms, participants are repeatedly shown a set of other-race faces to experimentally increase interracial experience. Tanaka and Pierce (2009) found that individuation training improved recognition performance for other-race faces, relative to participants who did not receive practice with distinguishing other-race faces, suggesting one's level of interracial experience is a significant predictor of performance on racial discrimination tasks.

The Sociocognitive Approach

According to the Sociocognitive approach, the ability to successfully encode a face is influenced by social factors such as perceived in-group/out-group membership (Levin, 1996). Faces categorized in a group for which the viewer has little interest or that are designated as out-group members will not be remembered, possibly reflecting a cognitive disregard of the out-group face (Hugenberg, Young, Sacco, & Berstein, 2011; Sporer, 2001; Wiese, Kaufmann, & Schweinberger, 2014). The motivational component of this approach arises when people are motivated to individuate the faces of in-group members more so than out-group members (Levin, 1996). For example, once other-race faces are categorized as part of an out-group, face processing may be truncated and attentional resources are reallocated elsewhere (Meissner & Brigham, 2001; Sporer, 2001; Valentine & Endo, 1992), resulting in insufficient encoding and an inability to subsequently remember other-race faces. Conversely, when processing in-group faces, viewers devote more attention to facial features that differentiate among members and thus are better able to individuate in-group faces (Hugenberg et al., 2011).

In keeping with the hypothesis that early identification of race influences subsequent processing are findings that there are race-dependent modulations of brain potentials that occur very early during face processing (Ito & Urland, 2003). Ito and colleagues (2003) instructed participants to categorize pictures of Black and White faces based on either gender or race. Event related brain potentials revealed that race is evaluated one-tenth of a second into face processing (even before the evaluation of gender) and influences brain activity related to subsequent processing of faces even if race is not relevant to the task. This rapid detection of race-specific features is due to internal featural differences in faces (skin color, eye and nose shape; Levin, 1996) which help to characteristically define a face by race. Effectively, featural

differences flag the other-race face to be classified as such an out-group member and results in insufficient processing (Brosch, Bar-David, & Phelps, 2012). Although rapid detection of superficial features may cause incomplete encoding of other-race faces, people are faster at classifying and categorizing other-race faces compared to same-race faces (Levin, 1996; Valentine & Endo, 1992). However, this categorization process may distract from the encoding of individual facial features and promote poor recognition memory (Hugenberg et al., 2011).

Importantly, the ORE can be reduced when other-race faces are made more salient. Motivation to fully and successfully encode an out-group member's face is increased when the viewer is highly aroused (Hugenberg et al., 2010) because angry out-group members may be more threatening, and thus need to capture more attention, than angry in-group members. The notion that increased attention may enhance processing of other-race faces and eliminate the ORE (Hills & Lewis, 2006; Hills & Pake, 2013) is supported by work showing that angry other-race faces are better remembered than angry same-race faces (Ackerman et al., 2006). Additionally, an ORE in infant participants can be overcome by modulating their motivation to attend to faces of differences races (Markant, Oakes, & Amso, 2016). By using a spatial cueing task to bias infants' attention to viewing same- and other-race faces, infants equally discriminated same other-race faces, effectively eliminating their ORE, thus motivation to encode a face may be increased when attention is automatically drawn to a face.

Infant Face Processing

Recent proposals that infant faces may not be subject to the ORE (Hodsoll et al., 2010; Proverbio et al., 2011) reflect a wealth of data demonstrating that infants are very salient stimuli that automatically attract attention (Cardenas, Harris, & Becker, 2013) and generate positive affect in the viewer (Lorenz, 1943). Prototypical infant features, including a large forehead and

eyes, and a small nose, mouth, and chin, comprise a "baby schema" (Golby, Gabrieli, Chiao, & Eberhardt, 2001) which generates infant cuteness (Glocker et al., 2009) and elicits a strong motivation for caretaking behavior (Parsons, Young, Kumari, Stein, & Kringelbach, 2011). The perception of infant cuteness and the release of caregiving behavior encompasses a phenomenon known as *Kindchenschema* (Lorenz, 1943). Moreover, cute infants are rated as likeable, friendly, healthy, and competent to a higher degree than infants who do not possess these characteristics as strongly (Ritter, Casey, & Langlois, 1991). Physical attributes of baby schema's effects extend to the age of 4.5 years (Luo, Hong, & Lee, 2014) as the child's head and face become more proportionally sized to its body, and the facial features become less characteristic of baby schema and more like the prototypical adult-face. It is around this age when the perceptual and behavioral effects of Kindchenschema decline.

Attentional Prioritization of Infant Faces

Within Kindchenschema, Lorenz (1943) claimed that humans respond to baby schema features with caretaking behaviors, such as increased attention to the otherwise helpless infant. The parental care offered to infants is not only important for the infant's survival, but for the reproductive success of the caregiver, themselves. Thus, infants are an example of a highly biologically relevant stimuli (i.e. they are salient). This saliency, which is in part caused by baby schema features, allows infants to be attentionally prioritized over other environmental stimuli (see recent review in Lucion, Oliveria, Bizarro, Bischoff, Silveria, & Kauer-Sant'Anna, 2017). For example, adults demonstrate an attentional bias toward infant faces compared to adult faces and objects (Brosch, Sander, Scherer, 2007; Cardenas et al., 2013; Hodsoll et al., 2010), and look longer at cuter infants compared to less cute infants (Borgi, Cogliati-Dezza, Brelsford, Meints, Cirulli, 2014). Adults also work harder to look at infant faces compared to adult faces (Parsons

et al., 2011). Using an eye tracker to measure attentional engagement of infant faces, Cardenas and colleagues (2013) presented infant and adult faces in pairs while participants' viewing time and the frequency of their eye movements indexed their attention toward each face. Eye tracking data suggested that both male and female participants had greater viewing time and more attention for infant faces compared to adult faces, providing further evidence for an attentional bias toward infant faces as discussed within Kindchenschema.

Similarly, Brosch and colleagues (2007) used a dot probe task to measure attentional prioritization of infant faces. Adult and infant face-pairs were shown for a brief period on opposite sides of a fixation point followed by the presentation of a cue that appeared either on the same side as the infant or the adult face. Responses were faster to the cue when it appeared on the same side as the infant face, compared to when the cue followed an adult face, demonstrating an attentional bias toward infant faces. Furthermore, infant faces were rated as more pleasant and more arousing than adult faces, suggesting that the arousing potential of the stimuli modulates attentional prioritization. These data suggest that infants are regarded as biologically significant, both in terms of attentional resources and control over the perceiver's affect, lending further support for the powerful attention-grabbing capabilities of baby schema features.

Infants and the ORE

Given the attentional and motivational saliency that accompanies baby schema, other-race infants may have the potential to overcome the attentional limitations associated with the processing other-race faces. As discussed within the ORE's Sociocognitive approach, there is often an attention bias in favor of same-race adult faces relative to other-race adult faces (Zhou et al., 2015). However, baby schema literature indicates that infant faces strongly attract attention

(Cardenas et al., 2013). This discrepancy in attentional bias for infant faces and same-race faces leads to the unanswered question of whether infant faces are subject to the attentional limitations that accompany the processing of other-race adult faces. Several studies have shown that increased attention to other-race faces may overcome the ORE. By manipulating selective attention, the visual processing of the attended information can be improved (Markant et al., 2015). This heightened processing not only includes improved quality of the vision, but enhanced acuity and contrast-sensitivity to the selected stimuli (for a review regarding visual attention, see Carrasco, 2011) which, consequently, enhances the encoding and recognition of the attended stimuli, relative to the unattended stimuli (Rutman, Clapp, Chadick, & Gazzaley, 2009). Therefore, the selective attention bias directed toward infant faces, regardless of an infant's race, should improve encoding and subsequent recognition of the infant face (Markant et al., 2015).

Investigations into whether same- and other-race infant faces similarly attract attention provide mixed results. As a measure of attentional engagement, Hodsoll and colleagues (2010) used a dot probe paradigm composed of White infant-adult pairings and South Asian infant-adult pairings. White participants responded faster to White (same-race) faces compared to South Asian (other-race) faces, suggesting that only same-race infants are attentionally salient. In attempting to replicate Hodsoll, Proverbio and colleagues (2011) reported the opposite finding, namely that infant faces were attentionally prioritized regardless of race. Results indicated that reaction times were faster for probes preceded by infant faces compared to adult faces, regardless of the infant's race. Thus, the ability for other-race infant faces to automatically attract attention remains unclear.

Further, Hodsoll (2010) and Proverbio (2011) framed their findings in the context of the ORE, suggesting that the pattern of attentional prioritization for same- and other-race infants

implies that infant faces are, and are not (respectively), subject to the Other Race Effect. However, the traditional way to measure the ORE requires the application of a memory paradigm and evaluation of memory errors for same- compared to other-race faces (Malpass & Kravitz, 1969; Meissner & Brigham, 2001; Valentine & Endo, 1992). While some ORE studies test the ORE by use of face-inversion paradigms (Hahn et al., 2012) or visual search tasks (Levin, 1996), I operationally defined the main behavioral component of the ORE as a difference in memory recognition between same- and other-race faces. Thus, a memory test was needed to make the claim that baby schema (and the attentional bias that accompanies baby schema) can overcome the ORE. Here, I report the results of two behavioral studies (one attention paradigm and one recognition memory paradigm) designed to more fully evaluate the ORE with infant faces.

Neural Mechanisms of ORE and Kindchenschema

Researchers have employed several functional imaging techniques to understand the brain mechanisms of how other-race and infant faces are processed. One such technique is an Electroencephalograph (EEG) which can be used to measure Event Related Potentials (ERPs) that reflect various cognitive and perceptual processes related to face processing (see Eimer, 2011). ERPs are an appropriate measure of how neural processes change across time as they have high temporal resolution and can be time-locked to a specific stimulus so that changes in neural activity can be isolated and the perceptual differences between viewing stimuli can be evaluated (Olivares, Iglesias, Saavedra, Trujillo-Barreto, & Vales-Sosa, 2015).

One such ERP component that is studied pervasively in the face processing literature is the N170. A human face, regardless of race or age, preferentially elicits an N170 component, a negative deflection in the EEG that is maximal at approximately 170ms over occipital channels

(Bentin & Deouell, 2010). The N170 has neural sources in the lateral and basal temporal lobe, and extrastriate occipital cortices (Olivares et al., 2015). Because the N170 is typically elicited by faces, the component may be primarily generated from the Fusiform Gyurs (FG) within the Fusiform Face Area (FFA), a region of cortex primarily responsible for processing faces (Golby et al., 2001). Because it originates from face processing areas, this ERP is thought to be sensitive to the structural encoding and representation of facial configuration (i.e. configural processing; Bentin, Allison, Pruce, Perez, & McCarthy, 1996; for a review of the N170, see Olivares et al., 2015), or be a marker of the facial-encoding processes of the occipito-temporal cortex. Research showing that the N170 is modulated by face familiarity provides further evidence that this component may reflect the activation of a mechanism that specializes in face structural encoding (Lucas, Chiao, & Paller, 2011; Stahl, Wiese, & Schweinberger, 2008).

Neural Substrates of the ORE

A handful of studies have shown that other-race faces cause a delayed (and sometimes larger) N170 peak (Hahn et al., 2012; Stahl et al., 2008; Wiese, Stahl & Schweinberger, 2009; Tanaka & Pierce, 2009; Wiese, 2012; Wiese et al., 2014), which is interpreted as impaired (Stahl et al., 2008) or inefficient (Wiese et al., 2009) configural processing of other-race faces. To investigate the disruption of configural processing of other-race faces, Hahn and colleagues (2012) measured ERP components as participants viewed normal and Thatcherized (eyes and mouth are rotated by 180 degrees) same- and other-race faces. Not only was there a larger N170 amplitude and peak latency when viewing other-race faces, but there was a greater neural response when viewing the other-race Thatcherized faces compared to the same-race Thatcherized faces. These data suggest that configural processing can be indexed by changes in the N170 component (Hahn et al., 2012; Stahl et al., 2008; Tanaka & Pierce, 2009; Wiese, 2012).

Thus the N170 is an essential component to study when investigating race differences in face processing.

Similarly, Stahl and colleagues (2008) investigated neural processing differences in viewing same- and other-race faces between participants with interracial experience and those with no experience. Both groups of participants completed a recognition memory task while an EEG measured neural activity. ERP analysis revealed a larger and delayed N170 component in response to other-race faces compared to same-race faces suggesting there is less configural processing when viewing other-race faces (Stahl et al., 2008). Further ERP analysis revealed that the P2 component, a positive waveform occurring 230-300ms over occipital/temporal channels, was modulated by participants' interracial experience as the perceptual difference between viewing same- and other-race faces was only seen in participants with no interracial experience. That is, there were no race differences in the P2 response for participants with interracial experience, suggesting that they could process other-race faces as effectively (and configurally) as same-race faces. When interpreting this difference (or lack thereof), Stahl and colleagues (2008) suggested that the P2 may be associated with effective extraction of individualizing features via second-order configural processing.

Neural Correlates of Kindchenschema

Several EEG studies have indicated a special neural response limited to infant faces. Proverbio et al. (2011) used 128-chanel EEG to investigate changes in brain activity when viewing an infant face. In their study, participants viewed pictures of infants, children, adults, and objects. Results showed an increased N170 component when viewing infant faces, relative to the other-age conditions, suggesting that infant faces are processed differently compared to adults or pre-pubertal children (Proverbio, Riva, Zani, & Martin, 2011). Further, Proverbio et al.

(2011) found an increase in the amplitude of the reward-related orbito-frontal N2 component when adults viewed faces of pre-pubertal children. Source localization of this component found that it was generated from the face processing area of the Fusiform Gyrus (FG), and the cingulate and orbitofrontal cortex which are areas typically responsible for evaluating and rewarding salient stimuli (Wallis, 2007). These ERPs and cortical areas are aligned with Kindchenschema by providing evidence that viewing infant faces results in the release of reward.

Other literature that has found an increased N170 response for infant faces (Colasante, Mossad, Dudek, & Haley, 2017; Hahn et al., 2015; Proverbio et al., 2011) suggests that an increase in neocortical activity may lead to a reallocation of attentional resources for a deeper processing of the infant face (Hahn & Perrett, 2014; Hahn et al., 2015), as face processing areas (such as the FG or FFA) are increased when viewing infant faces (Kringelbach et al., 2008; Proverbio et al., 2011; Colasante et al., 2017). Kringelbach and colleagues (2008) used a magnetoencepholograph (MEG) to measure the neural response to viewing infant and adult faces. Source analysis showed increased cortical activation first in the medial OFC, followed by activation in the right FFA in response to viewing infant faces (Kringelbach et al., 2008). These data suggest that the OFC may provide top-down amplification to increase FFA activity in response to infant faces which may, consequently, enhance the encoding and perceptual processing of infant faces (Nitschke et al., 2003). Kringelbach and colleague's (2008) work is supported by Jantzen and colleague's (under review) data which suggests an increase in the reward and attentional systems early on in infant face processing. Jantzen and colleagues had participants rate the cuteness and attractiveness of infant and adult face stimuli while their neural activity was recorded via EEG. An increase in the N170 and P2 amplitude was limited to infant faces, relative adult faces, suggesting an increase in perceptual processing in the visual cortex

when viewing an infant face (Hahn et al., 2015). After source analysis was performed on the components, an increase in activity of the OFC and FG during the 152-174ms time window was found when participants viewed infant faces suggesting neural connectivity between these two cortical areas, which may ultimately enhance the processing of an infant's face.

An ERP component that is an index of perceptually salient information and reward is the Late Positive Component (LPC) response, a positive waveform that occurs at 300-600 ms over the posterior midline electrodes. Though the LPC is not necessarily face-specific, the LPC reflects a stimulus' affective value and indicates a release of reward (i.e. the higher a stimulus' perceived reward is, the higher the LPC response). In the face processing literature, the LPC is modulated by perceived attractiveness as attractive faces are salient and are rewarding to view (Johnston & Oliver-Rodriguez, 1997). Johnston and Oliver-Rodriguez (1997) demonstrated this effect by experimentally manipulating the attractiveness of male and female faces and tasked participants with rating each face on perceived attractiveness. Faces that were rated as more attractive elicited a larger LPC response compared to unattractive faces, suggesting that the LPC is sensitive to a stimulus' saliency such that positive and rewarding stimuli will elicit a greater LPC response compared to less salient stimuli.

