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The effect of facial expression and identity information on the processing of own and other race faces

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Declaration

I declare this to be my own work, except for the collaboration with Peter J. B. Hancock which is included in Chapter 7.

Abstract

The central aim of the current thesis was to examine how facial expression and racial identity information affect face processing involving different races, and this was addressed by studying several types of face processing tasks including face recognition, emotion perception/recognition, face perception and attention to faces. In particular, the effect of facial expression on the differential processing of own and other race faces (the so-called the own-race bias) was examined from two perspectives, examining the effect both at the level of perceptual expertise favouring the processing of own-race faces and in-group bias influencing face processing in terms of a self-enhancing dimension. Results from the face recognition study indicated a possible similarity between familiar/unfamiliar and own-race/other-race face processing. Studies on facial expression perception and memory showed that there was no indication of in-group bias in face perception and memory, although a common finding throughout was that different race faces were often associated with different types of facial expressions. The most consistent finding across all studies was that the effect of the own-race bias was more evident amongst European participants. Finally, results from the face attention study showed that there were no signs of preferential visual attention to own-race faces. The results from the current research provided further evidence to the growing body of knowledge regarding the effects of the own-race bias. Based on this knowledge, for future studies it is suggested that a better understanding of the mechanisms underlying the own-race bias would help advance this interesting and ever-evolving area of research further.

Chapter 1

Introduction

1.1 Introduction

A human face is a visual stimulus from which viewers can derive several types of information about a person. The information available from faces can be classified into two broad categories. One type of information is perceptual, and this includes cues such as structural properties of a face (e.g. facial features and configuration), facial expressions and other person-based information that differentiates one individual from another. The other type of information is categorical, and this includes conceptual or abstracted representations of groups of people such as gender, familiarity and race. These group-based representations describe invariant feature(s) common to multiple individual persons, and social perception often starts at this level of category membership. Face perception, and social perception in general, entails the combination of perceptual and categorical information (e.g. Sanders, McClure and Zárate 2004; Smith and Zárate 1992).

Perception of faces, however, is not always accurate. Just as leading questions and misleading information can systematically distort memory reports for an original event (Loftus, Miller and Burns 1978; Loftus and Palmer 1974), there are several factors that could affect face perception and facial information processing at both perceptual and categorical levels. Investigation of the factors that may influence face perception is of practical importance, for face perception is one of the fundamental parts of human social interactions. It could also be useful in legal settings, as there are many instances of eye-witness mis-identifications leading to miscarriages of justice (e.g. Loftus 1992; Rattner 1988) and better knowledge of human face perception may help prevent such cases.

The central theme of the present research concerns face perception involving different races and factors that may influence the processing of own and other race faces. The main aim of the current research is to investigate the nature of the so-called own-race bias in face perception (i.e. a differential processing of own and other race faces) by examining facial expression and racial identity information as possible factors that could influence the processing of faces of different races at both perceptual and categorical levels.

The review which follows below will first define the term 'race' and then examine the own-race bias in face perception at perceptual and categorical levels in turn. The model of face processing by Bruce and Young (1986) will be examined next, with particular focus on the processing of identity and facial expression information. Finally research on the perception of familiar and unfamiliar faces will be examined, and the rational for using facial expression and racial identity information in the current study will be discussed.

1.2 Definition of 'Race'

1.2.1 Past Research on Race

The term 'race' is defined as a population of humans distinguished from other populations on the basis of common perceived physical characteristics, a socially-constructed cognitive concept which does not reflect biological or genetic reality (Cosmides, Tooby and Kurzban 2003; Reber and Reber 2001; Tate and Audette 2001).

Numerous researches in population genetics have attempted to pinpoint the genetic variations underlying the racial divisions, but these so far have failed to find any relationship between genetic variations in human species and race categories that are widely used in everyday lives (e.g. Caucasian, Asian, and African). Rather, findings from genetic research have shown that genetic variance within-race can be up to ten times greater than variance between different races (Nei and Roychoudhury 1982, 1993; Lewontin 1972). Research which examined physical anthropological measures of human faces also showed that the variability within a certain ethnic group was comparable to the variability between different groups (Goldstein 1979a, 1979b). These findings indicate that 'race' is not a mutually exclusive and inalterable variable, but instead it is thought to be a perception-dependent belief or a concept that describes underlying essences that differentiate humans into different categories (Tate and Audette 2001). In other words, 'race' is a concept that exists in human minds.

Findings from social psychology have indicated the existence of the concept of 'race' by showing that dimensions such as age, sex and race are encoded spontaneously and automatically when people encounter a new individual (Hewstone, Hantzi and Johnston 1991; Stangor, Lynch, Duan and Glass 1992; Taylor, Fiske, Etcoff and Ruderman 1978). These studies used a measure called memory confusion protocol (developed by Taylor *et al.* 1978), which examines the pattern of errors in recall to see if people spontaneously categorise a target individual along a dimension of interest such as race. In such an experiment, participants are first asked to form impressions of people whom they see engaged in a conversation. Participants then see a series of photos of the individuals paired with a sequence of sentences uttered by that individual. A surprise recall task is given next, and participants' task is to match each sentence with the correct individual. This task is difficult, and participants inevitably make many misattributions. By analysing the pattern of misattributions, however, it can be revealed whether participants had encoded a categorical dimension of interest during impression formation. This is because if a dimension had been encoded, people more readily confuse individuals whom they had categorised as members of the same category than if people had categorised the targets as members of different categories. For example, when the target individuals differ in race dimension (e.g. Caucasian and Asian), participants are more likely to make within-race than between-race errors if the race dimension is encoded, and if it is not encoded the probability of errors would be equal for within- and between-race categories. Although a more recent study using a similar technique indicated that race encoding is a by-product of adaptations evolved to detect coalitions and alliances, as manipulating coalitional variables decreased the extent to which race was remembered (Kurzban, Tooby and Cosmides 2001), the dimension of race seems to be in most cases encoded spontaneously even if its encoding is not always mandatory.

1.2.2 Definition of Race in the Current Research

Due to the nature of racial categories being socially-constructed and perception-dependent, in the current research racial categories of the facial stimuli were determined by self-report from volunteers from whom stimuli were taken, and racial categories of the participants who took part in the experimental studies were also determined by self-reports. Specifically, facial images taken from self-reported Caucasian (in Canada and the U.K.), Japanese Asian (in Japan) and Indian Asian (in the U.K.) people were used as stimuli, and self-reported Caucasian (in the U.K.), Japanese Asian (in Japan) and Indian Asian (in the U.K.) were recruited as participants. In the following sections the own-race bias in face perception will be examined, and past research that investigated the own-race bias as a bias affecting information at perceptual and categorical levels will be analysed in turn.

1.3 The Own-Race Bias – Influence on Perceptual Information

1.3.1 The Own-Race Bias as a Perceptual Bias

The own-race bias (also known as the other-race effect or cross-race effect) when it affects perceptual facial information refers to the tendency for people to be more accurate in perceiving and recognising differences amongst the faces of their own race than those belonging to other racial groups. This effect is robust, and has been shown in numerous experimental studies (for meta-analyses see Bothwell, Brigham and Malpass 1989; Meissner and Brigham 2001), although a complete crossover interaction between race of stimulus face and participant group is not universal and has only been shown in some studies. Sporer (2001) suggests that this may be due to differences in response criterion between two participant groups or differential item difficulty in the facial stimuli used. For example, in their meta-analysis of facial identification studies, Shapiro and Penrod (1986) reported that Black participants tended to have more lax response criterion than White participants (main effect of participant race), and White faces tended to be recognised more accurately than Black or Asian faces (main effect of face race). Because main effects of one of these factors (participant race and face race) could lead to an asymmetric interaction and potentially mask the crossover interaction, a complete crossover interaction is not a necessary prerequisite for demonstrating the own-race bias (Bothwell, Brigham and Malpass 1989).

1.3.2 The Own-Race Bias in Face Recognition

Typically, findings showing the own-race bias come from old/new recognition memory experiments in which people are shown a set of faces of both own and other races and then later shown a second set of faces. The second set contains some of the old faces with additional novel ones, and people usually distinguish the old from new faces more accurately if the faces are from their own, more familiar than from unfamiliar other races (e.g. Chiroro and Valentine 1995; Furl, Phillips and O'Toole 2002; Valentine and Endo 1992). For example, the old/new recognition memory study by Valentine and Endo (1992) used British and Japanese facial stimuli with British and Japanese participants, and it was found that British faces were recognised more accurately by British participants while Japanese faces were better recognised by Japanese participants (although the main effect of face race was significant and both British and

Japanese participants recognised British faces more accurately than Japanese faces). The own-race bias has also been shown in a setting closer to real-life situations. One study by Wright, Boyd and Tredoux (2001) used Black and White confederates who approached Black and White people in shopping centres in South Africa and England. Using methods similar to those used in criminal investigations, participants in both countries were later asked to identify the confederate from a sequential line-up (photographs are shown one at a time) or a forced-choice recognition test (photographs are shown simultaneously). It was found that the confederates were recognised more accurately when the race of the participant and the confederate were the same, and this trend was present in both countries with both identification tasks. Findings from these memory studies show the influence of the own-race bias on retrieval or memory stage of face processing.

