The Role of Differential Experience in Facial Age Processing

by

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Abstract

The present study investigated the role of differential experience in one’s processing of facial age information. Study 1 examined how differential experience with own- and other-race individuals, as well as differential experience with own- and other-age individuals, influences children’s and adults’ abilities to process facial age information. Study 2 examined how differential sociocultural experiences influence adults’ abilities to process facial age information. The results suggest that the influence of differential experience with own- and other-race faces is most evident when individuals have extremely limited to no experience with other-race faces. There was also a clear other-age effect in young adults’ facial age judgments, presumably due to their extensive experience with own-age peers. However 9- to 10-year-olds and 13- to 14-year-olds also showed an advantage in processing facial age information for young adult faces relative to child and middle-age adult faces. Thus, the 9- to 10-year-olds and 13- to 14-year-olds may have also had the most extensive experience with young adult individuals relative to individuals from other age groups. In addition, results suggest that the efficiency with which individuals process facial age information is influenced by differential sociocultural emphases on the need to differentiate between the facial ages of social partners.
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Chapter 1: Introduction

The ability to process faces is crucial in our daily social interactions. Simply looking at a face provides us with a variety of information about an individual, such as their gender, age, racial background, identity, and emotional state. The ability to extract such information is crucial for individuals to function adaptively, whereas the inability to do so (e.g., as seen in individuals with autism) leads to severe abnormalities. Among these many important abilities of face processing is that of abstracting age information. Such information can be used to gauge our subsequent social interactions. For example, being able to differentiate between individuals from different age groups is particularly useful in adequately adjusting one’s behavioural conduct and verbal exchange depending on whether the individual is a same-age peer, or a younger or older individual.

The present paper will first review the physical cues to facial age. The literature on adults’, infants’, and children’s perception of facial age, developmental changes in facial age judgments, and unresolved issues regarding the role of differential experience with faces on facial age judgments will also be discussed. Two studies examining children’s and adults’ facial age judgments as a function of their differential experience with faces will then be examined and discussed in detail.

Practical contributions of the present studies include important implications for eyewitness testimonies. That is, the present study provides implications regarding how an eyewitness’ age and ethnicity might interact with the age and ethnicity of the individual in question to influence accuracy in age judgments that eyewitnesses are typically asked to make. Theoretically, the present study will bridge the gap in the literature regarding the role of experience in facial age processing. More generally, the results have important
implications regarding differential experience with faces and its role in fine tuning our visual processing and perception of facial age.

1.1 Physical Cues to Facial Age

One notable cue to age is head shape and its accompanying facial shape (i.e., craniofacial structure). A young child’s head and face appears wider and shorter relative to adults (Enlow & Hans, 1996). With increased age, vertical facial growth eventually surpasses the initial expansion in facial width, and an adult face is thus characterized by a relatively more narrow facial shape and a relatively more protruding chin (Enlow & Hans, 1996).

Considering the relative delay in vertical facial growth, a young child’s internal facial features (e.g., eyes, nose, and mouth) and ears appear low-placed on the face so that the forehead region is large and the chin region is small (Enlow & Hans, 1996). However, with age, vertical facial growth increases and the internal facial features and ears appear to “move up” (Enlow & Hans, 1996). Thus, relative to young children, adults’ internal features appear to be placed on a more average position along the vertical axis of the face.

Other cues to facial age include the shape and size of various internal facial features. The nasal region continues to develop throughout childhood, thus, relative to adults, a young child’s nose appears shorter and rounder, their nasal bridge is lower, and their nasal profile is more concave in appearance (Enlow & Hans, 1996). Due to their relatively flat and wide face, a young child’s forehead also appears more bulbous, their cheeks appear more prominent, and their eyes appear larger relative to adults’ features (Enlow & Hans, 1996).
Relative to the myriad of craniofacial changes (i.e., spatial and featural changes) that occur during the childhood and adolescent years, the young adulthood years are characterized by more subtle craniofacial changes. The increased growth of the nose and lower jaw, as well as the increased vertical growth of the face, that begins during the childhood years continues during the young adulthood years (Akgül & Toygar, 2002; Sarnäs & Solow, 1980; Taylor, 2001; West & McNamara, 1999). Some evidence of fine lines may also begin to appear during young adulthood (Taylor, 2001). In addition, the eyebrows become fuller, the height of the upper lip increases slightly in size but decreases in thickness (Akgül & Toygar, 2002; Sarnäs & Solow, 1980; Taylor, 2001).

During the subsequent early middle-age adulthood years (e.g., 30s), the nose and lower jaw continue to increase in size, and vertical facial growth continues (Akgül & Toygar, 2002; Forsberg, 1979; West & McNamara, 1999). Loss of fatty tissues and decreased skin elasticity may lead to facial skin sagging, particularly under the eye region (Enlow & Hans, 1996). The upper eyelids may also begin to droop, which make the eyes appear smaller and accentuates the superior orbital grooves so that the eyes appear more deeply set (Nkengne et al., 2008; Taister, Holliday, & Borrman, 2000). Drooping jowls may also be found in the jaw region (Enlow & Hans, 1996). Loss of fatty tissues lead to a greater visibility of underlying venous networks, which in turn, results in an apparent darkening of skin below the eyes (Enlow & Hans, 1996). In addition, wrinkles and creases (e.g., “smile line,” “crow’s feet,” horizontal lines on forehead, etc.) typically form during the middle-age adulthood years and continue to increase in number and deepen and become more salient in appearance with increased age (Enlow & Hans, 1996; Taylor, 2001). The lips continue to thin and the eyebrows may begin to droop during the later
middle-age adulthood years. (Akgül & Toygar, 2002; Taylor, 2001; Zimbler, Kokoska, & Thomas, 2001).

1.2 The Influence of Intrinsic and Extrinsic Factors on Facial Aging

Intrinsic factors that influence facial aging refer to maturational changes in the craniofacial structure and soft facial tissues, as well as individual variability in such changes. A recent study with twins has shown that 55% of the variation in the number of facial wrinkles and 57% of the variation in the prominence of facial wrinkles can be attributed to genetic factors (Gunn et al., 2009). However facial aging is also influenced by extrinsic factors that may accelerate or exacerbate the facial aging process. For example, relative to non-smokers, smoking tobacco has been associated with a greater number and prominence of facial wrinkles, greater skin damage due to sun exposure, and greater perceived age (Asakura et al., 2009; Ernster et al., 1995; Nagata et al., 2010; O’Hare et al., 1999; Rexbye et al., 2006). In addition, sun exposure may lead to skin damage in the form of coarse wrinkles and hyperpigmentation typically known as “sun spots” (Griffiths, 1992). Previous studies have verified that greater sun exposure is associated with sun-damaged skin, a greater number and prominence of facial wrinkles, and greater perceived age (Ernster et al., 1995; Nagata et al., 2010; O’Hare et al., 1999; Rexbye et al., 2006). Greater tanning bed use has also been associated with a greater number and prominence of facial wrinkles (O’Hare et al., 1999), while sunscreen use has been associated with less sun-damaged skin (Asakura et al, 200; Martires, Fu, Polster, Cooper, & Baron, 2009). However, it should also be noted that there are genetic differences in susceptibility to extrinsic factors such as sun exposure in relation to developing “sun spots” and sun-damaged skin (Gunn et al., 2009).
In addition to smoking and sun exposure, individual variability in diet influence facial aging. Greater Body Mass Index (BMI) is associated with less sun-damaged skin, fewer and less prominent facial wrinkles, and younger perceived age (Ernster et al., 1995; Martires et al., 2009; Rexbye et al., 2006). Although the influence of specific diets on facial aging require further study, it appears that greater skin elasticity among 20- to 74-year-olds is associated with total fat intake, as well as with intake of saturated and monounsaturated fats (Nagata et al., 2010). A significant correlation has also been found between the degree of facial wrinkling and intake of green and yellow vegetables (Nagata et al., 2010).

Thus, although facial aging is a natural process, it should be noted that there are intrinsic and extrinsic factors that influence the appearance of facial age. The interaction between intrinsic and extrinsic factors likely also influences the appearance of facial age. All of these factors can contribute to variation in facial age appearance that is independent of actual chronological age.

1.3 Facial Age Judgments in Adults

Adults are generally accurate in judging the age (i.e., in years) of unfamiliar individuals by examining their faces (Burt & Perrett, 1995; George & Hole, 1995; 2000; Henss, 1991). However, there also appears to be high variability in adults’ age estimates for faces viewed in photographs. Henss (1991) found that the age range estimated for a given adult face stimulus was between 18 and 45 years.

Previous studies have found that adults examine a variety of facial cues when judging age. One such cue is craniofacial shape. With age, the foreheads of face profiles become less bulbous and the angle of facial profiles changes obliquely so that the lower
jaw shows more protrusion (see Figure 1). These changes in craniofacial shape are used by adults in their facial age judgments, so that sketches of facial profiles that show less protrusive foreheads and more protrusive lower jaws are assigned older age judgments than profiles with protrusive foreheads and less protrusive lower jaws (Pittenger & Shaw, 1975a). Consistent findings have been reported by Mark et al. (1980), who found an increase in perceived age as the foreheads of sketched facial profiles became less bulbous.

In addition, facial shape as viewed from the frontal direction offers cues to facial age. Burt and Perrett (1995) found that transforming the shapes of younger adult faces so that they matched the face shape of a composite face created from older faces between 50 to 54 years of age resulted in increased facial age judgments from adult raters. Adults have also been found to make use of facial contour as a cue to facial age, so that their facial age ranking of 12- to 19-year-olds were more accurate when the facial contour was visible than when the facial contour was cropped (Pittenger & Shaw, 1975b).

In addition to craniofacial shape, adults also use skin colour information in their facial age judgments. Burt and Perrett (1995) found that younger adult faces with their skin colours changed to match that of a composite face created from older faces resulted in increased facial age judgments from adult raters. Similar results were reported by Fink, Grammer, and Matts (2006) who found that adults gave older age estimates for faces with the same identity and face shape, but with increasingly uneven skin tones from older faces. Nkengne et al. (2008) also found that skin colour uniformity and sun spots influenced adults’ facial age judgments of adult faces.

Previous studies have also found that adults rely on the appearance of wrinkles
Figure 1. Face profiles showing decreased forehead protrusion and increased lower jaw protrusion with age. (Drawings courtesy of Brendan Adams.)
and the amount of cranial hair in their facial age judgments. An increase in the number of facial wrinkles and an increase in the salience of facial wrinkles (e.g., deeper, more accentuated wrinkles) result in older age estimates from adult raters (Aznar-Casanova, Torro-Alves, & Fukusima, 2010; Mark et al., 1980). Older age estimates are also observed as individuals have less cranial hair, graying hair, and thinning hair (Gunn et al., 2009; Wogalter & Hosie, 1991).

Adults have also been shown to rely on the appearance and height of the internal facial features when estimating facial age. With regards to the appearance of the internal facial features, adults rate schematic faces with large eyes positioned low on the face, small noses, and round facial contours as younger than faces with small eyes positioned high on the face, long noses, and angular facial contours (Gross, 1997). George and Hole (1995) also found an association between younger age estimates and low-placed internal facial features. However, this effect was only significant for photographs of young children’s faces between 5 to 10 years of age. Overall, findings suggest that configural information from the internal facial features alone is insufficient for accurate facial age judgments. Adults show the most difficulty in making facial age judgments when faces are blurred so that facial configuration and face shape are conserved but details about skin colour and the appearance of the internal facial features are minimized (George & Hole, 1995; 2000). Such high-contrast, low-spatial frequency images typically result in a “flattening” of age-estimates, so that younger faces are judged as older and older faces are judged as younger (George & Hole, 1995; 2000). Adults, instead, appear to benefit from combining various facial age cues. For example, facial shape and colour transformations have a greater influence on perceived age compared to either facial shape
or colour information alone (Burt & Perrett, 1995). In addition, adults typically rely on external features, such as facial contour and head shape, in combination with the internal facial features. For example, George and Hole (1998) found that replacing a young child’s internal facial features with those of an older child resulted in older facial age estimates from adult raters. Likewise, replacing an older child’s internal facial features with those of a younger child resulted in younger facial age estimates (George & Hole, 1998). In contrast, faces with a young child’s internal and external facial regions were given the youngest age estimates, and faces with an older child’s internal and external facial regions were given the oldest age estimates (George & Hole, 1998).

In addition to examining the variety of facial cues that adults use to determine facial age, the literature has also revealed a right hemisphere advantage in adults’ processing of facial age information. Based on a study that used chimeric faces, adults appear to primarily examine the right side of faces (i.e., on the perceiver’s left visual field) when making facial age judgments, presumably due to the right hemisphere’s greater specialization in processing faces (Burt & Perrett, 1997). Additional evidence also suggests that the posterior areas of the right hemisphere are most important for facial age judgment abilities. When asked to rank order faces by age, individuals with damage to the right posterior parietal, temporal, and occipital lobes performed worse relative to individuals with no brain damage or individuals with damage to the frontal lobes or damage to the left posterior areas (De Renzi, Bonacini, & Faglioni, 1989). Electrophysiological evidence further reveals larger amplitudes at frontal and central sites within a 200 ms post-stimulus presentation, as well as larger amplitudes at occipito-parietal sites evident between 200 and 400 ms post-stimulus presentation when adults
were engaged in an age judgment task relative to a task in which stimulus facial age was constant and required no age judgments (Mouchetant-Rostaing & Giard, 2003). Even in tasks that did not require explicit age judgments, but in which processing of age information was nonetheless possible, adults also showed larger amplitudes at frontal and central sites within a 200 ms post-stimulus presentation relative to a task that involved no age judgments (Mouchetant-Rostaing & Giard, 2003). Thus, it has been speculated that age may be implicitly processed during the early stages of face perception (Mouchetant-Rostaing & Giard, 2003).

Previous studies have also examined whether familiarity of faces influences adults’ age judgments. Such studies on age judgments for familiar (i.e., celebrity) or familiarized faces reveal an influence of identity on adults’ speeded categorical age judgments. When faces are presented for short intervals (i.e., between 150 to 200 ms), adults show faster and more accurate speeded categorical age judgments (i.e., “young” or “old”) for familiar or familiarized faces than for unfamiliar faces (Bruyer, Lafalize, & Distefano, 1991; Bruyer, Mejias, & Doublet, 2007; Dagovitch & Ganel, 2010).

1.4 Facial Age Judgments in Children

In addition to adults’ facial age judgment abilities, past studies also show that sensitivity to facial age cues arise at an early age. Brooks and Lewis (1976) found that infants as young as 7 months showed differential behaviour towards young children, typical adults, and adult midgets as measured by looking/gaze aversion, approach behaviours, and facial expressions. Infants smiled more and were more likely to move towards an approaching child, but they averted their gaze and frowned more at an approaching adult (Brooks & Lewis, 1976). Frowning towards an approaching adult
midget was also more likely than frowning towards children, but less likely than frowning towards typical adults (Brooks & Lewis, 1976). Infants were also more likely to look away from an approaching typical adult compared to an approaching child or adult midget (Brooks & Lewis, 1976). Thus, infants appear to use both facial cues as well as physical size cues in their differentiation between individuals from different age groups.

Studies with older age groups also show that very young children can make accurate but broad categorical age judgments and they can rank faces by age. Children as young as 2 years old can accurately group schematic faces under the broad categories of “baby”, “boy”, and “man” (Montepare & McArthur, 1986), and children as young as 3 years old can accurately rank coloured photographs of young, middle-aged, and old female adult faces (Downs & Walz, 1981).

Like adults, children also use a variety of facial cues when judging age. The paired relative age judgments (e.g., “which face is older?”) of children as young as 2 years old are influenced by facial wrinkles and the height of the internal facial features, so that they judge schematic faces with low-placed features as younger looking and faces with wrinkles as older looking (Montepare & McArthur, 1986). In addition, a study by Jones and Smith (1984) showed that 4-year-olds use the eyes as a reference when judging facial age, so that ranking adult faces according to age was most inaccurate when the eye region of photographs were masked relative to when the nose and cheek areas, or mouth and chin areas, or facial contour, hair, and neck areas were masked. However, 4- to 6-year-olds can also use facial configuration and craniofacial shape to deduce which child/adult face from a pair is older (George, Hole, & Scaife, 2000). Similar to adults, children as young as 5 years old also rate schematic faces with large low-placed eyes and
small noses as younger than faces with small high-placed eyes and long noses (Gross, 1997).

However, despite children’s early sensitivity to facial age cues, there is also evidence of age-related improvements in the accuracy of facial age judgments. Between 3 and 9 years of age, there is a steady increase in children’s accuracy in relative age judgments (i.e., “who is older?”) for schematic full-figure drawings of infants, children, adolescents, and adults (Looft, 1971). Although sensitivity to age cues emerges at a young age, it appears that young children rely more on physical size cues for their age judgments compared to older children. That is, in cases in which a younger individual is depicted as physically larger than an older individual (e.g., a child shown as larger than an adolescent), younger children are more likely than older children to respond that the larger (i.e., but younger) individual is older (Looft, 1971). This pattern of response was more common at 3 years of age (6.70% of responses) and showed a decrease with age so that 9-year-olds were only making this error in 2.30% of their responses (Looft, 1971). However, a later study that used more realistic photographs as stimuli (i.e., rather than schematic drawings) found that age-related improvements occurred earlier. Kratochwill and Goldman (1973) used full-figure photographs of infants, children, adolescents, and adults, and they manipulated the size of the individuals depicted in the paired photographs. Similar to Looft’s (1971) findings, Kratochwill and Goldman (1973) found age-related improvements in children’s accuracy in age judgments. However, in Kratochwill and Goldman’s (1973) study, the 9-year-olds were performing at ceiling and the 8-year-olds were no longer using figural size cues in their age judgments.

Taylor, Steele, and Roberto (1982) also found developmental changes in
children’s age judgments. Taylor et al. presented children and adults with pairs of photographs depicting individuals from different age groups who were all similar in physical size (i.e., photographs included more than just the facial area). Taylor et al. found that 5-year-olds were significantly better than 4-year-olds in a relative age judgment task requiring that they choose which individual from two photographs was older when the individuals were from different but consecutive age groups (e.g., a young adult vs. a middle-age adult), or from relatively more distal age groups (e.g., a young adult vs. an older adult, a pre-adolescent vs. an older adult). However, 4-year-olds did not differ in performance from 5-year-olds when the age discrepancy between the photographs was very large, such as in the case of a child paired with an older adult (Taylor et al., 1982). In addition, adults were significantly better than the 5-year-olds when the face pairs were from consecutive age groups and when there was one age group separating the face pairs (Taylor et al., 1982). Thus, the ability to discriminate between smaller differences in age improves from 4 to 5 years of age, but is still immature at 5 years.

Similarly, in a paired relative age judgment task with male and female faces, 4- to 6-year-olds do not appear to detect an age difference between middle-aged and old faces (i.e., 35- to 43-year-olds vs. 59- to 67-year-olds), and between old and very old faces (i.e., 59- to 67-year-olds vs. 78- to 86-year-olds) – discriminations that are more accurate among adolescents and young adults (Gross, 2004). Further age-related changes were observed in 8- to 10-year-olds who were able to detect an age difference between all facial age groups except for comparisons between old and very old faces (Gross, 2004). Thus, there appears to be a developmental improvement in facial age judgments, so that it
becomes easier to detect an age difference between older adult faces that are proximal in age. Similar results were found by Gross (2007) who showed that although young adults gave different age ratings (i.e., on a five-point scale) to young (i.e., 20- to 27-year-olds), early middle-aged (i.e., 32- to 39-year-olds), late middle-aged (i.e., 43- to 50-year-olds), early old age (i.e., 55- to 62-year-olds), and late old age (i.e., 71- to 82-year-olds) male adult faces, 5- to 7-year-old participants gave similar age ratings for young adults, early middle-aged, and late middle-aged adult faces. Adolescents also gave similar age ratings for young adults and early middle-aged adult faces (Gross, 2007).

1.5 Perception of Facial Age and Personal Attributes

Few studies have examined the relationship between facial age and perceived personal attributes. However, Gross (2004) has found differences in children’s and adolescents’ perceptions regarding cognitive ability, sociability, and physical fitness in relation to facial age. Four- to 10-year-old children judged middle-age adult faces between 35 to 43 years of age as more intelligent and as having better memory relative to older adult faces between 78 to 86 years of age (Gross, 2004). Adolescents judged young adult faces between 21 to 29 years of age as more intelligent and as having better memory relative to older adult faces between 78 to 86 years of age (Gross, 2004). Both children and adolescents also judged middle-age adult male faces as more sociable than older adult males between 78 to 86 years (Gross, 2004). In addition, both children and adolescents judged middle-age adult faces as more physically fit than older adult faces between 59 and 86 years of age (Gross, 2004).