Because viewing an infant face results in the release of reward, the LPC response is greater for viewing infants than when viewing adult faces (for a review see Hahn & Perrett, 2014; Hahn et al., 2015). In a source analysis of ERPs in response to infant faces, Jantzen and colleagues (under review) found that the LPC originated from the orbital frontal cortex, anterior cingulate (ACC) and superior temporal sulcus (Downar, Crawley, Mikulis, & Davis, 2002). Other neuroimaging studies have found that ACC activation may reflect planning behaviors to salient events while the frontal-parietal network (in its entirety) may identify and evaluate salient

information in general. Thus, the activation of these areas when viewing an infant face may reflect the activation of the dopamine system that contributes to and motivates the caretaking behavior as defined by Kindchenschema.

The current studies investigated if infant faces, given their enhanced processing as indexed by greater attention, may overcome the processing limitations associated with the ORE. A discrepancy currently exists in the literature with investigating attentional prioritization changes between same- and other-race infants (Hodsoll et al., 2010; Proverbio et al., 2011). Although the ORE suggests that there would only be enhanced processing of same-race infant faces (Hodsoll et al., 2010), the potential for overcoming the processing limitations associated with other-race infant faces remains ill-explored. Moreover, there have been no published experiments regarding ORE memory differences (the fundamental behavioral effect of the ORE), nor neural processing differences between viewing same- and other-race infant faces.

Experiment I: Does attention change depending on the race and age of a face?

In experiment one, I replicate studies of attentional bias toward same- and other-race infant faces (Hodsoll, 2010; Proverbio, 2011) by measuring attentional bias toward Black and White adult and infant faces via Posner spatial cueing task. This is critical given the lack of agreement between the only two published studies. Black faces were used because of the small local African American population, which reduces the likelihood of extensive "other race" contact and provides distinct same-race and other-race categories. If infants automatically attract attention (as given by the infant attentional bias triggered by baby schema), reaction time should be similar for same- and other-race infant faces (Proverbio et al., 2011) and, overall, should be faster than adult faces (Brosch et al., 2007; Hodsoll et al., 2010; Proverbio et al., 2011). For adult faces, an attentional bias should be present such that there should be greater attention for

same-race adult faces compared to other-race adult faces, in accordance with the Sociocognitive approach's explanation of same-race faces capturing viewer's attention (Levin, 1996; Valentine & Endo, 1992).

Participants

Sixty-eight Caucasians (56 females) participated in this experiment with a mean age of 21.92 years ($SD = 6.70$). Participants were recruited through the Psychology subject pool at Western Washington University and were compensated with course credit for their participation. This study was approved by Western Washington University's Institutional Review Board and abided by all ethical APA guidelines. Prior to participation, participants were placed in front of a computer screen and completed a consent form and a short demographic questionnaire about their personal experiences with other races and infants. Data from participants who were left-handed ($n = 4$) or who had daily to weekly contact with African Americans ($n = 12$) were excluded before analysis, leaving a total of 52 participants. See Table 3 and Table 4 for participants' responses on the Social Experience Questionnaire (SEQ) regarding their personal contact with African Americans.

Adult Faces

Two hundred standardized White and Black adult faces (100 of each race, with an equal number of males and females) were selected from the Chicago Face Database 2.0 (Ma, Correll, & Wittenbrink, 2015), which is comprised of a compilation of high resolution forward facing photographs of adult faces of different races demonstrating a range of emotional expressions. For each face, the database includes subjective ratings of appearance for several categories including emotional expression, age, and attractiveness. To eliminate the possibility that some faces may be more memorable than others, I rejected faces that were two standard deviations above or

below the average on ratings of perceived emotional expression (anger, fear, disgust, happiness, sadness, threat), attractiveness, and babyfacedness. All faces selected for the current study displayed neutral or slightly positive affect. The ratio of positive to neutral expression was selected to match that found in the infant face stimuli.

Infant Faces

One hundred White and 93 Black infant faces showing neutral or slightly positive expressions were obtained from a variety of public domain websites. The gender of most infants could not be determined from facial features, thus infant images were selected regardless of gender. I chose infants that I perceived as appearing older than a newborn and younger than a 4.5 year old child (Luo et al., 2014), ensuring that infant faces still displayed an average degree of baby schema.

Subjective ratings of the infant were used to further evaluate their appropriateness of stimulus selection. Using MediaLab, 15 participants pilot rated the standardized infant faces (see section below on standardization procedures) separately on cuteness and distinctness on a Likert scale from 1-5, where a score of 1 indicated not cute, not distinct and a score of 5 indicated very cute, very distinct. Participants also dichotomously rated each infant's age as being younger or older than 4 years old, and indicated each infant's race to be Caucasian, African American, or Other. See Table 1 for the descriptive statistics regarding the pilot ratings of Black and White infant faces.

Infant faces that were rated as two standard deviations above or below the average ratings for the cute and distinctness ratings were excluded from the grand stimulus set. Images incorrectly classified on race or perceived as being more than 4 years old by more than 20% of the participants were also excluded. After pilot rating, experimenters visually inspected the

images based on photo quality and excluded poor quality photos. The remaining 87 White and 76 Black infant faces comprised the stimulus set.

Image Manipulation

Using Psychomorph database (DeBruine & Tiddeman, 2007), all adult and infant images were standardized in size, scale, and position. Faces were individually delineated by manually placing specific coordinates over each image's facial landmarks (i.e. hairline, jawline, eyes) to standardize pupil level and face size across all images. The outline of the face, defined by the jawline and hairline, was used to mask out the ears, hair, and neck so that only the face of each image was visible against a white background (Cardenas et al., 2013; Kawakami et al., 2014). Subsequent image processing was performed in Matlab v.7.3.0 (Mathworks, Inc., Natick, MA, USA) to convert each 9cm x 9cm image to grayscale by eliminating hue and saturation information, while maintaining luminance. To account for differences in contrast among images, I adjusted pixel values such that the mean and standard deviation of all non-white (rgb = 255, 255, 255) voxels was equivalent across images.

Social Experience Questionnaire (SEQ)

A demographic questionnaire adapted from Walker and Tanaka (2003) measured participants' interracial experience ($\alpha = .97$). The survey contained a total of eleven questions regarding participants' experiences with other races. Three questions asked if they had ever lived abroad and if so, where and for how long. Five questions asked about the general racial make-up of the participant's family and close friends, and how often they see other-race (non-African American specific) family members and friends. Three questions asked about participants' interracial social contact specifically with African Americans. Specifically, the question "How many African Americans do you know very well?" with response options of (a)

up to 2, (b) up to 5, (c) up to 8, (d) up to 12, (e) more than 12, was asked. The statements "I often spend time with African Americans" and "I spend a lot of my free time doing things with African Americans" with response options of (a) strongly agree, (b) sort of agree, (c) not sure, (d) sort of disagree, (e) strongly disagree, were also provided. Refer to Appendix A for the specific questionnaire. Additionally, participants' basic demographic information such as age, sex, race, and handedness (refer to Appendix B for the Edinburgh handedness questionnaire; Oldfield, 1971) were obtained.

Procedure

A modification of the Posner spatial cueing task (Posner, 1980; Proverbio et al., 2011) was administered using Inquisit version 5.0 (de Clercq, Crombez, Buysse, & Roeyers, 2003) on an IBM-compatible PC. Participants were told to ignore all faces and fixate their gaze on a fixation-cross centered on the screen. On each trial, a 7cm x 7cm face (12 degrees of visual angle) was presented either 5 cm to the left or right of the fixation on a 19-inch LCD monitor. The trial type was determined by the face stimulus which was either a White or Black adult or infant face. For each participant, faces were chosen at random from the omnibus stimulus set. Immediately following the face cue, a probe stimulus was presented with equal probability on either the same side (a valid trial) or opposite side (an invalid trial) of the face. Probe placement was randomly selected for each trial and each trial had equal probability of being valid or invalid. The probe was a 3-cm tall equilateral triangle of RGB value (160, 160, 160). Participants indicated the triangle's orientation as quickly as possible by pressing the "I" key with their middle finger if the triangle was pointed up and the "J" key with their pointer finger if the triangle was pointed down. Trials were separated by a randomly selected interval between 1300-1500ms during which a fixation cross was presented. Reaction time (RT) and accuracy

was recorded for each trial. A practice block of 10 trials allowed participants to prepare for the task before the experimental block, consisting of 76 trials (19 faces/experimental condition), began.

Results

A data cleaning procedure was adopted to identify and remove participants who may not have been fully engaged in the experiment. Participants who made more than 15% of errors were excluded before analyses ($n = 3$; Brosch, Sander, Pourtois, Scherer, 2008). Participants who were two standard deviations above or below an experimental condition's average reaction time were also removed ($n = 2$; Proverbio et al., 2011). Additionally, an outlier was removed because of their extreme reaction times, which indicated that many of their trials timed-out before a response was recorded. Average numbers of errors for the remaining participants was 3.18 ($SD =$ 2.42), which accounted for less than 3% of the total experimental trials.

After data cleaning, a 2x2x2 repeated-measures ANOVA compared reaction time for age (infant, adult), race (same, other), and cue type (valid, invalid) on correct trials. There was a main effect of cue type, $F(1, 44) = 8.68$, $p = .005$, partial $\eta^2 = .17$, revealing that valid trials elicited faster RTs than invalid trials. There was also a significant three-way interaction of age x race x cue type, $F(1, 44) = 4.76$, $p = .03$, partial $\eta^2 = .10$. Post-hoc paired sample t-tests indicated that valid same-race adult faces elicited faster reaction times compared to valid other-race adult faces, $t(44) = 2.66$, $p = .01$ while there was no statistically significant difference between valid other- and same-race infant faces, $t(44) = 0.15$, $p = 0.88$. There was no main effect of age, $F(1, 44) = 0.31$, $p = .58$, partial $\eta^2 = .007$, nor was there a main effect for race, $F(1, 44) = 1.68$, $p = .20$, partial $\eta^2 = .04$. Further, there was no statistically significant interaction of cue type and age, $F(1, 44) = 0.78$, $p = .38$, partial $\eta^2 = .02$, nor an interaction of cue type and race, $F(1, 44) =$

1.06, $p = .31$, partial $\eta^2 = .02$. See Figure 1 for a visual representation of participants' average RTs to face cues, split by cue type (valid vs. invalid).

Discussion

This experiment tested whether other-race infant faces could overcome the attentional limitations associated with processing other-race faces, given the attentional biases associated with baby schema features. Furthermore, differences in attentional bias between viewing same- and other-race adult faces were measured to investigate how attention changes depending on the race of an adult face. I expected attention to be biased on the same side of the face cue, independent of face age or race. This prediction was supported as participants responded more quickly to valid probes (when the probe was presented on the same side as the face) for all trial types. This expected result reflects the automatic directing of attention toward exogenous cues (Brosch et al., 2008; Posner, 1980), and that selective attention is typically biased toward biologically relevant stimuli (for a review regarding infant attentional biases see Lucion et al., 2017), ultimately validating the paradigm.

When considering adults, I found an attentional bias that favored same-race (in-group) faces over other-race (out-group) faces, a finding consistent with previous work showing that other-race faces attract less attention than same-race faces (Ito & Urland, 2003; Valentine & Endo, 1992). These results support the prediction that there would be faster RT to same-race adult faces compared to other-race adult faces as attention was primarily limited to same-race faces (as discussed within the Sociocognitive approach). This attentional preference for same-race faces has been reliably found using other selective attention paradigms such as in eye tracking (Kelly et al., 2005) and visual search tasks (Zhou et al., 2015). For example, Zhou and colleagues (2015) measured selective attention when determining the presence of same- and

other-race faces among exogenous distractors in a visual search task. Participants displayed a same-race advantage such that same-race faces captured attention more efficiently than other-race faces. This same-race attentional bias has also been shown to occur relatively early on in development as 3-month-olds show a same-race attentional bias. Kelly and colleagues (2005) presented 3-month-olds with same- and other-race face pairings and found that infants attended to same-race faces more often than other-race faces, suggesting that this response may be developed early on and perpetuated into adulthood.

While same-race adult faces elicited greater attention than other-race adult faces, a similar bias was not observed when viewing infant faces, indicating a lack of a race bias for infant faces. The results showing no differences in RT between same- and other-race infant faces suggest that infant faces automatically attract attention regardless of race. These results support the prediction that same- and other-race infants should be equally attended to given that baby schema features elicit an attentional bias. These findings contradict Hodsoll and colleagues (2010) who reported automatic orienting only toward infants of one's own race. Specifically, they reported that reaction time to infant faces was faster than adult faces, but only for faces of one's own race. Instead, our results are generally in agreement with Proverbio and colleagues (2011) who reported an attentional bias toward infant faces regardless of the infant's race. These data also support the behavioral effects of Kindchenschema which suggests that infant faces have powerful attention-capture capabilities (Brosch et al., 2007) which resist attentional reallocation— a phenomenon that typically accompanies the processing of other-race faces (Meissner & Brigham, 2001). Thus, our results suggest that adults may perceive all infants as equally salient and important to attend to and care for.

This bias, which may be considered an automatic and prioritized response in adults, provides further evidence for infants' biological significance and the innate need to care for all infants, regardless of the infant's racial background. In keeping with this idea is the cooperative breeding hypothesis (Hardy, 2008) which suggests that the responsibility of infant caregiving is distributed across members of the community, creating an allo-parenting environment as opposed to the child rearing responsibility being left to the parents alone. Under this hypothesis, there is an evolutionary drive toward allo-parenting, which may increase the success of an infant's survival and the continuation of the species altogether. Equal attention to both same- and other-race infants supports the cooperative breeding hypothesis by showing that potential caregivers equally attend to infants, despite racial differences between the caregiver and the infant.

Interestingly, I did not observe a difference in automatic orienting between same-race infant and adult faces. Other studies that report infant attentional biases used attention paradigms that presented infant and adult faces in pairs (Brosch et al., 2007; Hodsoll et al., 2010), forcing participants to attend to either the adult or the infant face. We modeled our experimental task after Proverbio et al. (2011), measuring attentional bias to only one face cue at a time, as opposed to Hodsoll's et al. (2010) paradigm which presented face-cues in same-race pairs (akin to a traditional dot probe paradigm). This difference in paradigms may help to explain why I did not explicitly find an infant attentional bias as my participants were not forced to choose which face (infant vs. adult) to attend to. By presenting one face cue per trial, I was better able to compare attentional differences between our experimental conditions instead of Hodsoll's et al. (2010) dual-cue paradigm which compared attentional differences between same-race infant and adult face pairings. One potential benefit to our paradigm, compared to the classic duel dot

probe task, is that ours may provide a specific measure of attentional engagement versus disengagement because only one stimulus was presented at a time (for a review regarding attention bias paradigms, see Gibb, McGeary, & Beevers, 2015). However, future studies may want to directly compare the presentation of face cues in pairs to those presented alone to evaluate if the subtle differences are only evident when adult and infant same-race faces are directly presented.

Experiment II: The effects of baby schema and the ORE on encoding processes

Experiment I found that infant faces automatically attract attention regardless of race. Experiment II provides a more direct test of the ORE for infant faces by evaluating encoding differences between same- and other-race infant and adult faces. Although Hodsoll et al. (2010) and Proverbio et al. (2011) interpreted their findings on attentional bias in the context of the ORE, the ORE is traditionally defined as a difference in *memory* recognition between same- and other-race faces. While attention may influence successful encoding and memory processes, the ORE (a measure of failure in face processing memory), cannot be fully addressed without a memory recognition task (Lucas et al., 2011; Meissner, Brigham, & Butz, 2005; Wiese, 2012; Wiese et al., 2014).

Participants were shown infant and adult faces of same- and other-races within an encoding phase and were then asked to recognize faces in a later recognition phase. If attentional prioritization of infant faces is sufficient to enhance the processing of features critical for discrimination, infant faces (regardless of race) should be remembered better than adult faces. From Experiment I, expected no encoding differences between same- and other-race infant faces, given the similar attentional bias they elicited. However, if attention does not enhance discrimination, infant faces may be subject to an Other Age Effect and be remembered worse

than adults. For example, Chance and colleagues (1986) found participants were better at recognizing adult faces compared to infant faces; a finding consistent with the Other Age Effect (OAE), which states that people are better at remembering faces of their same age group (Anastasi & Rhodes, 2005; Chance, Goldstein, Andersen, 1986; Keufner, Macchi Cassia, Picozzi, & Bricolo, 2008; Macchi Cassia, Proietty, Gava, & Bricolo, 2015). In regards to race, an ORE should be present such that other-race adult faces would be remembered worse than same-race adult faces, in line with previous ORE studies.