Some evidence suggests the importance of the inter-racial contact in mediating the own-race bias in face recognition. For example, Chiroro and Valentine (1995) had Black and White participants with high and low contact with other-race faces in their recognition memory study using Black and White faces. It was found that the effect of the own-race bias was smaller in high-contact compared with low-contact groups. Using Black and White faces with Black and White participants, the recognition memory study by Wright, Boyd and Tredoux (2003) also found a positive correlation between cross-race recognition accuracy for Black participants and self-reported inter-racial contact. These findings suggest that the cross-race recognition deficit may be closely related to the quality/quantity of contact people have with other-race faces.

1.3.3 The Own-Race Bias in Emotion Recognition

The own-race bias has also been documented in the recognition of emotional facial expressions. For example, Kito and Lee (2004) compared British and Japanese people's ability to decipher non-verbal, interpersonal relationships depicted by Japanese people in photographs. It was found that, compared with British participants, Japanese participants were generally better at understanding subtle information provided by facial expression to decipher interpersonal relationships. A meta-analysis of emotion recognition by Elfenbein and Ambady (2002) also showed that, although the basic emotions were recognised universally at better than chance levels, the recognition accuracy for emotion was higher when emotions were expressed and perceived by members of the same 'cultural' (national, racial or regional) groups. The authors suggested that this in-group advantage seems to arise due to greater exposure people have with emotional expressions expressed by the familiar cultural group, and subtle differences in expressive style across different cultural groups may underlie the in-group advantage. In the meta-analysis, cultural familiarity was found to affect the magnitude of the in-group advantage, as the in-group advantage was smaller for cultural groups that had more cross-cultural contact than those groups living across different cultures. Just as familiarity with different races modulates people's ability to differentiate face identities, familiarity with emotions in different cultural groups also seems to influence people's ability to distinguish facial expressions.

Moreover, the in-group advantage in emotion recognition seems to be independent of biological or ethnic factors, as indicated in a study by Elfenbein and Ambady (2003). In this study, participants from China and United States were deliberately sampled in order to examine the effect of cultural exposure on emotion recognition systematically. Participants were classified into four groups, depending on their level of exposure to China and the United States, and these included (a) Chinese students living in China, (b) Chinese students living in the United States, (c) Chinese Americans and (d) Americans of non-Asian ancestry. Photographs of facial expressions from both Chinese and American people were prepared, and emotion recognition accuracy was measured in a forced choice task. The relative advantage in recognising emotions in American photographs was compared across the four participant groups, which showed that Chinese people (Chinese students and Chinese American) living in the United States and American people both recognised emotions in American faces more accurately than in Chinese faces, while Chinese people living in China were less accurate in recognising American emotions. This finding indicates that observers were more accurate in judging emotions expressed by a cultural group with which they were most familiar, irrespective of whether or not the cultural group was their 'own-race'. In most circumstances, however, the cultural group people have most exposure with is likely to be one's own racial group.

Although differences in subtle expressive style between members of different races seem to account for some of the in-group advantage in emotion recognition, recently Thibault, Bourgeois and Hess (2006) suggested that decoder biases, such as the difference in the level of group identification, may also affect the pattern of in-group advantage in emotion recognition. In this study, Caucasian participants were shown Caucasian and African faces showing different facial expressions (happiness, sadness and anger) and were asked to identify the facial expression. Here, half of the participants were basketball players and the other half non-basketball players. The crucial manipulation was that half of the faces were labelled as basketball players, and the other half was labelled as non-players, which were counterbalanced across player and non-player participants. The results showed that participants described as basketball players were more accurate in decoding facial expression exhibited in faces labelled as basketball players than in faces labelled as non-players, although the labelling of player/non-player in face stimuli was counterbalanced. The results from non-player participants showed that they were better at decoding facial expression in faces labelled as non-players that belong to their own racial group (i.e. Caucasian faces). Thus the results showed that people were better at understanding emotions expressed by those that belong to a group they identify with, even when the expressiveness of the faces was equal between in-group and out-group. It was suggested that a motivational factor, such as people's willingness to invest effort into decoding the expressions of members of groups they identify with, may also account for the in-group advantage in emotion recognition.

1.3.4 The Own-Race Bias in Face Perception

Anecdotal evidence, illustrated in statements such as "they all look alike to me", also suggests that people have difficulty in perceiving as well as recognising the characteristics of other-race faces. For example, Lindsay, Jack and Christian (1991) used a delayed match-to-sample task involving African American and White faces with African American and White participants. On each trial participants saw a target face followed by a mask, which was then followed by a test pair composed of the target and a novel face, and the task was to choose the previously shown target. It was found that White participants performed less accurately on trials involving African American faces, while there was no such racial difference amongst African American participants. Based on this finding, authors suggested that perceptual skills or expertise specific to the processing of own-race faces underlie the own-race bias. Another study by Walker and Tanaka (2003) used a sequential same/different discrimination task and found that Asian and Caucasian participants more accurately detected differences in own than other race faces. Here, the original Caucasian and East Asian faces were morphed together on a linear continuum by 10% increment, creating nine intervening morphed faces between the two original 'parent' faces. Participants first saw either East Asian or

Caucasian parent face followed by either the same parent face or a different morphed face consisting of 90%, 80%, 70%, 60% or 50% contribution from the parent face and the remaining percent contribution provided by the other parent face. The task here was to decide whether the second face was the same or different from the first face, and Asian and Caucasian participants' performance on the discrimination task was evaluated by assessing the number of correct rejections for Asian and Caucasian faces. The results showed that participants were better able to discriminate the differences in their own-race faces. Findings such as these suggest that the difficulty people have with other-race faces is present at the encoding (perceptual) level as well as at the level of retrieval or memory.

Recently, Tanaka, Kiefer and Bukach (2004) suggested that the own-race bias may be due to less efficient holistic encoding of other-race faces with less expertise. In this study, Caucasian and Asian faces (presented either whole or in isolation) were used in a two-alternative forced-choice paradigm. Caucasian and Asian participants first saw a target face followed by a mask, and then saw a test pair composed of the target and a foil, and the task was to choose the target shown during the study phase. On half of the trials, target and foil stimuli were presented in whole faces which varied by one internal feature (eye, nose or mouth), and for the rest target and foil were the changed face parts only, shown in isolation. It was found that Caucasian participants were more accurate in matching Caucasian faces shown in the whole face than in isolation, while with Asian faces there was no reliable difference in performance between the two test conditions, indicating that Caucasian participants processed own-race faces more holistically than Asian faces. Asian participants, on the other hand, did not show a differential pattern of performance for both race faces whether shown in whole or in isolation, indicating that the level of holistic encoding in Asian participants was equal for both race faces. In this study, participants' relative experience with own and other-race faces was also measured. Caucasian participants reported extensive exposure to own-race faces and relatively little contact with Asians, while Asian participants reported similar levels of contact with both Asian and Caucasian people, showing that the amount of racial experience mirrored the pattern of holistic encoding in the two participant groups. Based on these findings, the authors suggested that expertise in processing own-race faces may influence holistic processing, and the own-race bias may be a result of differential holistic encoding of own-race face (or faces from a highly familiar racial group) compared with faces that are less familiar.

A study by Schuchinsky and Murray (2005), however, showed that processing of local representation of configural information (which can be accessed independent of face orientation) is influenced by expertise in processing own-race faces. Here, a simultaneous paired-comparison paradigm was used, and Caucasian participants saw Caucasian and Chinese faces in which interocular distance was either unaltered or distorted by 10%, and participants made same-different decisions for pairs of faces. For both race faces, stimuli were varied in terms of face version (whole or partial) and orientation (upright or inverted). Results from Caucasian participants showed that accuracy was higher for own-race Caucasian faces than other-race Asian faces, irrespective of face version or orientation. Thus these findings suggest that race expertise not only influences holistic encoding of configural information but it also affects the local encoding of facial configuration.

1.3.5 The Own-Race Bias and Attention to Faces

A recent study by Humphreys, Hodsoll and Campbell (2005) examined the effect of the own-race bias during the attentional stage of face processing. Here, the own-race bias in face perception was examined in a change blindness study using a flicker paradigm.

Caucasian and Indian Asian participants viewed natural scenes containing Caucasian and Indian Asian people and objects. Participants were shown two images with one blank in between, which alternated very quickly. The two images were identical except for one change made to one of the images, and the change was made either to a face (Caucasian or Asian), to body parts (Caucasian or Asian) or to objects in the background. Participants were asked to respond when they detected the change made to the scenes and reaction times were recorded. It was found that changes made to faces were detected faster than changes in body parts, which were detected faster than changes in the background. Moreover, it was found that both Caucasian and Indian Asian people detected changes made to own-race faces faster than changes in other-race faces, but there was no racial difference in detecting changes made to body parts. Based on the results showing that participants of both races attended equally to the changes in body parts of own and other races, the authors concluded that the crossover effect in detecting changes in faces was due to participants attending to both own and other race faces equally, but were less sensitive to changes made in other-race faces. It was suggested that change detection requires perceptual mechanisms that allow visual information to be differentiated in memory, as well as attention to this visual information. Given that the own-race bias is already present at the encoding stage of face processing (e.g. Walker and Tanaka 2003) this is a very probable explanation. However, another possibility would be that people may have differentially attended to own-race faces over other-races. In this study it was assumed that Caucasian and Asian participants attended equally to the two races in the scene (based on the results showing the equal processing of own and other race body parts) and attention to different race faces was not directly examined. Therefore, the possibility of differential attention to own-race faces still remains and this issue requires further investigation.