1.6 Summary of Facial Age Judgments in Adults and Children

Overall, studies on facial age judgment abilities have revealed that both adults and
children rely on a combination of different cues to determine facial age. Developmental changes in facial age judgment abilities have also been well-established. However, few studies have examined the potential role of experience on facial age judgment abilities. Thus, this thesis presents two studies that examine how different types of experiences might influence facial age judgment abilities. Study 1 examined how adults’ and children’s facial age judgments are potentially influenced by differential experience with i) own-race and other-race faces, and ii) own-age and other-age faces. Thus, Study 1 determined whether differential experience with race and age groups influence facial age judgments for own- and other-race faces and own- and other-age faces. Study 2 investigated the role of a type of differential experience on facial age processing that has yet to be examined – that of sociocultural experience. By examining the facial age judgments of Asian adults in Japan, China, and Canada, Study 2 determined whether sociocultural differences in the extent to which individuals attend to the age of their social partners had a significant influence on their abilities to abstract facial age information.
Chapter 2: Facial Age Judgments in Adults and Children –

Differential Experiences with Race and Age Groups

2.1 Developmental Changes and the Role of Own- and Other-race Experience in Face Processing Abilities

Evidence for developmental changes in the accuracy of facial age judgments is consistent with well established age-related improvements in other areas of face processing. For example, accuracy in facial recognition improves with age (reviewed in Lee, Anzures, Quinn, Pascalis, & Slater, 2011). However, in addition to this general developmental change, previous studies have also shown that face processing abilities are largely influenced by one’s differential experience with faces. Young infants, for example, show more sophisticated processing of female faces relative to male faces in terms of recognition abilities (Quinn, Yahr, Kuhn, Slater, & Pascalis, 2002; reviewed in Ramsey, Langlois, & Marti, 2005) presumably due to their greater experience with their primary caregivers who are typically female (Rennels & Davis, 2008). Similarly, the own-race advantage in adults’ facial recognition (reviewed in Meissner & Brigham, 2001) can already be observed among infants and children who also demonstrate better recognition of own-race faces and diminished recognition of other-race faces with which they have relatively less experience (Anzures, Pascalis, Quinn, Slater, & Lee; in press; Anzures, Quinn, Pascalis, Slater, & Lee, 2010; Chance, Turner, & Goldstein, 1982; Corenblum, & Meissner, 2006; Goodman et al., 2007; Kelly et al., 2007, 2009; Pezdek, Blandon-Gitlin, & Moore, 2003; Rehnman & Herlitz, 2006; Sangrigoli & de Schonen, 2004). This own-race advantage in recognition memory appears to be driven by better memory for own-race facial features (Hayward, Rhodes, Schwaninger, 2008; Mondloch
et al., 2010; Rhodes, Hayward, & Winkler, 2006), better memory for differences in the
spacing between own-race facial features (Hancock & Rhodes, 2008; Hayward et al.,
2008; Mondloch et al., 2010; Rhodes et al., 2006), and better holistic processing (i.e.,
perceiving a face as a whole rather than as individual features) of own-race faces (Michel,
Rossion, Han, Chung, & Caldara, 2006; Tanaka, Kiefer, & Bukach, 2004; but see
Mondloch et al., 2010).

2.2 The Role of Own- and Other-age Experience in Face Processing Abilities

Some recent evidence also suggests that differential experience with own- and
other-age faces might elicit an effect similar to the other-race effect – that of an other-age
effect in recognition memory. Although a previous study by Goldstein and Chance (1964)
failed to show an own-age bias in facial recognition, more recent evidence by Macchi
Cassia, Kuefner, Picozzi, and Vescovo (2009) shows that 3-year-olds who have younger
siblings show comparable accuracy in their recognition of newborn and adult faces,
whereas 3-year-olds without younger siblings show a significant impairment in their
recognition of newborn faces relative to their recognition of adult faces. Similarly, adults
with experience with infants show a significant decrement in their recognition of infant
and adult faces when the faces are inverted, whereas adults with little to no experience
with infants only show such a decrement in their recognition of adult faces (Macchi
Cassia et al., 2009; Macchi, Cassia, Picozzi, Kuefner, & Casati, 2009). Consistent with
Macchi Cassia et al.’s findings, Kuefner, Macchi Cassia, Picozzi, and Bricolo (2008)
found that adults showed superior recognition of adult faces relative to their recognition
of infants’ and children’s faces. However, if adults had sufficient experience with young
children (i.e., 1- to 6-year-olds), the recognition advantage for adult faces disappeared
(Kuefner et al., 2008). Anastasi and Rhodes (2005) also found an own-age bias in facial recognition among an older group of adult participants (i.e., 55- to 89-year-olds), and a trend towards an own-age bias in facial recognition among 5- to 8-year-olds. However, this own-age bias was much more defined and stronger among the older adults relative to the child participants (Anastasi & Rhodes, 2005). Further evidence of an own-age bias in face recognition is provided by Bäckman (1991) who found that young adults were better in their recognition of young adult faces relative to their recognition of older adult faces, whereas an older group of adults (63- to 70-year-olds) showed the opposite pattern of performance. A study by Kuefner, Macchi Cassia, Vescovo, and Picozzi (2010) suggests that these face recognition biases are at least partially due to greater holistic processing of faces with which we have an abundance of visual experience.

However, it should noted that the evidence for own-age recognition biases among adults has not been consistent, with some studies citing an own-age bias in young adults’ recognition of adult faces but no such bias among older adults (Bartlett & Leslie, 1986; Fulton & Bartlett, 1991; Wiese, Schweinberger, & Hansen, 2008; Wright & Stroud, 2002), whereas other studies cite an own-age bias among older adults’ recognition of adult faces but no such bias among younger adults (Anastasi & Rhodes, 2006; Lamont, Stewart-Williams, & Podd, 2005).

2.3 The Role of Experience in Facial Age Judgment Abilities

As summarized in the previous sections, the literature cites the importance of experience in the development of face recognition abilities. Thus, the current research findings showing developmental changes in facial age judgments might be confounded by the potential influence of differential experience with faces from different races and
different age groups. However, very few studies have directly examined the influence of differential experience on facial age judgment ability.

An exception to this is a study by Dehon and Bredart (2001), which found that differential experience with own-race and other-race faces may influence one’s accuracy in processing facial age. Dehon and Bredart (2001) found that Caucasian adults living in Belgium were significantly better in their facial age judgments for own-race Caucasian adult faces relative to other-race African adult faces. However, African adults who had been living in Belgium for 5 to 35 years showed comparable facial age judgments for the Caucasian and African faces, presumably due to their experiences with both Caucasian and African faces.

A review of the facial age processing literature also reveals more subtle allusions regarding the possible influence of differential experience on the accuracy of facial age judgments. In addition to differential experience with own-race versus other-race faces, differential experience with faces may exist for male versus female faces, and own-age versus other-age faces. There exists indirect evidence that young children’s perception of facial age might differ for male and female faces. To date, the best evidence of this is a study by Downs and Walz (1981) which showed that children as young as 3 years old were able to accurately rank female adult faces by age, but were unable to do so with male adult faces. The 3-year-olds accurately ranked old male faces as oldest, but they did not show differentiation between young and middle-aged male adult faces. Although there is no documented evidence that preschoolers have more experience with female adult faces, it can be speculated that young children’s more accurate perception of female adult facial age relative to male adult facial age might stem from a greater experience
with primary caregivers who are typically female. However, this superiority in facial age judgments for females relative to males may be limited to preschoolers. Evidence provided by Jones and Smith (1984) suggests that 4-year-olds can accurately rank photographs of seven male and seven female faces (i.e., infants/toddlers, 3- to 5-year-olds, 7- to 8-year-olds, 15- to 17-year-olds, 25- to 30-year-olds, 48- to 52-year-olds, older than 70 years old) according to facial age.

In addition to the influence of differential experience with male and female faces, facial age judgments might also be affected by differential experience with own-age and other-age faces. Willner and Rowe (2001) report an age-related decline in adults’ accuracy in judging the facial age of 13- to 16-year-old males and females, which offers support for an own-age bias in facial age judgments. Similar results have been found in children, with 4- and 6-year-olds showing greater accuracy in a paired relative age judgment task when both faces comprised of young children relative to when both faces comprised of adults (George, Hole, & Scaife, 2000). Twenty- to 35-year-olds also show the least error in their age judgments when judging the facial age of own-age faces than when judging the facial age of older adult faces (Nkengne et al., 2008). However, older adult participants showed no such own-age advantage in their age judgments (Nkengne et al., 2008).

2.4 The Present Study

Considering the lack of research that has examined the influence of differential experience with faces on accuracy in facial age judgments, Study 1 investigated whether Caucasian and Chinese children’s and adults’ facial age judgments are influenced by differential experience with: i) own-race and other-race faces, and ii) own-age and other-
age faces. Relatively more experience with a particular face type (e.g., own-race and own-age) might lead to more sophisticated and more accurate abstraction of age-related information in such faces. In contrast, the ability to abstract age information for less familiar face types (e.g., other-race and other-age) may be less optimal thereby resulting in a decrease in the level of sophistication and accuracy of facial age judgments for such unfamiliar faces.

Thus, Study 1 aimed to replicate Dehon and Bredart’s (2001) findings of an other-race effect in adults’ facial age judgments as a function of their differential experience with own- and other-race faces. Study 1 also aimed to extend such previous findings of an other-race effect in facial age judgments to a younger population of child and adolescent participants. It was hypothesized that Caucasian and Chinese adult participants who have little to no experience with other-race faces would show significantly greater accuracy and/or shorter latencies in their facial age judgments for own-race faces relative to their age judgments for other-race faces. It was also hypothesized that the other-race effect in age judgments would already be present in children and adolescents.

In addition, Study 1 offered a more direct examination of a potential other-age effect in facial age judgments by comparing children’s, adolescents’, and adults’ facial age judgments of own-age faces to their facial age judgments of other-age faces. This direct examination of facial age judgments for own- and other-age faces provides an ideal opportunity to ascertain whether the influence of experience on face processing is long-lasting or whether the advantages of such experiences are dependent on the maintenance of those experiences. That is, does experience with a particular age group during a given period lead to more sophisticated processing of those faces regardless of subsequent
experience with that age group, or is continued extensive experience with a given age group necessary to preserve that level of sophisticated face processing?

Study 1 examined young adults’ current age judgment ability for three different age groups: i) own-age young adult faces with which they would typically have an abundance of current experience, ii) children’s faces with which they would have had an abundance of previous (but typically limited current) experience, and iii) older middle-age adult faces with which they likely have less experience relative to own-age faces. Study 1 also examined 9- to 10-year-olds’ and 13- to 14-year-olds’ current age judgment abilities for three different age groups: i) own-age children’ faces with which they would typically have an abundance of current experience, ii) other-age young adult and middle-age adult faces which would have been predominant in their early experiences but would now likely comprise of relatively limited current experience. It was hypothesized that children and young adults would show significantly greater accuracy and/or shorter latencies in their facial age judgments for own-age faces with which they presumably have the most current experience.

Method

2.5 Participants

Thirty-six Chinese young adults ($M$ age in years = 21.54, $SD = 2.28$, 18 males) from China and 40 Caucasian young adults ($M$ age in years = 21.42, $SD = 2.24$, 20 males) from Canada participated in Study 1. Forty-one Chinese 9- to 10-year-olds ($M = 9.87, SD = .46$, 16 males), 39 Chinese 13- to 14-year-olds ($M = 13.77, SD = .48$, 19 males), 40 Caucasian 9- to 10-year-olds ($M = 9.94, SD = .52$, 21 males), and 28 Caucasian 13- to 14-year-olds ($M = 13.73, SD = .42$, 14 males) also participated in Study 1.
An additional 3 Chinese young adults, 2 Caucasian young adults, 4 Chinese 9- to 10-year-olds, 3 Chinese 13- to 14-year-olds, 3 Caucasian 9- to 10-year-olds, and 3 Caucasian 13- to 14-year-olds were tested, but they were excluded from the final analyses. These participants were excluded because i) their accuracy and latency measures in the relative age judgment task for a single stimulus age group were below/above 2 standard deviations from the mean of their respective age groups, or ii) their accuracy and/or latency measures in the relative age judgment task were either below or above 2 standard deviations from the mean of their respective age groups on at least 2 stimulus facial age groups. These exclusions ensured that the data included in the final analyses are representative of each participant race and participant age group. A number of additional Caucasian and Chinese participants were excluded due to speed-accuracy tradeoffs as will be discussed in a later section. Adult participants were given either course credit or an honorarium for their participation. Child participants were given a toy or gift for their participation.

We specifically chose to test 9- to 10-year-old children so as to match our youngest Caucasian and Asian face stimuli which we expected would be judged as being about 9 to 10 years of age. In addition to the 9- to 10-year-olds, we also recruited 13- to 14-year-olds because both groups of children would likely have an abundance of current experience with own-age peers and relatively fewer experiences with older individuals in the young and middle-age adult age range. Adult participants were also recruited because they would have likely had an abundance of previous experience with children’s faces, an abundance of current experience with own-age young adult peers, and relatively fewer previous and current experiences with older individuals in the middle-age adult age
range.

The Chinese adults were undergraduate students at Zhejiang Sci-Tech University. Participant recruitment in the city of Hangzhou, which is in the Zhejiang province of China – a location with extremely minimal numbers of Caucasian residents – ensured that the Chinese adult and child participants had extremely limited or no direct experiences with Caucasian individuals. It has been reported that 99.14% of the population in the Zhejiang province is Hans Chinese (Zhejiang China, 2000). The remaining .86% of the population belongs to ethnic minorities – a large proportion of which are other Chinese ethnic groups (Zhejiang China, 2000). A recent study by Ge et al. (2009) showed that young adults from the Zhejiang province demonstrated an other-race effect in their recognition of Asian and Caucasian faces.

The Caucasian adults were undergraduate students at Brock University. Participant recruitment in Canada occurred in an area with limited numbers of Asian residents (i.e., 2.90% East Asians as reported by Statistics Canada, 2006). However, to ensure that Caucasian adult and child participants had limited experience with Asians, they were asked to complete a questionnaire that inquired about their experience with Caucasian and Asian individuals.

2.6 Stimuli

Sixteen Asian male adult faces of Chinese descent (i.e., 31- to 40-year-olds, $M = 34.95, SD = 2.82$) were used to create an averaged Asian male adult face, and sixteen Asian male child faces of Chinese descent (i.e., 11- to 12-year-olds, $M = 11.5, SD = .52$) were used to create an averaged Asian male child face. The averaged faces were created to control for individual differences in facial growth and facial age appearance within a
given age group. That is, due to individual differences in facial age appearance that result from different intrinsic and extrinsic factors that influence facial aging, our averaged male adult face is likely more representative of the male middle-age adult facial age group relative to the individual male adult faces that were used to create the averaged face. Our averaged male child face is likely also more representative of the male pre-adolescent facial age group relative to the individual faces that were used to create the averaged face.

The “Old” (i.e., adult’s face) and “Young” (i.e., child’s face) average faces were then averaged together in 5% increments to make additional composite faces with varying degrees of old/young facial age information (see Figure 2). The same procedures were used to create a Caucasian male adult composite from 30- to 40-year-old faces ($M = 34.80, SD = 3.14$), a Caucasian child composite from 10- to 13-year-olds ($M = 11.66, SD = 1.12$), and a set of 21 Caucasian composite faces from the adult and child composite faces (see Figure 3). All face stimuli were standardized in size (i.e., chin to hairline) and presented in grayscale.

### 2.7 Questionnaires

Study 1 used a Cross-race Experience Questionnaire that inquired about participants’ ethnic backgrounds and their experience with Caucasian and East Asian individuals (see Appendix A). More specifically, this questionnaire inquired about participants’ degree of contact with Caucasian and East Asian individuals, participants’ number of Caucasian and East Asian friends, the degree to which participants felt that Caucasian individuals look the same, and the degree to which participants felt that East Asian individuals look the same.
*Figure 2.* Study 1 stimulus set of Asian male faces with varying degrees of child/adult facial age information.
Figure 3. Study 1 stimulus set of Caucasian male faces with varying degrees of child/adult facial age information.
2.8 Procedure

Participants completed two age judgment tasks. In Part 1, participants were required to make relative facial age judgments by comparing two different faces at a time. In Part 2, participants were required to make absolute age judgments by providing an age estimate (i.e., in years) for each face. Within each age judgment task, Asian and Caucasian faces were presented in separate blocks. Participants were always administered the Relative Age Judgment task prior to the Absolute Age Judgment Task. Prior to the age judgment tasks, Caucasian adults were asked to complete the Cross-race Questionnaire. Caucasian children who were tested in a lab setting rather than in a school setting also completed the Cross-race Questionnaire with their parents. Chinese adults and children were not asked to complete the Cross-race Questionnaire due to the extremely low Caucasian population in the area.

**Part 1: Relative Age Judgment Task.** Participants were seated about 30 cm away from a 17-inch computer screen on which the stimuli (13.31° visual angle for the vertical dimension; 10.85° visual angle for the horizontal dimension) were presented. Half of the participants completed the task with Asian faces first, and the remaining participants completed the task with Caucasian faces first. During the task, each trial began with a 500 ms crosshair, followed by a face pair that was presented for a maximum of 10 seconds or until a response was made. Participants were asked to choose which face was older via a key press. Participants were instructed to only use their dominant hand to make their responses.

In the relative age judgment task, face pairs always belonged to the same stimulus facial age group (i.e., child, young adult, or middle-age adult stimulus age groups). Each
stimulus face was paired with every other stimulus face in their respective stimulus facial age group twice (i.e., left-right reversals of stimuli presentation). Thus, there were 42 trials for each stimulus facial age group, so that the entire relative age judgment task for each stimulus face race comprised of a total of 126 trials. Participants were given the option to take a break between the Asian and Caucasian blocks.

**Part 2: Absolute Age Judgment Task.** Those participants who completed the Relative Age Judgment Task with Asian faces first, also completed the Absolute Age Judgment Task with Asian faces first. The remaining participants completed the Absolute Age Judgment Task with Caucasian faces first. In the Absolute Age Judgment Task, participants were shown sequential presentations of each average face (i.e., 100% Old to 0% Old) in one of four random orders to which participants were randomly assigned. Participants were asked to judge the age of each face in years (i.e., one absolute age for each face rather than an age range). During this task, participants were able to control the speed with which they moved through each trial, but they were not allowed to move back to previous trials.

**Results and Discussion**

**2.9 Caucasian Participants’ Cross-race Experiences**

In general, Caucasian adults, 13- to 14-year-olds, and 9- to 10-year-olds reported limited experience with other-race East Asian individuals and much greater and extensive experience with own-race Caucasian individuals. Participants from all age groups also felt that other-race Asian individuals look more alike than own-race Caucasian individuals.

**Caucasian adult participants.** Caucasian adults reported that on average
approximately 7.53% ($SD = 8.91$) of the students in their high schools were East Asians. They also reported a significantly greater number of Caucasian friends ($M = 6.74, SD = 3.14$) than East Asian friends ($M = 1.85, SD = 2.01$), $t(38) = 8.60, p < .001$. Using a 7-point scale (1 = very little, 7 = very extensive), Caucasian adults reported limited experience with East Asian individuals ($M = 3.49, SD = 1.41$) and extensive experience Caucasian individuals ($M = 6.74, SD = .50$). This differential experience with other-race Asian and own-race Caucasian individuals was significantly different, $t(38) = 14.07, p < .001$. Using a 7-point scale (1 = definitely not the same as my personal experience, 7 = definitely the same as my personal experience), Caucasian adults also reported that they did not feel that East Asians ($M = 3.31, SD = 1.34$) or Caucasians ($M = 1.89, SD = 1.18$) look alike. However, the difference in ratings indicate that Caucasian adults felt that other-race East Asian individuals look more alike than own-race Caucasian individuals, $t(37) = 6.17, p < .001$.

**Caucasian 13- to 14-year-old participants.** Caucasian 13- to 14-year-olds reported that on average approximately 6.58% ($SD = 8.07$) of the students in their schools are East Asian. Caucasian adolescents also reported significantly more Caucasian friends ($M = 3.16, SD = 2.84$) than Asian friends ($M = .88, SD = 1.24$), $t(24) = 3.51, p < .05$. Using a 7-point scale (1 = very little, 7 = very extensive), Caucasian 13- to 14-year-olds reported limited experience with East Asian individuals ($M = 3.52, SD = 1.56$) and extensive experience Caucasian individuals ($M = 5.80, SD = 2.06$). This differential experience with other-race Asian individuals and own-race Caucasian individuals was significantly different, $t(24) = 4.64, p < .001$. Using a 7-point scale (1 = definitely not the same as my personal experience, 7 = definitely the same as my personal experience),
Caucasian children also reported that they did not feel that East Asians ($M = 3.04, SD = 1.37$) or Caucasians ($M = 1.80, SD = 1.16$) look alike. However, the difference in ratings indicated that Caucasian 13- to 14-year-olds felt that other-race Asian individuals look more alike than own-race Caucasian individuals, $t(24) = 3.38, p < .05$.

**Caucasian 9- to 10-year-old participants.** Caucasian 9- to 10-year-olds reported that on average approximately $2.75\%$ ($SD = 3.06$) of the students in their schools are East Asian. Caucasian 9- to 10-year-olds reported significantly more Caucasian friends ($M = 5.30, SD = 3.63$) than Asian friends ($M = .57, SD = .75$), $t(19) = 5.99, p < .001$. Using a 7-point scale (1 = very little, 7 = very extensive), Caucasian children reported limited experience with East Asian individuals ($M = 2.55, SD = 1.68$) and extensive experience Caucasian individuals ($M = 6.55, SD = 1.41$). This differential experience with other-race Asian individuals and own-race Caucasian individuals was significantly different, $t(21) = 7.48, p < .001$. Using a 7-point scale (1 = definitely not the same as my personal experience, 7 = definitely the same as my personal experience), Caucasian children also reported that they did not feel that East Asians ($M = 3.95, SD = 1.83$) or Caucasians ($M = 2.32, SD = 1.52$) look alike. However, the difference in ratings suggest that Caucasian children felt that other-race Asian individuals look more alike than own-race Caucasian individuals, $t(20) = 3.00, p < .05$.