Participants

Sixty Caucasians (52 females) participated in this experiment for course credit with a mean age of 19.8 years ($SD = 5.16$). Participants were recruited through the Psychology subject pool at Western Washington University and were compensated for course credit for their participation. This study was approved by Western Washington University's Institutional Review Board and abided by all ethical APA guidelines. Prior to participation, participants were placed in front of a computer screen and completed the consent form and a short demographic questionnaire asking about their personal experiences with other races and infants. Data from participants who had daily to weekly contact with African Americans ($n = 10$) and daily to weekly contact with infants ($n = 6$) were excluded before analysis, leaving a total of 45 participants, (37 females). Refer to Table 5 and Table 6 for participants' SEQ responses regarding their experiences with African Americans.

Stimuli

The potential stimulus set was comprised of 83 White and 74 Black infant faces. Four White infant faces and two Black infant faces were rated as too distinct by the pilot rating cohort and were excluded from the stimulus set. Similarly, adult faces that were rated as too distinct, as

found within the Chicago Face Database 2.0 (Ma et al., 2015), were excluded from the stimulus set. Twenty faces from each condition (White and Black infant and adult faces) were manually selected from the stimulus set and were used as face cues in the paradigm. Adult faces were selected such that the number showing an expression of perceived happiness was equal to the number of infant faces with an expression of perceived happiness. The same faces were used for all participants, though their presentation order was randomly selected for each participant.

Social Experience Questionnaire (SEQ)

A demographic questionnaire adapted from Walker and Tanaka (2003) measured participants' interracial experience. Refer to Experiment I's method section for a description about the SEQ.

Infant Experience Questionnaire (IEQ)

The infant experience questionnaire was adapted from the survey administered by Chance et al. (1986) as a measure of participants' personal contact with infants. The survey contained three questions asking about participants' past and current experiences with infants. Specifically, it asked "Have you ever taken care of an infant?" and "If so, for how long? What was the infant's race?" It also asked "Have you recently played with or held an infant?" and "If yes, when? What was the infant's race?" Lastly, it asked if they are currently a parent. Refer to Appendix C for the IEQ.

Procedure

The experiment consisted of an encoding phase and a recognition phase. During encoding, 10 faces of each race (same, other) and age (infant, adult) were presented in random order on a computer screen for 3 seconds each (Meissner et al., 2005) using Inquisit version 5.0 (de Clercq et al., 2003) running on a 19-inch PC. Faces were presented in middle of a white

background, and were 7cm x 7cm in size, subtending 12 degrees of visual angle. A black fixation cross appeared for 500ms between faces. Participants were instructed to remember each face as they were going to be asked to recognize the faces in the last half of the experiment.

The recognition phase immediately followed encoding (Michel et al., 2006; Tanaka et al., 2009; Valentine & Endo, 1992). Participants viewed the same faces as during encoding (Old faces) as well as 10 previously unviewed faces (New faces) from each experimental condition. Faces were presented centrally one at a time in a similar manner as during encoding. Participants were instructed to use the mouse to indicate whether each face was old or new by clicking the words "New" or "Old", which appeared 3cm below each face. They were told that they would have up to a maximum of 7 seconds to respond before a new face would be presented. Participants' reaction times, as well as their responses in the recognition phase, were recorded for each trial.

Results

A *d'* (Stanislaw & Todorov, 1999) was estimated from the hit and false alarm rate according to the following formula:

$$d' = Z(\text{hits}) - Z(\text{false alarms}),$$

where $Z(p)$ is the inverse probability distribution. The *d'* provides a measure of sensitivity by correcting the probability of correctly identifying an old face by the probability of falsely identifying a new face as old.

One participant was eliminated prior to statistical analysis because they had an average RT that was two standard deviations above the overall mean RT. Because more than 10% of the trials timed out, it is likely that this participant was not attending to the task. The *d'* scores from the remaining 43 participants were transformed and normalized by taking the square root of the

d' scores (Malpass & Kravitz, 1969) because of the non-normally distributed *d'* scale which is bounded by zero at the lower end of the index.

The transformed data were subjected to a 2 age (infant, adult) by 2 race (same, other) repeated-measures ANOVA. There was a main effect of race, $F(1, 42) = 9.14$, $p = .004$, partial η^2 = .18, such that White faces were better remembered than Black faces. There was also a main effect of age, $F(1, 42) = 9.86$, $p = .003$, partial $\eta^2 = .19$, such that adult faces were better remembered than infant faces. The interaction between race and age was not significant, $F(1, 42) = 0.07$, $p = .79$, partial $\eta^2 = .002$. See Figure 2 for a visual representation regarding the differences in *d'* values across the four experimental conditions.

To validate that the ORE was manifested from an inability to discriminate between other-race faces (i.e. claiming a face is familiar when it is actually new), which can be indexed by false alarm rates (Meissner & Brigham, 2001), a repeated-measured ANOVA separately analyzed the hit and false alarm rates for same- and other-race infant and adult faces. For the raw hit scores, there were no statistically significant differences for a main effect of age, a main effect of race, or an age x race interaction, $F(1, 42) = 0.60$, $p = .445$, $MSE = 2.50$, partial $\eta^2 = .01$, $F(1, 42) = 2.33$, $p = .134$, $MSE = 1.95$, partial $\eta^2 = .05$, and $F(1, 42) = 2.31$, $p = .136$, $MSE = 2.27$, partial η^2 = .05, respectively. For the raw false alarms, there was a statistically main effect of age, $F(1, 42) = 18.52$, $p < .001$, $MSE = 3.40$, partial $\eta^2 = .31$ such that there were more false alarms for infants compared adults. There was also a main effect of race, $F(1, 42) = 9.68$, $p = .003$, $MSE = 1.38$, partial $\eta^2 = .19$ such that there were more false alarms for other-race faces compared to same-race faces. The false alarm rate's age x race interaction was not statistically significant, $F(1, 42)$ = 2.82, $p = .10$, $MSE = 2.11$, partial $\eta^2 = .06$. See Table 2 for the descriptive statistics for hits and false alarms for each condition. These results are consistent with previous ORE literature

that attribute the ORE to a failure in recognizing which other-race faces are new and which are old.

Discussion

This experiment tested whether same- and other-race infant faces were subject to the ORE as indicated by higher recognition scores for same-race adult faces compared to other-race adult faces (Carroo, 1986; Malpass & Kravitz, 1969; Tanaka et al., 2004; Valentine & Endo, 1992; Walker & Tanaka, 2003). There were two main findings. First, same-race faces were remembered better than other-race faces. This is a finding that has been replicated by numerous studies in the ORE literature (for a review, see Meissner & Brigham, 2001), with same-race faces being more successfully individualized and recognized compared to other-race faces. Based on the attention results of Experiment I, I expected no differences in memory between same- and other-race infant faces. Surprisingly, this was not the case as this race effect was consistent across both infant and adult faces. That is, same-race infants were remembered better than other-race infants, clearly indicating an ORE for infant faces.

Taken together, Experiment I and Experiment II suggest that while other-race infants may overcome the attentional limitations associated with other-race faces, increased attention allocated to other-race infants does not improve encoding processes. Though it is evolutionary beneficial for infants to attract attention, regardless of their race, it may not evolutionary important to remember out-group infants because all infants will receive the attention; they do not necessarily need to be individuated. Moreover, it may be more evolutionary beneficial to remember and individuate one's own offspring from those similarly aged because infants depend on specific caregivers for survival. Applicably, this can be seen in caregiving situations such as picking one's infant up in a nursery or from preschool (Macchi Cassia, Picozzi, Kuefner, &

Casati, 2009)—the caregiver may attend to all infants, but it is more imperative that they remember their own infant than the faces of other infants.

Second, adult faces were, overall, remembered better than infant faces across both same- and other-race conditions. Given that adult faces were better remembered than infant faces, an own-age memory bias may help to explain our current findings. Chance and colleagues (1986) first suggested an Other Age Effect (OAE) when they found that adults had better recognition memory for adult faces compared to infant faces. Since then, the robustness of the OAE has been replicated by several studies (Anastasi & Rhodes, 2005; Keufner et al., 2008; Macchi Cassia et al., 2009; Macchi Cassia et al., 2015). Similar to the ORE, there are two central mechanisms that are adopted when understanding why an OAE occurs: the inability to configurally process infant faces (similar to the Contact hypothesis; Keufner et al., 2008), or the categorization of infant faces into an out-group category which results in poor encoding of the infant face (similar to the Sociocognitive approach; Anastasi & Rhodes, 2005).

For evidence that supports the perceptual expertise component of the OAE, Keufner and colleagues (2008) used inverted and upright adult and newborn faces to measure how recognition changes depending on changes to the configural information and age of the face. An OAE was observed as participants were better at recognizing upright adult faces compared to upright infant faces. For inverted faces, an inversion effect was limited to adult faces suggesting that adults do not configurally process infant faces. Further support for the configural explanation of the OAE is research showing that infant faces are rated as more similar than adult faces (Chance et al., 1986). This may be due to infants' baby schema traits as the physical face structure of infant faces is less variable than adult faces which consequently causes an inability to discriminate infant faces (Chance et al., 1986). Thus, infant faces may be processed featurally (according to

their baby schema features), as opposed to configurally, resulting in the inability to individuate infant faces.

Other research on an OAE suggests that social categorization and lack of experience may work in conjunction to undermine individuation of infant faces during encoding. Hodsoll et al. (2010) argues that, like other-race adult faces, infant faces may be socially categorized early in face processing which may moderate the ability to successfully encode the face. While infants may attract attention (Brosch et al., 2007), they may be considered as part of an out-group since participants (made up of college students in the current study) have little contact with infants. To show in-group/out-group categorization with differently-aged faces, Anastasi and Rhodes (2005) used older adults and children as participants to investigate how recognition memory differed across ages. Participants had to first dichotomously categorize each face according to its appropriate age group then, using the same categorized faces, participants completed a recognition memory task. Faces from the participants' same age group were better remembered than other-age faces, possibly due to different processing strategies used to process the categorized in-group/out-group faces. Because our results are parallel to previous literature that similarly show an own-age bias in memory, the OAE phenomenon may best describe our results.

Experiment III: Neural Substrates of ORE and Kindchenschema

Experiment three investigated the neural processes underlying viewing same- and other-race infant and adult faces. An EEG recorded participants' neural activity while they passively viewed images of White and Black adult and infant faces. In keeping with previous literature, the N170 was expected to be more negative and delayed when processing other-race adult faces compared to same-race adult faces (Stahl et al., 2008; Weise et al., 2014; Weise, 2012) because of poorer configural processing of other-race faces (as seen in poorer recognition memory for

other-race faces compared to same-race faces in Experiment II). It was also expected that there would be a decreased P2 response for other-race faces compared to same-race faces (Lucas et al., 2011; Stahl et al., 2008; Tanaka & Pierce, 2009; Weise, 2012), as less individuating features would be extracted from other-race faces.

With respect to infant faces, an increase in the N170 amplitude (Hahn et al., 2015; Proverbio et al., 2011) has been previously reported. I expected a similar change in the N170 given the behavioral results from Experiment II which suggest that infant faces are not processed configurally. The P2 response, which is associated with the identification stage of face processing, should be reduced for infants because if, as suggested in Experiment II, they are not well individuated. Finally, if infants are attentionally and motivationally salient regardless of race, the LPC response should be similar for both same- and other-race infants, which should be an increased response compared to viewing adult faces (Hahn et al., 2015; Proverbio et al., 2011).

Participants

Eighteen Caucasians (13 females) with a mean age of 25.17 years ($SD = 4.95$) volunteered for this experiment. This study was approved by Western Washington University's Institutional Review Board and abided by all ethical APA guidelines. Prior to participation, participants were placed in front of a computer screen and completed the consent form and a short demographic questionnaire asking about their personal experiences with other races and infants. All participants were right-handed and reported no daily to weekly contact with African Americans or infants, thus no participants were excluded from data analysis. See Table 7 and Table 8 for participants' SEQ responses regarding their experiences with African Americans.

Stimuli

Stimuli were comprised of the faces from Experiment I. A control condition consisted of seventy-six non-face objects which were obtained from the Face Research Laboratory (University of Glasgow) and included high quality images of shoes, chairs, and cars presented on a white background. Object images were standardized and converted to grayscale using Matlab v.7.3.0 (Mathworks, Inc., Natick, MA, USA) so that image size and color matched the face stimuli.

A demographic questionnaire adapted from Walker and Tanaka (2003) measured participants' interracial experience. Refer to Experiment I's method section for a description about the SEQ. The infant experience questionnaire was adapted from the survey administered by Chance et al. (1986) as a measure of participants' personal contact with infants. Refer to Experiment II's method section for a description about the IEQ.

Procedure

Participants were placed in a dimly lit room and sat in a comfortable chair approximately 1 meter from a computer screen that presented the stimuli via Inquisit version 5.0 (de Clercq et al., 2003) running on a Dell computer. EEG was continuously recorded from 64 channels, using BioSemi ActiveTwo Ag/AgCl electrodes and hardware (Biosemi, Amsterdam, The Netherlands). The electrodes were placed using a 10-5 electrode system (Oostenveld & Praamastra, 2001) via nylon electrode cap. The exact position if each electrode was determined separately for each participant using Polaris camera system. EEG signals were sampled at 512 Hz and were amplified with a bandpass of DC-104 Hz by BioSemi ActiveTwo amplifiers.

Participants were instructed to fixate their gaze on a centrally-presented fixation cross, and to minimize eye and body movements during the experimental session. EEG data were collected over five experimental blocks (180 trials/block). On each trial, a single image was

presented for 700ms (Caldara, Rossion, Bovet, & Hauret, 2004; Hahn et al., 2015) with a

randomly selected intertrial interval of 1200-1500ms (Caldara et al., 2004), during which a

fixation cross was presented. To control for attention, participants pressed the spacebar with

their right index finger each time a black triangle was presented (Proverbio et al., 2011).

Participants had a maximum of 1500ms to respond to each triangle before the trial timed-out.

The triangle stimulus was an equilateral triangle of RGB value (160, 160, 160) subtending 1.0

cm. Face and object images were 7cm x 7cm in size and were centrally presented. Triangles,

face images, and non-face objects were randomly selected for presentation and were presented

twice (Caldara et al., 2004) for a total of 900 trials (150 trials per experimental condition).

Participants were allowed a short break (2 min, maximum) between experimental blocks, with a

total of 4 block breaks over the duration of the experimental session.

EEG analysis

Off-line segmentation and averaging of the EEG data were performed with EEGlab

v.13.6.5b (Delorme & Makeig, 2004), via Matlab 7.3.0 (Mathworks, Inc., Natick, MA, USA).

For seven participants, a single channel was excessively noisy and was replaced by a new

channel via spherical interpolation of the neighboring channels. Data were high-passed filtered

at .1 Hz. Epochs time locked to the onset of each image were extracted from the cleaned data

with a time window of -500ms to 1000ms. An independent component analysis (ICA) was

performed on the epoched data of each participant to isolate and remove artifacts and noise

sources (Jung et al., 2000). I manually inspected the spatial and temporal properties of each

component and removed trials containing large artifacts and removed components that clearly

contained eye blinks, eye movements, and muscle artifacts. ERPs for each condition were

generated by low pass filtering the remaining trials at 20 Hz, re-epoching the data using a

window of -200 to 800ms around stimulus onset, and averaging separately for each condition (same-race infant, other-race infant, other-race adult, same-race adult, and non-face object). To objectively identify ERP components, I computed the grand average (across participant and condition) global field power (GFP; which is the average of the standard deviation across electrodes). Peaks in GFP at 98ms, 148ms, 225ms are consistent with well documented P1, N170 and P2 faces processing components. An LPC was also observed and is shown at the last two representative time points in Figure 3 of the GFP plot. Refer to Figure 4 for a scalp map of channels names and locations.

The latency of the N170 was defined as the time in milliseconds of the most negative voltage within a 100ms time window centered on the mean peak in the GFP (148ms). The amplitude of the N170 was defined as the average voltage within a 20ms window centered on the peak latency. Analysis focused on the six channels (P7, P8, P9, P10, PO7, and PO8) demonstrating the largest N170 amplitude. See Figure 5 for the N170 ERP waveform across channels PO7 and PO8 and Figure 6 for the N170 at channel P7.

The latency of the P2 was defined as the time in milliseconds of the most positive voltage within a 100ms time window centered on the mean peak in the GFP (225ms). The amplitude of the P2 was defined as the average voltage within a 20ms window centered on the peak latency. Analysis focused on the seven channels (PO7, PO8, O1, O2, PO3, PO4, and POz) demonstrating the largest P2 amplitude. See Figure 7 for the P2 ERP waveforms across channels O1 and O2.