1.4 The Own-Race Bias – Influence on Categorical Information

1.4.1 Race as a Social Category

The own-race bias also affects facial information related to race at the categorical level. 'Race' and other group-based information (such as age or gender) are abstracted through a process called social categorisation, the process which divides the social world into two separate 'in-group' and 'out-group' categories (Hogg and Abrams 1988). Social categorisation is a fundamental process in social perception, and categorisation can take place on several social dimensions including race. One consequence of social categorisation is the emergence of in-group bias, a social-cognitive bias that affects person perception including face perception involving different races.

1.4.2 In-group Bias and Ethnocentrism

In-group bias is the tendency for people to favour their in-group members over members of out-group in such instances where distribution of positive outcomes (e.g. rewards) or social judgements about the characteristics of other people are required (for a review see Brewer and Brown 1998). In general, people tend to hold more positive views about their in-group members, and several studies have shown people's biased attribution of socially desirable characteristics towards the in-group. For example, Johnson (1981) showed that supporters of major political parties in Canada tended to choose photos of more attractive individuals as depicting supporters from their own party, while photos of less attractive individuals were more likely to be attributed to supporters of rival political parties.

When the strong discriminative nature of in-group bias is specifically related to the social dimension of 'race', it is sometimes termed as ethnocentrism, which has been shown experimentally (e.g. Hewstone and Ward 1985; Taylor and Jaggi 1974). In one recent study, Rustemli, Mertan and Ciftci (2000) asked native and immigrant Turkish Cypriots to judge the applicability of certain trait characteristics. It was found that both groups of people judged the positive traits (e.g. loyalty, honesty and reliability) to be more applicable to their respective in-group members than members of the out-group.

Some evidence suggests that socially valued emotional expressions are more often associated with in-group than with out-group members. For example, Gaunt, Leyens and Demoulin (2002) found that people tended to attribute more subtle and complex emotions to in-group than to out-group members. Here, the authors classified emotions into two broad categories: primary and secondary emotions. Primary emotions (e.g. anger and surprise) were regarded as basic emotions experienced by both humans and other species, while secondary emotions (e.g. hope and admiration) were thought to be more subtle and complex emotions that are uniquely human. In this study, Belgian participants' memory associations for primary and secondary emotion words with in-group (Belgians) and out-group (Arabs) members were tested. Participants were first shown pairs of words consisting of one emotion word (primary or secondary) and one group label (Belgians or Arabs). The group label was always presented in its normal form, but the emotion word was presented as an anagram, and participants were asked to solve each anagram as quickly as possible. A surprise recognition memory test followed, which included pairs of words presented in the first phase as well as new pairs of words. It was found that conscious memory for secondary emotion words was better when paired with out-group than in-group label, while no such difference was found for memory for primary emotion words. The authors concluded that, because the association between in-group and secondary emotion was more consistent with people's general beliefs about their own group members, people tended to have better conscious memory for pairs between secondary emotions and out-group label which were less expected and more memorable. The absence of memory differences for primary emotions between two group categories on the other hand ruled out the possibility of people attributing more emotions to their in-group in general. Taken together, the results suggested that people generally attribute more uniquely human emotional characteristics to their in-group than to out-group.

Moreover, this in-group ‘ethnocentric’ bias has also been seen in the attributions of smile to own-race over other-race faces (Beaupré and Hess 2003). In this study, European, African and Asian participants were asked to read a short story describing a protagonist in a non-emotional situation (e.g. “Marc/Anne is alone in a room sitting in front of a computer screen while the computer is starting up.”). Participants were then asked to choose one of six facial expressions, which participants regarded as most appropriate to the context, from a set showing a person of either European, African or Asian descent. These six facial expressions included smiles showing different intensities (strong, high-medium, low-medium, weak), a miserable smile (with a frown) and a neutral face. The results showed that participants from all three groups tended to attribute smiling expression more often to their respective in-group members than members of out-group, to whom neutral faces were more often attributed. The finding thus indicates that in-group bias in attributing socially valued emotions is seen not only for a conceptual notion of ‘race’, but it also has impact on the attribution of socially valued emotions to own and other race ‘faces’.

1.4.3 Underlying Cause of In-group Bias

It has been suggested that in-group bias may be the result of people’s need to establish and enhance their self-esteem, by positively identifying with in-group while differentiating (often negatively but not necessarily so, see Brewer 1999) from the out-group (e.g. Tajfel and Turner 1986). The bias may in turn determine the dimension of comparison between ‘groups’ to those self-enhancing dimensions (Hogg and Abrams 1988). Self-esteem is the self-evaluation made by each individual, and one of the reasons people engage in this act is its function of self-enhancement (Sedikides 1993). It is suggested that a person seeks favourable self-knowledge when evaluating him/herself, which can be achieved by engaging in relative comparison at two levels, individual and group. Social comparison theory by Festinger (1954) describes comparison at the level of individuals. It holds that there is a universal human drive to evaluate one’s opinions and abilities, which is achieved by comparing oneself with others who are perceived to be similar in relevant aspects of comparison. Evaluation at the level of group is also possible. Social identity theory (e.g. Tajfel 1982; Tajfel and Turner 1986) is an extension of social comparison theory, developed to account for the presence of asymmetry favouring the in-group by applying the social comparison process to group level. The theory supposes that the drive to have a positive self-concept is linked with positive identification with the in-group, which results in in-group bias. The outcome of inter-group comparisons is critical in maintaining high self-esteem and positive self-concept, and thus comparison tends to be emphasised when the in-group shows a clear advantage over the out-group, thus determining the dimension of comparison. For example, Cialdini, Borden, Thorne, Walker, Freeman and Sloan (1976) found that college students were more likely to wear college insignia after the victory of their football team than on days following a defeat. The willingness to be identified as a part of a group was linked to the group’s success, showing that categorisation and identification only occurs when it is self-enhancing.

In contrast, when comparison involves a dimension that is not self-enhancing (e.g. negative characteristics associated with in-group or positive characteristics associated with out-group), three strategies could be taken to prevent any self-degrading effect of categorisation (Hogg and Abrams 1988). One could find new comparison dimensions that serve self-enhancement, redefine the negative value attached to the in-group as something positive, or compare with another out-group with lower status than one's own. In some instances, however, such strategies may not be possible. For example, if witness identification is required for a suspect belonging to an own-race category (who attacked a victim from an other-race category), one is faced with, and cannot ignore, the race comparison dimension. In such cases, it is imaginable that perception (and memory) may become distorted to serve self-enhancement such that the suspect is remembered as a representative of the out-group rather than the in-group category.

1.5 The Model of Face Perception

1.5.1 Bruce and Young (1986) Model

In the last two sections a very specific area of face research was examined, namely, the own-race bias in face perception at perceptual and categorical levels. Before undertaking research in this specific area of face perception, however, it is important and useful to examine what current scientific knowledge can offer regarding face perception in general. In the sections that follow below, the classic model of face processing by Bruce and Young (1986) will be examined, with particular focus on the processing of identity and facial expression information and familiar/unfamiliar face processing.

1.5.2 Independent Processing of Identity and Expression Information

In an influential model of face processing by Bruce and Young (1986), the processing of specific types of facial information available (e.g. facial identity, emotional expression and facial speech) operates in parallel and independently in specialised functional modules. Evidence from several empirical studies supports this view of functional independence, in particular the independent processing of identity and expression. For example, using single-unit recordings of the cells responsive to faces in the monkey temporal cortex, neurophysiological findings have shown the existence of cells selectively responsive to either identity or expression, which are localised in different cortical regions. Neurons responsive to identity are primarily found in the inferior temporal gyrus, while neurons responding to expressions are located in the superior temporal sulcus (Hasselmo, Rolls and Baylis 1989; Perrett, Smith, Potter, Mistlin, Head, Milner and Jeeves 1984). The dissociation between identity and emotion processing has also been found in several neuropsychological findings, in which some prosopagnosic patients show impaired facial identity processing but relatively intact emotion recognition ability (Bruyer, Laterre, Seron, Feyereisen, Strypstein, Pierrard and Rectem 1983; Tranel, Damasio and Damasio 1988), while in other cases some patients show impaired judgements of facial expressions with intact facial identity processing (Humphreys, Donnelly and Riddoch 1993; Parry, Young, Saul and Moss 1991). Supporting evidence also comes from neuroimaging studies. For example, Sergent, Ohta, MacDonald and Zuck (1994) showed the activation of different brain regions during perception of facial identity (activation primarily in the ventro-medial part of the right hemisphere including the limbic system) and emotion (predominantly in the dorsal region of the limbic system) in a positron emission tomography (PET) study. Findings from event-related potential (ERP) studies have also shown differential time sequence and distribution of effects related to the processing of identity and expressions. For example, Münte, Brack, Grootheer, Wieringa, Matzke and Johannes (1998), using identity and expression matching tasks, found that the earliest ERP effects for identity matching tasks came earlier than expression matching tasks (around 200ms for identity and 450ms for expression tasks), and also found differential scalp distribution for identity (fronto-central effect) and expression (centro-parietal effect) matching tasks.