### 2.10 Part 1: Caucasian Participants’ Relative Age Judgments

A preliminary analysis that included adult, 9- to 10-year-old, and 13- to 14-year-old participants showed a significant interaction between stimulus race and stimulus race order, $F(1, 102) = 6.29, p < .05$, partial $\eta^2 = .06$. This interaction revealed a fatigue effect in one of the two stimulus order conditions. Participants showed comparable accuracy
and response times in their relative age judgments of Asian faces when Asian faces were
presented first ($M = .61, SD = .08; M = 1902.81, SD = 698.31$) and when they were
presented after Caucasian faces ($M = .63, SD = .09; M = 2157.54, SD = 842.59$), $p > .05$.
However, participants were more accurate and slower in their relative age judgments of
Caucasian faces when they received the Caucasian face block first ($M = .64, SD = .07; M$
$= 2446.56, SD = 871.22$) than when they received the Asian face block first ($M = .59, SD$
$= .09; M = 1879.17, SD = 750.84$), $t(92) = 3.26, p < .05$. Thus, participants’ responses for
only the first block of relative age judgments (i.e., Asian or Caucasian faces) are
examined below. Preliminary analyses also showed a significant speed-accuracy tradeoff
in 9- to 10-year-olds’ relative age judgments for Caucasian young adult faces ($r = .50, p <$
.05). Thus, two participants who showed the largest speed-accuracy tradeoffs (one
participant who was the most accurate but the slowest and another participant who was
the least accurate but the fastest) were excluded. The remaining participants from each
age group showed no significant speed-accuracy tradeoffs, and no groups showed
significant speed-accuracy tradeoffs after the exclusions (see Table 1 and Table 2).

Preliminary analyses also revealed slightly different patterns of results for the
Caucasian adult and child participants. Thus, separate analyses were conducted for the
Caucasian adult and child participant age groups.

**Caucasian adult participants.**

*Accuracy.* Preliminary analyses revealed no main effect or interactions with
participant gender ($p$ values $> .05$). Thus, participant gender was not included in the
follow-up analyses. A 3 (stimulus age group: child, young adult, middle-age adult) x 2
(stimulus race: Caucasian, Asian) ANOVA was conducted with participants’ accuracy in
Table 1.

*Caucasian participants’ accuracy and response time scores in milliseconds for Caucasian stimulus faces.*

<table>
<thead>
<tr>
<th>Caucasian Participant Age Group</th>
<th>Caucasian Stimulus Age Group</th>
<th>Accuracy</th>
<th>Response Time</th>
<th>Pearson Correlation</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>Mean</td>
<td>SD</td>
<td>Mean</td>
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<tr>
<td>9- to 10-year-olds</td>
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<td>Middle-age Adult</td>
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<td>13- to 14-year-olds</td>
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<td>.12</td>
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<td></td>
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<td>2609.96</td>
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Table 2.  

*Caucasian participants’ accuracy and response time scores in milliseconds for Asian stimulus faces.*

<table>
<thead>
<tr>
<th>Caucasian Participant Age Group</th>
<th>Asian Stimulus Age Group</th>
<th>Accuracy</th>
<th>Response Time</th>
<th>Pearson Correlation</th>
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<td></td>
<td>Mean</td>
<td>SD</td>
<td>Mean</td>
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</table>
proportion correct scores as the dependent variable. Results showed a significant main effect of stimulus age group, \( F(2, 76) = 32.89, p < .001 \), partial \( \eta^2 = .46 \). Follow-up simple contrast analyses with sequential Bonferroni corrections showed that Caucasian young adult participants were significantly more accurate in their relative age judgments for own-age young adult faces \( (M = .75, SD = .09) \) than for other-age children’s faces \( (M = .61, SD = .10) \) and middle-age adult faces \( (M = .64, SD = .09) \), \( F(1, 38) = 57.80, p < .001 \), partial \( \eta^2 = .60 \) and \( F(1, 38) = 45.45, p < .001 \), partial \( \eta^2 = .55 \), respectively (see Figure 4). There was no significant difference in Caucasian young adult participants’ accuracy for other-age children’s and middle-age adult faces \( (p > .05) \). The main effect of stimulus race and the two-way interaction between stimulus age group and stimulus race were not significant \( (p \text{ values } > .05) \).

**Response time.** Preliminary analyses revealed no main effect or interactions with participant gender \( (p \text{ values } > .05) \). A 3 (stimulus age group: child, young adult, middle-age adult) x 2 (stimulus race: Caucasian, Asian) ANOVA was conducted with participants’ response times in milliseconds (ms) as the dependent variable. Results showed a significant main effect of stimulus age group, \( F(2, 76) = 3.71, p < .05 \), partial \( \eta^2 = .09 \). Follow-up simple contrast analyses with sequential Bonferroni corrections showed that Caucasian adult participants were significantly faster in their relative age judgments for own-age young adult faces \( (M = 2271.77, SD = 1011.45) \) than for other-age children’s faces \( (M = 2403.50, SD = 1069.42) \), \( F(1, 38) = 9.42, p < \text{adjusted alpha of .02}, \) partial \( \eta^2 = .20 \) (see Figure 5). However, there were no differences in Caucasian young adult participants’ response times for middle-age adult faces \( (M = 2278.30, SD = 1017.27) \) compared to children’s faces or young adult faces \( (p \text{ values } > .05) \).
Figure 4. Caucasian adult, 13- to 14-year-old, and 9- to 10-year-old participants’ accuracy (and standard error bars) in their relative age judgments for Caucasian and Asian child, young adult, and middle-age adult faces. * indicates $p < .05$. 
Figure 5. Caucasian adult and 9- to 14-year-old participants’ correct response times (and standard error bars) in their relative age judgments for child, young adult, and middle-age adult faces. * indicates $p < .05$. 
There was also a significant main effect of stimulus race, $F(1, 38) = 5.14, p < .05$, partial $\eta^2 = .12$. Caucasian adult participants were significantly faster in their relative age judgments for other-race Asian faces ($M = 1936.39, SD = 806.23$) than for own-race Caucasian faces ($M = 2629.96, SD = 1072.97$); see Figure 6. The two-way interaction between stimulus age group and stimulus race was not significant ($p > .05$).

*Cross-race experience and relative age judgments.* Adult Caucasian participants’ performance on the relative age judgment task for other-race Asian faces was related to their experiences with own-race and other-race individuals. There was a significant negative correlation between proportion correct scores for Asian children’s faces and the number of Caucasian friends reported ($r = -.66, p < .05$). Thus, adult Caucasian participants showed decreased accuracy in their relative age judgments for Asian children’s faces as they reported greater numbers of Caucasian friends. There was also a significant negative correlation between proportion correct scores for Asian young adult faces and participants’ degree of contact with Caucasian individuals ($r = -.54, p < .05$). Thus, adult Caucasian participants showed decreased accuracy in their relative age judgments for Asian young adult faces as they reported greater experience with Caucasian individuals. Overall, it appears that greater experience with own-race individuals is associated with lower accuracy in relative age judgments for other-race Asian faces.

However, there was also a significant negative correlation between participants’ response times for Asian children’s faces and the percentage of East Asians in participants’ high schools ($r = -.49, p < .05$). Thus, faster response times for Asian children’s faces were associated with greater exposure to East Asians during high school.
Figure 6. Caucasian adult, 13- to 14-year-old, and 9- to 10-year-old participants’ correct response times (and standard error bars) in their relative age judgments Caucasian and Asian faces. * indicates $p < .05$. 
In addition, there were significant negative correlations between accuracy for Asian middle-age adult faces and i) the percentage of East Asians in participants’ high schools \( (r = -.49, p < .05) \) ii) participants’ degree of contact with East Asians \( (r = -.53, p < .05) \). Thus, it appears that Caucasian adult participants’ previous experiences with East Asian adolescent individuals, as well as their current (and most likely own-age) experiences with East Asian individuals, are associated with lower accuracy in their relative age judgments for Asian middle-age adult faces.

The remaining analyses examining the relationships between Caucasian adult participants’ own- and other-race experiences and their accuracy and response times in their relative age judgments were not significant \( (p \text{ values} > .05) \). More specifically, Caucasian adult participants’ number of current East Asian friends, the difference between their number of Caucasian and East Asian friends, the degree to which they felt that own-race faces look alike, and the degree to which they felt that other-race Asian faces look alike were not significantly related to participants’ accuracy and response times in their relative age judgments for Caucasian and Asian child, young adult, and middle-age adult faces.

**Caucasian 9- to 10-year-olds and 13- to 14-year-old participants.**

**Accuracy.** A 3 (stimulus age group: child, young adult, middle-age adult) x 2 (stimulus race: Caucasian, Asian) x 2 (participant age group: 9- to 10-year-olds, 13- to 14-year-olds) x 2 (participant gender) ANOVA was conducted with participants’ accuracy in proportion correct scores as the dependent variable. Results showed a significant main effect of stimulus age group, \( F(2, 120) = 22.12, p < .001 \), partial \( \eta^2 = .27 \). Caucasian 9- to 10-year-olds and 13- to 14-year-olds were significantly more accurate.
their relative age judgments for young adult faces ($M = .66, SD = .11$) than for children’s faces ($M = .55, SD = .10$) and middle-age adult faces ($M = .60, SD = .10$), $F(1, 60) = 43.78, p < .001$, partial $\eta^2 = .42$, and $F(1, 60) = 11.42, p = .001$, partial $\eta^2 = .16$, respectively. Caucasian 9- to 10-year-olds and 13- to 14-year-olds were also significantly more accurate in their relative age judgments for middle-age adult faces than for children’s faces, $F(1, 60) = 10.83, p < .05$, partial $\eta^2 = .15$ (see Figure 4). There was also a trend towards a significant main effect of participant age group, with Caucasian 13- to 14-year-olds ($M = .62, SD = .07$) showing greater accuracy in their relative age judgments compared to Caucasian 9- to 10-year-olds ($M = .59, SD = .07$), $F(1, 60) = 3.43, p = .07$, partial $\eta^2 = .05$. In addition, there was a trend towards a significant main effect of participant gender, with female participants ($M = .62, SD = .07$) showing greater accuracy in their relative age judgments compared to male participants ($M = .59, SD = .07$), $F(1, 60) = 3.40, p = .07$, partial $\eta^2 = .05$. The remaining main effect of stimulus race was not significant ($p > .05$).

The above main effects were subsumed by a significant four-way interaction between stimulus age group, stimulus race, participant age group, and participant gender. Separate 3 (stimulus age group) x 2 (stimulus race) x 2 (participant gender) ANOVAs were conducted for 9- to 10-year-olds and 13- to 14-year-olds. The ANOVA with the 13- to 14-year-olds showed a significant main effect of stimulus age group, $F(2, 48) = 7.09, p < .05$, partial $\eta^2 = .23$. As described above, Caucasian 13- to 14-year-olds were significantly more accurate in their relative age judgments for young adult faces ($M = .69, SD = .11$) than children’s faces ($M = .57, SD = .10$) and middle-age adult faces ($M = .63, SD = .10$), $F(1, 24) = 12.18, p < .05$, partial $\eta^2 = .34$ and $F(1, 24) = 4.65, p < .05$, partial
\( \eta^2 = .16 \), respectively. They also showed a trend towards more accurate relative age judgments for middle-age adult faces than for children’s faces, \( F(1, 24) = 3.45, p = .08 \), partial \( \eta^2 = .13 \). In addition, there was a trend towards a significant main effect of participant gender, \( F(1, 24) = 3.95, p = .06 \), partial \( \eta^2 = .14 \). This reflected a tendency towards greater accuracy in the relative age judgments of female 13- to 14-year-olds (\( M = .65, SD = .06 \)) compared to male 13- to 14-year-olds (\( M = .60, SD = .07 \)). The remaining main effect of stimulus race and the two- and three-way interactions were not significant (\( p \) values > .05).

Similar to the results from the Caucasian 13- to 14-year-old participants, the ANOVA for the Caucasian 9- to 10-year-old participants also showed a significant main effect of stimulus age group, \( F(2, 72) = 17.05, p < .001 \), partial \( \eta^2 = .32 \). Caucasian 9- to 10-year-olds were significantly more accurate in their relative age judgments for young adult faces (\( M = .65, SD = .11 \)) compared to their age judgments for middle-age adult faces (\( M = .59, SD = .09 \)) and children’s faces (\( M = .54, SD = .10 \)), \( F(1, 36) = 7.86, p < .05 \), partial \( \eta^2 = .18 \) and \( F(1, 36) = 38.45, p < .001 \), partial \( \eta^2 = .52 \), respectively. Caucasian 9- to 10-year-olds were also significantly more accurate in their relative age judgments for middle-age adult faces compared to their age judgments for children’s faces, \( F(1, 36) = 8.43, p < .05 \), partial \( \eta^2 = .19 \).

There was also a significant main effect of stimulus race among the Caucasian 9- to 10-year-olds, \( F(1, 36) = 5.74, p < .05 \), partial \( \eta^2 = .14 \). This main effect of stimulus race showed that Caucasian 9- to 10-year-olds were significantly more accurate in their relative age judgments for own-race Caucasian faces (\( M = .62, SD = .06 \)) compared to their relative age judgments for other-race Asian faces (\( M = .57, SD = .07 \)). However, this
main effect of stimulus race was subsumed by a significant two-way interaction between stimulus age group and stimulus race, \( F(2, 72) = 4.17, p < .05, \) partial \( \eta^2 = .10. \) Follow-up independent-samples t-tests showed Caucasian 9- to 10-year-old participants were significantly more accurate in their relative age judgments for own-race children’s faces \((M = .60, SD = .09)\) compared to their relative age judgments for other-race children’s faces \((M = .48, SD = .08), t(38) = 4.41, p < .001\) (see Figure 4). Although Caucasian 9- to 10-year-olds also showed greater accuracy in their relative age judgments for own-race young adult \((M = .66, SD = .10)\) and middle-age adult \((M = .60, SD = .08)\) faces compared to their relative age judgments for other-race young adult \((M = .64, SD = .12)\) and middle-age adult \((M = .58, SD = .10)\) faces, respectively, these differences were not significant \((p \text{ values } > .05)\). Thus, Caucasian 9- to 10-year-old participants’ own-race advantage in the accuracy of their relative age judgments was restricted to their age judgments for own-age children’s faces. The remaining main effect of stimulus gender and the two-way and three-way interactions were not significant \((p \text{ values } > .05)\).

Response time. A 3 (stimulus age group: child, young adult, middle-age adult) x 2 (stimulus race: Caucasian, Asian) x 2 (participant age group: 9- to 10-year-olds, 13- to 14-year-olds) x 2 (participant gender) ANOVA was conducted with participants’ response times in milliseconds (ms) as the dependent variable. Results showed a significant main effect of stimulus age group, \( F(2, 120) = 5.38, p < .05, \) partial \( \eta^2 = .08. \) Caucasian 9- to 10-year-old and 13- to 14-year-old participants were significantly faster in their relative age judgments for young adult \((M = 2077.07, SD = 696.59)\) and middle-age adult \((M = 2079.82, SD = 696.76)\) faces compared to their relative age judgments for children’s faces \((M = 2186.47, SD = 797.06), F(1, 60) = 7.35, p < .05, \) partial \( \eta^2 = .11\) and
$F(1, 60) = 7.32, p < .05$, partial $\eta^2 = .11$, respectively (see Figure 5). However, they showed no difference in the speed with which they made relative age judgments for young adult and middle-age adult faces ($p > .05$).

There was also a significant main effect of stimulus race, $F(1, 60) = 4.56, p < .05$, partial $\eta^2 = .07$, which showed that Caucasian 9- to 10-year-old and 13- to 14-year-old participants were faster in their relative age judgments for Asian faces ($M = 1884.49, SD = 644.69$) than they were in their relative age judgments for Caucasian faces ($M = 2355.90, SD = 704.99$). In addition, there was a significant main effect of participant gender, $F(1, 60) = 4.29, p < .05$, partial $\eta^2 = .07$, which showed that female participants ($M = 1952.97, SD = 515.47$) were significantly faster than their male counterparts ($M = 2279.83, SD = 829.61$). The remaining main effect of participant age group was not significant ($p > .05$).

However, there was a significant interaction between participant age group and stimulus race, $F(1, 60) = 5.30, p < .05$, partial $\eta^2 = .08$. Separate independent-samples t-tests for each participant age group were conducted to examine participants’ efficiency in judging the facial age of own- and other-race faces. Results showed that only the Caucasian 9- to 10-year-old participants were significantly faster in their relative age judgments for other-race Asian faces ($M = 1655.23, SD = 486.45$) than they were in their relative age judgments for own-race faces ($M = 2392.87, SD = 773.97$), $t(38) = 3.61, p < .05$ (see Figure 6). Caucasian 13- to 14-year-old participants showed no difference in the speed with which they made relative age judgments for other-race ($M = 2237.19, SD = 715.05$) and own-race faces ($M = 2303.09, SD = 617.28$), $p > .05$. The remaining two-way and three-way interactions were not significant ($p$ values $> .05$).
Cross-race experience and relative age judgments. Caucasian 9- to 10-year-olds’ and 13- to 14-year-olds’ performances on the relative age judgment task was also related to their experiences with own-race and other-race individuals. There was a significant negative correlation between participants’ accuracy for Caucasian children’s faces and participants’ number of Asian friends \((r = -.52, p < .05)\). Thus, greater accuracy in relative age judgments for Caucasian children among Caucasian 9- to 10-year-old and 13- to 14-year-old participants was associated with participants having fewer Asian friends.

The difference between participants’ number of Caucasian and Asian friends was also significantly and positively related to participants’ accuracy in relative age judgments for Caucasian young adult faces \((r = .65, p = .001)\). Thus, having more own-race than other-race friends was associated with more accurate responses in Caucasian 9- to 10-year-old and 13- to 14-year-old participants’ relative age judgments for own-race young adult faces.

There were also significant positive correlations between participants’ proportion correct scores for Caucasian young adult faces and participants’ i) number of Caucasian friends \((r = .62, p < .05)\), and ii) degree of contact with Caucasian individuals \((r = .43, p < .05)\). There was also a significant positive correlation between participants’ proportion correct scores for Caucasian middle-age adult faces and their degree of contact with Caucasian individuals \((r = .48, p < .05)\). Thus, it appears that greater accuracy in Caucasian 9- to 10-year-old and 13- to 14-year-old participants’ relative age judgments for own-race young adult and middle-age adult faces is associated with greater experience with own-race individuals.

In addition, there was a significant positive correlation between Caucasian 9- to
10-year-old and 13- to 14-year-old participants’ accuracy in their relative age judgments for Asian children’s faces and participants’ ratings regarding the degree to which Caucasian faces look alike ($r = .41, p = .05$). Thus, better accuracy in relative age judgments for other-race Asian children’s faces was associated with greater agreement that own-race Caucasian individuals look alike.

There was also a significant correlation between Caucasian 9- to 10-year-old and 13- to 14-year-old participants’ accuracy in their relative age judgments for Asian middle-age adult faces and participants’ degree of contact with East Asian individuals ($r = .46, p < .05$). Thus, better accuracy in participants’ relative age judgments for other-race Asian middle-age adult faces was associated with greater contact with Asian individuals.

The remaining analyses examining the relationships between Caucasian 9- to 10-year-old and 13- to 14-year-old participants’ own- and other-race experiences and their accuracy and response times in their relative age judgments were not significant ($p$ values $> .05$). More specifically, Caucasian 9- to 10-year-old and 13- to 14-year-old participants’ reported percentage of East Asians in their schools, and the degree to which they felt that East Asian individuals look alike were not significantly related to participants’ accuracy and response times in their relative age judgments for Caucasian and Asian child, young adult, and middle-age adult faces.

2.11 Part 1: Chinese Participants’ Relative Age Judgments

A preliminary analysis with adult, 9- to 10-year-old, and 13- to 14-year-old participants showed that accuracy in relative age judgments among Chinese participants were not influence by the order of the stimulus faces (i.e., no significant main effect or
interactions with stimulus race order, $p > .05$). However, Chinese participants’ response times in their relative age judgments for Caucasian and Asian faces were affected by stimulus race order, $F(1, 236) = 25.19, p < .001$, partial $\eta^2 = .18$. Further analyses showed that Chinese participants were significantly faster in their relative age judgments for Caucasian faces ($M = 1271.78, SD = 499.25$) than for Asian faces ($M = 1352.75, SD = 550.94$) if they received Asian faces first. However, if participants received a Caucasian face block first, they tended to be significantly faster in their relative age judgments for Asian faces ($M = 1411.88, SD = 502.22$) than for Caucasian faces ($M = 1603.70, SD = 571.27$). Collectively, these results indicate that Chinese participants showed a training effect in their relative age judgments rather than a fatigue effect, in that they became more efficient in their relative age judgments in the second block of the task. Thus, only Chinese participants’ first block of relative age judgments (i.e., Asian faces or Caucasian faces) was analyzed to avoid such training effects, as well as to maintain consistency in analyses across the Caucasian and Asian participants.

Preliminary analyses also revealed significant speed-accuracy tradeoffs in adults’ relative age judgments for Caucasian young adult faces ($r = .48, p < .05$), 13- to 14-year-olds’ relative age judgments for Caucasian middle-age adult faces ($r = .50, p < .05$) and Asian middle-age adult faces ($r = .53, p < .05$), and in 9- to 10-year-olds’ relative age judgments for Asian middle-age adult faces ($r = .47, p < .05$). Thus, two participants from each group who showed the largest speed-accuracy tradeoffs (one participant who was the most accurate but the slowest and another participant who was the least accurate but the fastest) were excluded. The remaining participants from each age group showed no significant speed-accuracy tradeoffs, and no groups showed significant speed-accuracy
tradeoffs after the participant exclusions (see Table 3 and Table 4). Preliminary analyses also revealed different patterns of results for the Chinese adult and child participants. Thus, separate analyses were conducted for the Chinese adult and child participant age groups.