Because the LPC is a temporally extended response with no identifiable peak (300-600ms), I split analysis of the LPC into two time windows. The amplitude of the LPC's first time window centered on the main peak in the GFP (400ms) and was defined as the average voltage within a 20ms window centered on the peak. Analysis focused on the eight channels

(O1, O2, PO3, PO4, POz, Pz, P1, and, P2) demonstrating the largest amplitudes in the first LPC time window. The amplitude of the LPC's second time window centered on the main peak in the GFP (600ms) and was defined as the average voltage within a 20ms window centered on the peak. Analysis focused on the nine channels (PO3, PO4, POz, P1, P2, Pz, CP1, CP2, and CPz) demonstrating the largest amplitudes in the second LPC time window. See Figure 8 for LPC waveforms for the four face conditions for channels POz and Pz.

To correct for multiple comparisons, a false discovery rate (FDR) was calculated for each ANOVA. An FDR controls for Type I errors by maintaining a bound on error while maximizing statistical power. It accounts for the number of comparisons, and their associated p-values, and provides a threshold alpha. Comparisons at or below the FDR threshold were considered statistically significant.

<div align="center">

ERP Results

</div>

N170

Latency. There was a statistically significant main effect of age for channel P9 such that infant faces elicited a longer latency than adult faces, see Figure 9 for a plot of the descriptive statistics for this channel. No other channels were statistically significant at the FDR alpha.

There was a statistically significant main effect of age for channel P10 as well as a statistically significant age x race interaction, see Figure 10 for a plot of the descriptive statistics for this channel. Paired samples t-test follow-up showed that other-race infants had an increased latency compared to other-race adults, $t(17) = -5.72$, $p < .001$, and same-race infants, $t(17) = -4.68$, $p < .001$, respectively. See Table 9 for the statistically significant F values for the N170 latency's ANOVA.

Amplitude. There was a statistically significant main effect of age for channel PO7 such that infant faces had a larger amplitude compared to adult faces, see Figure 11 for a plot of the descriptive statistics for this channel.

There was a statistically significant main effect of age for channel P7 as well as a statistically significant age x race interaction, see Figure 12 for a plot of the descriptive statistics for this channel. Paired samples t-tests revealed that same-race infant faces had a larger amplitude compared to same-race adult faces, $t(17) = 5.70$, $p < .001$, and that other-race adult faces had a larger amplitude compared to same-race adult faces, $t(17) = 2.94$, $p = .009$, respectively.

There was a statistically significant age x race interaction for channel P9, see Figure 13 for a plot of the descriptive statistics for this channel. Paired samples t-tests revealed that same-race infant faces had a larger amplitude compared to same-race adult faces, $t(17) = 4.04$, $p = .001$, and that other-race adult faces had a larger amplitude compared to same-race adult faces, $t(17) = 3.39$, $p = .003$, respectively. See Table 10 for the statistically significant F values for the N170 amplitude's ANOVA.

P2

Amplitude. There was a statistically significant main effect of age for channel PO7 such that adult faces had a larger amplitude compared to infant faces, see Figure 14 for a plot of the descriptive statistics for this channel. There was a statistically significant main effect of age for channel O1 such that adult faces had a larger amplitude compared to infant faces, see Figure 15 for a plot of the descriptive statistics for this channel. There was a statistically significant main effect of age for channel PO8 such that adult faces had a larger amplitude compared to infant faces, see Figure 16 for a plot of the descriptive statistics for this channel. There was a

statistically significant main effect of age for channel O2 such that adult faces had a larger amplitude compared to infant faces, see Figure 17 for a plot of the descriptive statistics for this channel. See Table 11 for the statistically significant F values for the P2 amplitude's ANOVA.

Late Positive Component (LPC)

Amplitude for LPC at time window 1. There was a statistically significant main effect of age for channel P1 such that infant faces had a larger amplitude compared to adult faces, see Figure 18 for a plot of the descriptive statistics for this channel. There was a statistically significant main effect of age for channel PO3 such that infant faces had a larger amplitude compared to adult faces, see Figure 19 for a plot of the descriptive statistics for this channel. There was a statistically significant main effect of race for channel O1 such that same-race faces had a larger amplitude compared to other-race faces, see Figure 20 for a plot of the descriptive statistics for this channel. There was a statistically significant main effect of age for channel POz such that infant faces had a larger amplitude compared to adult faces, see Figure 21 for a plot of the descriptive statistics for this channel. No other channels were statistically significant at the FDR alpha. See Table 12 for the statistically significant F values for the LPC's first window for the amplitude's ANOVA.

Amplitude for LPC at time window 2. There was a statistically significant main effect of age for channel P1 such that infant faces had a larger amplitude compared to adult faces, see Figure 22 for a plot of the descriptive statistics for this channel. There was a statistically significant main effect of age for channel PO3 such that infant faces had a larger amplitude compared to adult faces, see Figure 23 for a plot of the descriptive statistics for this channel. There was a statistically significant main effect of age for channel POz such that infant faces had a larger amplitude compared to adult faces, see Figure 24 for a plot of the descriptive statistics

for this channel. There was a statistically significant main effect of age for channel Pz such that infant faces had a larger amplitude compared to adult faces, see Figure 25 for a plot of the descriptive statistics for this channel. See Table 13 for the statistically significant *F* values for the LPC's second window for the amplitude's ANOVA.

Discussion

The goal of this experiment was to measure when face processing mechanisms diverge when perceiving same- and other-race infant and adult faces. For this experiment, I chose to analyze the N170, P2, and LPC when viewing same- and other-race infant and adult faces, given that each of these components reflect cognitive processes when processing a face. To validate the face-specific components and the exogenous stimuli used in the experiment, non-face objects acted as a control stimulus to better compare face-related activity to. Neural differences between viewing a face and a non-face object were found when looking at scalp activity and ERPs, see Figure 26 for the activation differences between faces and objects, suggesting that the components and stimuli used were appropriate when measuring face-related neural responses.

I chose to analyze conditions' differences in the N170 because this specific component typically reflects face processing mechanisms (Olivares et al., 2015), such as configural processing. It was predicted that there would be a more negative and delayed N170 when viewing an other-race face and an infant face because of the inability to configurally processes such faces. Infant faces elicited an increased and delayed N170 response compared to adults, a finding consistent with the Kindchenschema literature as previous studies have found a similar increased N170 response for infant faces (Hahn et al., 2015; Proverbio et al., 2011). Though previous studies have found a similar increased N170, they interpret this response as an enhanced encoding of infant faces (Kringelbach et al., 2008). Kringelbach and colleagues (2008)

used MEG to measure differences in cortical activity when viewing adult and infant faces, and found an increase in the medial orbitofrontal cortex (OFC) 130ms after infant face presentation, which was immediately followed by increased activity of the right FFA, peaking at 165ms after face onset. They proposed a top-down amplification from the OFC to the FFA which consequently heightens activation of face processing areas and may result in a deeper processing of the infant face. This increased cortical processing of the infant face should, theoretically, result in improved encoding of the infant face. However, the recognition memory results from Experiment II suggest that infant faces are encoded less successfully compared to processing an adult face. Thus, perhaps the increased and delayed N170 when looking at an infant face does not reflect enhanced processing of the infant face, but rather impaired configural processing.

Interestingly, I also found differences in how same- and other-race infant faces were processed as reflected by an increased N170 latency for other-race infants relative to same-race infants. This finding supports Experiment II's recognition memory task as other-race infants were remembered worse than same-race infants. Thus, other-race infant faces may take more time to encode and are less likely to be configurally processed than same-race faces (Stahl et al., 2008). While both same- and other-race infants displayed characteristic baby schema traits (such as large eyes and forehead, round cheeks, and small chin), race-specific features (such as dark skin and differences in nose shape) were salient in other-race infant faces, which may have contributed to the differential processing between same- and other-race infants. This evaluation of race flags the other-race face for differential processing and has been reliably shown when processing adult faces (Caldara et al., 2004; Golby et al., 2001; Ito & Urland, 2003).

Additionally, I found a larger N170 when viewing other-race faces compared to a same-race faces, which supports the hypothesis that other-race faces provoke more effortful encoding

mechanisms (or, rather, it indicates a lack of configural processing; Weise, 2012; Wiese et al., 2014). Wiese and colleagues (2014) had participants complete a recognition memory test while an EEG measured participants' neural activity. Not only did they replicate previous ORE findings by showing that same-race faces were better remembered than other-race faces, but they found that viewing other-race faces elicited a larger N170 component. Wiese and colleagues (2014) interpreted this difference as reflecting less efficient encoding of other-race faces.

A few channels in which the N170 was maximal did not show N170 effects between same- and other-race faces. Caldara and colleagues (2003) investigated changes in the N170 with viewing Caucasian (same-race) and Asian (other-race) faces and non-face objects. While they found differential responses between faces and objects as seen in differences in ERP scalp maps, the N170 did not differ, both in terms of amplitude and latency, between same- and other-race faces, a finding similar to the current study's data. The differences in the N170, both in terms of amplitude and latency, suggest that the N170 may not be sensitive to the salience of a face so much as it reflects the ability to configurally process a face. To follow up on this claim, an inversion study using upright and inverted adult and infant faces may help to better understand mechanisms when processing infant faces. This would not only allow for confirmation that the N170 reflects structural encoding of a face, but how configural processing changes when looking at an infant and adult face.

Though most ERP research provides evidence that the N170 reflects configural processing (and may support the perceptual expertise component of the Contact hypothesis), several studies have shown that the N170 can be influenced by attention. Carlson and Reinke (2010) measured the effects that selective attention biases have on the N170 through a backward-masked fearful faces paradigm. In this task, a fearful face is immediately followed by a neutral

face, which potentially masks and disrupts the encoding of the first face. Similar to same-race faces, fearful faces are attentionally salient and there is an increased motivation to attend to the fearful face due to the perception of threat (Carlson & Reinke, 2010). Spatial attention was captured by masked fearful faces, and this biased attention modulated the early stages of face processing as indexed by changes in the N170. Specifically, directed spatial attention to fearful faces enhanced the N170's amplitude to which the authors interpreted as the attention-grabbing effects of fearful faces facilitating face processing areas of cortex (Carlson & Reinke, 2010). Thus, not only can the N170 be influenced by perceptual expertise, but also by changes in biased attention.

The perceptual expertise mechanism (as part of the Contact hypothesis) may help to explain the effect of age on the P2 component. I found that there was a more positive P2 for adult faces compared to infant faces, a finding consistent with Wiese (2012), who investigated age and race biases in recognition memory. There was a larger P2 for younger (same-age) faces compared to older (other-age) faces, which was correlated with better recognition memory for same-age faces compared to other-age faces. Wiese (2012) interpreted this ERP and behavioral data as providing support for a perceptual expertise hypothesis because adult faces are commonly viewed which results in adult faces receiving deeper processing and increased recognition memory compared to other-age faces. Though Weise (2012) used older faces as part of his stimulus set, as opposed to infants, his results can still have relevance to the P2-related age effects such that infant faces (like older faces) were not processed as much as same-age faces. These P2 effects (adult faces had increased P2 amplitude compared to infant faces) are aligned with Experiment II's recognition memory task in which adult faces were better remembered than

infants. Thus, more identifying information may be extracted from adult faces allowing for better individuation of same-age faces relative to other-age faces, which creates a robust OAE.

While recent studies have found a larger P2 for same-race faces compared to other-race faces (Lucas et al., 2011; Wiese et al., 2012), I found no P2 differences between same- and other-race faces. Similar to our results, Stahl and colleagues (2008) found no differences in P2 between viewing same- and other-race faces when participants had equal experience with viewing same- and other-race faces. This lack of race-effect in other-race experts suggest an effect of expertise with early face-processing mechanisms. Though our participants had little to no contact with other-races, they most likely did have extensive experiences with viewing adult faces. While other-race adult faces had race-specific features, they also have features that are consistent with prototypical adult faces (which are commonly processed), making same- and other-race faces received equal processing in terms of the P2 component. That is, the infant-adult age differences were so salient that the perceptual differences in viewing same- and other-race faces were attenuated.

Lastly, I hypothesized that the parieto-central Late Positive Component (LPC), a marker of processing meaningful or motivationally relevant stimuli, would be higher for infant faces than for adult faces (Hahn et al., 2014). This is aligned with Kindcheschema as baby schema features are more rewarding to view and result in positive affect felt by the perceiver or caregiver (Glocker et al., 2010). I also predicted that there would be no differences in the LPC between viewing same- and other-race infant faces as both groups of infants displayed characteristic baby schema features and, consequently, result in similar Kindchenschema effects, a prediction similar to the hypotheses in Experiment I. These data support my predictions as, first, there was an increased LPC response when viewing infant faces compared to adult faces and, second, there

were no differences in LPC response between same- and other-race infant faces. This robust effect was not only consistent across multiple channels, but across the two time windows that encompass the LPC. Given that the LPC reflects attentional and motivation processing of a particularly salient stimulus (Johnston & Oliver-Rodriguez, 1997), the enhanced response to infant faces suggests that infant faces provoke increased attention and motivational behaviors relative to adult faces. Further, no differences in the LPC response between same- and other-race infants indicate that infants, regardless of their race, are perceived as equally salient and rewarding to view. This finding aligns closely with the equal attention bias that was found in Experiment I.

This increased LPC response is consistent with facial processing literature that shows the LPC is modulated by facial attractiveness (i.e. cuteness; Johnston & Oliver-Rodriguez, 1997; Zeng et al., 2012). Zeng and colleagues (2012) had male participants choose between viewing pictures of attractive female faces or gains in monetary values while their neural responses were recorded via EEG. They found that facial attractiveness, as indexed by a larger LPC response, may be a stronger reward stimulus than money. This behavioral result was attributed to the evolutionary need to find a mate is more biologically salient for males than the reward of monetary gain, while the neural result provided more evidence for the LPC being a neural correlate of reward. This idea is similar to caregiving mechanisms which are released when viewing baby schema as viewing an infant face (regardless of its race) triggers caretaking behaviors in an effort to evolutionarily maintain the species. It also can relate to the cooperative breeding hypothesis (Hardy, 2008) as all infants are perceived as salient, regardless of the kinship the viewer has with the infant.

General Conclusions

Notably, there are some limitations which accompany these three studies. First, all three experiments had fewer male participants than female participants so I must be careful when generalizing these findings to both sexes. In Hahn and Perret's review (2014), several studies suggest that there are sex differences in infant face processing, specifically that females may have an increased attentional bias and hyper-cortical reward activation when viewing infant faces (Proverbio et al., 2011). While the male sample was too small to separate into male-female groups and run statistics between sexes, future studies should include a larger sample of males to better control for sex-related differences in ORE and baby schema processing. Second, the other-race stimuli were operationally defined as Black adults and infants, not entirely encompassing of all other-races. While using Black faces may have been appropriate to use given the location of the studies (Pacific Northwest), future studies may want to use a variety of racially diverse stimuli in order to understand the wide-ranging effects of the ORE. Or, conversely, future studies should obtain both same- and other-race participants to measure the ORE's interaction when viewing same- and other-race infant and adult faces.

Together, these three experiments tested if the ORE can be overcome by baby schema, given the strong attentional bias elicited when viewing an infant face. While there was an equal attention bias for same- and other-race infants, other-race infant faces elicited lower recognition memory scores compared to same-race infants. Thus, while other-race infants may overcome the attentional bias associated with the processing other-race faces, they cannot overcome the encoding limitations of the ORE. Perhaps, then, the mechanism of the ORE may not be strictly due to an attentional bias (as discussed within the Sociocognitive approach) as preferential attention to same- and other-race infants did not enhance the enhance the encoding of infant

faces. Instead, the perceptual expertise discussed within the Contact hypothesis may be a better mechanism to understand both the ORE and OAE.

Experiments II and III suggest that other-race adult faces and infant faces (regardless of race) are not configurally processed, which may be attributed to the lack of experience with viewing and encoding such faces (given the lack of experience with Blacks and infants the participants reported). Same-race adult faces may be viewed and encoded on a daily basis which, consequently, results in effective configural processing as reflected in better recognition memory and effective encoding, as indexed by ERP components, as opposed to other-race adults and infants. To better address the interaction between experience and face processing mechanisms, future studies should recruit participants with extensive experience with other-races and infants to measure how perceptual experience mediates face processing.

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Table 1

Descriptive Statistics of Infant Pilot Rating Task.