Finally, evidence is also available from experimental psychology. A study by Etcoff (1984) showed that people can selectively attend to either identity or expression without interference from the irrelevant stimulus dimension in Garner-type speeded classification tasks. Here, the two stimulus dimension of expression (happy or sad) and identity (person A or B) were either correlated (e.g. person A always shows happy expression, person B always shows sad expression), constant (e.g. person A shows both happy and sad expressions) or orthogonal (e.g. both person A and B show happy and sad expressions equal times). It was found that sorting times were not affected by different task conditions, indicating a relatively independent processing of identity and expression dimensions. Other experimental studies also showed that there was no effect of face familiarity on reaction times (RTs) in tasks that involved speeded judgements of emotional expressions (Bruce 1986; Young, McWeeny, Hay and Ellis 1986). All these findings point towards the notion that processing of identity and expression information is largely independent.

1.5.3 Interaction between Identity and Expression Information

More recently, however, several studies have indicated a possible interaction between facial expression and identity processing. For example, Endo, Endo, Kirita and Maruyama (1992) examined the effect of different facial expressions on recognition latency for personally familiar and famous faces. The results showed that personally familiar faces were recognised faster when presented with neutral rather than happy or angry expressions, whereas famous faces were recognised faster with happy than neutral expressions. The findings were explained in terms of typical expression with which different types of familiar faces are frequently observed; famous faces are more often seen with happy expressions whereas personally familiar faces may be more frequently observed in neutral expression. Furthermore, Baudouin, Gilibert, Sansone and Tiberghien (2000) found that smiling compared with neutral expression increased ratings of familiarity for both unfamiliar and famous faces. This indicates that a happy expression falsely increases the sense of familiarity in faces that are unfamiliar. Similarly, Garcia-Marques, Mackie, Claypool and Garcia-Marques (2004) found that, compared with novel faces with neutral expression, smiling novel faces were more likely to be incorrectly judged as familiar. Another study by D'Argembeau, Van der Linden, Comblain and Etienne (2003) showed that unfamiliar faces that had been learned with happy rather than angry expression were recognised better when tested with a neutral expression, a result which was only present in intentional and not in incidental learning condition. Finally, using Garner-type speeded classification tasks with identity and expression as two stimulus dimensions and comparing reaction times, Schweinberger and Soukup (1998) found that task-irrelevant variations in facial expression did not interfere with identity classifications, while expression classifications were influenced by face identity using unfamiliar faces. This finding was also replicated by Schweinberger, Burton and Kelly (1999) using unfamiliar morphed faces. Recently, however, expression has also been shown to influence familiarity judgement, at least in familiar famous faces. Using both familiar and unfamiliar faces that were morphed from happy to angry expression within a given identity, Kaufmann and Schweinberger (2004) found that reaction times for classifications of familiar faces were fastest with moderately happy expressions, whereas reaction times for classifying unfamiliar faces were independent of facial expressions. Moreover, Ganel and Goshen-Gottstein (2004) showed a Garner interference effect from expression to identity as well as from identity to expression in familiar but not in unfamiliar faces. Taken together, these findings cast some doubt into the notion of clear dissociation between the processing of identity and expression, and instead suggest that facial identity and emotional expression processing may sometimes interact in some conditions. In particular, a happy expression seems to be associated with familiarity, having a facilitative effect on the processing of identity in familiar faces, and a detrimental effect due to the increase in perceived familiarity (falsely) in the processing of unfamiliar faces.

1.6 Perception of Familiar and Unfamiliar Faces

1.6.1 Familiar and Unfamiliar Face Processing in the Bruce and Young Model

Originally the model of face processing by Bruce and Young (1986) was mainly developed to describe the processes underlying familiar face perception. However, the model does describe the differences between information available from familiar and unfamiliar faces when recognising facial identity. It is suggested that seven types of information (codes) are available from faces, which are the products of the processing in functionally independent components that underlie the recognition of facial identity, emotional expression and facial speech. In recognising facial identity, two types of codes are involved: pictorial and structural. A pictorial code is essentially a two-dimensional image of a face. This code captures the static pose or expression of a face as well as details of lighting, grain and possible imperfections in a photograph. A match at the level of pictorial code is useful in recognising an identical picture from memory, but pictorial code alone would not be sufficient to subserve face recognition when there are changes in, for example, head angle, lighting, and expression. A structural code, on the other hand, captures the essential aspects of facial configuration that distinguish one face from others. It corresponds to a three-dimensional and (to some extent) view-invariant representation of a face and it can be used to recognise faces despite changes in facial expression, angle, lighting and so on. In this model, the recognition of identity is thought to be based primarily on the formation and the use of structural codes, which are essential in distinguishing one face from another. Although pictorial codes can be useful in mediating recognition tasks in studies of episodic memory where identical pictures of previously unfamiliar faces are used at presentation and test, face recognition in its true meaning requires structural codes which are more abstract representation of faces that can survive changes in viewing conditions necessarily involved in everyday face recognition. Recognition of identity is thought to take place when there is a match between the current and the stored structural codes, or in other words, 'what we see matches what we stored'. Here, it is thought that different processes underlie recognition of familiar and unfamiliar faces, because structural codes for unfamiliar faces by definition are not yet present when people encounter unfamiliar faces for the first time. Essentially, the difference between structural codes for familiar and unfamiliar faces lies in the 'richness' of the structural codes. It is thought that for familiar faces, there are rich and elaborated structural codes due to frequent exposure with the faces already represented in what Bruce and Young termed face recognition units (FRUs). With unfamiliar faces, however, it is thought that the richness of the structural codes are limited by the conditions in which facial information is extracted when unfamiliar faces are encountered for the first time, such as whether or not varying views and/or facial expressions were seen.

1.6.2 Research on Familiar and Unfamiliar Face Perception

The distinction between pictorial and structural codes was demonstrated in a study by Bruce (1982) who investigated how changing the view of faces affected recognition accuracy and response latency for both familiar and unfamiliar faces. Here, participants were presented with personally familiar and unfamiliar photographs of faces, and were asked to remember the faces for a recognition test later. At test, the faces were either changed in their angle and expression or remained the same, and novel faces were also added. It was found that unfamiliar faces were recognised less accurately and more slowly when there was a change in view between learning and test, whereas with familiar faces there was no difference in the recognition accuracy between view-changed and the original faces, although changing views reliably increased the response latency. The pattern of results from unfamiliar faces suggests that people are not good at forming a structural representation from a single picture of a face that allows recognition of the same identity in a novel viewpoint. With reference to Bruce and Young's model, it appears that successful unfamiliar face recognition depends on the quality of initial exposure to establish adequate structural codes and the degrees of pictorial similarities between the learning and the test faces. With familiar faces, on the other hand, people were able to extrapolate to a novel viewpoint without reducing the recognition accuracy, which might be due to the already established structural code (in FRUs) for familiar faces. Although changing views did not affect recognition accuracy in familiar faces, it did reliably increase the response latency. This implies that there must be an additional retention of episodic characteristics of previously known faces even when invariant structural details are sufficient for later recognition decision. Thus these findings indicate the existence of both pictorial and structural codes mediating recognition for familiar and unfamiliar faces.

As indicated in the study by Bruce (1982), and shown in several other studies, people are generally good at identifying familiar faces even in impoverished viewing conditions but performance for recognising, or even matching, unfamiliar faces suffers dramatically when there is a change in lighting, viewpoint, or expression between images (see Hancock, Bruce and Burton 2000 for a review). For example, performance in matching a target image taken from video clip with arrays of photographic stills was extremely good when the viewer was familiar with the target, and this was even true when the target images were taken from very poor quality video (Burton, Wilson, Cowan and Bruce 1999). However when unfamiliar faces were used, this task turned out to be very difficult for the viewers, even when high quality video images were used and viewpoint and expression were also matched. In addition, changes in viewpoint or expression led to more errors (Bruce, Henderson, Greenwood, Hancock, Burton and Miller 1999). The difficulty in matching images of unfamiliar faces is seen even when people are asked to match a target face from a video against a pair of photographs, one a slightly different picture of the target and the other a distractor of similar appearance (Henderson, Bruce and Burton 2001). This suggests that the number of distractor items has no significant effect on the difficulty people have when matching unfamiliar faces. Rather, it indicates that the difficulty arises due to the degree of similarities between variations within one identity (similarity between one and another image of the target person) and variations between the target and the distractor. It seems that unfamiliar face processing is problematic when the differences between images of the same identity outweigh the differences between two identities.