**Chinese adult participants.**

**Accuracy.** Preliminary analyses revealed no main effect or interactions with participant gender ($p$ values $> .05$). Thus, participant gender was not included in the follow-up analyses. A 3 (stimulus age group: child, young adult, middle-age adult) x 2 (stimulus race: Caucasian, Asian) ANOVA was conducted with participants’ accuracy in proportion correct scores as the dependent variable. Results revealed a significant main effect of stimulus age group, $F(2, 68) = 26.39, p < .001$, partial $\eta^2 = .44$. Follow-up simple contrast analyses with sequential Bonferroni corrections showed that Chinese young adult participants were significantly more accurate in their relative age judgments for own-age young adult faces ($M = .72, SD = .10$) than for other-age children’s faces ($M = .60, SD = .08$) and middle-age adult faces ($M = .68, SD = .10$), $F(1, 34) = 55.13, p < .001$, partial $\eta^2 = .62$ and $F(1, 34) = 5.51, p < .05$, partial $\eta^2 = .14$, respectively. Chinese adults were also significantly more accurate in their relative age judgments for middle-age adult faces than for children’s faces, $F(1, 55) = 22.94, p < .001$, partial $\eta^2 = .40$ (see Figure 7).

The main effect of stimulus race was not significant ($p > .05$), however, the two-way interaction between stimulus age group and stimulus race was significant, $F(2, 68) = 3.05, p = .05$, partial $\eta^2 = .08$. Follow-up separate independent-samples t-tests for each stimulus age group were conducted. Chinese adults showed no difference in accuracy in
Table 3.

*Chinese participants’ accuracy and response time scores in milliseconds for Caucasian stimulus faces.*

<table>
<thead>
<tr>
<th>Chinese Participant Age Group</th>
<th>Caucasian Stimulus Age Group</th>
<th>Accuracy</th>
<th>Response Time</th>
<th>Pearson Correlation</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>Mean</td>
<td>SD</td>
<td>Mean</td>
</tr>
<tr>
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Table 4.

*Chinese participants’ accuracy and response time scores in milliseconds for Asian stimulus faces.*

<table>
<thead>
<tr>
<th>Chinese Participant Age Group</th>
<th>Asian Stimulus Age Group</th>
<th>Accuracy Mean</th>
<th>Accuracy SD</th>
<th>Response Time Mean</th>
<th>Response Time SD</th>
<th>Pearson Correlation</th>
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their relative age judgments for Asian and Caucasian young adult faces or in their relative age judgments for Asian and Caucasian middle-age adult faces (\(p\) values > .05). However, they were more accurate in their relative age judgments for other-race Caucasian children’s faces than for own-race Asian children’s faces, \(t(34) = 3.32, p < .05\) (see Figure 7).

**Response time.** Preliminary analyses revealed no main effect or interactions with participant gender (\(p\) values > .05). Thus, participant gender was not included in the follow-up analyses. A 3 (stimulus age group: child, young adult, middle-age adult) x 2 (stimulus race: Caucasian, Asian) ANOVA was conducted with participants’ response times in milliseconds (ms) as the dependent variable. Results showed a significant main effect of stimulus age group, \(F(2, 53) = 19.05, p < .001, \text{partial } \eta^2 = .36\). Follow-up simple contrast analyses with sequential Bonferroni corrections showed that Chinese young adults were significantly faster in their relative age judgments for young adult faces (\(M = 1599.52, SD = 604.75\)) and middle-age adult faces (\(M = 1561.76, SD = 611.65\)) than for children’s faces (\(M = 1833.61, SD 788.66\)), \(F(1, 34) = 20.44, p < .001, \text{partial } \eta^2 = .38\) and \(F(1, 34) = 24.05, p < .001, \text{partial } \eta^2 = .41\), respectively (see Figure 8). However, Chinese adult participants showed no difference in their response times for young adult and middle-age adult facial age judgments (\(p > .05\)). The main effect of stimulus race and the two-way interaction were not significant (\(p\) values > .05).

**Chinese 9- to 10-year-old and 13- to 14-year-old participants.**

**Accuracy.** A 3 (stimulus age group: child, young adult, middle-age adult) x 2 (stimulus race: Caucasian, Asian) x 2 (participant age group: 9- to 10-year-olds, 13- to 14-year-olds) x 2 (participant gender) ANOVA was conducted with participants’
proportion correct scores as the dependent variable. Results showed a significant main effect of stimulus age group, $F(2, 144) = 19.70, p < .001$, partial $\eta^2 = .22$. Follow-up simple contrast analyses with sequential Bonferroni corrections showed that Chinese 9- to 10-year-olds and 13- to 14-year-olds were significantly more accurate in their relative age judgments for young adult faces ($M = .62, SD = .09$) and middle-age adult faces ($M = .59, SD = .10$) than for children’s faces ($M = .54, SD = .07$), $F(1, 72) = 46.10, p < .001$, partial $\eta^2 = .39$ and $F(1, 72) = 11.65, p = .001$, partial $\eta^2 = .14$, respectively. Chinese 9- to 10-year-olds and 13- to 14-year-olds were also significantly more accurate in their relative age judgments for young adult faces than for middle-age adult faces, $F(1, 72) = 6.36, p < .05$, partial $\eta^2 = .08$ (see Figure 7).

The main effect of participant age group was also significant, and showed that Chinese 13- to 14-year-old participants ($M = .60, SD = .06$) were significantly more accurate in their relative age judgments compared to Chinese 9- to 10-year-old participants ($M = .57, SD = .06$), $F(1, 72) = 4.51, p < .05$, partial $\eta^2 = .06$. However, the interaction between participant age group and participant gender was also significant, $F(1, 72) = 5.70, p < .05$, partial $\eta^2 = .07$. Follow-up separate ANOVAs for 9- to 10-year-olds and 13- to 14-year-olds showed that Chinese female 13- to 14-year-olds ($M = .62, SD = .06$) were significantly more accurate in their relative age judgments compared to Chinese male 13- to 14-year-olds ($M = .58, SD = .06$), $F(1, 37) = 4.29, p = .05$, partial $\eta^2 = .10$. However, Chinese female 9- to 10-year-olds ($M = .56, SD = .06$) were comparable to Chinese male 9- to 10-year-olds ($M = .58, SD = .05$) in their accuracy in relative age judgments ($p > .05$).

The two-way interaction between stimulus age group and stimulus race was also
Figure 7. Chinese adult, 13- to 14-year-old, and 9- to 10-year-old participants’ proportion correct scores (and standard error bars) in their relative age judgments for child, young adult, and middle-age adult Caucasian and Asian faces. * indicates $p < .05$. 
significant, $F(2, 144) = 3.66, p < .05$, partial $\eta^2 = .05$, but separate independent-samples t-tests for each stimulus age group showed that Chinese 9- to 10-year-olds and 13- to 14-year-olds were comparable in their accuracy for Asian and Caucasian children’s faces ($M = .53, SD = .06$ and $M = .55, SD = .08$, respectively), young adult faces ($M = .64, SD = .09$ and $M = .60, SD = .09$, respectively), and middle-age adult faces ($M = .58, SD = .09$ and $M = .60, SD = .12$, respectively), $p$ values > .05.

Although the above two-way interaction was subsumed by a significant three-way interaction between stimulus age group, stimulus race, and participant gender, $F(1, 72) = 4.16, p = .05$, partial $\eta^2 = .06$, separate independent-samples t-tests for male and female participants showed no significant differences in relative age judgment accuracy for Asian and Caucasian child, young adult, and middle-age adult faces. However, there was a trend towards Chinese male 9- to 10-year-olds and 13- to 14-year-olds showing more accurate relative age judgments for Asian young adult faces ($M = .64, SD = .08$) than for Caucasian young adult faces ($M = .58, SD = .09$), $t(33) = 1.90, p = .07$.

**Response time.** Preliminary analyses revealed no main effect or interactions with participant gender ($p$ values > .05). Thus, participant gender was not included in the follow-up analyses. A 3 (stimulus age group: child, young adult, middle-age adult) x 2 (stimulus race: Caucasian, Asian) x 2 (participant age group: 9- to 10-year-olds, 13- to 14-year-olds) ANOVA was conducted with participants’ response times in milliseconds (ms) as the dependent variable. Results showed a significant main effect of stimulus age group, $F(2, 152) = 7.95, p < .05$, partial $\eta^2 = .10$. Follow-up simple contrast analyses with sequential Bonferroni corrections showed that Chinese 9- to 10-year-olds and 13- to 14-

year-olds were significantly faster in their relative age judgments for middle-age adult faces \((M = 1375.60, SD = 500.25)\) than for children’s faces \((1493.49, SD = 593.44)\), \(F(1, 76) = 13.59, p < .001, \partial \eta^2 = .15\) (see Figure 8). However, they showed no differences in relative age judgment response times for middle-age adult faces and young adult faces \((M = 1425.88, SD = 541.34)\), or for children’s faces and young adult faces \((p \text{ values } > \text{ adjusted alphas of .05 and .03, respectively})\).

There was also a significant main effect of participant age group, \(F(1, 76) = 9.00, p < .05, \partial \eta^2 = .11\), which showed that Chinese 13- to 14-year-olds \((M = 1273.20, SD = 421.83)\) were significantly faster in their relative age judgments compared to Chinese 9- to 10-year-olds \((M = 1582.38, SD = 572.91)\). The main effect of stimulus race was also significant, \(F(1, 76) = 13.89, p < .001, \partial \eta^2 = .16\), and showed that Chinese 9- to 10-year-olds and 13- to 14-year-olds were significantly faster in their relative age judgments for own-race Asian faces \((M = 1229.73, SD = 409.27)\) than for other-race Caucasian faces \((M = 1614.36, SD = 555.51)\); see Figure 9. The remaining two-way and three-way interactions were not significant \((p \text{ values } > .05)\).

2.12 The Role of Experience in Adults’ and Children’s Relative Age Judgments

Although previous studies have found more consistent other-race effects with regards to adults’ face recognition memory (reviewed in Meissner & Brigham, 2001), the present study revealed more ambiguous findings regarding the influence of differential experience with own- and other-race faces on adults’ facial age judgments. Caucasian and Chinese adults showed no overall differences in accuracy in their relative age judgments for own-race and other-race faces. In addition, contrary to the hypothesized results, Caucasian adults were significantly faster in their relative age judgments for other-race
Figure 8. Chinese adult and 9- to 14-year-old participants’ correct response times (and standard error bars) in their relative age judgments for child, young adult, and middle-age adult faces. * indicates $p < .05$. 
Figure 9. Chinese adult and 9- to 14-year-old participants’ correct response times (and standard error bars) in their relative age judgments for Caucasian and Asian faces. * indicates $p < .05$. 
Asian faces than for own-race Caucasian faces. One possibility for such seemingly contradictory results is that the other-race effect in facial age judgments in the current study is similar to the other-race effect in adults’ categorical judgements for race. Previous studies have found that other-race faces are detected faster and categorized by race faster than own-race faces, presumably because other-race faces are processed at the categorical level and own-race faces are categorized at the individual level (Levin, 1996, 2000; Ge et al., 2009). Considering the categorical nature of relative age judgments (e.g., which face is older?), the Caucasian adults in the present study may have been more efficient in their age judgments for other-race faces than for own-race faces.

Again, contrary to the predicted results, Chinese adults were significantly more accurate in their relative age judgments for other-race Caucasian children than for own-race Asian children. However, an examination of Chinese adult participants’ accuracy and response times for Caucasian children’s faces showed a trend towards a significant speed accuracy tradeoff \(p = .08\). Thus, it is possible that this trend towards a significant speed accuracy tradeoff may have influenced the current findings.

Despite the overall ambiguous results regarding an other-race effect in adults’ relative age judgments, Caucasian adult participants’ other-race relative age judgments were related to their experiences with own-race and other-race individuals. Lower accuracy in Caucasian adult participants’ relative age judgments for other-race Asian child and young adult faces were significantly related to greater numbers of own-race Caucasian friends and greater degrees of contact with own-race Caucasian individuals. For Caucasian participants in the present study, greater own-race contact may be synonymous with lower other-race contact, and such differential experience may in turn
lead to lower accuracy in relative age judgments for other-race faces. Thus, although Caucasian adults may have had an initial advantage in efficiency by processing other-race faces at the categorical level, greater experience with own-race individuals and less experience with other-race individuals may nonetheless be associated with lower accuracy in Caucasian adults’ other-race facial age judgments.

However, even limited experience with other-race Asian individuals influenced Caucasian adults’ relative age judgments for Asian faces. Although Caucasian adult participants in the present study reported generally low percentages of East Asian individuals in their high schools, experience with relatively higher percentages of East Asians during adult participants’ high school years was significantly related to faster relative age judgments for Asian children’s faces. In addition, lower accuracy in Caucasian adult participants’ relative age judgments for other-race Asian middle-age adult faces was significantly related to experience with relatively higher percentages of East Asians during their high school years. Thus, the benefits of other-race experience on Caucasian adult participants’ other-race relative age judgments appear to be restricted to the age group of the other-race individuals to which participants were exposed. In addition, lower accuracy in Caucasian adult participants’ relative age judgments for other-race Asian middle-age adult faces was significantly related to greater degrees of current contact with East Asian individuals. It is likely that such current contact with East Asians was largely with own-age young adult peers. This would again suggest that the benefits of other-race experience on Caucasian adult participants’ other-race relative age judgments are restricted to the age group of the other-race individuals to which participants were exposed.
Chinese young adults' cross-race experiences were not measured considering the almost non-existent Caucasian population in Hangzhou China. However, it is possible that Chinese young adult participants in the present study had exposure to Caucasian individuals via indirect experiences – particularly through movies from Western media. Future studies examining the influence of differential own- and other-race experience on relative facial age judgments should, therefore, consider this possibility by including indirect cross-race experience measures that inquire about own- and other-race media exposure. Although such influence has rarely been directly measured, there is nonetheless reported evidence of better recognition of Black faces among Caucasian individuals who had experience differentiating between other-race Black basketball players compared to Caucasian individuals who had less experience differentiating between Black basketball players (reviewed in Meissner & Brigham, 2001). Thus, adults’ relative age judgments may be similarly influenced by media exposure to other-race individuals. Despite this possibility, it should nonetheless be noted that a previous study by Ge et al. (2009) found an other-race effect in the recognition memory of Chinese young adults in Hangzhou where the current study was also conducted. Thus, it appears that potentially minimal exposure to other-race individuals has a greater influence on young adult participants’ other-race facial age judgments than on their other-race face recognition memory.

In contrast to the adult participants, the relative age judgments from 9- to 10-year-old Caucasian participants were more consistent with the hypothesized results. Caucasian 9- to 10-year-olds were significantly more accurate in their relative age judgments for own-race Caucasian children’s faces than for other-race Asian children’s faces. However, they were also faster in their age judgments for other-race Asian faces than own-race
Caucasian faces. The low and non-significant correlations between Caucasian 9- to 10-year-olds’ accuracy and response times in their relative age judgments for own-race and other-race faces suggests that this pattern of results is likely not due to speed-accuracy tradeoffs. It appears more likely that Caucasian 9- to 10-year-old participants’ own-race advantage in accuracy and other-race advantage in response times may be independent manifestations of an other-race effect in relative age judgments. That is, although other-race faces may be initially processed at the categorical level allowing for greater efficiency in other-race facial age judgments, experience with faces may be associated with increased accuracy in facial age judgments. Thus, greater experience with own-race peers may lead to greater accuracy in age judgments for own-race children’s faces relative to other-race children’s faces. In contrast to the Caucasian 9- to 10-year-olds, the Caucasian 13- to 14-year-olds showed no difference in accuracy or correct response times in their relative age judgments for own-race and other-race faces.

However, similar to the Caucasian adults, Caucasian 9- to 10-year-old and 13- to 14-year-old participants’ experiences with own- and other-race individuals were related to their relative age judgments. Caucasian 9- to 10-year-old and 13- to 14-year-old participants showed lower accuracy in their relative age judgments for own-race Caucasian children’s faces as they reported a greater number of Asian friends. Caucasian 9- to 10-year-old and 13- to 14-year-old participants also showed greater accuracy in their relative age judgments for own-race young and middle-age adult faces as they reported greater degrees of contact with own-race individuals. Thus, Caucasian 9- to 10-year-old and 13- to 14-year-olds’ differential experiences with own-race and other-race individuals were reflected in their relative age judgments for own-race faces.
However, Caucasian 9- to 10-year-old and 13- to 14-year-olds also showed greater accuracy in their relative age judgments for own-race young adult faces as they reported greater numbers of Caucasian children as friends. Thus, it appears that for Caucasian 9- to 10-year-olds and 13- to 14-year-olds, the advantages in relative age judgments gained from experience with a particular age group from a given race is not necessarily restricted to that age group.

Caucasian 9- to 10-year-old and 13- to 14-year-old participants’ relative age judgments for other-race Asian faces were also influenced by their experience with own-and other-race faces. Caucasian 9- to 10-year-olds and 13- to 14-year-olds showed greater accuracy in their relative age judgments for Asian children’s faces as they reported greater agreement that own-race Caucasian faces look alike. They also showed greater accuracy in their relative age judgments for other-race Asian middle-age adult faces as they reported greater degrees of contact with other-race Asian individuals.

Overall, it is evident that although the Caucasian 9- to 10-year-old and 13- to 14-year-old participants in the present study had limited experience with other-race Asian individuals, it appears that such limited experience was sufficient to influence their relative age judgments of other-race Asian faces.

Stronger evidence of an other-race effect in relative age judgments was observed in Chinese 9- to 10-year-old and 13- to 14-year-old male participants, who showed a trend towards more accurate judgments for own-race Asian young adult faces compared to other-race Caucasian young adult faces. Both male and female Chinese 9- to 10-year-old and 13- to 14-year-old participants were also significantly faster in their age judgments for own-race Asian faces than for other-race Caucasian faces. A less
ambiguous other-race effect among the Chinese 9- to 10-year-old and 13- to 14-year-old participants may be due to their more limited experience with other-race individuals. These children attended an elementary school which did not have any Caucasian students. This younger age group would also likely have had more limited experience with Western media that depicts Caucasian individuals. In contrast, the more ambiguous results obtained from the Caucasian participants and the Chinese adult participants may have been due to more varied experiences with other-race individuals.

Despite the ambiguity of an overall other-race effect in relative age judgments, there appeared to be an other-age effect in adults’ age judgments. Caucasian young adult participants were most accurate in their relative age judgments for young adult faces and they were faster in their relative age judgments for young adult faces compared to children’s faces. Similarly, Chinese young adult participants were also most accurate and fastest in their relative age judgments for young adult faces. Thus, it is possible that young adult participants’ presumably greater experience with own-age peers leads to more accurate and more efficient processing of age information for familiar own-age faces.

Chinese young adult participants were also more accurate and faster in their relative age judgments for middle-age adult faces compared to their relative age judgments for children’s faces. This may be due to potentially greater experience with middle-age adult individuals and less experience with children. Alternatively, this may be due to greater resemblance of middle-age adult faces to the young adult faces with which the Chinese young adult participants are most familiar. Thus, future studies should include measures inquiring about participants’ experiences with own-age and other-age
individuals to more accurately evaluate the influence of differential age group experience on relative age judgment abilities.

However, Caucasian and Chinese 9- to 10-year-olds and 13- to 14-year-olds were also most accurate in their relative age judgments for young adult faces. Chinese 9- to 10-year-olds and 13- to 14-year-olds were also more accurate and faster in their relative age judgments for middle-age adult faces compared to their relative age judgments for children’s faces. Thus, the possibility exists that children and adolescents may typically have greater experience with adult faces (e.g., parents, teachers, etc.), and this may then lead to greater accuracy in processing age information for adult faces. Indeed, Caucasian 9- to 10-year-old and 13- to 14-year-old participants showed greater accuracy for their relative age judgments for own-race young adult and middle-age adult faces as they reported greater contact with own-race individuals. However, Caucasian 9- to 10-year-old and 13- to 14-year-old participants’ accuracy in their relative age judgments for own-race children’s faces was not related to their degree of experience with own-race individuals. This pattern of results is consistent with the possibility that the Caucasian 9- to 10-year-old and 13- to 14-year-old participants in the present study had greater current experience with adults than with children. Such results are consistent with findings that 3-year-olds without experience with younger individuals but with experience with adults are better in their recognition of adult faces than in their recognition of infant faces (Macchi Cassia et al., 2009). Again, future studies that include measures inquiring about participants’ experience with own-age and other-age individuals will ascertain whether or not the present findings are due to current differences in experience with different age groups.

Alternatively, 9- to 10-year-olds’ and 13- to 14-year-olds’ cumulative experiences
(i.e., previous and current experiences) with adult individuals may explain their facial age processing expertise for adult faces. In addition, even if their current experiences are predominantly with own-age peers, 9- to 14-year-olds may still be developing their age processing expertise for children’s faces. Future studies should examine the facial age judgments of novice and long-term elementary school teachers to ascertain whether there is improved accuracy or efficiency in facial age judgments for children’s faces with greater experiences with children.