	Cuteness	Age	Race	Distinctness
Black Infants	3.77 (0.67)	1.12 (0.18)	1.99 (0.08)	3.31 (0.71)
White Infants	3.77 (0.64)	1.02 (0.07)	1.03 (0.09)	3.46 (0.50)

Note: Cuteness and distinctness rating was on a Likert scale from 1 to 5; age was dichotomously rated with 1 representing "less than 4 years old" and 2 representing "more than 4 years old;" race was dichotomously rated with 1 representing "Caucasian" and 2 representing "African American." Parenthetical numbers represent standard deviations.

Table 2

Means of Memory Task data, given by Hits and False Alarms.

		Face Race			
		Same		Other	
		Hits	False Alarms	Hits	False Alarms
Face Age	Adult	7.71	2.33	7.02	2.52
	Infant	7.07	3.12	7.24	4.14

Table 3

SEQ responses for Experiment I. Proportion of participants that answered questions regarding social contact with African Americans.

Responses	I often spend time with African Americans	I spend a lot of my free time doing things with African Americans
Strongly Agree	0%	0%
Sort of Agree	19.05%	9.52%
Neutral	11.90%	2.38%
Sort of Disagree	47.62%	52.38%
Strongly Disagree	21.42%	28.57%

Note: These responses are from the participants whose data were analyzed. Participants who had daily to weekly contact with African Americans were not analyzed, and thus their responses to the SEQ are not included in this table.

Table 4

SEQ responses for Experiment I. Proportion of participants that knew African Americans.

Response	How many African Americans do you know very well?
Up to 2	52.38%
Up to 5	42.86%
Up to 8	2.38%
Up to 12	0%
More than 12	2.38%

Table 5

SEQ responses for Experiment II. Proportion of participants that answered questions regarding social contact with African Americans.

Responses	I often spend time with African Americans	I spend a lot of my free time doing things with African Americans
Strongly Agree	5%	2.5%
Sort of Agree	30%	17.5%
Neutral	15%	10%
Sort of Disagree	30%	42.5%
Strongly Disagree	20%	22%

Note: These responses are from the participants whose data were analyzed. Participants who had daily to weekly contact with African Americans were not analyzed, and thus their responses to the SEQ are not included in this table.

Table 6

SEQ responses for Experiment II. Proportion of participants that knew African Americans.

Response	How many African Americans do you know very well?
Up to 2	50%
Up to 5	22%
Up to 8	12.5%
Up to 12	7.5%
More than 12	2.5%

Table 7

SEQ responses for Experiment III. Proportion of participants that answered questions regarding social contact with African Americans.

Responses	I often spend time with African Americans	I spend a lot of my free time doing things with African Americans
Strongly Agree	6.25%	0%
Sort of Agree	23.52%	11.76%
Neutral	11.76%	6.25%
Sort of Disagree	17.64%	29.41%
Strongly Disagree	35.29%	47.06%

Note: These responses are from the participants whose data were analyzed. Participants who had daily to weekly contact with African Americans were not analyzed, and thus their responses to the SEQ are not included in this table.

Table 8

SEQ responses for Experiment III. Proportion of participants that knew African Americans.

Response	How many African Americans do you know very well?
Up to 2	58.82%
Up to 5	29.41%
Up to 8	5.88%
Up to 12	0%
More than 12	5.88%

Table 9

N170 latency F values

Channel	Type of Effect	$df_{between}, df_{error}$	F	p	partial eta squared	MSE
P9	Age	1, 17	12.89	.023	.43	5.93
P10	Age	1, 17	18.55	< .001	.52	3.70
P10	Interaction	1, 17	8.77	.009	.34	3.45

Table 10

N170 amplitude F values

Channel	Type of Effect	$df_{between}, df_{error}$	F	p	partial eta squared	*MSE*
PO7	Age	1, 17	14.64	.001	.46	0.48
P7	Age	1, 17	22.29	< .001	.58	0.34
P7	Interaction	1, 17	8.77	.009	.34	3.45
P9	Interaction	1, 17	10.96	.004	.39	0.38

Table 11

P2 amplitude F values

Channel	Type of Effect	$df_{between}, df_{error}$	F	p	partial eta squared	*MSE*
PO7	Age	1, 17	15.42	.001	.48	0.73
O1	Age	1, 17	9.49	.007	.36	0.57
PO8	Age	1, 17	15.23	.001	.47	1.42
O2	Age	1, 17	8.31	.01	.33	0.86

Table 12

The first window of the LPC amplitude F values

Channel	Type of Effect	$df_{between}, df_{error}$	F	p	partial eta squared	*MSE*
P1	Age	1, 17	12.50	.003	.52	0.16
PO3	Age	1, 17	8.45	.01	.33	0.47
O1	Race	1, 17	13.55	.002	.44	0.35
POz	Age	1, 17	7.91	.012	.32	0.62