1.7 The Current Research

1.7.1 Aim and Rationale

The aim of the current research is to investigate the nature of the so-called own-race bias in face perception by examining facial expression and racial identity information as possible factors that could influence the processing of different race faces at both perceptual and categorical levels. Face perception involving different races, and face processing in general, entails the combination of perceptual and categorical information. However, past research on the own-race bias in face perception tended to study the effect either from a perceptual or a categorical viewpoint and the two are rarely studied in the same framework. The current studies will therefore examine the own-race bias in face perception from both perspectives, as a perceptual expertise that differentially affects the processing of different race faces, and as an 'ethnocentric' in-group bias that may influence racial face processing in terms of a self-enhancing dimension. Moreover, where appropriate the own-race bias from two perspectives will be examined in the same study.

The current studies will examine facial expression and racial identity information as possible factors that affect the own-race bias in face perception. Facial expression and racial identity information were selected because the two types of information can serve as common variables that could potentially affect the own-race bias as perceptual expertise or as in-group 'ethnocentric' bias.

1.7.2 Facial Expression and Racial Identity – Effects on Perceptual Expertise

As considered above, several studies have examined the role of expression and identity information on familiar and unfamiliar face processing. One of the goals in the current experiments is to examine whether the differential degree of familiarity people have with the faces unfamiliar to them (e.g. own and other race faces) would influence unfamiliar face processing such that it parallels the pattern that has been observed in the processing of familiar (personally or famous) and unfamiliar faces from a single race. According to the model of face processing by Bruce and Young (1986), strictly speaking there should be no pre-experimentally established structural codes for either own or other races in FRUs to aid identity processing, if both race faces used were unfamiliar. However, several findings showing the own-race bias in face perception and recognition clearly indicate that processing of own-race faces is superior to that of other-race faces. This may imply that people are better at constructing rich and enduring structural codes for (unfamiliar) own-race faces that subserve sufficient face processing due to the degree of familiarity people have with own-race compared with other-race faces. If this were the case, then an analogy between the processing of familiar/unfamiliar and own-race/other-race may hold. Thus some of the current experiments replicated the past studies that directly compared the processing of familiar and unfamiliar faces using unfamiliar Japanese and European faces both in Japan and in the U.K., with a view to investigating the possible similarity in the patterns of processing between familiar/unfamiliar and own-race/other-race face perception and memory. In particular, past research that looked at identity and expression processing were replicated, as these two factors were shown to differentiate familiar and unfamiliar face processing.

1.7.3 Facial Expression and Racial Identity – Effects on In-Group Bias

Another aim of the current research was to examine the own-race bias from a social-cognitive perspective, that is, the own-race bias as in-group bias in relation to faces. As seen earlier, some studies showed the effect of in-group bias as an increase in the attribution of positive emotions to in-group own-race members (e.g. Beaupré and Hess 2003; Gaunt, Leyens and Demoulin 2002). Whether the same effect would be seen in perception and memory for different race faces still awaits empirical investigation, and this will be investigated in the current studies in Japan and in the U.K. using Japanese and European faces. The common prediction will be that perception of and/or memory for own and other race faces will be distorted to serve self-enhancement. Here, facial expressions and racial identity information are used to provide people a means for differentiating two groups for the purpose of self-enhancement. It was predicted that positive facial expressions (e.g. happy) would be associated more often with perception/memory for own-race faces, compared with other-race faces which may be associated with neutral or, if available, negative facial expressions (e.g. angry).

1.8 Structure of the Thesis

In Chapter 2 below, the general methodology regarding the use of two programs (used for image transformation and image presentation) employed in some of the experimental studies will be briefly described. The experimental chapters that follow will then examine the own-race bias in face perception from both perceptual and categorical perspectives, by employing tasks involving identity recognition, emotion perception/recognition, face perception and attention related to different races. In Chapter 3, two experiments which looked at identity recognition memory for own and other race faces will be described, and the similarity between familiar/unfamiliar and own-race/other-race face processing will be examined. Chapter 4 will describe two experiments that looked at perception and memory for facial expressions in own and other race faces, and the possible influence of ethnocentric bias in emotion processing involving different races will be examined. In Chapter 5, one experiment that looked at the relationship between facial expression and perception of face typicality in own and other race faces will be examined, following results from Chapter 3 and Chapter 4 that indicated the possibility of differences in typical facial expression for different race faces. Chapter 6 will describe two experiments that looked at the effect of the own-race bias at the encoding level of face processing, with reference to the processing of identity and expression information. In Chapter 7, one experiment which investigated the possible effect of the own-race bias on attention to different race faces will be examined by analysing people's eye-movements to faces of own and other race faces. Finally, Chapter 8 will summarise the results from studies in Chapter 3 to Chapter 7, evaluate the findings and provide discussions and conclusions.

Chapter 2

General Methodology

2.1 General Methodology

2.1.1 Overview

This section is intended to provide the reader with some general information regarding the software used for stimuli preparation and presentation in some of the experiments described in the following chapters. The sections below will briefly describe the general methodology regarding image transformation software (PsychoMorph 8.3), used for stimuli preparation, and an interactive image display program, employed for stimuli presentation. These programs were used in Experiment 3 and Experiment 4 in Chapter 4 and Experiment 7 in Chapter 6.

2.1.2 Image Transformation Software (PsychoMorph 8.3)

PsychoMorph 8.3 is image transformation software developed by B. P. Tiddeman at the University of St Andrews. This software can be used to create facial templates, and these templates are in turn used to construct facial averages (prototypes), apply facial transformations onto images, and create sequences of facial images based on facial transformation. The software was used for preparing stimuli used in Experiment 3 and Experiment 4 in Chapter 4 and Experiment 7 in Chapter 6.

Delineating Facial Images and Creating Templates

Facial templates are created by manually marking (delineating) 179 feature points on facial images. Such feature points define the main facial features (e.g. eyes, nose and mouth) and the outline (e.g. jaw line, hair line) of a face, and the outline points can also be used to mask each face to remove background and hair. Figure 2.1 shows examples of an original face image, the original face after delineation and the template only. The outmost hair points are usually not delineated but placed to set an approximate boundary between the face and the background. In Figure 2.2, a masked version of the original face is shown with the template superimposed.

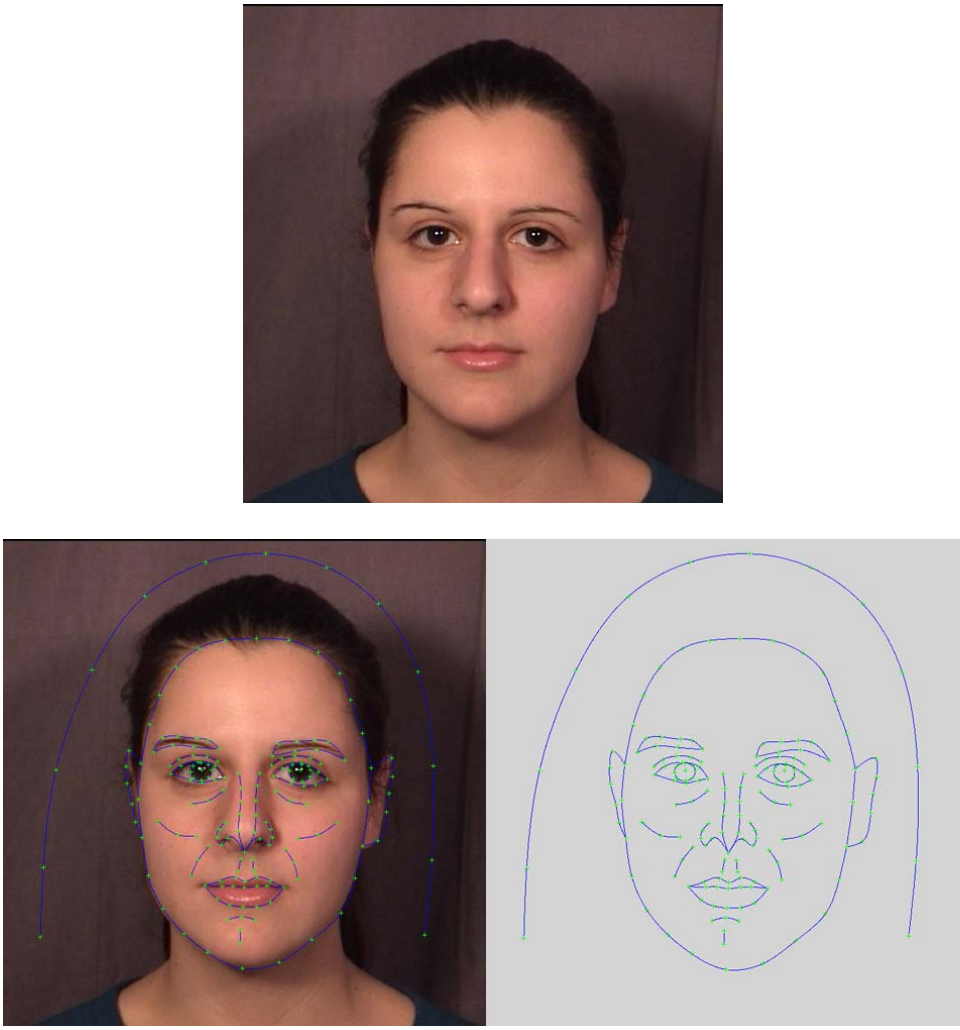


Figure 2.1 An illustration of facial delineation: Top=original face, Bottom Left=original face with template, Bottom Right=template.