There were also developmental improvements in relative age judgments. Caucasian 13- to 14-year-olds were significantly more accurate than 9- to 10-year-olds, and Chinese 13- to 14-year-olds were significantly more accurate and faster than 9- to 10-year-olds. These developmental changes are consistent with previous findings of age-related improvements in age judgment abilities (Gross, 2004, 2007; Kratochwill & Goldman, 1973; Looft, 1971; Taylor et al., 1982).

In addition to the developmental changes, the present study also found gender effects. Caucasian female 9- to 10-year-olds and 13- to 14-year-olds were significantly faster in their relative age judgments compared to Caucasian males, and Chinese female 13- to 14-year-olds were significantly more accurate in their relative age judgments compared to Chinese male 13- to 14-year-olds. However, these gender effects in relative age judgments among children and adolescents disappear by adulthood.

2.13 Part 2: Caucasian Participants’ Absolute Age Judgments

Preliminarily analyses showed that absolute age judgments for the stimulus age groups was influenced by the order in which participants were presented with the Caucasian and Asian faces, $F(1, 174) = 3.01, \ p = .05$, partial $\eta^2 = .03$. Caucasian
participants tended to give older age judgments for young adult faces if they received Caucasian faces first, \( t(97) = 1.96, p = .05 \). There was also a trend towards older age judgments for middle-age adult faces if participants received Caucasian faces first (\( p = .08 \)). Thus, only participants’ absolute age judgments for their first blocks of faces (i.e., Caucasian or Asian) was examined.

**Caucasian adult participants.** A 7 (stimulus: individual faces within each age group) x 3 (stimulus age group: child, young adult, middle-age adult) x 2 (stimulus race: Caucasian, Asian) x 2 (participant gender) ANOVA was conducted with participants’ age estimates (in years) as the dependent variable. Results showed a significant main effect of stimulus, \( F(6, 216) = 68.02, p < .001 \), partial \( \eta^2 = .65 \), so that age estimates generally increased as the stimuli themselves increased in age (i.e., containing increasing proportions of the old composite face). There was also a significant main effect of stimulus age group, \( F(1, 49) = 388.42, p < .001 \), partial \( \eta^2 = .92 \). Follow-up simple contrast analyses showed that children’s faces (\( M = 11.03, SD = 3.24 \)) were given significantly younger age estimates compared to young adult (\( M = 20.44, SD = 3.56 \)) and middle-age adult faces (\( M = 28.39, SD = 5.70 \)), \( F(1, 36) = 264.52, p < .001 \), partial \( \eta^2 = .88 \) and \( F(1, 36) = 469.70, p < .001 \), partial \( \eta^2 = .93 \), respectively. Young adult faces were also given significantly younger age estimates compared to middle-age adult faces, \( F(1, 36) = 329.71, p < .001 \), partial \( \eta^2 = .90 \). Both the main effects of stimulus and stimulus age group were expected, and they confirmed the fact that our stimulus preparation did indeed mirror the natural facial aging process.

There was also a significant interaction between stimulus and stimulus age group, \( F(7, 264) = 24.65, p < .001 \), partial \( \eta^2 = .41 \). Follow-up simple contrast analyses with
sequential Bonferroni corrections showed that Caucasian young adult participants demonstrated greater differentiation in their age estimates for own-age young adult faces relative to other-age children’s faces and middle-age adult faces, $F(1, 36) = 189.70, p < .001$, partial $\eta^2 = .84$ and $F(1, 36) = 87.85, p < .001$, partial $\eta^2 = .71$ (see Figure 10).

However, Caucasian young adult participants showed no difference in their degree of differentiation in age estimates for other-age children’s faces and middle-age adult faces ($p > .05$).

The two-way interaction between stimulus and stimulus race was significant, $F(6, 216) = 10.85, p < .001$, partial $\eta^2 = .23$. The interaction between stimulus age group and stimulus race was also significant, $F(2, 72) = 23.34, p < .001$, partial $\eta^2 = .39$. Separate independent-samples t-tests for each stimulus age group showed that Caucasian adult participants gave significantly younger age estimates for other-race Asian children’s faces ($M = 9.27, SD = 2.61$) compared to own-race Caucasian children’s faces ($M = 12.47, SD = 3.02$), $t(38) = 3.55, p < .05$, but significantly older age estimates for other-age Asian middle-age adult faces ($M = 31.10, SD = 6.15$) compared to own-race Caucasian middle-age adult faces ($M = 26.18, SD = 4.28$), $t(38) = 2.98, p < .05$. However, Caucasian adult participants showed comparable age estimates for own-race and other-race young adult faces ($M = 20.86, SD = 3.59$ and $M = 19.92, SD = 3.59$, respectively), $p > .05$.

The two-way interaction between stimulus age group and participant gender was also significant, $F(2, 72) = 3.41, p < .05$, partial $\eta^2 = .09$. However, both male and female participants nonetheless showed the same pattern of differentiation described above regarding the main effect of stimulus age group (i.e., greatest differentiation for own-age
Figure 10. Caucasian adults’ absolute age judgments for Caucasian and Asian child, young adult, and middle-age adult faces.
young adult faces and no difference in degree of differentiation between other-age child and middle-age adult faces).

The three-way interaction between stimulus, stimulus age group, and stimulus race was significant, $F(12, 423) = 5.24, p < .001$, partial $\eta^2 = .13$. However, separate ANOVAs for stimulus race showed the same pattern of differentiation for both own-race and other-race faces as described above regarding the two-way interaction between stimulus and stimulus age group (i.e., greatest differentiation for own-age young adult faces and no difference in degree of differentiation between other-age child and middle-age adult faces).

**Caucasian 9- to 10-year-old and 13- to 14-year-old participants.** Preliminary analyses showed no significant main effect or interactions with participant gender. Thus, participant gender was not included in the subsequent analyses. A 7 (stimulus: individual faces within each age group) x 3 (stimulus age group: child, young adult, middle-age adult) x 2 (stimulus race: Caucasian, Asian) x 2 (participant age group: 9- to 10-year-olds, 13- to 14-year-olds) ANOVA was conducted with participants’ age estimates (in years) as the dependent variable. Results showed a significant main effect of stimulus, $F(5, 328) = 36.34, p < .001$, partial $\eta^2 = .36$, so that Caucasian 9- to 10-year-olds and 13- to 14-year-olds generally gave increasingly older age estimates as the stimulus faces themselves increased in age. Results also showed a significant main effect of stimulus age group, $F(1, 84) = 164.18, p < .001$, partial $\eta^2 = .72$. Follow-up simple contrast analyses with sequential Bonferroni corrections showed that Caucasian 9- to 10-year-olds and 13- to 14-year-olds gave significantly younger age estimates for children’s faces ($M = 11.17, SD = 3.17$) compared to their age estimates for young adult faces ($M = 18.18, SD$...
and middle-age adult faces ($M = 24.05, SD = 8.27), F(1, 64) = 146.16, p < .001, partial $\eta^2 = .70$ and $F(1, 55) = 189.74, p < .001, partial $\eta^2 = .75$. Caucasian 9- to 10-year-olds and 13- to 14-year-olds also gave significantly younger age estimates for young adult faces compared to their age estimates for middle-age adult faces, $F(1, 64) = 111.51, p < .001, partial $\eta^2 = .64$.

The main effect of stimulus race was significant, $F(1, 64) = 4.16, p < .05, partial $\eta^2 = .06$, and showed that Caucasian 9- to 10-year-olds and 13- to 14-year-olds tended to give younger age estimates to other-race Asian faces ($M = 16.51, SD = 4.48$) than to own-race Caucasian faces ($M = 19.01, SD = 5.30$). There was also a significant main effect of participant age group, $F(1, 64) = 12.29, p < .05, partial $\eta^2 = .16$, which showed that Caucasian 13- to 14-year-olds ($M = 20.17, SD = 4.77$) gave overall older age estimates compared to Caucasian 9- to 10-year-olds ($M = 16.14, SD = 4.60$).

Caucasian 9- to 10-year-olds and 13- to 14-year-olds also showed a significant interaction between stimulus and stimulus age group, $F(7, 467) = 7.84, p < .001, partial $\eta^2 = .11$. Follow-up simple contrast analyses with sequential Bonferroni corrections showed that Caucasian 9- to 10-year-olds and 13- to 14-year-olds demonstrated significantly greater differentiation in their age estimates for young adult faces and middle-age adult faces compared to children’s faces, $F(1, 64) = 40.09, p < .001, partial $\eta^2 = .39$ and $F(1, 64) = 7.60, p < .05, partial $\eta^2 = .11$, respectively. They also showed significantly greater differentiation in their age estimates for young adult faces compared to middle-age adult faces, $F(1, 64) = 14.75, p < .001, partial $\eta^2 = .19$ (see Figure 11).

There was also a significant interaction between stimulus age group and participant age group, $F(2, 128) = 4.85, p < .05, partial $\eta^2 = .07$. Caucasian 13- to 14-
Figure 11. Caucasian 9- to 10-year-old and 13- to 14-year-old participants’ absolute age judgments for Caucasian and Asian child, young adult, and middle-age adult faces.
year-olds gave older age estimates than 9- to 10-year-olds for children’s faces (\(M = 12.16, SD = 3.36\) and \(M = 10.48, SD = 2.86\), respectively), young adult faces (\(M = 20.62, SD = 5.90\) and \(M = 16.47, SD = 5.44\), respectively), and middle-age adult faces (\(M = 27.73, SD = 7.29\) and \(M = 21.46, SD = 8.01\), respectively), \(t(66) = 2.21, p < .05\), \(t(66) = 2.99, p < .05\), and \(t(66) = 3.30, p < .05\), respectively. The remaining two-way, three-way, and four-way interactions were not significant, \(p > .05\).

### 2.14 Part 2: Chinese Participants’ Absolute Age Judgments

Preliminary analyses showed that Chinese participants’ absolute age judgments for Caucasian and Asian faces were influenced by the order in which they were presented, \(F(1, 103) = 10.97, p < .05\), partial \(\eta^2 = .10\). More specifically, Chinese participants gave significantly younger age judgments for own-race Asian faces (\(M = 19.08, SD = 3.43\)) compared to other-race Caucasian faces (\(M = 20.42, SD = 3.65\)) when Caucasian faces were presented first, \(F(1, 52) = 19.10, p < .001\), partial \(\eta^2 = .27\). There were no differences in age judgments for Asian faces (\(M = 19.97, SD = 5.11\)) and Caucasian faces (\(M = 19.60, SD = 4.49\)) when Asian faces were presented first (\(p > .05\)). Only participants’ first blocks of absolute age judgments (i.e., Caucasian or Asian) were included in the final analyses.

**Chinese adult participants.** Preliminary analyses showed no significant main effect or interactions with participant gender. A 7 (stimulus: individual faces within each age group) x 3 (stimulus age group: child, young adult, middle-age adult) x 2 (stimulus race: Caucasian, Asian) ANOVA was conducted with participants’ age estimates (in years) as the dependent variable. Results showed a significant main effect of stimulus, \(F(5, 166) = 61.80, p < .001\), partial \(\eta^2 = .65\), so that age estimates generally increased as
the stimuli themselves increased in age (i.e., containing increasing proportions of the old composite face). There was also a significant main effect of stimulus age group, $F(1, 42) = 435.07, p < .001$, partial $\eta^2 = .93$. Follow-up simple contrast analyses with sequential Bonferroni corrections showed that Chinese adult participants gave significantly younger age estimates for children’s faces ($M = 11.15, SD = 2.90$) compared to young adult faces ($M = 18.34, SD = 3.71$) and middle-age adult faces ($M = 26.64, SD = 5.20$), $F(1, 34) = 402.45, p < .001$, partial $\eta^2 = .92$ and $F(1, 34) = 488.93, p < .001$, partial $\eta^2 = .94$, respectively. Younger age estimates were also given for young adult faces compared to middle-age adult faces, $F(1, 34) = 328.52, p < .001$, partial $\eta^2 = .91$. The remaining main effect of stimulus race was not significant ($p > .05$).

There was also a significant interaction between stimulus and stimulus age group, $F(7, 244) = 13.50, p < .001$, partial $\eta^2 = .28$. Follow-up simple contrast analyses with sequential Bonferroni corrections showed that Chinese adult participants demonstrated significantly greater differentiation between own-age young adult faces compared to other-age children’s faces and middle-age adult faces, $F(1, 34) = 158.88, p < .001$, partial $\eta^2 = .82$ and $F(1, 34) = 31.10, p < .001$, partial $\eta^2 = .48$, respectively. Chinese adult participants also demonstrated significantly greater differentiation in their age estimates for middle-age adult faces compared to their degree of differentiation for children’s faces, $F(1, 34) = 24.32, p < .001$, partial $\eta^2 = .42$ (see Figure 12).

There were also significant two-way interactions between stimulus age and stimulus race, $F(6, 204) = 18.11, p = .05$, partial $\eta^2 = .06$, and between stimulus age group and stimulus race, $F(2, 68) = 4.70, p < .05$, partial $\eta^2 = .12$. Separate independent-samples t-tests for each stimulus age group showed that Chinese adult participants gave
Figure 12. Chinese adults’ absolute age judgments for Caucasian and Asian child, young adult, and middle-age adult faces.
significantly younger age estimates for Asian children’s faces \((M = 9.69, SD = 2.69)\) compared to Caucasian children’s faces \((M = 12.98, SD = 2.00)\), \(t(34) = 4.08, p < .001\). They also gave significantly younger age estimates for Asian young adult faces \((M = 17.29, SD = 4.31)\) compared to Caucasian young adult faces \((M = 19.65, SD = 2.27)\), \(t(30) = 2.11, p < .05\). However, Chinese adults showed no difference in their age estimates for Asian \((M = 26.56, SD = 6.21)\) and Caucasian middle-age adult faces \((M = 26.75, SD = 3.79)\), \(p > .05\).

The three-way interaction between stimulus, stimulus age group, and stimulus race was significant, \(F(12, 408) = 2.62, p < .05\), partial \(\eta^2 = .07\). However, separate ANOVAs for Asian and Caucasian faces showed the same pattern of response for both types of faces, as discussed above with regards to the interaction between stimulus and stimulus age group (i.e., greatest differentiation between young adult faces, and greater differentiation between middle-age adult faces compared to children’s faces).

**Chinese 9- to 10-year-old and 13- to 14-year-old participants.** Preliminary analyses showed no significant main effect or interactions with participant gender. Thus, participant gender was not included in the subsequent analyses. A 7 (stimulus: individual faces within each age group) x 3 (stimulus age group: child, young adult, middle-age adult) x 2 (stimulus race: Caucasian, Asian) x 2 (participant age group: 9- to 10-year-olds, 13- to 14-year-olds) ANOVA was conducted with participants’ age estimates (in years) as the dependent variable. Results showed a significant main effect of stimulus, \(F(5, 362) = 50.98, p < .001\), partial \(\eta^2 = .41\), so that age estimates generally increased as the stimuli themselves increased in age (i.e., containing increasing proportions of the old composite face). There was also a significant main effect of stimulus age group, \(F(1, 100)\)
Follow-up simple contrast analyses with sequential Bonferroni corrections showed that Chinese 9- to 10-year-olds and 13- to 14-year-olds gave significantly younger age estimates for children’s faces ($M = 14.05$, $SD = 3.71$) compared to young adult faces ($M = 20.86$, $SD = 5.21$) and middle-age adult faces ($M = 27.72$, $SD = 6.89$), $F(1, 75) = 255.74$, $p < .001$, partial $\eta^2 = .77$ and $F(1, 75) = 398.54$, $p < .001$, partial $\eta^2 = .84$, respectively. They also gave significantly younger age estimates for young adult faces compared to middle-age adult faces, $F(1, 75) = 271.03$, $p < .001$, partial $\eta^2 = .78$. In addition to the significant main effects of stimulus and stimulus age group, there was a trend towards a significant main effect of participant age group, $F(1, 75) = 3.45$, $p = .07$, partial $\eta^2 = .04$, due to younger age estimates from Chinese 13- to 14-year-old participants ($M = 19.89$, $SD = 4.09$) than from 9- to 10-year-old participants ($M = 21.79$, $SD = 4.92$). The main effect of stimulus race was not significant ($p > .05$).

There was also a significant interaction between stimulus and stimulus age group, $F(7, 513) = 7.69$, $p < .001$, partial $\eta^2 = .09$. Follow-up simple contrast analyses with sequential Bonferroni corrections showed that Chinese 9- to 10-year-olds and 13- to 14-year-olds demonstrated significantly greater differentiation in their age estimates for young adult faces compared to their degree of differentiation for children’s faces and middle-age adult faces, $F(1, 75) = 22.14$, $p < .001$, partial $\eta^2 = .23$ and $F(1, 75) = 26.96$, $p < .001$, partial $\eta^2 = .26$, respectively (see Figure 13). There was no difference in the degree of differentiation between children’s faces and middle-age adult faces ($p > .05$).

There were also significant two-way interactions between stimulus and stimulus race, $F(6, 450) = 2.75$, $p < .05$, partial $\eta^2 = .04$, and between stimulus age group and stimulus race, $F(2, 150) = 9.70$, $p < .001$, partial $\eta^2 = .12$. Separate independent-samples
Figure 13. Chinese 9- to 10-year-old and 13- to 14-year-old participants’ absolute age judgments for Caucasian and Asian child, young adult, and middle-age adult faces.
t-tests for each stimulus age group showed that Chinese 9- to 10-year-olds and 13- to 14-year-olds gave significantly younger age estimates for Asian children’s faces ($M = 13.08, SD = 3.51$) compared to Caucasian children’s faces ($M = 14.92, SD = 3.71$), $t(77) = 2.25, p < .05$. There was also a trend towards older age estimates for Asian middle-age adult faces ($M = 29.26, SD = 7.79$) compared to Caucasian middle-age adult faces ($M = 26.36, SD = 5.73$), $t(77) = 1.90, p = .06$. However, there was no difference in age estimates for Asian ($M = 21.01, SD = 6.01$) and Caucasian ($M = 20.71, SD = 4.45$) young adult faces ($p > .05$).

There was also a significant three-way interaction between stimulus, stimulus age group, and stimulus race, $F(12, 900) = 3.28, p < .001, .04$. Separate ANOVAs for Asian and Caucasian faces only showed a significant interaction between stimulus and stimulus age group for Asian faces, $F(5, 161) = 9.55, p < .001$, partial $\eta^2 = .21$ and $p > .05$, respectively. Thus, Chinese 9- to 10-year-old and 13- to 14-year-old participants only showed greater differentiation in age estimates for own-race young adult faces compared to own-race children’s faces and middle-age adult faces, $F(1, 35) = 18.22, p < .001$, partial $\eta^2 = .34$ and $F(1, 35) = 27.45, p < .001$, partial $\eta^2 = .44$. There were no differences in the degree of differentiation for Caucasian child, young adult, and middle-age adult faces ($p$ values $> .05$).

### 2.15 The Role of Experience in Adults’ and Children’s Absolute Age Judgments

Although Dehon and Bredart (2001) found an other-race effect in Caucasian adults’ absolute age judgments, the present study found no evidence of an other-race effect among Caucasian and Chinese adults. However, it should be noted that the dependent variables and the ways in which the other-race effect was determined differed
across the two studies. In Dehon and Bredart (2001), the dependent variable was mean error in age estimates, whereas in the present study, the dependent variable of absolute age estimates was used to determine the degree of differentiation between facial stimuli within the same age group. Thus, the other-race effect in absolute age judgments is evident when directly examining adult participants’ age estimates to the actual age of the faces depicted in the photographs. However, degree of differentiation in facial age for own-race faces and for other-race faces appears to be comparable among both Caucasian and Chinese adults.

Caucasian 9- to 10-year-olds and 13- to 14-year-olds also appeared to show no other-race effect in their absolute age judgments. However, Chinese 9- to 10-year-olds and 13- to 14-year-olds showed evidence of a form of an other-race effect in that they showed greater differentiation in their age estimates for own-race Asian young adult faces relative to Asian child and middle-age adult faces, but they showed comparable degrees of differentiation in their age estimates for child, young adult, and middle-age adult Caucasian faces. Thus, it is possible that Chinese 9- to 10-year-olds and 13- to 14-year-olds have more experience or more accumulated experience with own-race young adult individuals and thereby show the greatest degree of differentiation between own-race young adult faces, but this advantage for own-race young adult faces does not transfer onto other-race young adult faces.

Although for most of the age groups, there was no evidence of an other-race effect, there appeared to be an other-age effect in Caucasian and Chinese adults’ absolute age judgments. That is, Caucasian and Chinese young adult participants showed the greatest differentiation in their age estimates for young adult faces. Thus, it is possible
that young adult participants’ presumably greater experience with own-age peers leads to this advantage in processing age information for own-age young adult faces. However, Caucasian and Chinese 9- to 10-year-olds and 13- to 14-year-olds also showed the same advantage for young adult faces. Thus, 9- to 10-year-olds and 13- to 14-year-olds may also typically have greater current experience or greater accumulated (i.e., previous and current) experience with young adult faces compared to faces from other age groups.

The present study also alluded to differences in the perception of the facial age of individuals from the Caucasian and Asian races. Caucasian and Chinese adults and Chinese 9- to 10-year-olds and 13- to 14-year-olds gave younger age estimates to Asian child than to Caucasian child faces. Chinese adults and Caucasian 9- to 10-year-olds and 13- to 14-year-olds also gave younger age estimates for Asian young adult faces than for Caucasian young adult faces. In addition, Caucasian adults and Chinese 9- to 10-year-olds and 13- to 14-year-olds gave older age estimates for Asian middle-age adult faces than for Caucasian middle-age adult faces. Considering the consistency in the pattern of responses across Caucasian and Chinese participants, these cross-race differences in the perceived age of child, young adult, and middle-age adult faces are likely not due to differential experience with own- and other-race faces. Thus, it appears that Asian faces look younger than Caucasian faces until the middle-age adult years when Asian faces begin to look older than Caucasian faces.