Table 13

The second window of the LPC amplitude F values

Channel	Type of Effect	$df_{between}, df_{error}$	F	p	partial eta squared	*MSE*
P1	Age	1, 17	7.93	.012	.32	0.55
PO3	Age	1, 17	7.84	.012	.32	0.63
POz	Age	1, 17	10.65	.005	.39	1.14
Pz	Age	1, 17	6.57	.02	.28	0.55
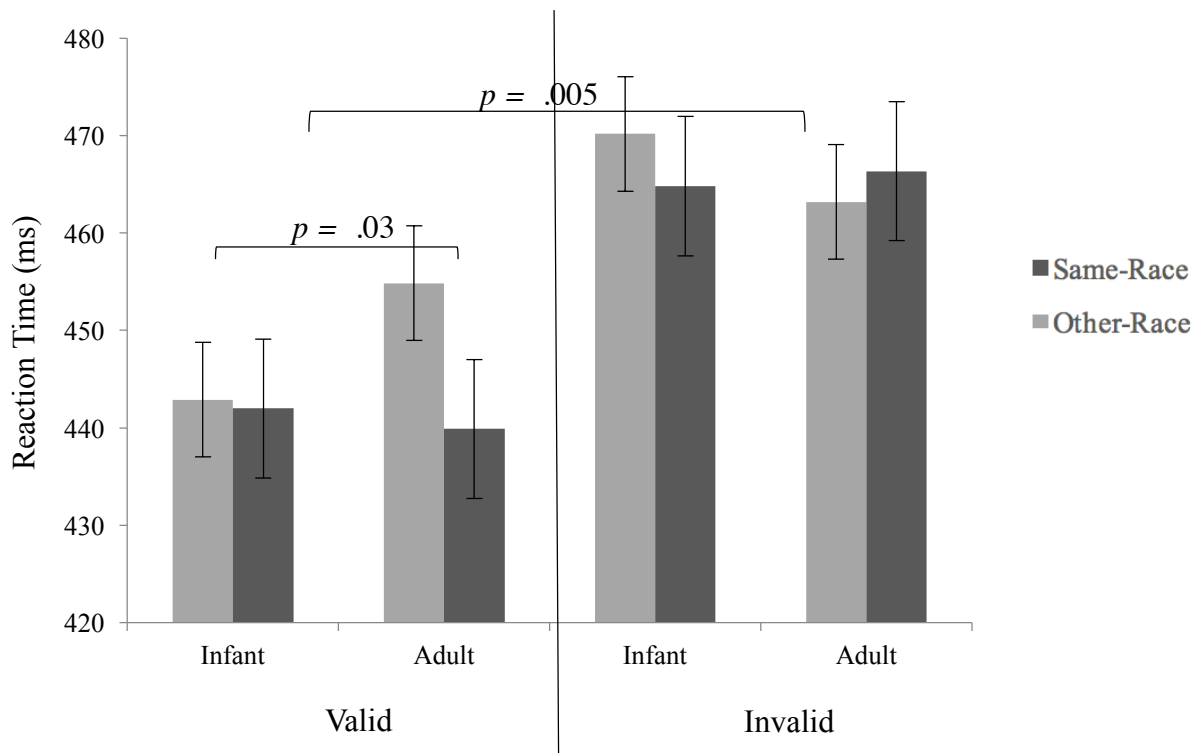
Figure 1. Average reaction times, measured in milliseconds, for each condition in spatial cueing paradigm from Experiment I between valid and invalid cues across the four conditions. Error bars represent standard error.
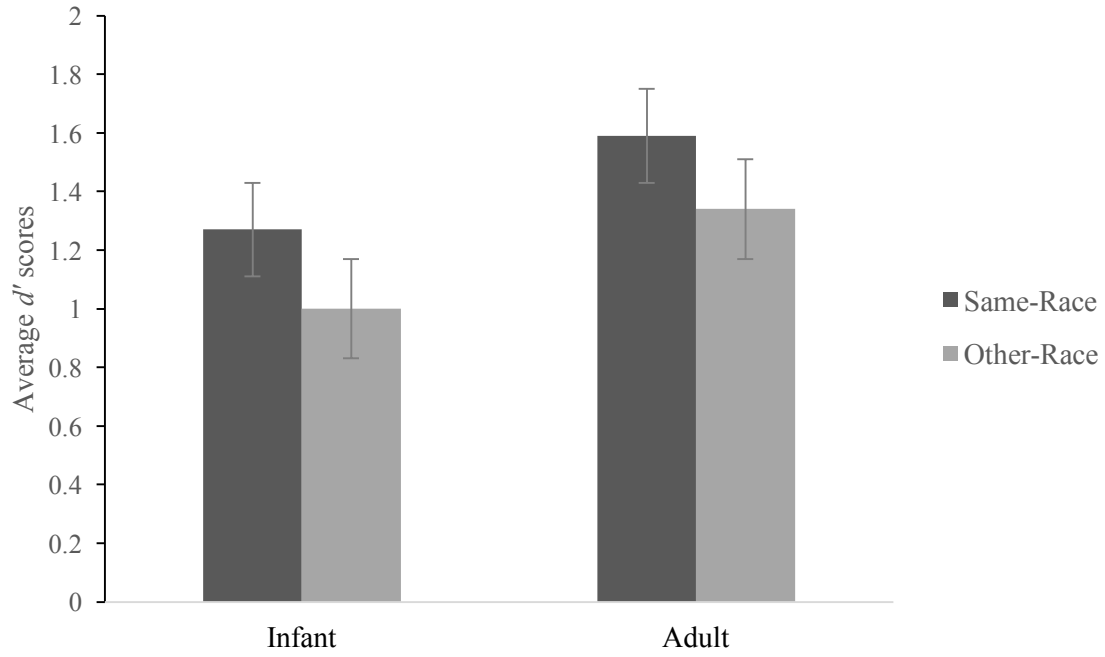
Figure 2. Average *d'* scores across the four conditions in Experiment II. Error bars represent standard error.
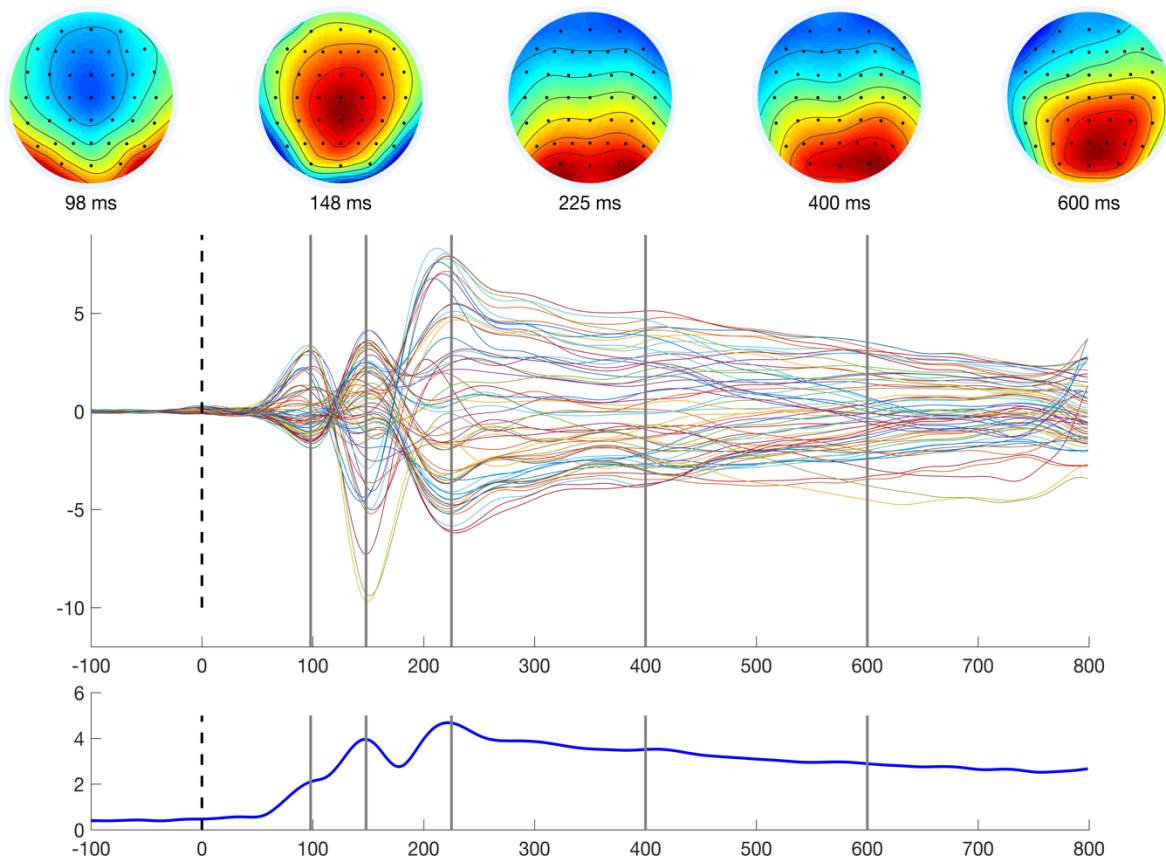
Figure 3. Plot of computed Global Field Power (GFP). Pictured in the top plot are the scalp maps at times where there are differential points in the GFP waveform (pictured in the bottom plot). Pictured in the middle butterfly plot are the individual participants' GFP waveforms, averaged for all conditions.
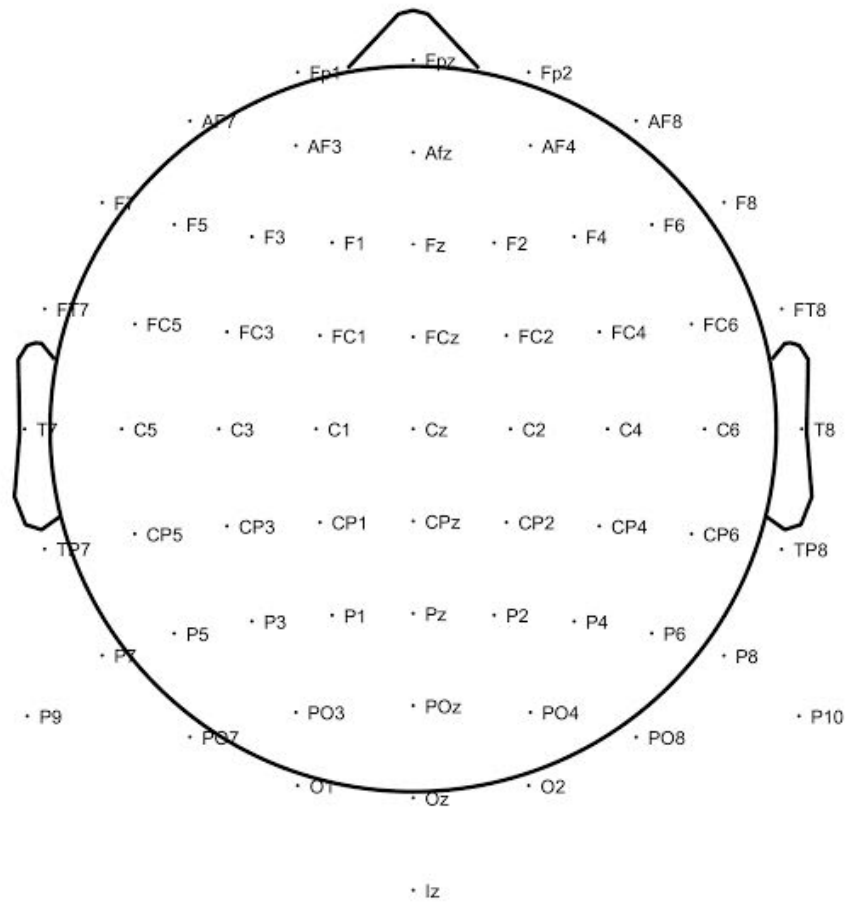
Figure 4. The scalp distribution of channel locations and names is plotted above. Fpz indicates the channel most anterior on the scalp (toward the nasion) while Iz indicates the channel most posterior on the scalp (toward the inion).
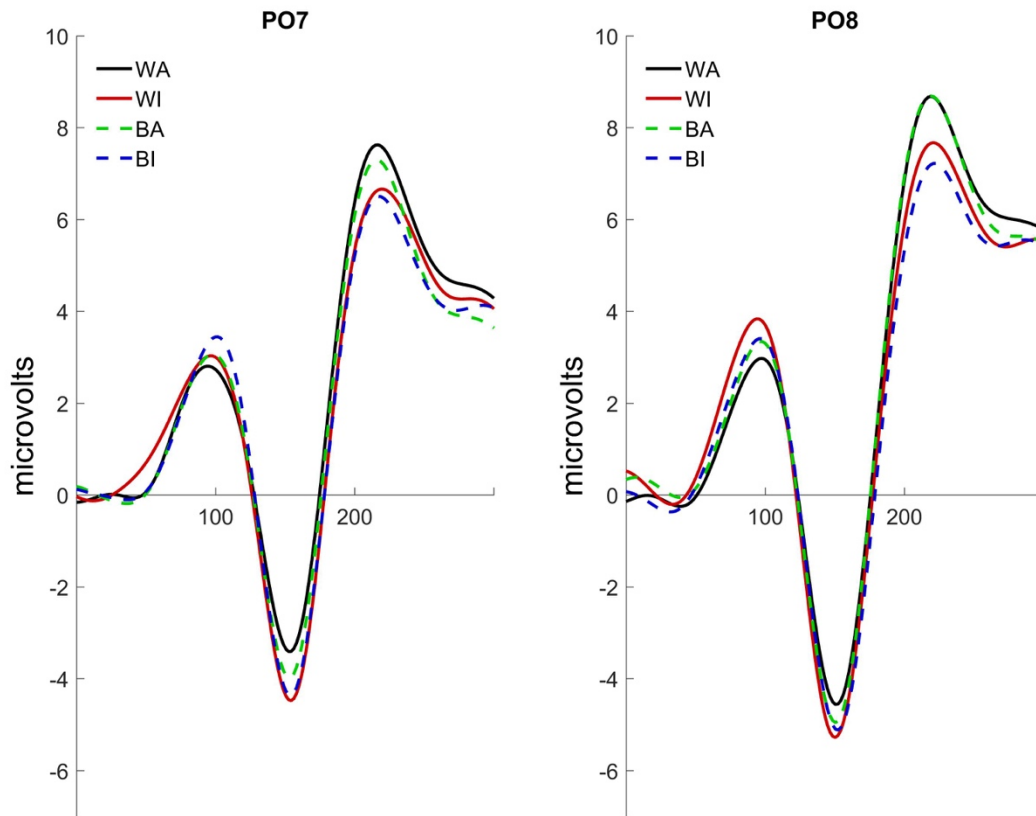
Figure 5. The difference in the N170 over the posterior-occipital channels between the four face conditions.
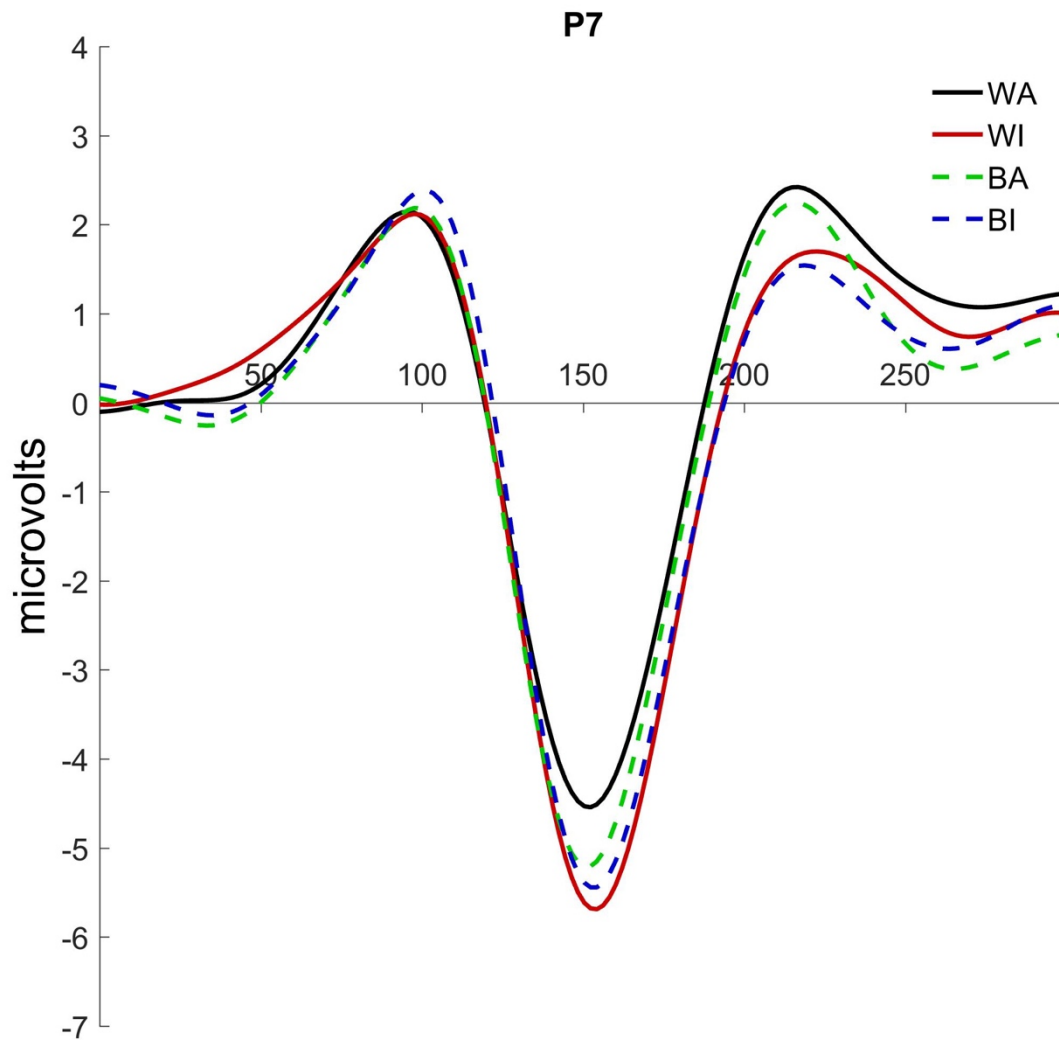
Figure 6. This figure shows an interaction in N170 amplitude, driven by the increased response to infant faces and Black adult faces.
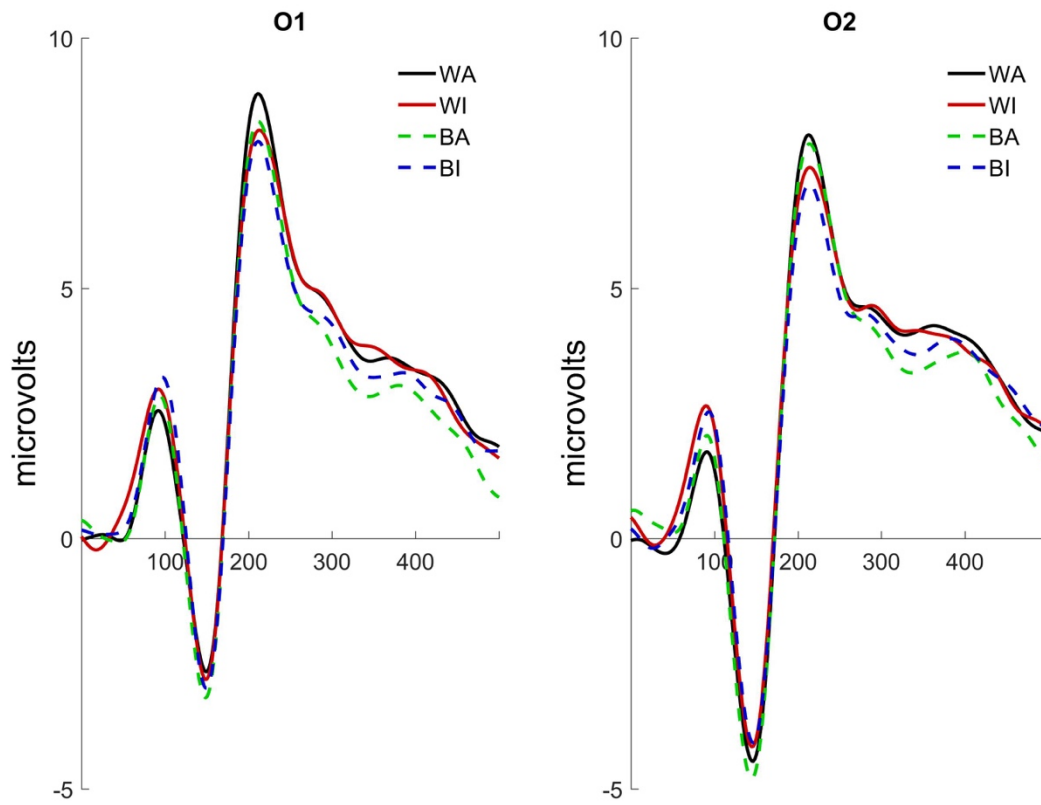
Figure 7. The differences in the P2 is shown in the posterior-occipital channels between the four face conditions.
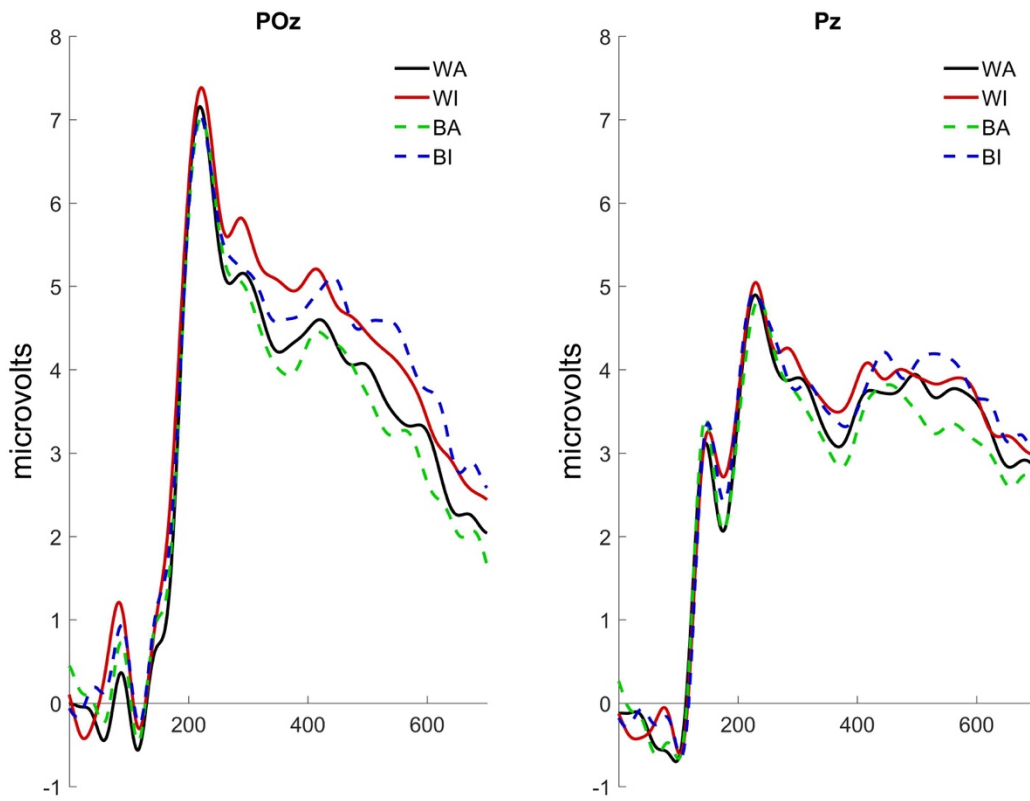
Figure 8. The difference in the LPC in the centro-parietal channels is shown between the four face conditions.

N170 Latency for Channel P9
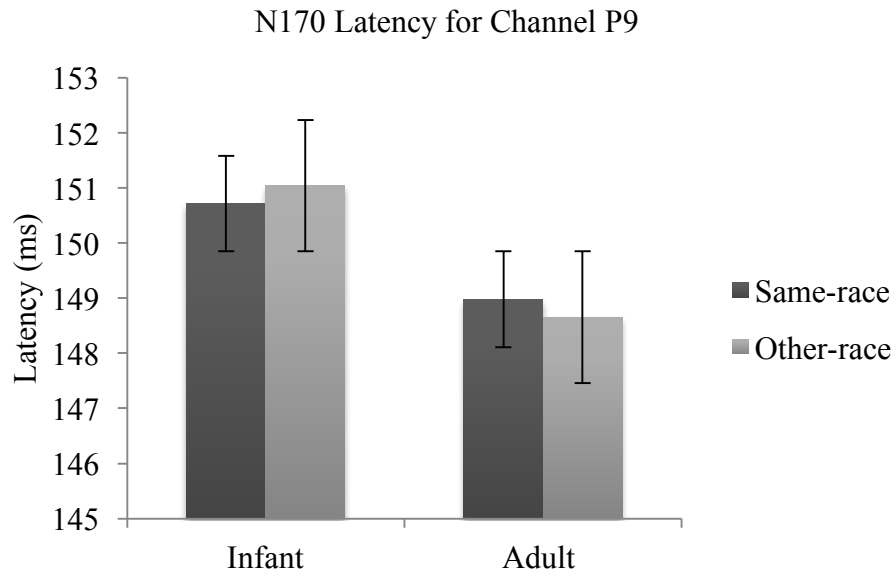
Figure 9. Latency, measured in milliseconds, is plotted for the N170 component demonstrating a statistically significant main effect of age across infant and adult faces. Bars represent standard error.
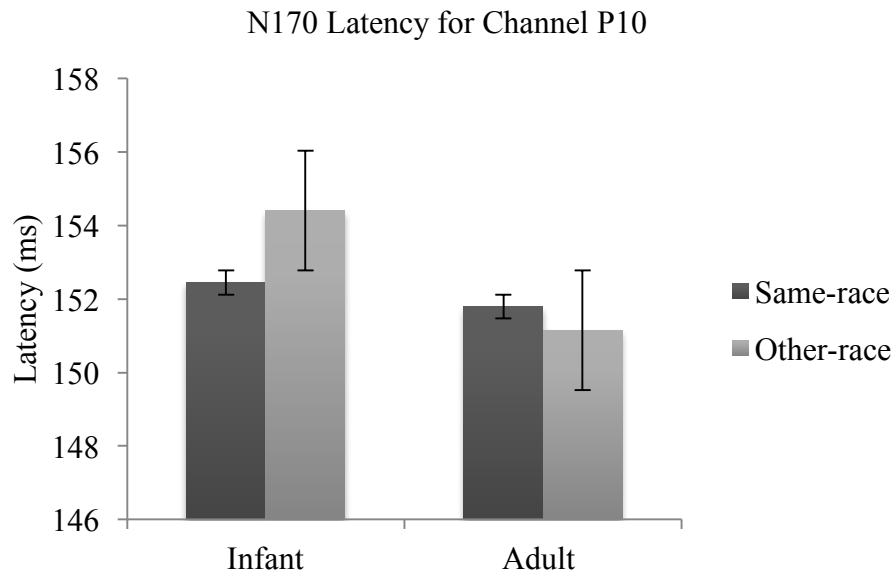
Figure 10. Latency, measured in milliseconds, is plotted for the N170 component demonstrating a statistically significant age x race interaction. Bars represent standard error.
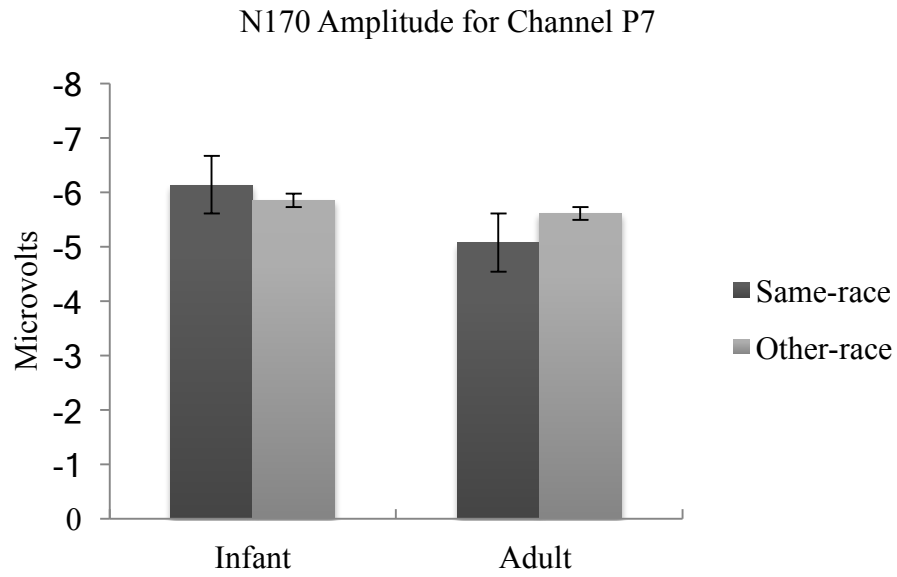
Figure 11. Amplitude, measured in microvolts, is plotted for the N170 component demonstrating a statistically significant main effect of age across infant and adult faces. Bars represent standard error.
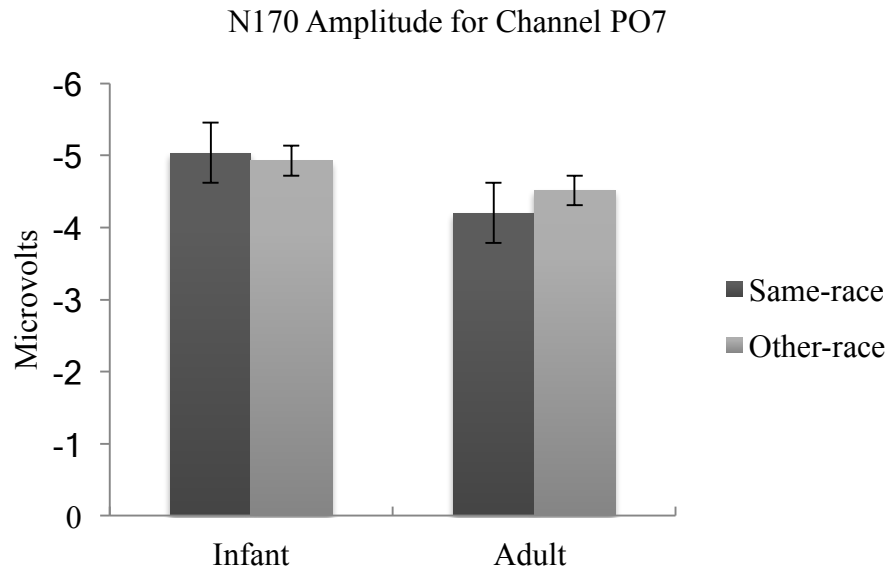
Figure 12. Amplitude, measured in microvolts, is plotted for the N170 component demonstrating a statistically significant age x race interaction between same- and other-race infant and adult faces. Bars represent standard error.