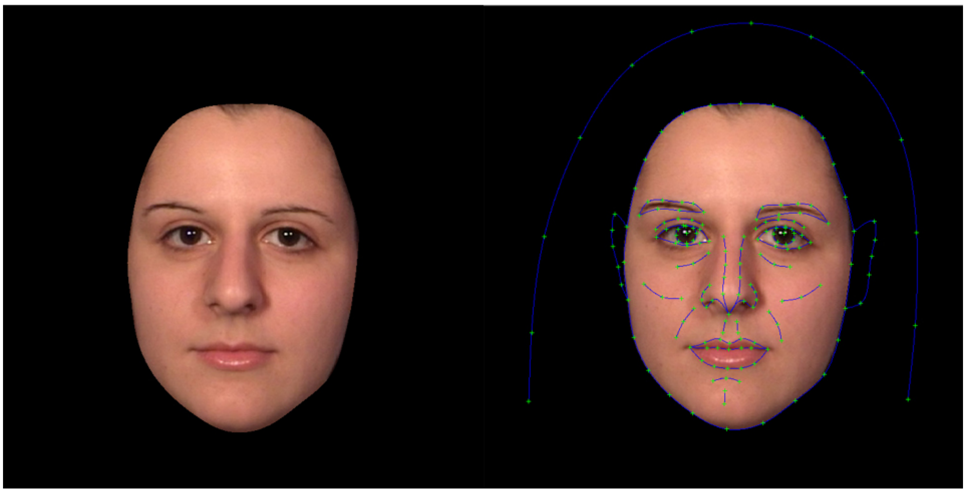


Figure 2.2 An illustration of facial masking: Left=masked original face, Right=masked original face with template.

Constructing Facial Averages (Prototypes)

Facial averages (prototypes) are constructed by averaging sets of facial images in terms of 2D shape and pixel colour (Tiddeman and Perrett 2001; Tiddeman, Burt and Perrett 2001). The first step in prototype construction is the delineation of faces (Figure 2.3).

Figure 2.3 Delineation of original images (here three faces are shown for illustration purposes only).

Figure 2.4 shows the steps involved in prototype construction. First, a set of images (here, European female) are delineated (there were 25 images in total, three are shown). The average shape is found by averaging the position of each delineated point across the image set. Original images are then warped based on the average shape, and the mean colour is calculated at each pixel and blended into the images. Warped images are then averaged together to create the final prototype image (European female prototype).

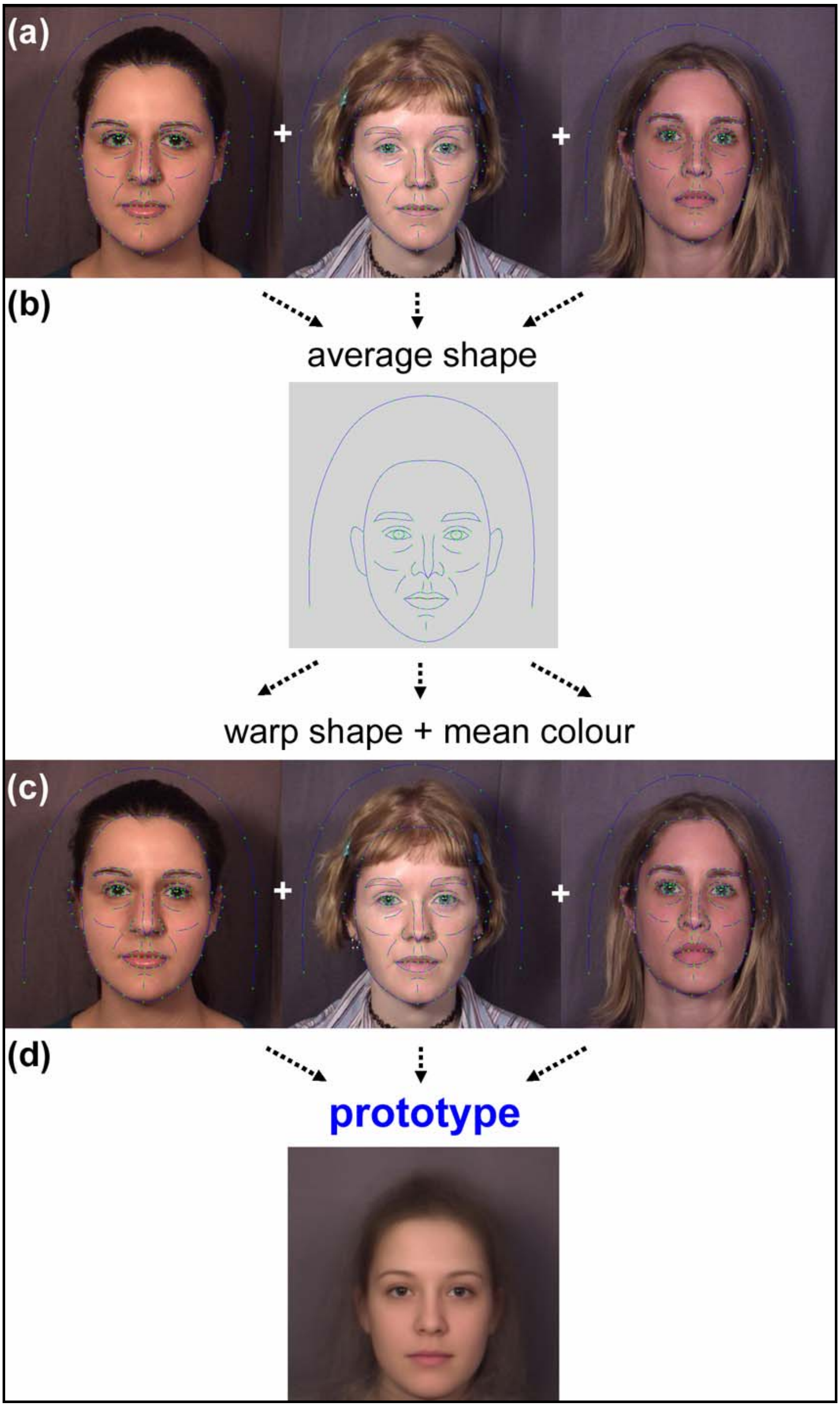


Figure 2.4 An illustration of prototype construction process: (a) original images are delineated, (b) average shape is calculated, faces are warped into average shape and mean colour is added, (c) warped images are averaged to create (d) a prototype image.

Applying Facial Transformations

As seen in the previous section, prototypes can be created for different types of groups (e.g. male and female, European and Japanese) by averaging face images belonging to different categories, and these prototypes define typical differences between such categories. These differences can be applied to a delineated individual face to create a new transformed face. The first step of facial transformation is the normalisation of the position of the two prototypes (source and destination) to the original image. The source is usually of the same class as the original image undergoing the transformation. Next the differences between the source prototype and the destination prototype is calculated, scaled if desired, and added to the original image to create a new transformed image. Figure 2.5 shows an example of facial transformation process using a female European as the original face. Differences between two prototypes (female Asian and European prototypes) are calculated and applied to create the new image with Asian facial transformation.

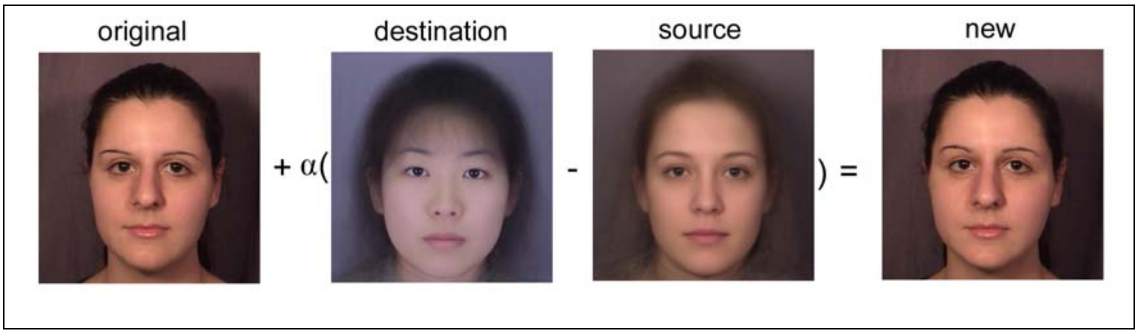


Figure 2.5 An illustration of facial transformation process: New face is constructed by calculating differences between two images (source and destination), scaled if desired (α) and adding to the original face.

Creating Facial Sequences

The facial transformation process can also be used to create a sequence of images. Here, the differences between the source and destination images are calculated and applied in equal percentage increments across a continuum. Figure 2.6 shows examples of facial sequences based on Asian and European differences applied onto a European female original face.