The younger appearance of Asian faces prior to the middle-age adulthood years may be due to cross-race differences in craniofacial structure. Chinese heads are generally characteristically round in shape, whereas North American and European Caucasian heads are generally characteristically more oval in shape (Ball et al., 2010;
Hajniš, Farkas, Ngim, Lee, & Venkatadri, 1994). Such differences in head shape correspond to noted racial differences in face shape and structure, so that Chinese faces are wider and less protrusive (e.g., least protrusive nasal tip), whereas North American Caucasian faces are relatively more narrow, long, and protrusive (Hajniš et al., 1994). Thus, the typical Chinese craniofacial structure is reminiscent of the characteristic features of children, whereas the North American Caucasian craniofacial structure is more reminiscent of the characteristic features of adults. This may be why, in the present study, Chinese child and young adult faces were given younger age estimates than their Caucasian counterparts.

However, there is also limited evidence that the facial aging process during the middle-age adulthood years might differ across Chinese and Caucasian individuals. Nouveau-Richard et al. (2005) found that the incidence and prevalence of facial wrinkles occurs at younger ages for European Caucasian females than for Chinese females. However, wrinkle formation, prevalence, and intensity appear to occur among Chinese females in a shorter time period (Nouveau-Richard et al., 2005). Thus, Chinese females appear to undergo a period of accelerated facial aging (Nouveau-Richard et al., 2005). This accelerated facial aging with regards to facial wrinkling may also be accompanied by changes in other facial cues that may lead to the appearance of Chinese faces as older (e.g., changes in skin colour uniformity, height of eye opening, etc.). This may explain why the Chinese middle-age adult faces in the present study were given older age estimates than their Caucasian counterparts.

2.16 Summary

Overall, evidence of an other-race effect in the relative age judgments of
Caucasian adults, Chinese adults, and Caucasian 9- to 10-year-olds remain ambiguous, and there was no difference in performance for own- and other-race faces among the Caucasian 13- to 14-year-olds. However, Caucasian participants did show evidence that own-race and other-race experiences do influence their relative age judgments for own- and other-race faces. Chinese 9- to 10-year-old and 13- to 14-year-old participants showed the most clear evidence of an other-race effect in their relative age judgments, perhaps due to their even limited other-race experiences relative to the other participant groups.

There was also no evidence of an other-race effect in Caucasian participants’ and Chinese adult participants’ absolute age judgments. However, there was some evidence of an other-race effect in Chinese 9- to 10-year-old and 13- to 14-year-old participants’ absolute age judgments. Thus, again, the possibility remains that the degree of experience with other-race faces may account for this pattern of results.

The Caucasian adults and children in the present study did generally have some limited experience with Asian individuals, and such experiences were related to their performances in the relative age judgment task. Thus, such limited experience may have been sufficient to minimize an other-race effect in their relative and absolute age judgment abilities. The Chinese adults in the present study likely had even more limited direct experiences with other-race Caucasian individuals, however, they may have had some limited experience with Caucasian individuals depicted in Western media. In contrast, the Chinese 9- to 10-year-olds and 13- to 14-year-olds had no Caucasian students in their classrooms/schools, and likely limited to no experiences with Caucasian individuals through the media. Thus, extremely limited to no experience with other-race
Caucasian faces may have led to some advantage in processing the age of own-race faces. Such findings suggest that very little exposure to other-race faces may be sufficient to effectively minimize the other-race effect in facial age processing, even though limited exposure may not be sufficient to minimize the other-race effect in face recognition memory (Meissner & Brigham, 2001). It is possible that cues to facial aging may be generally universal. Thus, very little experience with other-race faces may be needed to minimize the other-race effect in facial age judgments. In contrast, cues to identity may be more intricately tied to race, and thereby requiring greater other-race experience to minimize the other-race effect in face recognition memory.

However, it is important to note that even among the Chinese 9- to 14-year-olds who had no experiences with other-race Caucasian individuals, the other-race effects in relative and absolute age judgments were more subtle than expected. Thus, these results combined with the lack of an other-race effect or ambiguous evidence of subtle other-race effects among the other Caucasian and Chinese age groups suggest that children and adults may represent facial age in several ways. One mental representation of facial age might be specific to age group as may be suggested by Caucasian 9- to 10-year-olds’ greater accuracy in relative age judgments for own-race than for other-race children’s faces. Another mental representation of facial age might be specific to race as may be suggested by the present evidence of some degree of an other-race effect, especially among Chinese children. A third mental representation of facial age might be more generic so that age group or race categories are not considered. This less specific mental representation of facial age may be due to the generally universal ways in which the craniofacial structure changes with age. Differential experiences may influence the
degree to which one’s mental representation of facial age can generalize across different categories of faces (e.g., age group, race), however, a more generic representation of facial age would ensure adequate facial age judgment abilities even for a novel category of faces (e.g., novel other-race faces). Indeed, even among the Chinese 9- to 14-year-olds who had no experience with other-race Caucasian faces, their other-race effect in facial age judgments were more subtle than expected. In addition, if own- and other-race relative age judgments are considered as a within-subject variable, the Chinese participants showed a training effect in their age judgments. That is, Chinese participants were faster in their second block of relative age judgments regardless of the order of the stimulus faces (i.e., Asian first/Caucasian first). A more general mental representation of facial age that is independent of race parallels findings that allude to a mental representation of face gender that is independent of facial age group (Barrett & O’Toole, 2009), and a mental representation of facial age that is independent of face gender (Schweinberger et al., 2010).

In addition, it should be noted that the salient facial age cues available in the stimuli in the present study were mainly craniofacial shape cues, the size and shape of the internal facial features, and the spacing of internal facial features. Although using averaged faces allowed better control of varying amounts of young/old facial age information, the averaging process likely also minimized certain cues to facial age such as wrinkles and skin tone information. The removal of some degree of skin tone information and facial wrinkles may have influenced participants’ perceptions of young adult and middle-age adult faces in particular, so that these adult faces may have been perceived as younger in appearance. Indeed, participants’ age judgments for the oldest
stimulus face composite (i.e., 100% Old) appeared to be a few years younger than the average estimated age of the Caucasian and Asian 100% Old composite faces.

Although skin colour does not appear to play a prominent role in infants’ and adults’ differential recognition memory for own- and other-race faces (Anzures et al., in press; Bar-Haim, Säidel, & Yovel, 2009), skin colour cues appear to be important in adults’ facial age judgments of adult faces (Burt & Perrett, 1995; Fink et al., 2006; Nkengne et al., 2008). Thus, the possibility remains that minimizing skin colour cues may have minimized an other-race effect in facial age judgments. However, this potential influence of skin colour cues would likely have been limited to the adult stimulus faces.
Chapter 3: Facial Age Processing –

The Role of Differential Sociocultural Experiences

Across cultures there exists variability in the degree to which respect for the elderly is manifested. In the Japanese culture, for example, there exists an age hierarchy that is embedded in everyday social interactions (e.g., in the workplace, home, school, etc.). In the Japanese culture, both behavioural and linguistic markers are used to show respect for any individual older than oneself. In comparison, the Chinese culture engages in behavioural forms of respect for very old individuals, but generally lacks the linguistic markers that characterize the Japanese culture. In contrast to both the Japanese and Chinese cultures, North American culture shows relatively limited behavioural forms of respect for the elderly, and also lacks linguistic markers associated with age differences among individuals. Thus, it can be speculated that such differences in the need to attend to the age of individuals with whom one interacts, might influence one’s level of sophistication and accuracy in processing facial age.

3.1 The Influence of Sociocultural Experience on Cognition

Indeed, the effects of differential sociocultural experiences on cognition have been well-documented. Previous research has shown that consistent with the Western emphasis on the individual, North American adults relative to East Indian adults make more references to an agent’s personal characteristics (e.g., personality traits) to explain social behaviour (Miller, 1984; Morris & Peng, 1994). In contrast, consistent with the Eastern emphasis on relations between individuals, objects, and events, East Indian and Chinese adults relative to North American adults make more references to context (e.g., social, situational, etc.) to explain individual behaviour (Miller, 1984; Morris & Peng,
Differential sociocultural conceptions of change are also evident in cross-cultural differences in predictions, with North American adults making predictions that typically reflect a conservation of the status quo and East Asians making contrasting predictions that typically indicate a change from the status quo (Ji, Nisbett, & Su, 2001).

Such sociocultural differences in cognition likely stem from different child-rearing and socialization practices. For example, 5-month-old infants tend to be given more maternal encouragement to attend to their mothers in the Japanese culture relative to the North American culture (Bornstein, Toda, Azuma, Tamis-LeMonda, & Ogino, 1990). When interacting with their 6-, 12- and 19-month-old infants, Japanese mothers also tend to make more inferences to social routines (e.g., “hello”, “goodbye”, “thank you”, etc.) relative to North American mothers (Fernald & Morikawa, 1993). Such emphasis on interpersonal and social interactions may shape the later Eastern emphasis on relations between individuals, objects, and events. In contrast, relative to Japanese mothers, North American mothers tend to encourage infant attention towards objects and events in the environment (Bornstein et al., 1990), and they tend to label objects in the environment more than Japanese mothers (Fernald & Morikawa, 1993). Thus, North American infants appear to be socialized with less emphasis on the relations between individuals, objects, and events, thereby promoting a relatively more autonomous view of individuals, objects, and events.

**Sociocultural experience and visual perception.** Marked sociocultural differences in characteristic ways of thinking have also been found to influence one’s perceptual organization of objects in the surrounding environment. North Americans tend to use rule-based and analytic or featural strategies in their grouping of items, such as
grouping birds together because they all have wings (Chiu, 1972; Norenzayan, Smith, Kim, & Nisbett, 2002). In contrast, East Asians tend to group items together based on: i) their overall or holistic similarity even if no one feature characterize all of the items (Norenzaya, 2002), or ii) the relations between items, such as grouping a cow with grass because cows eat grass (Chiu, 1972).

In addition to such sociocultural differences in one’s perceptual organization of the environment, there also seem to be sociocultural differences in the perceptual processing of items in the environment. For example, in a classic test of field dependence (i.e., ability to differentiate an object from the field) – the rod-and-frame test – participants are asked to decide if a rod placed in the center of a frame is vertical regardless of the position of the frame. North American adults tend to show better performance on the rod-and-frame test relative to East Asian adults, presumably because the North American adults are better able to process a given object independently of its surrounding context (Ji, Peng, & Nisbett, 2000). In contrast, East Asians appear to be relatively more influenced by the relation between an object and its surrounding environment (Ji et al., 2000). Similar results were found by Kitayama, Duffy, Kawamura, and Larsen (2003) who showed participants a square frame with a vertical line and asked them to complete two tasks: i) an absolute task in which they had to draw a line of the same length in a different square frame, and ii) a relative task in which they had to draw a line in a different square frame, but of the same proportion as shown in the first frame. The first frame was the same size, larger, or smaller than the first frame. Kitayama et al. (2003) found that North American adults were better in the absolute task than in the relative task, and they were better than the East Asian adults in the absolute task. In
contrast, East Asian adults were better in the relative task than in the absolute task, and they were better than the North American adults in the relative task (Kitayama et al., 2003). Thus, North American adults performed better in the task in which their judgments were uninfluenced by contextual information, whereas East Asian adults performed better in the task in which their judgments depended on contextual information.

Cultural differences in the physical environment have also been found to cultivate differences in visual perception. For example, Euro-Canadians whose environment is dominated by right angles (e.g., architectural structures such as buildings) demonstrate higher visual acuity for grating patterns presented in the horizontal and vertical orientations relative to patterns presented in oblique orientations (Annis & Frost, 1973). In contrast, Cree-Indians whose environment is comprised of more heterogeneous contour orientations demonstrate no difference in visual acuity across different orientations (Annis & Frost, 1973).

Other cross-cultural differences pertain to Japanese adults’ selective attention to the context or background scenery, and American adults’ selective attention to foreground or focal objects (Masuda & Nisbett, 2006). However, differences in the physical environment across cultures appear to induce these differences in attentional allocation. Regardless of participant ethnicity, American scenery, which is perceived to be more simple relative to Japanese scenery, induces attention to focal or foreground information, whereas Japanese scenery, which is perceived to more visually complex relative to American scenery, induces attention to contextual information (Masuda & Nisbett, 2006; Miyamoto, Nisbett, & Masuda, 2006).
3.2 The Role of Sociocultural Experience in Facial Age Processing

Overall, the existing cross-cultural literature suggests that differential experience at the level of both the physical and the sociocultural environment influences our visual perception of the world. The focus of Study 2 is on the latter – the influence of differential sociocultural environment on our visual perception of facial age. However, a review of the adult facial age literature shows that very few studies have examined how differential experience influences facial age judgments. For example, aside from the present paper, only one published study to date has examined how differential experience with own- and other-race faces affects adults’ processing of facial age (Dehon & Bredart, 2001).

In addition to differential experience with own-race and other-race social partners, as reviewed earlier, differential sociocultural experiences drives differences in visual perception. Thus, it remains plausible that exposure to unique cultural practices resulting in differential attention to facial age might cultivate different levels of sophistication in processing age-related information. For example, in certain cultures, such as the Japanese culture, there exists an age hierarchy that is embedded in everyday social interactions (Palmore & Maeda, 1985). In the Japanese culture, deference towards older individuals exists not only at the behavioural level (e.g., bowing) – it is also salient at a linguistic level. It is customary to speak to individuals from different age groups in different ways so as to show proper respect. Respect for an acquaintance even one year older than oneself requires the use of a polite form of speech (e.g., different nouns, verbs, suffixes, prefixes, etc.). Respect for even older individuals is also reflected in the use of a more polite form of speech – the honorific form, which is characterized by a distinct set of
syntactic rules and basic grammar (Palmore & Maeda, 1985). In contrast, a more casual way of speaking (e.g., use of slang, bluntness) is appropriate for close friends, and such speech is, in turn, slightly more casual and direct when speaking to younger individuals (Palmore & Maeda, 1985).

In the Chinese culture, although respect for older individuals is also emphasized (Yue & Ng, 1999), such emphasis on respect appears to be of a relatively lesser degree than in Japan. Respectful speech in the Chinese culture is limited to one linguistic marker (i.e., a polite form of the word “you”) that is reserved for senior citizens. In contrast, in North America, such respect is emphasized to an even lesser degree. There exist no established behavioural or linguistic displays of such respect, and disrespect towards the elderly is common (Palmore, 2004). Thus, in contrast to both the Japanese and Chinese cultures, the North American culture shows less emphasis on respect for adults who are younger than the elderly even if such adults are older than oneself. The North American culture also shows relatively less emphasis on respect for the elderly.

Overall, a comparison of the Japanese, Chinese, and North American culture reveals differences in the social need to differentiate individuals by age, with Japanese individuals living in Japan showing the greatest social need to do so, followed by Chinese individuals living in China, and individuals living in North American. Study 2 determined whether adults’ exposure to such unique cultural practices cultivate different levels of sophistication in their processing of age-related information. Study 2, therefore, capitalized on these naturally occurring differences in experience by examining whether cultural emphases on age differentiation enhance perceptual sensitivity to facial age cues. Thus, Study 2 compared the facial age judgments of Japanese participants in Japan to
those of Chinese participants in China and Asian participants in Canada.

To investigate the role of differential sociocultural experiences, Japanese, Chinese, and Asian-Canadian participants were asked to make relative and absolute facial age judgments for male Asian faces. If the differential attention allocated to the age of social partners across cultures influences age judgments, then Japanese participants should be most accurate and fastest in their judgments, followed by the Chinese participants, then the Asian-Canadians.

In addition, similar to Study 1, Study 2 involved participants’ absolute age judgments of child, young adult, and middle-age adult Asian faces. It was expected that young adult Asian participants from Japan, China, and Canada would show greater differentiation in their age judgments for own-age young adult faces, presumably due to their greater experience with own-age young adult individuals.

Method

3.3 Participants

Thirty-two Japanese adults (\(M\) age in years = 22.84, \(SD = 2.62\), 15 males) living in Japan, 39 Chinese adults (\(M\) age in years = 21.54, \(SD = 1.10\), 18 males) living in China, and 33 Asian-Canadians (\(M\) age in years = 21.00, \(SD = 2.06\), 3 males) participated in the study. An additional 6 Japanese adults, 7 Chinese adults, and 5 Asian-Canadian adults were tested, but they were excluded from the final analyses. These participants were excluded because their accuracy or latency measures in the relative age judgment task were below or above 2 standard deviations from the mean of their respective age groups on at least 2 stimulus facial age groups. These exclusions ensured that the data included in the final analyses are representative of each participant race and participant
age group. Participants from all three sites were undergraduate students from Kyoto University, Zhejiang Sci-tech University, or the University of Toronto. Participants were given an honorarium for their participation.

Of the 33 Asian-Canadians, 22 were of Chinese descent, and the remaining were of Korean, Filipino, Japanese, Vietnamese, or mixed Asian descent. Three of the Asian-Canadian participants were international students, 10 were Asian-Canadian immigrants, and the remaining did not volunteer information regarding their status in Canada.

3.4 Stimuli

Twenty Asian male adult faces (i.e., 31- to 40-year-olds, $M = 34.95$, $SD = 2.82$) were used to create an averaged “100% Old” East Asian male adult face, and twenty Asian male children’s faces (i.e., 11- to 12-year-olds, $M = 11.5$, $SD = .51$) were used to create an averaged “0% Old” East Asian male child face. All of the models that were used to create the stimuli were of Chinese descent. The averaged faces were created to control for individual differences in facial growth and facial age appearance within a given age group. That is, our averaged male adult face is likely more representative of the male middle-age adult facial age group relative to the individual male adult faces that were used to create the averaged face. Our averaged male child face is likely also more representative of the male pre-adolescent facial age group relative to the individual faces that were used to create the averaged face.

The 100% Old (i.e., adult’s face) and 0% Old (i.e., child’s face) average faces were then averaged together in 5% increments to make additional composite faces (i.e., 21 composite faces in total) with varying degrees of old/young facial information that ranged from 100% Old to 0% Old (see Figure 14). All photos were presented in
Child Stimulus Faces

Young Adult Stimulus Faces

Middle-age Adult Stimulus Faces

*Figure 14.* Study 2 stimulus set of Asian male faces with varying degrees of child/adult facial age information.
3.5 Questionnaires

Similar to Study 1, Study 2 used a Cross-race Experience Questionnaire that inquired about participants’ ethnic backgrounds, as well as their experience with Caucasian and Asian individuals (see Appendix A). Study 2 also used a second questionnaire – the Vancouver Acculturation Index (Ryder, Alden, & Paulhus, 2000) – to inquire about participants’ values, social relationships, and adherence to traditions, so as to gauge their degree of acculturation to North American society (see Appendix B). The Vancouver Acculturation Index comprise of two sets of questions that participants answer using a 5-point scale (1 = strongly disagree, 3 = neutral/depends, 5 = strongly agree). One set of questions inquire about participants’ interactions and relationships with individuals from their heritage culture (i.e., East Asians), their engagement in social activities that are typical of their heritage culture, and their adherence to the traditions of their heritage culture (e.g. It is important for me to maintain or develop the practices of my heritage culture.). Answers to this first set of questions are totalled to compute participants ‘heritage score’. A second set of questions inquire about participants’ interactions and social relationships with North American individuals, their engagement in social activities that are typical of North American culture, and their adherence to North American traditions (e.g., It is important for me to maintain or develop North American cultural practices.). Answers to this second set of questions are totalled to compute an “acculturation score”.

3.6 Procedure

Similar to Study 1, participants completed two age judgment tasks. In contrast to
Study 1, their tasks involved only Asian faces. In Part 1, participants were required to make relative age judgments. In Part 2, participants were required to make absolute age judgments. Participants were always administered the Relative Age Judgment task prior the Absolute Age Judgment Task. To ensure that Asian-Canadian participants had sufficient experience with own-race Asian individuals, they were asked to complete the Cross-race Experience Questionnaire. Asian-Canadian participants were also asked to complete the Vancouver Acculturation Index to ensure that they were acculturated to North American society. Both questionnaires were administered prior to the age judgment tasks.

**Part 1: Relative Age Judgment Task.** Participants were seated about 30 cm away from a 17-inch computer screen on which the stimuli (13.31° visual angle for the vertical dimension; 10.85° visual angle for the horizontal dimension) were presented. Each trial began with a 500 ms crosshair, followed by a face pair that was presented for a maximum of 10 seconds or until a response was made. Participants were asked to choose which face was older via a key press. Participants were instructed to only use their dominant hand to make their responses.

Each stimulus face was paired with every other stimulus face four times (e.g., for trials with stimulus A and stimulus B, there were two presentations with stimulus A on the left, and two presentations with stimulus B on the left). Thus, there was a total of 840 trials. Participants were given the option to take a break half way through the task.

**Part 2: Absolute Age Judgment Task.** Participants were shown sequential presentations of each average face (i.e., 100% Old to 0% Old) in one of four random orders to which participants were randomly assigned. Participants were asked to judge the
age of each face in years (i.e., one absolute age for each face rather than an age range). During this task, participants were able to control the speed with which they moved through each trial, but they were not allowed to move back to previous trials.