N170 Amplitude for Channel P9
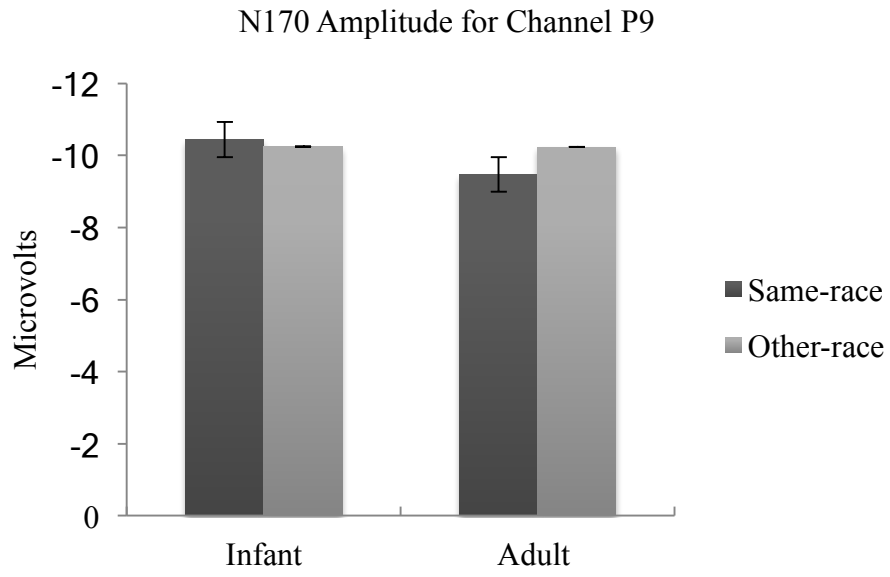
Figure 13. Amplitude, measured in microvolts, is plotted for the N170 component demonstrating a statistically significant age x race interaction between same- and other-race infant and adult faces. Bars represent standard error.

P2 Amplitude for Channel PO7
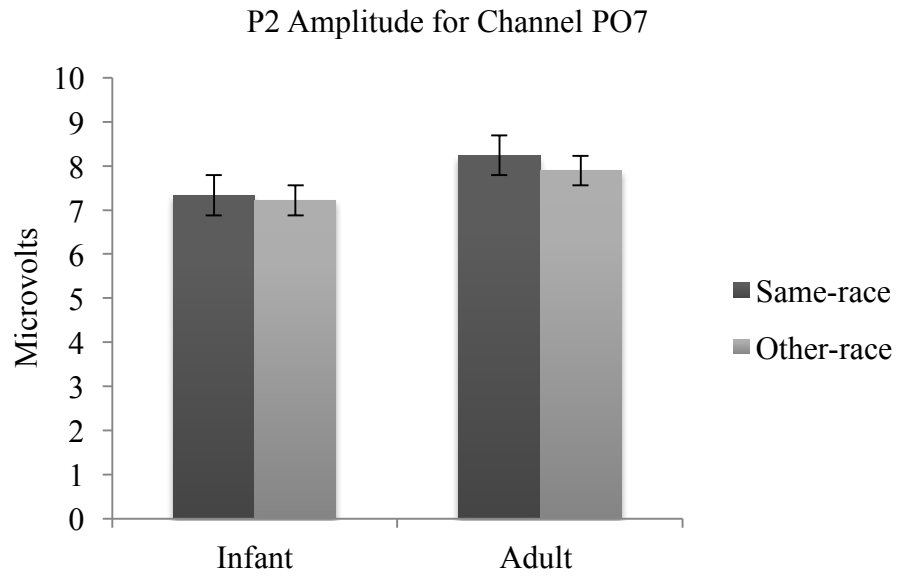
Figure 14. Amplitude, measured in microvolts, is plotted for the P2 component demonstrating a main effect of age between infant and adult faces. Bars represent standard error.
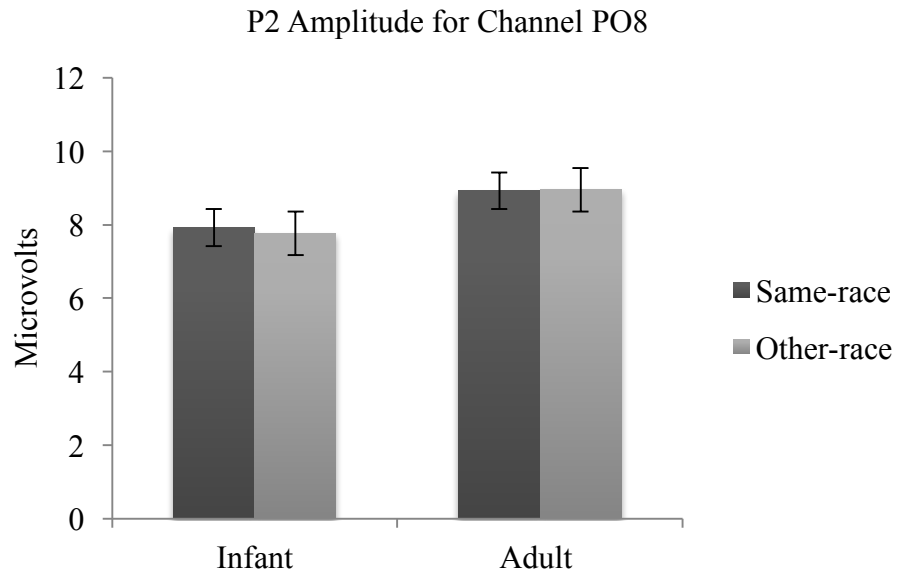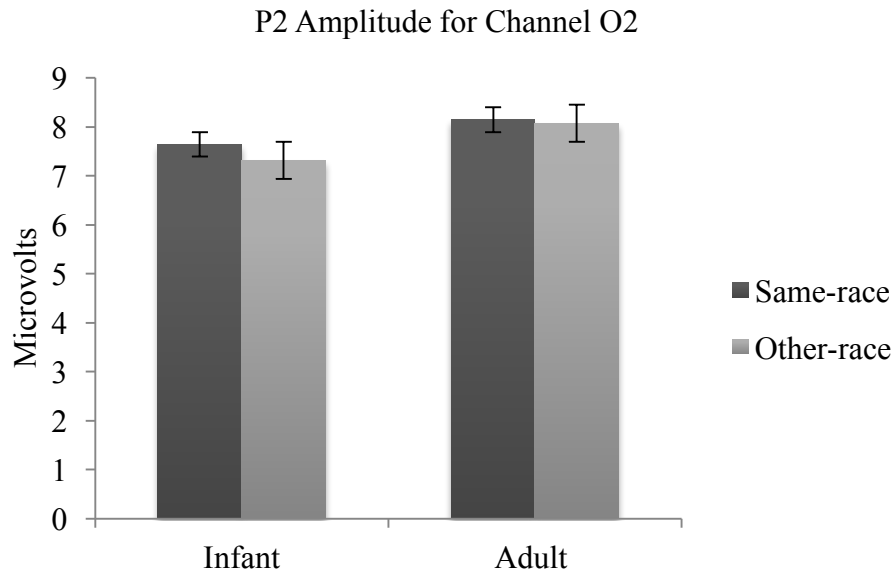
P2 Amplitude for Channel O1
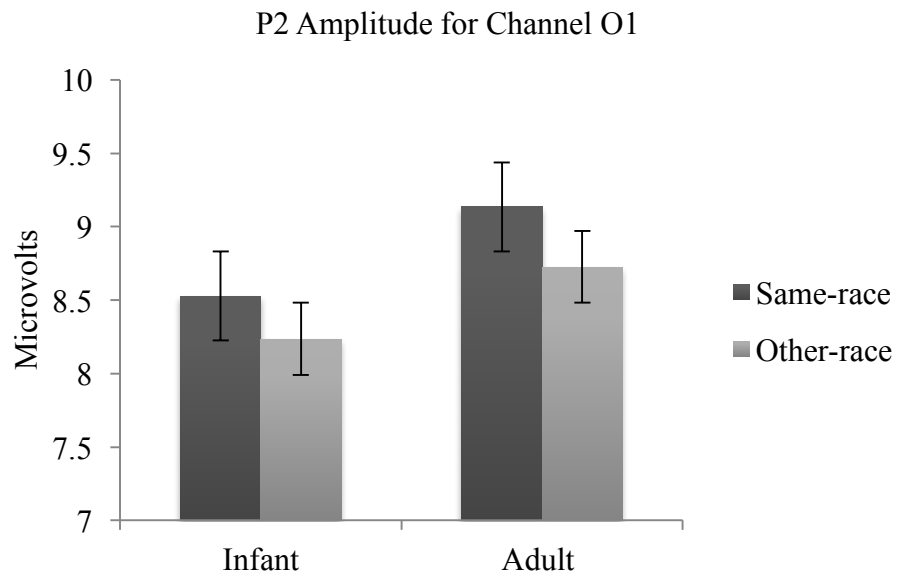
Figure 15. Amplitude, measured in microvolts, is plotted for the P2 component demonstrating a main effect of age between infant and adult faces. Bars represent standard error.
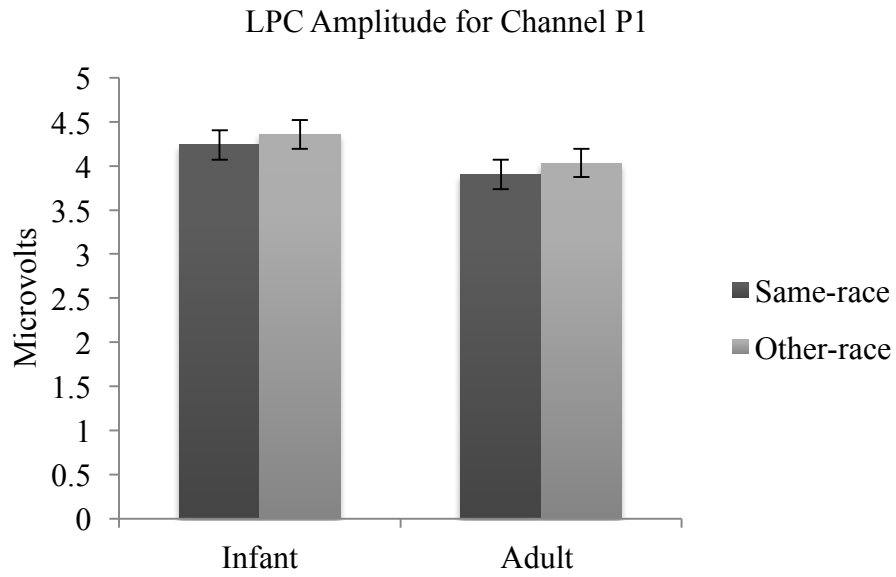
P2 Amplitude for Channel PO8

Figure 16. Amplitude, measured in microvolts, is plotted for the P2 component demonstrating a main effect of age between infant and adult faces. Bars represent standard error.

P2 Amplitude for Channel O2

Figure 17. Amplitude, measured in microvolts, is plotted for the P2 component demonstrating a main effect of age between infant and adult faces. Bars represent standard error.

LPC Amplitude for Channel P1

Figure 18. Amplitude, measured in microvolts, is plotted for the first window of the LPC demonstrating a main effect of age between infant and adult faces. Bars represent standard error.
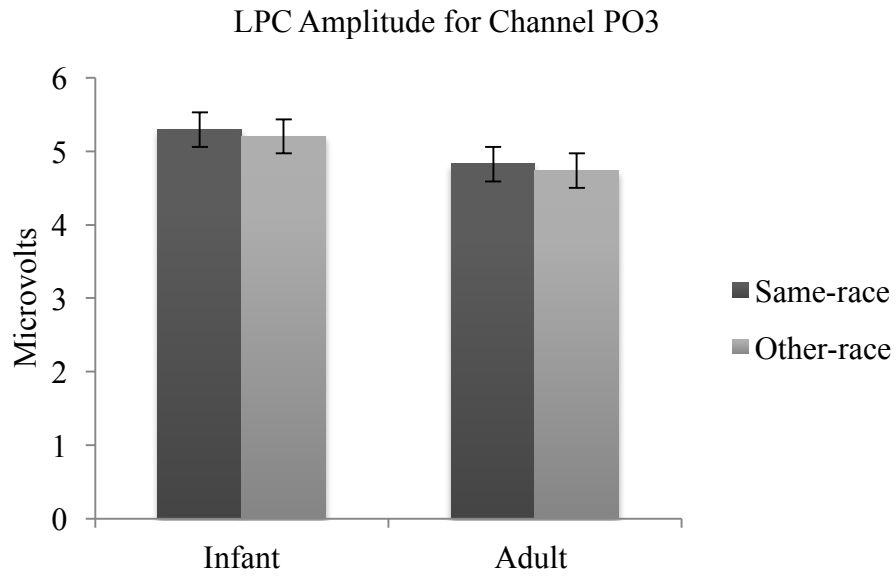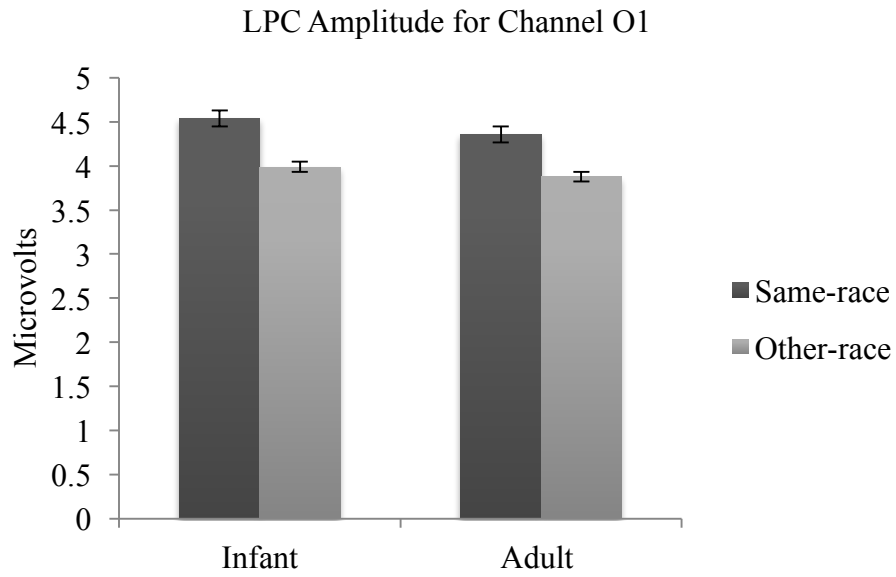
Figure 19. Amplitude, measured in microvolts, is plotted for the first window of the LPC demonstrating a main effect of age between infant and adult faces. Bars represent standard error.