Figure 2.6 An illustration of facial sequences: The European female original face is transformed based on Asian and European prototypes, creating here a 5-step continuum of faces more European to more Asian.

2.1.3 Interactive Image Display Program

An interactive image display program developed by D. M. Burt at the University of Durham was used to present face sequences in Experiments 3 and 4 in Chapter 4. This program presents images in sequence on a computer screen and, when participants move the mouse from left to right or right to left, the sequence is played forward or backward respectively. The starting position and the direction of the sequence presentation can be randomised. Participants have full control over the number, direction and speed of the sequence presentation, and when participants decide on a frame for their response, they click the mouse once, and the program records the current frame of the sequence in a data file and advances to the next stimulus. The top image in Figure 2.7 shows an example of what participants actually see during trials using the interactive image display program. An image is shown in the middle of the computer screen (here, the mouse and the arrows are shown for illustration purpose only), and the experimental question is displayed at the top of the screen. The bottom image of Figure 2.7 shows what happens when participants move the mouse to play the sequence. Depending on the mouse position, a different frame from the sequence will be shown.

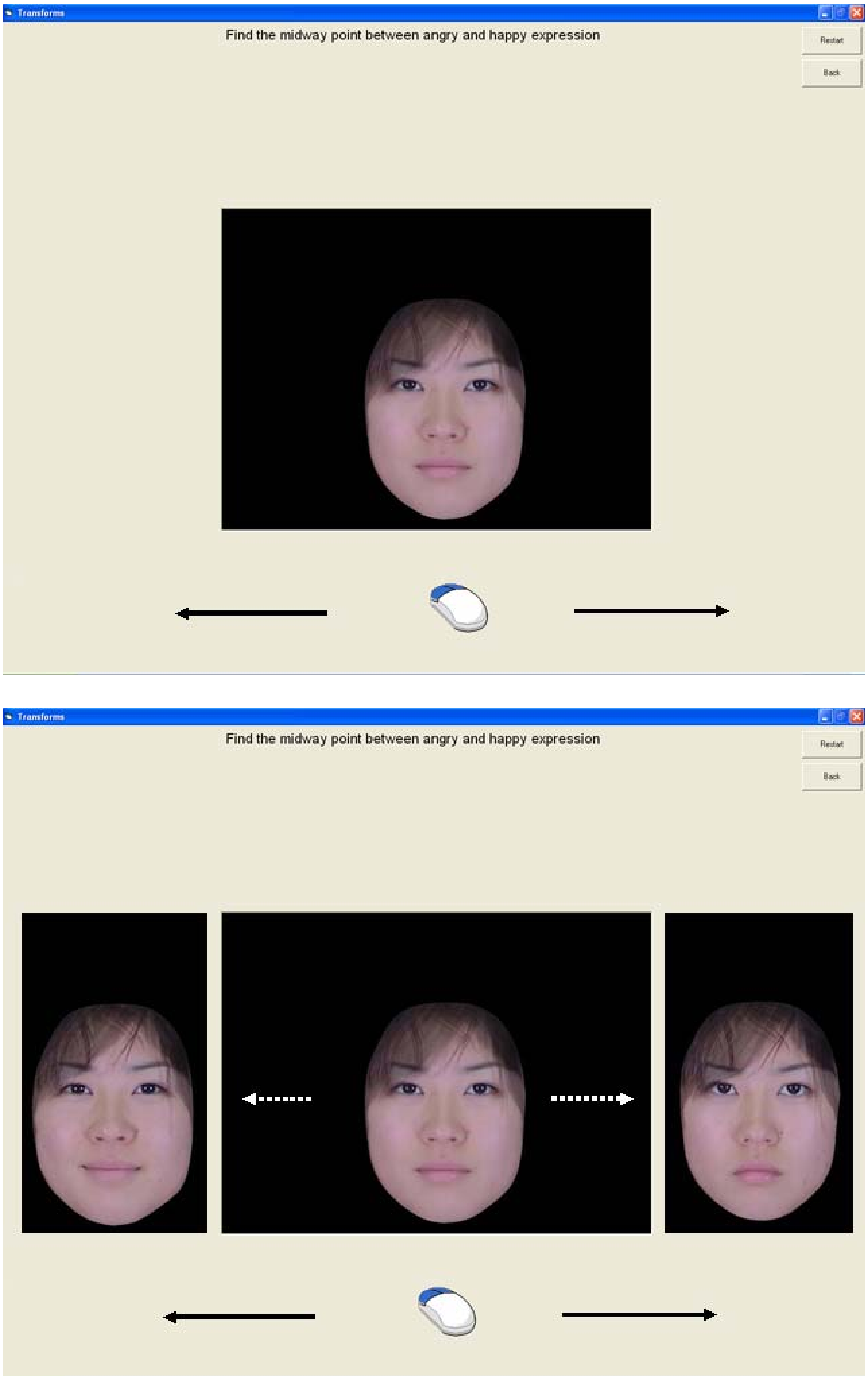


Figure 2.7 An illustration of an interactive image display program: Top=an image is displayed in the middle and participants move the mouse side to side to play the sequence, Bottom=when mouse is moved the image in the middle will change to a different frame from the sequence.

2.1.4 Summary

The current chapter described the general methodology regarding image transformation software (PsychoMorph 8.3) and an interactive image display program used in some of the experimental studies described in the following chapters. It showed that PsychoMorph 8.3 can be used to construct facial templates and prototypes, apply facial transformations and create facial sequences. The section on the interactive image display program showed how the program can be used to play a sequence of images. The method sections of the experimental chapters that used the software will contain more detailed information about how stimuli were prepared and/or presented. However, if necessary, the reader is advised to refer to the current chapter when reading through the method sections in Experiment 3 and Experiment 4 in Chapter 4 and Experiment 7 in Chapter 6.

Chapter 3

The Own-Race Bias and Identity Recognition

3.1 General Introduction

This chapter will describe two experiments which looked at the effect of expression change on recognition memory for own and other race faces. The main aim here was to examine a possible similarity between familiar/unfamiliar and own-race/other-race face processing. As reviewed in the Introduction, people are generally good at processing familiar faces but the processing of unfamiliar faces is more problematic (Bruce 1982; Bruce *et al.* 1999; Burton *et al.* 1999; Henderson, Bruce and Burton 2001). The Bruce and Young (1986) model of face perception explains the difference between familiar and unfamiliar face processing in terms of the difference in the richness of the structural codes for the two face types. It is thought that for familiar faces there are elaborated structural codes due to frequent exposure whereas it is thought that the richness of the structural codes for unfamiliar faces are limited by the conditions of the initial exposure. When considering own and other race face processing, according to the Bruce and Young model there should be no pre-experimentally established structural codes for either own or other races to aid identity processing, if both race faces used were unfamiliar. However, as examined in the Introduction, several findings showing the own-race bias in face perception and recognition exist, which clearly indicates that the processing of own-race faces is superior to that of other-race faces.

The similarity between familiar/unfamiliar and own-race/other-race face processing suggests both may be supported by a similar set of processes. Specifically, the effect of the own-race bias may be conceptualised in terms of the general difficulties people have with faces that are less familiar. In this sense, an analogy between the processing of familiar/unfamiliar and own-race/other-race faces may hold, the crucial factor being the varying degree of familiarity people have with different types of faces, both at the level of individual and the group. One weakness in past researches on the own-race bias as perceptual expertise, however, is that generally they tended to examine the effect relatively independently, with little reference to the knowledge available from researches on face perception in general. This means that it is not known whether or not specific processes underlie the own-race bias, or whether a general processes that underlie face processing from a single race also applies to the processing of own and other race faces. This chapter therefore addressed the issue of a possible similarity between familiar/unfamiliar and own-race/other-race face processing. Specifically, past research that looked at the effect of facial transformation (facial expression change) on recognition memory was replicated, as this factor was shown to differentiate familiar and unfamiliar face processing.

Another aim of the current experiments was to examine the effect of facial expression information on identity recognition memory for own and other race faces. Although faces in real life are seen in a variety of facial expressions, the majority of studies that examined the own-race bias have tended to use faces in neutral expression, and rarely examined the influence the presence of facial expression may have on recognition memory (e.g. Meissner and Brigham 2001; Sporer 2001). Moreover, the effect of a change in facial expression between study and test when recognising faces of own and other race faces has never been systematically examined before. The examination of both of these factors (the presence of facial expression information and the possible effect of changing expression) on recognition memory would have a practical implication, as it is conceivable that in real-life eye-witness identification a suspect's face would need to be identified in a different facial expression. Therefore the current experiments used a variety of facial recognition performance measures to examine the effect of facial expression on identity memory.