**Results and Discussion**

3.7 Cross-race Experience and Acculturation of Asian-Canadian Participants

To ensure that the Asian-Canadian participants had sufficient experience with Asian individuals and that they were acculturated to North American society, Asian-Canadian participants’ responses to the cross-race and acculturation questionnaires were examined. The Asian-Canadian participants had been living in Canada for an average of nine years \( \text{SD} = 4.65 \), and they reported that approximately 44.59\% \( \text{SD} = 30.31 \) of the individuals in their high schools were East Asian. The Asian-Canadian participants also reported an average of eight East Asian friends \( \text{SD} = 3.86 \) and an average of four Caucasian friends \( \text{SD} = 3.37 \). Using a 7-point scale \( 1 = \text{very little}, 7 = \text{very extensive} \), Asian-Canadian participants reported moderate to extensive amounts of experience with both East Asian \( \text{M} = 6.00, \text{SD} = 1.41 \) and Caucasian \( \text{M} = 5.00, \text{SD} = 1.35 \) individuals. Using a 7-point scale \( 1 = \text{definitely not the same as my personal experience}, 7 = \text{definitely the same as my personal experience} \), Asian-Canadian participants reported that they did not feel that East Asians \( \text{M} = 3.00, \text{SD} = 1.81 \) or Caucasians \( \text{M} = 3.43, \text{SD} = 1.93 \) look alike. In addition, Asian-Canadian participants gave overall neutral ratings on a five-point scale to questions that inquired whether they often behaved in ways that are typical of their heritage culture \( \text{M} = 3.31, \text{SD} = 1.00 \) and whether it was important for them to maintain or develop the practices of their heritage culture \( \text{M} = 3.75, \text{SD} = 1.05 \). Thus, at least to some extent, the Asian-Canadians in the present sample appear to have
acculturated to North American society.

### 3.8 Part 1: Relative Age Judgments

Although each stimulus face was paired with every other stimulus face in Study 2, results were analyzed in the same way as the results in Study 1. That is, participants’ relative age judgments for each stimulus face were examined relative to the other stimulus faces within their respective stimulus age groups (i.e., children’s faces paired with children’s faces, etc.). If results were analyzed so that each stimulus face was paired with every other stimulus face, the youngest composite face (i.e., 0% Old) and the oldest composite face (i.e., 100% Old) would be the easiest to visually discriminate by age relative to the other stimulus faces because they are at the extreme ends of the continuum of stimulus faces. Thus, stimulus faces towards the end of the continuum of stimulus faces would have an unfair advantage over the stimulus faces that are more central (e.g., 50% Old) in the continuum of stimulus faces. Therefore, the results were analyzed so that each stimulus face was compared to other faces within the same age group. This analysis ensured that the difficulty of the task was more comparable across the different stimulus age groups.

The analyses first examine participants’ accuracy and their response times when judging the relative ages of pairs of Asian faces. However, there was a speed-accuracy trade-off for Asian child ($r = .50, p < .05$), young adult ($r = .53, p < .05$), and middle-age adult ($r = .49, p < .05$) stimulus faces. Thus, follow-up analyses using inverse efficiency scores were conducted to account for the speed-accuracy trade-off.

**Accuracy.** A preliminary analysis showed no significant main effect of or interactions with participant gender ($p$ values > .05). Thus, follow-up analyses did not
include participant gender. A 3 (participant ethnicity: Japanese, Chinese, Asian-
Canadian) x 3 (stimulus age group: child, young adult, middle-age adult) ANOVA was
conducted with participants’ accuracy in their age judgments as the dependent variable.
Results showed a significant main effect of participant ethnicity, $F(2, 101) = 22.73$, $p <
.001$, partial $\eta^2 = .31$. Follow-up simple contrast analyses with the sequential Bonferroni
correction showed that the Asian-Canadian participants were significantly more accurate
than the Japanese ($p < .001$) and the Chinese ($p < .001$) participants. The Japanese
participants were also significantly more accurate than the Chinese participants ($p <
.001$); see Table 5.

There was also a significant main effect of stimulus age group, $F(2, 176) = 762.08$,
$p < .001$, partial $\eta^2 = .88$. Follow-up simple contrast analyses with the sequential
Bonferroni correction showed that participants were more accurate in their age judgments
for young adult and middle-age adult faces relative to their age judgments for children’s
faces, $F(1, 101) = 1072.49$, $p < .001$, partial $\eta^2 = .91$, and $F(1, 101) = 899.73$, $p < .001$,
partial $\eta^2 = .90$, respectively. However, participants showed no difference in their
accuracy for young adult and middle-age adult faces ($p > .05$).

The significant main effects were subsumed by a significant two-way interaction
between participant ethnicity and stimulus age group $F(4, 202) = 7.56$, $p < .001$, partial $\eta^2
= .13$. Thus, Sheffe’s test for multiple comparisons with the sequential Bonferroni
correction was conducted for each stimulus age group. Results showed that for children’s
faces, the Asian-Canadian participants were significantly more accurate than the Japanese
($p = .001$) and the Chinese participants ($p < .001$). The Japanese participants were also
significantly more accurate than the Chinese participants ($p < .05$). For the young adult
Table 5.

*Participants’ accuracy and response time scores in milliseconds for child, young adult, and middle-age adult age judgment trials (i.e., prior to adjustment for speed-accuracy tradeoffs).*

<table>
<thead>
<tr>
<th>Stimulus Facial Age Group</th>
<th>Participant Ethnicity</th>
<th>Accuracy</th>
<th>Response Time</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>Mean</td>
<td>SD</td>
</tr>
<tr>
<td>Child</td>
<td>Japanese</td>
<td>.54</td>
<td>.06</td>
</tr>
<tr>
<td></td>
<td>Chinese</td>
<td>.49</td>
<td>.08</td>
</tr>
<tr>
<td></td>
<td>Asian-Canadians</td>
<td>.62</td>
<td>.09</td>
</tr>
<tr>
<td>Young Adult</td>
<td>Japanese</td>
<td>.79</td>
<td>.06</td>
</tr>
<tr>
<td></td>
<td>Chinese</td>
<td>.79</td>
<td>.07</td>
</tr>
<tr>
<td></td>
<td>Asian-Canadians</td>
<td>.83</td>
<td>.05</td>
</tr>
<tr>
<td>Middle-age Adult</td>
<td>Japanese</td>
<td>.81</td>
<td>.06</td>
</tr>
<tr>
<td></td>
<td>Chinese</td>
<td>.78</td>
<td>.05</td>
</tr>
<tr>
<td></td>
<td>Asian-Canadians</td>
<td>.85</td>
<td>.05</td>
</tr>
</tbody>
</table>
faces, the Asian-Canadian participants were significantly more accurate than the Japanese ($p < .05$) and the Chinese participants ($p = .05$); however, there was no difference in accuracy between the Japanese and the Chinese participants ($p > .05$). For the middle-age adult faces, the Asian-Canadian and Japanese participants were significantly more accurate than the Chinese participants ($p < .001$ and $p < .05$, respectively); however, there was no difference in accuracy between the Asian-Canadian and the Japanese participants ($p > .03$ as per the sequential Bonferroni correction).

**Response time.** A preliminary analysis showed a significant main effect of participant gender, $F(1, 98) = 5.21, p < .05$, partial $\eta^2 = .05$, and a trend towards a significant two-way interaction between participant ethnicity and participant gender, $F(2,98) = 2.58, p < .08$, partial $\eta^2 = .05$. Separate ANOVAs for each participant ethnic group showed no difference in performance between the males and females among the Japanese and Chinese participants ($p$ values $> .05$). Although there was a significant difference between the males and females among the Asian-Canadian participants $F(1, 31) = 4.32, p = .05$, partial $\eta^2 = .12$, with the males showing faster response times compared to the females, this was likely due to unequal cell sizes for male and female participants in this ethnic group (i.e., 30 female participants and only 3 male participants). Thus, follow-up analyses did not include participant gender.

A 3 (participant ethnicity: Japanese, Chinese, Asian-Canadian) x 3 (stimulus age group: child, young adult, middle-age adult) ANOVA was conducted with participants’ response times in their age judgments (on correct trials) as the dependent variable. Results showed a significant main effect of participant ethnicity, $F(1, 101) = 16.36, p < .001$, partial $\eta^2 = .25$. Follow-up simple contrast analyses with the sequential Bonferroni
correction showed that Japanese participants were significantly faster in their age judgments compared to the Chinese ($p < .05$) and the Asian-Canadian ($p < .001$) participants. The Chinese participants were also significantly faster in their age judgments compared to the Asian-Canadian participants ($p < .001$).

There was also a significant main effect of stimulus age group, $F(1, 147) = 150.81, p < .001$, partial $\eta^2 = .60$. Follow-up simple contrast analyses with the sequential Bonferroni correction showed that participants were significantly faster in their age judgments for young adult and middle-age adult faces compared to their age judgments for children’s faces, $F(1, 101) = 199.92, p < .001$, partial $\eta^2 = .66$ and $F(1, 101) = 166.06, p < .001$, partial $\eta^2 = .62$, respectively. Participants were also significantly faster in their age judgments for middle-age adult faces relative to their age judgments for young adult faces $F(1, 101) = 11.17, p = .001$, partial $\eta^2 = .10$.

In addition to the significant main effects, there was also a significant two-way interaction between participant ethnicity and stimulus age group, $F(4, 202) = 8.10, p < .001$, partial $\eta^2 = .14$. Thus, Sheffe’s test for multiple comparisons with the sequential Bonferroni correction was conducted for each stimulus age group. Results showed that for children’s faces, the Japanese and Chinese participants made significantly faster age judgments compared to Asian-Canadian participants ($p < .001$ and $p = .001$, respectively). There was no significant difference in response time performance for children’s faces between the Japanese and Chinese participants ($p > .05$). For young adult faces, Japanese and Chinese participants again made significantly faster age judgments compared to Asian-Canadian participants ($p < .001$ and $p < .05$, respectively). There was no significant difference in response time performance for young adult faces between the
Japanese and Chinese participants \( p > .05 \). The same pattern of results was found for middle-age adult faces, so that Japanese and Chinese participants were significantly faster in their age judgments compared to Asian-Canadian participants, \( p < .001 \) and \( p < .05 \), respectively. There was no difference in response time performance for middle-age adult faces between the Japanese and Chinese participants \( p > .05 \).

**Inverse efficiency scores.** Inverse efficiency scores were computed to account for participants’ speed-accuracy tradeoffs. To compute these scores, participants’ response time scores for each stimulus facial age group were divided by their corresponding proportion correct score so that differences in response time performance decrease if differences in accuracy are large but remain the same if accuracy is identical. These inverse efficiency scores, expressed in milliseconds (ms), were then used in the subsequent analyses.

Preliminary analyses showed a significant main effect of participant gender, \( F(1, 98) = 5.16, p < .05 \), partial \( \eta^2 = .05 \), so that female participants had lower IESs relative to male participants \( M = 2350.22, SD = 862.31 \) and \( M = 2360.92, SD = 924.52 \), respectively). However, this was likely due to the greater number of female participants \( n = 68 \) compared to male participants \( n = 36 \). The remaining interactions with participant gender were not significant \( p \) values \( > .05 \). Thus, participant gender was not included in the follow-up analyses.

To determine whether differential sociocultural experience influences relative facial age judgments, a 3 (participant ethnicity: Japanese, Chinese, Asian-Canadian) \( \times 3 \) (stimulus facial age: child, young adult, middle-age adult) ANOVA was conducted with participants’ inverse efficiency scores as the dependent variable. The results revealed
significant main effects of participant ethnicity, $F(2, 101) = 11.09, p < .001$, partial $\eta^2 = .18$. Japanese participants were significantly faster than the Chinese and the Asian-Canadians in their relative age judgments ($p$ values < .05). There was no difference in performance between the Chinese and Asian-Canadian participants ($p > .05$).

There was also a significant main effect of stimulus facial age, $F(1, 112) = 263.49, p < .001$, partial $\eta^2 = .72$. Participants were significantly faster in their relative age judgments for young adult and middle-age adult faces than for children’s faces $F(1, 101) = 272.04, p < .001$ and $F(1,101) = 274.03, p < .001$, partial $\eta^2 = .73$, respectively. Participants were also significantly faster in their age judgments for middle-age adult faces than for young adult faces $F(1, 101) = 13.73, p < .001$, partial $\eta^2 = .12$.

However, there was a significant interaction between stimulus facial age and participant ethnicity, $F(2, 112) = 5.63, p < .05$, partial $\eta^2 = .10$ (see Figure 15). Japanese participants were significantly faster than the Chinese and the Asian-Canadians in their age judgments for children’s faces, $t(69) = 3.26, p < .05$, and $t(63) = 4.61, p < .001$ respectively. The Chinese and Asian-Canadians did not differ in their age judgments for children’s faces ($p > .05$). Japanese and Chinese participants were comparable in the speed of their age judgments for young adult faces ($p > .05$), but both groups were significantly faster than the Asian-Canadians, $t(63) = 4.61, p < .001$ and $t(70) = 2.84, p < .05$, respectively. In addition, Japanese participants were faster in their age judgments for middle-age adult faces compared to Chinese and Asian-Canadian participants, $t(69) = 2.81, p < .05$ and $t(63) = 4.88, p < .001$, respectively. The Chinese participants, were in turn, faster in their age judgments for middle-age adult faces than the Asian-Canadian participants, $t(70) = 2.38, p < .05$. 
Figure 15. Young adult participants’ adjusted response times (IES) for own-race child, young adult, and middle-age adult relative facial age judgments.
Control trials. To ensure that differences between the participant groups were not due to general group differences in motivation and response time, participants’ relative age judgments for trials that paired the 100% Old average male adult face with the 0% Old average male child face were examined. As expected, participants in the three groups were highly accurate in these control trials. An ANOVA with participants’ raw response time scores as the dependent variable revealed no significant difference in performance between the Japanese ($M = 652.88$ ms, $SD = 165.83$ ms), Chinese ($M = 762.97$ ms, $SD = 231.84$ ms), and Asian-Canadian ($M = 798.02$ ms, $SD = 354.76$ ms) participants ($p > .05$). A separate ANOVA with participants’ inverse efficiency scores as the dependent variable also revealed no significant difference in performance between the Japanese ($M = 664.98$ ms, $SD = 170.12$ ms), Chinese ($M = 805.74$ ms, $SD = 452.33$ ms), and Asian-Canadian ($M = 805.00$ ms, $SD = 354.86$ ms) participants ($p > .05$).

Thus, the group differences in the speed with which participants made their facial age judgments appear to be limited to small differences in facial age. Discrimination based on large facial age differences was comparable across the three ethnic groups. This pattern of performance suggests that the differences across the Japanese, Chinese, and Asian-Canadian participants for trials with faces from the same stimulus facial age group were not due to group differences in motivation or general response time.

3.9 Asian-Canadian Participants’ Own-race Experience, Acculturation, and Age Judgments

Asian-Canadians’ performance on the relative age judgment task was examined in relation to their own-race experience and acculturation to North American society. Pearson correlations were conducted with Asian-Canadian participants’ performance (i.e.,
accuracy scores, unadjusted response time scores, and inverse efficiency scores) and the duration of time that they had lived in North America, participants’ estimates of the percentage of East Asian individuals in their high schools, the number of participants’ East Asian friends, the number of participants’ Caucasian friends, participants’ estimated amount of experience with East Asian individuals, participants’ estimated amount of experience with Caucasian individuals, the degree to which participants thought East Asians look alike, the degree to which participants thought Caucasians look alike, participants’ acculturation scores, and participants’ heritage scores.

**Relative age judgments for children’s faces.** There was a significant and positive correlation between Asian-Canadian participants’ inverse efficiency scores (IES) for children’s faces and the degree to which Asian-Canadian participants felt that East Asians look the same ($r = .41, p < .05$). Thus, Asian-Canadian participants required more time in their age judgments of Asian children’s faces when they showed greater agreement that East Asians look the same. Asian-Canadian participants’ accuracy scores, unadjusted response time scores, and IESs for children’s faces were not significantly related to any other measures.

**Relative age judgments for young adult faces.** There were significant and positive correlations between Asian-Canadian participants’ accuracy scores, unadjusted response time scores, and IES for young adult faces and participants’ degree of contact with East Asian individuals ($r = .46, p < .05$, $r = .41, p < .05$, and $r = .38, p < .05$, respectively). Thus, Asian-Canadian participants were more accurate but required more time in their age judgments for Asian young adult faces when they had greater experience with East Asian individuals. Asian-Canadian participants’ accuracy scores,
unadjusted response time scores, and IES were not significantly related to any other measures.

**Relative age judgments for middle-age adult faces.** There were significant and positive correlations between Asian-Canadian participants’ unadjusted response time scores and IESs for middle-age adult faces and the degree to which participants felt that East Asians look alike ($r = .47, p < .05$ and $r = .48, p < .05$, respectively). Thus, participants required more time in their age judgments for Asian middle-age adult faces when they showed greater agreement that East Asians look alike.

There was also a significant relationship between the number of years that the young adult Asian-Canadian participants had lived in North America and their efficiency in judging the facial age of relatively older middle-age adult faces. The longer the Asian-Canadian participants had lived in North America, the longer their response times in making facial age judgments for middle-age adult faces ($r = .33, p = .05$). This is consistent with the notion that the more acculturated participants have become to North American society which does not emphasize respect for older individuals, the less efficient they are at processing facial age information for individuals older than themselves.

**3.10 The Role of Sociocultural and Own-age Experiences on Adults’ Relative Age Judgments**

Overall, the results show that differential sociocultural experiences do, indeed, have an influence on our visual processing of facial age. Japanese participants who experience greater sociocultural need to identify the age of their social partners were overall faster in their facial age judgments compared to the Chinese and Asian-Canadian
participants. Thus, greater sociocultural emphasis in considering the age of social partners leads to an increased efficiency in processing facial age information. Although individuals most likely also rely on feedback regarding the age of their social partners (e.g., via age-related information exchanged during such interactions), the present study suggests that culturally distinct experiences also influence processing of facial age information.

Moreover, an examination of the interaction between participant ethnicity and stimulus facial age shows a more refined influence of differential sociocultural experience on facial age judgments. Japanese participants were fastest in their age judgments for children’s faces, likely due to their socially constrained need to also consider the age of social partners younger than themselves. Thus, although the Japanese culture places a great degree of emphasis on respect towards individuals older than oneself, it appears that the linguistic manners used in interactions with individuals younger than oneself (e.g., use of slang and bluntness) may also enhance young adults’ efficiency of age judgments for children’s faces. In contrast, Chinese and Asian-Canadian participants who use no behavioural or linguistic markers when interacting with individuals younger than themselves showed no such advantage in their age judgments for children’s faces. In addition, age judgments for young adult faces were more comparable across ethnic groups, likely due to the young adult participants’ extensive experience with own-age peers. However, Japanese and Chinese participants whose cultures attach greater importance to the age of their social partners were still significantly faster than the Asian-Canadians in their age judgments for own-age young adult faces.
Perhaps the most clear-cut example of the influence of differential sociocultural experience on facial age processing is evident in young adults’ age judgments for older middle-age adult stimulus faces. Japanese participants whose culture places the greatest emphasis on respect for older individuals were faster than the Chinese and the Asian-Canadian participants. Chinese participants whose culture emphasizes respect for older individuals to a greater degree than North American culture (but to a lesser degree than the Japanese) were significantly faster than the Asian-Canadians in their age judgments for middle-age adult faces. Interestingly, Asian-Canadian young adult participants who had lived in North America for a longer time also tended to show slower response times in their age judgments for the middle-age adult faces. This tendency might be due to North American society’s relative lack of emphasis on respect for older individuals. Thus, acculturation to North American society might be associated with less efficient processing of facial age information for individuals older than oneself.

A potential alternative explanation to our findings is group-related differences in processing speed across our Japanese, Chinese, and Canadian samples. More specifically, the main effect of participant ethnicity may be due to generally faster processing speed of Japanese participants. However, the interaction between participant ethnicity and stimulus facial age shows that although the Japanese were fastest in their age judgments for children’s faces and middle-age adult faces, they were comparable to the Chinese participants in their age judgments of young adult faces. Performance on the control age judgment trials that compared the youngest average face with the oldest average face also showed no difference across the Japanese, Chinese, and Asian-Canadian participants. Thus, it is unlikely that the group differences in performance were due to general
differences in processing speed. Such differences in performance are, instead, likely shaped by cultural differences in social interactions.

Overall, these results provide the first evidence of a link between social practices and face processing. This finding suggests that cultural practices play an important role in our perception of socially significant stimuli in our environment. Such practices perhaps calibrate our visual system to attend to, and develop expertise for, the culturally significant aspects of social stimuli. More broadly, the present findings combined with findings from cultural psychological research suggest that cultural practices calibrate the manner in which we not only see the world (Annis & Frost, 1973; Chiu, 1972; Ji et al., 2000; Kitayama et al., 2003; Masuda & Nisbett, 2006; Miyamoto et al., 2006), but also how we reason (Ji et al., 2001) and explain behaviour (Miller, 1984). This culture-specific calibration likely leads to the development of optimal interactions with the social partners of one’s own culture.