LPC Amplitude for Channel O1

Figure 20. Amplitude, measured in microvolts, is plotted for the first window of the LPC demonstrating a main effect of race between same-race and other-race faces. Bars represent standard error.
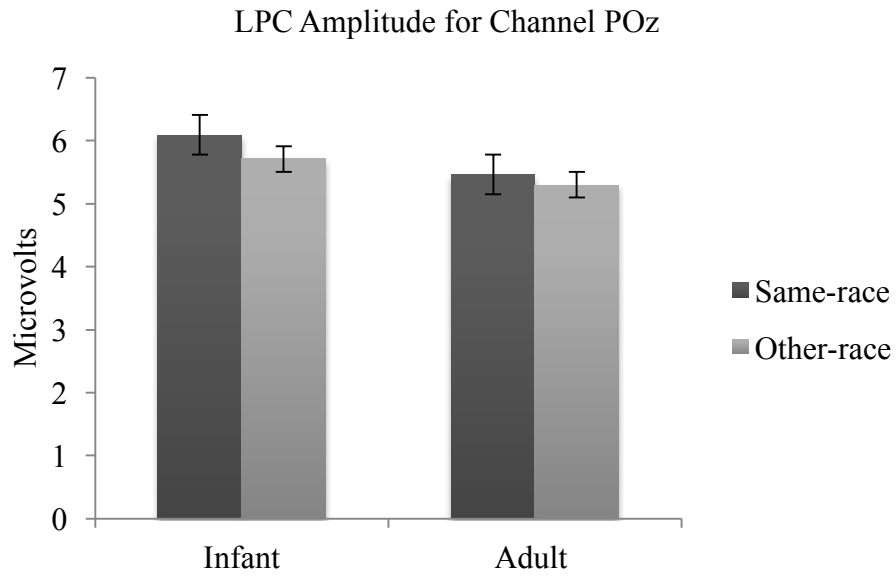
LPC Amplitude for Channel POz

Figure 21. Amplitude, measured in microvolts, is plotted for the first window of the LPC demonstrating a main effect of age between infant and adult faces. Bars represent standard error.
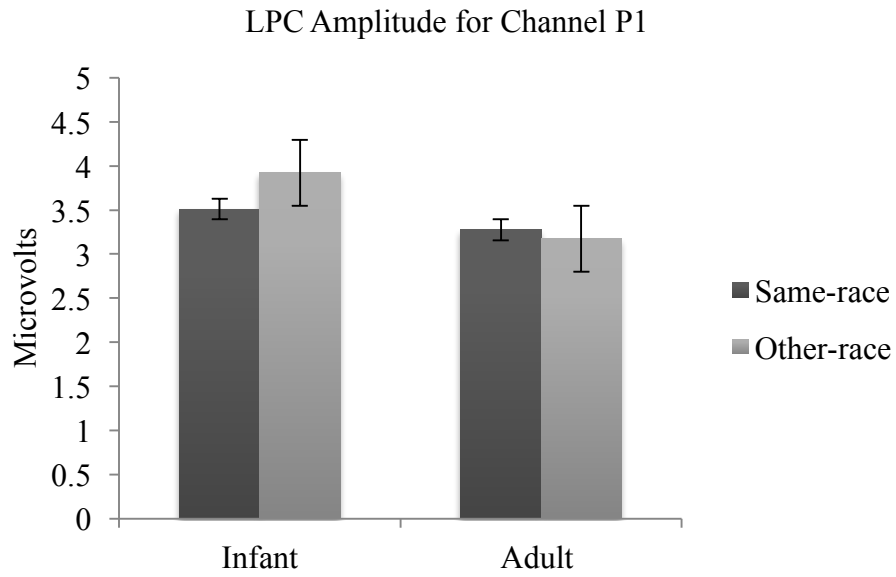
LPC Amplitude for Channel P1

Figure 22. Amplitude, measured in microvolts, is plotted for the second window of the LPC demonstrating a main effect of age between infant and adult faces. Bars represent standard error.

LPC Amplitude for Channel PO3

Figure 23. Amplitude, measured in microvolts, is plotted for the second window of the LPC demonstrating a main effect of age between infant and adult faces. Bars represent standard error.
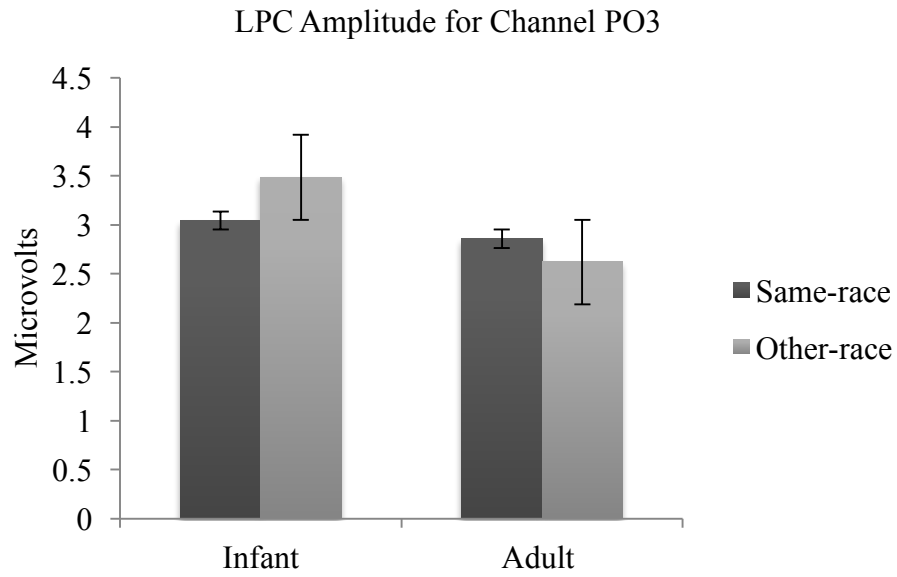
Figure 24. Amplitude, measured in microvolts, is plotted for the second window of the LPC demonstrating a main effect of age between infant and adult faces. Bars represent standard error.

LPC Amplitude for Channel Pz

Figure 25. Amplitude, measured in microvolts, is plotted for the second window of the LPC demonstrating a main effect of age between infant and adult faces. Bars represent standard error.
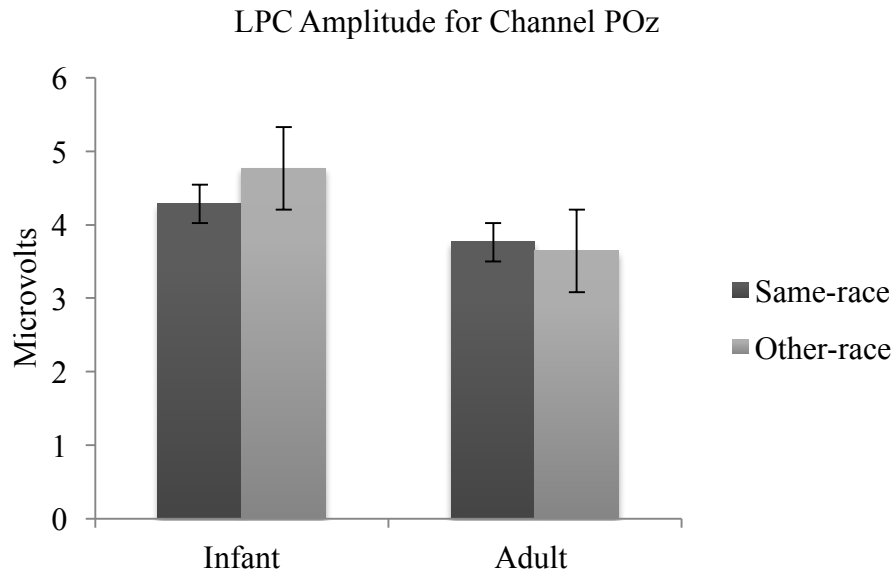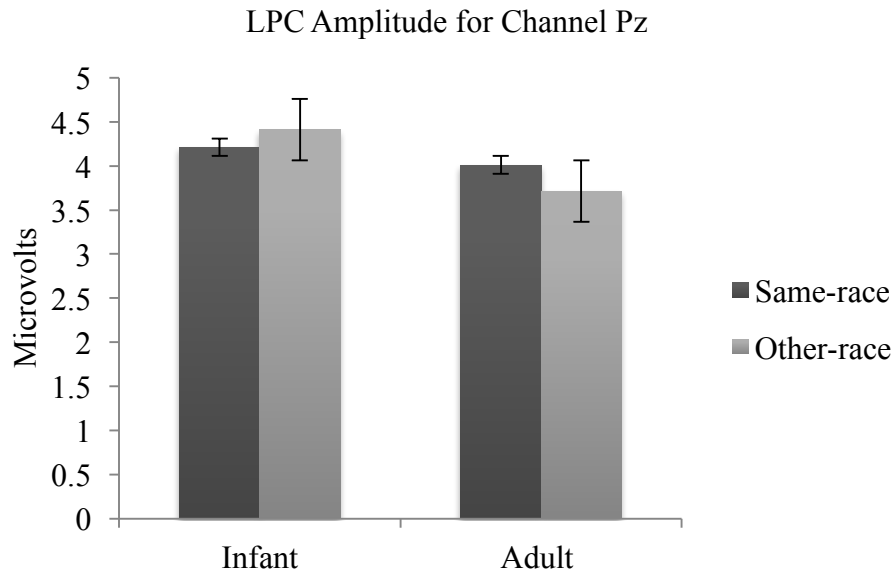
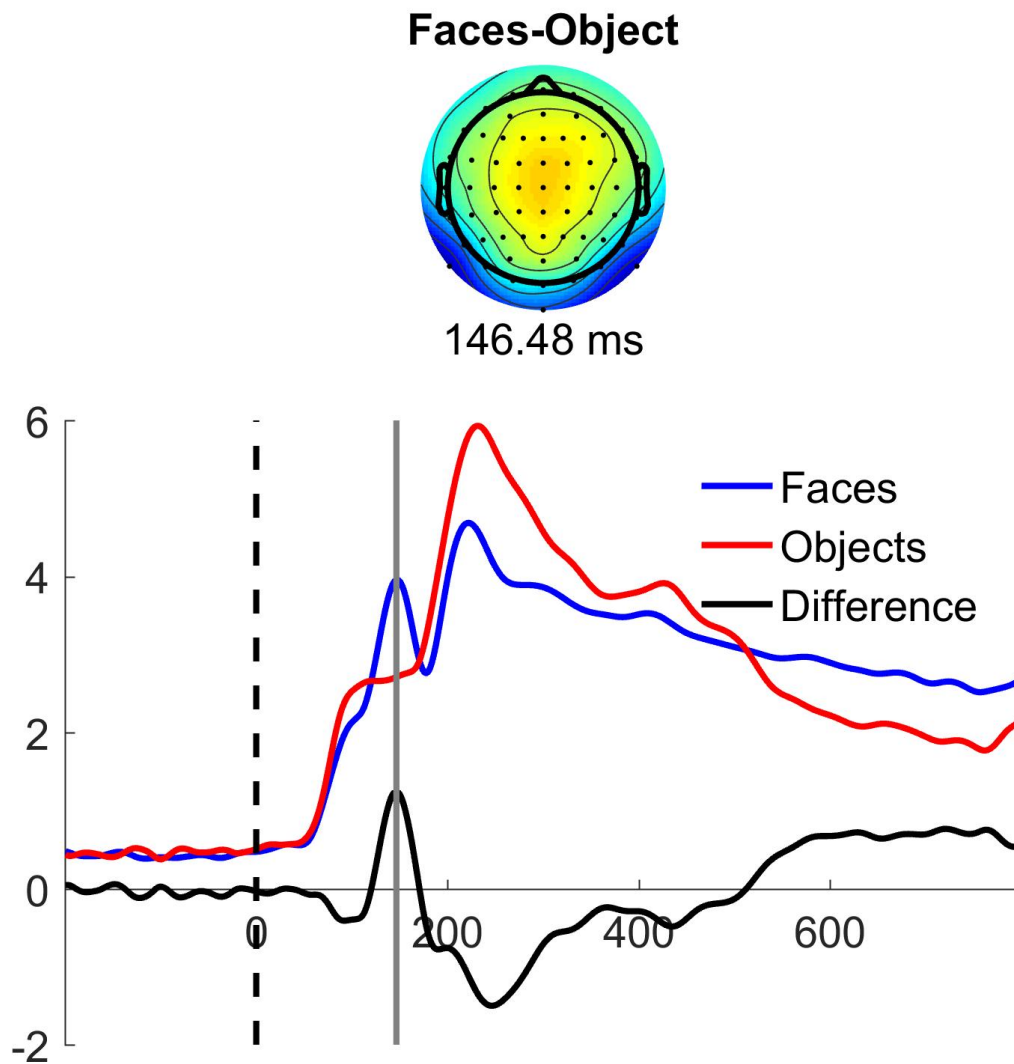*Figure 26.* Pictured in the top subplot is the scalp map showing the moment in time (146ms) and scalp distribution where the Face – Object difference is maximal. This time coincides with the face-specific N170 component, providing support for the exogenous stimuli used in the experiment and validating that we found a face-effect. Pictured in the bottom subplot are the grand average ERPs for the face and object conditions.

Appendix A
<u>Background Questionnaire</u>   Participant No. _____

1. How old are you? _____

2. Circle your sex: Male   Female

3. What is your race? _____

4. In which country were you born? _____

5. Have you ever lived in a country other than your place of birth? Please circle Y / N

    If yes, please list:

    Country   Length of time (approximately)

    _____   _____

    _____   _____

6. Where was your mother born? _____

7. What is her ethnicity? _____

8. Where was your father born? _____

9. What is his ethnicity? _____

10. Do you have any relatives (by birth or marriage) or close friends who are members of

other ethnic or racial groups? Please circle Y / N

    If yes, please list:

    Their ethnicity   Relationship to you   How often you see them (circle one)

    _____   _____   Daily   Weekly Yearly <Yearly

    _____   _____   Daily   Weekly Yearly <Yearly

11. Have you ever lived with people from other ethnic groups? Please circle Y / N

    If yes, please list:

    Their ethnicity   Length of cohabitation   Your age when moved in

    _____   _____   _____

    _____   _____   _____

<u>Social contact</u>

1. How many African Americans do you know very well?

    a. up to 2
    b. up to 5
    c. up to 8

d. up to 12
e. more than 12

2. I often spend time with African Americans
    a. strongly agree
    b. sort of agree
    c. not sure
    d. sort of disagree
    e. strongly disagree

3. I spend a lot of my free time doing things with African Americans

    a. strongly agree
    b. sort of agree
    c. not sure
    d. sort of disagree
    e. strongly disagree

Appendix B
Edinburgh Handedness Questionnaire

When performing the following activities…	Which hand do you prefer?			Do you ever use the other hand?	
Writing	None	Left	Right	Yes	No
Drawing	None	Left	Right	Yes	No
Throwing	None	Left	Right	Yes	No
Using Scissors	None	Left	Right	Yes	No
Using a Toothbrush	None	Left	Right	Yes	No
Using a Knife (without fork)	None	Left	Right	Yes	No
Using a Spoon	None	Left	Right	Yes	No
Using a Broom (upper hand)	None	Left	Right	Yes	No
Striking a Match	None	Left	Right	Yes	No
Opening a Box (lid)	None	Left	Right	Yes	No

Totals
Handedness Score

Appendix C
Infant Experience Questionnaire   Participant No. _____

1. Have you ever taken care of an infant? Please circle   Y / N

    If yes: for how long? _____

    What was the infant's race? _____

2. Have you recently played with or held an infant? Please circle   Y / N

    If yes: when? _____

    What was the infant's race? _____

3. Are you a parent? Please circle   Y / N