3.11 Part 2: Absolute Age Judgments

Preliminary analyses revealed a significant interaction between participant ethnicity, participant gender, stimulus, and stimulus age group, $F(24, 1176) = 1.55, p < .05$, partial $\eta^2 = .14$. Thus, separate ANOVAs were conducted for each participant ethnic group (i.e., Japanese, Chinese, Asian-Canadian participants). Within each participant group, we examined age judgments for children’s faces (0% to 30% Old faces, mean perceived age = 10.98 years, $SD = 3.42$), young adult faces (35% to 65% Old faces, mean perceived age = 19.59 years, $SD = 3.48$), and middle-age adult faces (70% to 100% Old faces, mean perceived age = 30.84 years, $SD = 4.64$).

**Japanese participants.** A 7 (stimulus: individual faces within each age group) x
ANOVA was conducted with participants’ age estimates (in years) as the dependent variable. The ANOVA revealed a significant main effect of stimulus so that age judgments (in years) generally increased as the individual faces themselves increased in age, \( F (4, 125) = 54.82, p < .001, \) partial \( \eta^2 = .65. \) There was also a significant main effect of stimulus age group, so that age judgments increased as the stimulus age group increased in age, \( F (1, 36) = 375.07, p < .001, \) partial \( \eta^2 = .93. \)

Crucial to the central question of the present study, the analysis revealed a significant interaction between stimulus age group and the stimulus faces within each age group, \( F (7, 209) = 14.54, p < .001, \) partial \( \eta^2 = .33. \) A follow-up simple contrast analysis with sequential Bonferroni correction and with young adult stimulus faces as the reference showed a significant difference in the linear slopes of participants’ age judgments for each stimulus age group. Japanese participants’ age judgments for own-age young adult stimulus faces showed a significantly greater incline or slope relative to their age judgments for children and middle-age adult stimulus faces, \( F(1, 30) = 119.37, p < .001, \) partial \( \eta^2 = .80 \) and \( F(1, 30) = 40.99, p < .001, \) partial \( \eta^2 = .58, \) respectively. That is, despite similar changes in facial age information (i.e., 5% difference between each face within a given stimulus age group), the Japanese participants’ age judgments showed the greatest differentiation between own-age faces from the young adult stimulus facial age group (see Figure 16). In contrast, participants’ age judgments showed relatively less differentiation between other-age faces from the younger and older stimulus facial age groups. In addition, a comparison of the Japanese participants’ age judgments for other-age faces showed greater differentiation between faces in the middle-age adult stimulus
age group relative to children’s faces $F(1,30) = 15.25, p < .001$, partial $\eta^2 = .34$.

Although the main effect of participant gender and the two-way interactions with participant gender were not significant, the three-way interaction between participant gender, stimulus age group, and stimulus was significant, $F (7, 209) = 2.27, p < .05, \eta^2 = .07$. Further analyses showed no difference in male and female participants’ age judgments for other-age child and middle-age adult stimulus faces ($p > .05$). However, female participants showed greater differentiation in their age judgments for own-age young adult stimulus faces relative to male participants.

**Chinese participants.** A $7 \times 3 \times 2$ ANOVA was conducted with participants’ age estimates (in years) as the dependent variable. The ANOVA revealed a significant main effect of stimulus so that age judgments (in years) generally increased as the individual faces themselves increased in age, $F (6, 222) = 74.31, p < .001$, partial $\eta^2 = .67$. There was also a significant main effect of stimulus age group, so that age judgments increased as the stimulus age group increased in age, $F (1, 49) = 291.24, p < .001$, partial $\eta^2 = .89$.

Most importantly, the analysis revealed a significant interaction between stimulus age group and the stimulus faces within each group, $F (7, 262) = 8.25, p < .001$, partial $\eta^2 = .18$. A follow-up simple contrast analysis with sequential Bonferroni correction and with young adult stimulus faces as the reference showed a significant difference in the linear slopes of participants’ age judgments for each stimulus age group. Participants’ age judgments for own-age young adult stimulus faces showed a significantly greater incline or slope relative to their age judgments for children and middle-age adult faces, $F(1, 37)$
Thus, despite similar changes in facial age information (i.e., 5% difference between each face within a given stimulus age group), participants’ age judgments showed the greatest differentiation between own-age faces from the young adult stimulus age group (see Figure 16). In contrast, participants’ age judgments showed relatively less differentiation between other-age faces from the younger and older stimulus facial age groups. In addition, a comparison of participants’ age judgments for other-age faces showed greater differentiation between faces in the middle-age adult stimulus age group relative to children’s faces, $F(1, 37) = 22.34, p < .001$, partial $\eta^2 = .38$. The main effect of participant gender and the remaining interactions involving participant gender were not significant ($p$ values $> .05$).

**Asian-Canadian participants.** A $7 \times 3 \times 2$ (stimulus: individual faces within each age group) x 3 (stimulus age group: child, young adult, middle-age adult) x 2 (participant gender) ANOVA was conducted with participants’ age estimates (in years) as the dependent variable. The ANOVA revealed a significant main effect of stimulus, as well as a significant main effect of stimulus age group, so that age judgments (in years) generally increased as the individual faces and the stimulus age group themselves increased in age, $F(6, 372) = 21.30, p < .001$, partial $\eta^2 = .41$ and $F(1, 223) = 155.92, p < .001$, partial $\eta^2 = .83$, respectively. Although the main effect of participant gender was not significant ($p > .05$), there was a significant interaction between stimulus and participant gender, $F(6, 372) = 2.48, p < .05$, partial $\eta^2 = .07$, which showed that female participants gave slightly older age judgment estimates ($M = 20.83, SD = 2.58$) relative to male participants ($M = 19.75, SD = 3.75$). However, the gender effect among Asian-Canadian
participants should be interpreted with caution due to the low number of male participants (n = 3) and the relatively high number of female participants (n = 30) in the sample.

Most importantly, there was also a significant interaction between stimulus age group and the stimulus faces within each group, $F (7, 223) = 3.13, p < .05$, partial $\eta^2 = .09$. A follow-up simple contrast analysis with sequential Bonferroni correction and with young adult stimulus faces as the reference showed a significant difference in the linear slopes of participants’ age judgments for each stimulus age group. Participants’ age judgments for own-age young adult stimulus faces showed a significantly greater incline or slope relative to their age judgments for children’s faces, $F(1, 31) = 20.52, p < .001$, partial $\eta^2 = .40$ (see Figure 16). A comparison of Asian-Canadian participants’ age judgments for other-age child and middle-age adult faces showed a significant difference in linear slopes ($p < .05$). Thus, unlike the Chinese and Japanese participants, the Asian-Canadian participants showed similar degrees of differentiation between young adult and middle-age adult faces.

3.12 The Role of Own-age and Sociocultural Experiences in Adults’ Absolute Age Judgments

The results showed that young adults have an own-age bias in their facial age judgment ability. Even when age information across faces from the same age group is varied in equal steps for child, young adult, and middle-age adult faces, young adult participants showed the greatest differentiation between own-age faces relative to other-age faces. This own-age bias in facial age judgment ability likely stems from greater experience (e.g., daily social interactions) with own-age peers and relatively less experience with children and middle-age adults. Such findings regarding the importance
Figure 16. Young adult participants’ mean absolute facial age judgments (in years) for child, young adult, and middle-age adult stimulus faces.
of differential experience in face processing are consistent with previous studies that have shown that differential experience with own- and other-race faces and own- and other-age faces influence recognition memory (Anastasi & Rhodes, 2005; Bäckman, 1991; Kuefner et al., 2008; see Meissner & Brigham, 2001 for a review).

In addition to an own-age bias in facial age judgment ability, our findings also revealed differences in Japanese and Chinese participants’ age judgments for the other-age child and middle-age adult stimulus faces. The young adult Japanese and Chinese participants in the present study showed greater differentiation in their age judgments for middle-age adult faces relative to their age judgments for children’s faces. This difference in performance for other-age faces may be due to participants’ possibly greater experience with middle-age adult faces relative to children’s faces (e.g., frequent experience with parents and their cohorts who are typically middle-age adults or older). Alternatively, the difference in performance for other-age faces may stem from the structural differences between own-age young adult faces, children’s faces, and middle-age adult faces. Relative to children’s faces, middle-age adult faces are more similar in structure to young adult faces. Thus, it is possible that participants’ perception of middle-age faces may have benefited from their own-age advantage for young adult faces.

The present results also suggest that one’s current experience with own-age faces may be most influential in our face processing ability. Although the young adult participants in the current study would have had experience with own-age children in the past, they showed less differentiation in their age estimates for those faces. The superiority of current experience over past experience is consistent with findings by Sangrigoli et al. (2005) who found that Korean adults who were adopted into European
Caucasian families during childhood were comparable to Caucasian adults in their face recognition of Korean and Caucasian faces. That is, the Korean adults also showed better recognition memory for Caucasian faces with which they had an abundance of current experience, and poorer recognition memory for own-race Korean faces with which they had an abundance of previous, but no current, experience. Thus, our face processing abilities appear to remain malleable so that they are fine-tuned for the most current and frequently encountered faces.

However, considering the results from Study 1 of the present paper, it appears that accumulated experience with a given age group (e.g., children’s previous and continued current experiences with adult individuals) likely also influences facial age processing. Thus, current experience is likely most important if the previous category of frequently encountered faces becomes extremely limited – as is typically the case with young adults’ abundance of current experience with young adult faces and previous, but lack of current, experience with children’s faces.

Overall, the present results showed that young adults have an own-age bias in their facial age judgments. This own-age bias suggests that adults’ visual perception of facial age may be continuously recalibrated as they age and subsequently gain the most experience with own-age individuals, so that they are always most sensitive to small facial age differences within the age group to which they currently belong. This own-age bias in facial age judgments also has broad implications for our understanding of the nature of the role of experience in face processing. It suggests that adults’ current abilities to process faces is influenced by a combination of their lack of continued experience with a facial category (e.g., children’s faces) and their abundance of current and accumulated
experience with a different facial category (e.g., adult faces).

3.13 Summary

Study 2 revealed the influence of both sociocultural experience and own-age experience on young adults’ facial age judgments. Part 1 revealed that greater sociocultural emphasis on the age of social partners is associated with more efficient processing of small differences in facial age information. Part 2 revealed that when participants are asked to give absolute age estimates, experience with own-age individuals is likely associated with greater facial age differentiation between own-age individuals relative to other-age individuals.
Chapter 4: General Discussion

The present studies aimed to investigate the role of differential experience in facial age judgment abilities. The findings suggest that differential experience with own- and other-race faces do not necessarily lead to an other-race effect in facial age judgments. Study 1 revealed ambiguous findings regarding an other-race effect among Caucasian participants and Chinese adults. Such findings could be due to participants’ experience – albeit limited experience – with other-race individuals. Indeed, Chinese 9-to 10-year-olds and 13- to 14-year-olds, who most likely had extremely limited to no experience with other-race Caucasians, showed more definitive evidence of an other-race effect in their relative and absolute age judgments. Thus, it is possible that an other-race effect in age judgments exists prior to any sort of exposure to other-race individuals. However, even small amounts of experience with other-race individuals may be sufficient to minimize such an other-race effect.

The notion that only small amounts of experience with other-race individuals is required to minimize the other-race effect in age judgments is consistent with studies that have examined the other-race effect in face recognition memory. Such studies show that the other-race face recognition memory in adults can be improved in a period as short as a single training session (Goldstein & Chance, 1985; Hills & Lewis, 2006; Rhodes, Locke, Ewing, & Evangelista, 2009; Tanaka & Pierce, 2009). However, to effectively improve other-race face recognition memory, it is essential that attention is given towards individuating between other-race individuals (Goldstein & Chance, 1985; Hills & Lewis, 2006; Rhodes et al., 2009; Scott & Monesson, 2009; Tanaka & Pierce, 2009). Thus, passive exposure to other-race individuals is not sufficient to improve other-race face
recognition memory. From the results of the present study, it remains unclear whether such individuation in facial identity is similarly required to minimize an other-race effect in processing facial age information.

The ambiguity of an other-race effect in the age judgments of Caucasian participants and Chinese adult participants in the present study, and the possibly limited amounts of other-race experience that is required to minimize an other-race effect in age judgments are consistent with notion of generally universal cues to facial age. Thus, very limited experience with other-race faces may be needed to minimize an other-race effect in facial age judgments because such own- and other-race faces likely age in similar ways. In addition, even among Chinese children who had no exposure to other-race Caucasian individuals, the other-race effect in facial age judgments was more subtle than expected. Thus, in addition to mental representations of facial age that are specific to age group or race, individuals may also possess more general representations of facial aging.

Both Study 1 and Study 2 alluded to the importance of differential experience with individuals from different age groups on facial age judgments. The young adult participants in both studies showed an own-age advantage in their relative and absolute age judgments, likely due to their greater current experience with young adult peers. Caucasian and Chinese 9- to 10-year-olds and 13- to 14-year-olds also showed an advantage in their relative and absolute age judgments for young adult faces, possibly because they too have greater current as well as past experience or greater accumulated experience with young adult individuals. However, another participant age group (e.g., middle-age adults) or a group with known experience with a particular age group (e.g., elementary school teachers) should be tested on the relative and absolute age judgment
tasks and given a questionnaire inquiring about their experience with individuals from different age groups. Additional studies will help to further clarify the role of experience in facial age judgments when such experience is transient versus maintained.

It should also be noted that the overall advantage in relative age judgments for Caucasian and Asian young adult faces among both the Caucasian and Chinese participants suggests that experience with a given age group from a given race may have advantages that transfer over to the same age group of a different race. This pattern of results was also found in Caucasian participants’ and Asian adults’ absolute age judgments. However, the Chinese 9- to 10-year-olds and 13- to 14-year-olds in the present study likely had almost no experience with Caucasian individuals and they only showed an advantage in differentiating between own-race young adult faces relative to own-race middle-age adult and children’s faces. The Chinese children showed no difference in their discriminability in absolute age judgments for child, young adult, and middle-age adult Caucasian faces. Thus, it appears that when participants have extremely limited to no experience with other-race individuals, a discriminability advantage in absolute age judgments for a given own-race age group may not generalize to the same age group in another race.

Study 2 also revealed the role of sociocultural experience in relation to the efficiency in processing facial age information. Japanese adult participants who have greater social need to differentiate between the ages of their social partners were generally more efficient in processing facial age information relative to Chinese and Asian-Canadian adults. Relative to Chinese and Asian-Canadian adults, Japanese adults were fastest in their relative age judgments for children’s faces, presumably due to their
use of distinct linguistic rules when interacting with social partners from younger age groups. Japanese adults were also fastest in their age judgments for middle-age adult faces, followed by the Chinese participants, then the Asian-Canadian participants. This pattern of results reflects the degree of importance that each culture places on respect for older individuals – with the greatest sociocultural emphasis in the Japanese culture, followed by the Chinese culture, and the least sociocultural emphasis in North American culture. Japanese, Chinese, and Asian-Canadian young adults were more comparable in their efficiency in processing the facial age information in young adult faces, likely due to their extensive experiences with own-age individuals. Future studies should be conducted with children to investigate when the influence of sociocultural experience on facial age processing efficiency emerges.

The influence of sociocultural experience on the efficiency of processing facial age information was also apparent in the longer responses times for middle-age adult faces as young adult Asian-Canadians reported longer durations of having lived within the North American culture – a result that is consistent with greater sociocultural emphasis on respect for older individuals in Eastern cultures and less emphasis on such respect in Western cultures. In addition, it is interesting to note that Caucasian adults in Study 1 showed no difference in their degree of differentiation in absolute age judgments between other-age children’s faces and middle-age adult faces. In contrast, Caucasian child participants in Study 1 and all of the Asian participants from China and Japan in Study 1 and 2 showed greater differentiation in their absolute age judgments for middle-age adult faces than for children’s faces. This pattern of results may be due to the differential emphasis on respect for older individuals across the Eastern and Western
cultures. An advantage for other-age middle-age adult faces relative to children’s faces may stem from greater emphasis on respect for older individuals that is more characteristic of Eastern cultures. A similar advantage among Caucasian children may possibly be due to parenting practices that teach respect for the elderly. However, with age, with no continued emphasis on this teaching, and with no distinct linguistic and behavioural markers for such respect, this advantage for middle-age adult faces over children’s faces disappears among young adult Caucasians in North America.

Aside from the theoretical contributions that the present findings offer towards the role of differential experience on facial age judgments, the present findings also offer some additional practical implications. For example, in the cases of eyewitness testimonies, it may be helpful to measure eyewitnesses’ experiences with individuals from different race and age groups to gauge the accuracy of their facial age judgments. It might also be helpful to keep in mind that individuals from Eastern cultures may differentiate between the ages of older individuals to a greater degree relative to individuals from Western cultures.

Overall, this thesis has extended the little that is known about the role of experience in facial age judgment abilities. The findings reveal that experiences with different races, age groups, and cultures may indeed influence facial age judgments. However, this thesis has only begun to explore the relationship between experience and facial age judgment abilities in children and adults. Additional investigations are crucial to further explicate the complex role of experience on the ability to process facial age information.
References


other-age effect. The Quarterly Journal of Experimental Psychology, 62(6), 1099-1107.


Appendix A

Experiment _________________________

Participant Number ___________

Birth date (m/d/y): ________________    Date (m/d/y) __________________

Gender (circle one) -   Male  |  Female

1. To which ethnic or cultural group(s) did your ancestors belong? (You can choose more than one category: IF YOU CHOOSE AMERICAN, PLEASE ALSO CHOOSE ANOTHER ITEM.)


If ancestry is not listed please specify ______________________

2. To which ethnic or cultural group(s) do you consider yourself to belong?


If ethnic or cultural group not listed, please specify ______________________

3. Are both your parents’ members of this group? (Circle one)    Yes  |  No

   If not, to which other ethnic group do your parents belong? ________________

4. Are you born and raised in Canada? (Circle one)    Yes  | No

   If not, in which country did you grow up? ______________________

   If not, how long have you lived in Canada? ________ years ________months

5. Were there Eastern Asian students (Chinese, Japanese, and Korean) in your high school? (Circle one)    Yes  | No

   If yes, approximately what percentage of students in your school were Eastern Asian? __________
6. Do you have close friends who are Eastern Asian (Chinese, Japanese, and Korean)? (Circle one)
   Yes | No
   If yes, how many? ______________
   Please give their last names

7. Do you have close friends who are Caucasian (European Caucasian or Hispanic Caucasian)? (Circle one)
   Yes | No
   If yes, how many? ______________
   Please give their last names

8. In general how would you rate your amount of contact with Eastern Asian people?

   1  2  3  4  5  6  7

   1 = very little  7 = very extensive

9. In general how would you rate your amount of contact with Caucasian people?

   1  2  3  4  5  6  7

   1 = very little  7 = very extensive

10. In North America some people feel that Eastern Asian people “all look the same”
    and are difficult to tell apart. Is this your personal experience as well?

    1  2  3  4  5  6  7

    1 = definitely NOT the same as my personal experience  7 = definitely the same as my personal experience.

11. In Eastern Asia (e.g. China, Japan and Korea) some people feel that Caucasian people “all look the same” and are difficult to tell apart. Is this your personal experience as well?

    1  2  3  4  5  6  7

    1 = definitely NOT the same as my personal experience  7 = definitely the same as my personal experience.
Appendix B

VANCOUVER INDEX OF ACCULTURATION

Please answer each question as carefully as possible by choosing one of the numbers to indicate your degree of agreement or disagreement.

Many of these questions will refer to your heritage culture, meaning the culture that has influenced you most (other than North American culture). It may be the culture of your birth, the culture in which you have been raised, or another culture that forms part of your background. This questionnaire was designed based on individuals, who have secondary cultural background other than Canadian/North America. If there are several such cultures, pick one that has influenced you most (e.g., Irish, Chinese, Korean, Mexican, etc.). If you do not feel that you have been influenced by any other culture, please try to identify a culture that may have had an impact on previous generations of your family.

What is your heritage culture? ______________________________

Use the following key to guide your answers to the below questions:

<table>
<thead>
<tr>
<th>Strongly Disagree</th>
<th>Disagree</th>
<th>Neutral/Depends</th>
<th>Agree</th>
<th>Strongly Agree</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
<td>5</td>
</tr>
</tbody>
</table>

1. I often participate in my heritage cultural traditions. 1 2 3 4 5
2. I often participate in North American cultural traditions. 1 2 3 4 5
3. I could be willing to marry a person from my heritage culture. 1 2 3 4 5
4. I could be willing to marry a North American person. 1 2 3 4 5
5. I enjoy social activities with people from the same heritage culture as myself. 1 2 3 4 5
6. I enjoy social activities with typical North American people. 1 2 3 4 5
7. I am comfortable working with people of the same heritage culture as myself. 1 2 3 4 5
8. I am comfortable working with typical North American people. 1 2 3 4 5
9. I enjoy entertainment (e.g., movies, music) from my heritage culture. 1 2 3 4 5
10. I enjoy North American entertainment (e.g., movies, music). 1 2 3 4 5
11. I often behave in ways that are typical of my heritage culture. 1 2 3 4 5
12. I often behave in ways that are ‘typically North American.’ 1 2 3 4 5
13. It is important for me to maintain or develop the practices of my heritage culture. 1 2 3 4 5
14. It is important for me to maintain or develop North American cultural practices. 1 2 3 4 5
15. I believe in the values of my heritage culture. 1 2 3 4 5
16. I believe in mainstream North American values. 1 2 3 4 5
17. I enjoy the jokes and humor of my heritage culture. 1 2 3 4 5
18. I enjoy typical North American jokes and humor 1 2 3 4 5
19. I am interested in having friends from my heritage culture. 1 2 3 4 5
20. I am interested in having North American friends. 1 2 3 4 5