3.2 Experiment 1 – Changing Expression and Recognition Memory 1

3.2.1 Introduction

Experiment 1 aimed to examine how facial transformation between study and test (e.g. changes in pose and/or expression) may influence recognition memory for faces of own and other races. Specifically, the effect of changes in facial expression between learning and testing on recognition memory for own and other race faces was investigated cross-racially in this study. As reviewed in the Introduction above, numerous studies have shown the effect of the own-race bias in face recognition memory, that people are in general better at recognising faces of own racial group than those belonging to other-race (e.g. Meissner and Brigham 2001; Sporer 2001). However, the majority of studies published in this area tended not to examine the effect of facial transformation on recognition memory for different race faces, even when this was possible, given that in some studies different sets of facial stimuli were used between study and test to prevent mere stimulus recognition (e.g. Chiroro and Valentine 1995; Valentine and Endo 1992). One exception was the study by Ellis and Deregowski (1981), which examined the effect of changes in pose on recognition memory for faces of two different races cross-racially. Here, Black and White faces were used in an intentional recognition memory test (i.e. participants knew during the study phase that a recognition test would follow) with Black African and White European participants. All stimuli faces were photographed in two different poses, one in full face and the other in three-quarter profile, and in half of the trials the pose was untransformed between study and test (full face→full face or profile→profile) and for the other half the pose was transformed (full face→profile or profile→full face). The results showed that overall participants recognised untransformed faces more accurately than transformed faces, and people also performed better with their own-race faces than other-race faces. Moreover, it was found that participants' performance was disrupted more by transformation in other-race faces than transformation in own-race faces (see Figure 3.1).

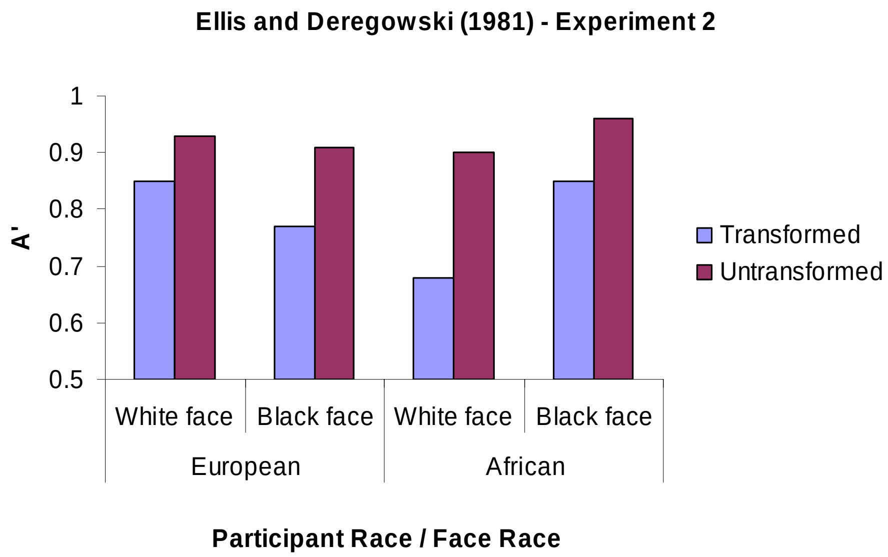


Figure 3.1 Adapted from Ellis and Deregowski (1981) Experiment 2 (A'=a non-parametric measure of recognition performance, higher value indicates better performance).

The results from Ellis and Deregowski (1981) indicated that during the course of repeated experience with faces of a particular racial group (usually own-race faces), people not only learn to recognise faces of their own racial group more accurately, but people also appear to learn to better recognise individuals from their own racial group despite transformations due to a change in pose.

Another kind of facial transformation could be due to changes in facial expression. The effect of changes in facial expression on recognition memory has been investigated in the past, but these studies only used faces of one racial group (Bruce 1982; Parkin and Goodwin 1983) and the effect of changes in expression has not been investigated cross-racially. However, the study by Bruce (1982), which examined the effect of transformation (pose and expression) on recognition performance using familiar and unfamiliar faces, is conceptually relevant here, as the findings appear to indicate a possible parallel pattern between familiar/unfamiliar and own-race/other-race face processing. In this study, participants were presented with personally familiar and unfamiliar photographs of faces, and were asked to learn these faces to prepare for a recognition memory test later. At test, the faces either changed in their angle and expression or remained the same, and novel faces were also added. It was found that participants were less accurate when the angle and expression changed between learning and testing, but this drop in recognition accuracy only happened for unfamiliar faces (see Figure 3.2).

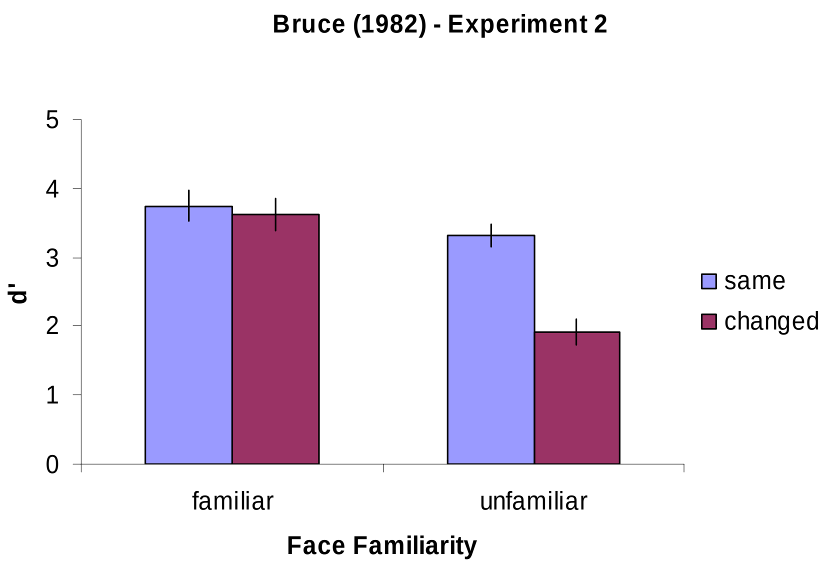


Figure 3.2 Adapted from Bruce (1982) Experiment 2 (d'=a parametric measure of recognition performance, higher value indicates better performance).

The results from Bruce (1982) indicated that people are not good at forming a representation of an unfamiliar face from a single exposure that allows them to recognise the same face in a novel viewpoint or expression. One interesting point regarding the studies by Bruce (1982) and Ellis and Deregowski (1981) is that the way in which the transformation affected familiar and unfamiliar faces from a single race was similar to the way in which the transformation affected own and other race faces (which were all 'unfamiliar' to the participants). With reference to the Bruce and Young

(1986) model of face recognition, the findings from Bruce (1982) can be explained by the difference in the richness of the structural codes for familiar and unfamiliar faces, as structural codes for familiar faces are thought to be well established due to frequent exposure whereas the richness of the structural codes for unfamiliar faces depends on the quality of the initial exposure to establish adequate structural codes. However, findings from Ellis and Deregowski (1981) may suggest that the degree to which people are familiar with different groups of faces (e.g. own and other race faces) might affect how well structural codes for 'unfamiliar' faces are established, as it was found in this study that recognition memory performance was less affected by facial transformation in own-race faces.

In Experiment 1, the effect of changes in facial expression between learning and testing on recognition memory for own and other race faces was investigated cross-racially, and whether there would be a similar pattern between the processing of familiar/unfamiliar faces and own-race/other-race faces was investigated. Specifically, Experiment 1 extended the general paradigm used in Ellis and Deregowski (1981) and Bruce (1982), and looked at the effect of facial expression transformation on recognition memory using European and Japanese faces with European and Japanese participants. Facial recognition performance was analysed by examining hit rates (hits) and false identification rates (false positives). These two measures were then combined to form a non-parametric statistical decision theory statistic A' (Rae 1976), which is an unbiased estimate of recognition performance. In addition, a measure of response bias called bias index (Snodgrass and Corwin 1988) was also obtained by combining hits and false positives. It was predicted that the processing of own-race faces (for both race participants) would show a similar pattern to the processing of familiar faces, that there will be no/less difference in the recognition accuracy (measured by A') between expression-changed and the original faces whereas with other-race faces changing expression will have a detrimental effect on recognition accuracy. In addition, based on previous research showing the effect of the own-race bias on face recognition, an overall recognition advantage for own-race faces was also predicted.

3.2.2 Method

Participants

Forty European (Caucasian) students (12 males) at University of Stirling (Scotland, U.K.) and 40 Japanese students (8 males) at Ritsumeikan University (Kyoto, Japan) participated in this study. All received payments or course credits for their participation.

Stimuli and Apparatus

Ninety-six European faces (48 males) and 96 Japanese faces (48 males) were used. Two pictures of each individual were available, one in a full-face happy expression and the other in a full-face neutral expression, creating 384 faces in total. Here, the facial expressions in these stimuli were posed but the type and the magnitude of facial muscle movement were not controlled. Instead, people who provided the stimuli were asked to pose a certain facial expression (e.g. a happy face) in their own manner. Twenty-four European faces (12 males) and 24 Japanese faces (12 males) were used to construct two training sets (with equal number of neutral and happy expressions in each set), where expression with regard to identity was counterbalanced across the two sets. The testing sets consisted of the training sets with another 48 novel faces, with equal number of each race, gender and expression as the training set. In the testing sets, half of the original training set changed in their expressions (neutral→happy or happy→neutral), and the rest remained unchanged (neutral→neutral or happy→happy). Whether the expression was changed between training and testing with regard to identity was counterbalanced, creating a total of four different testing sets. European faces were from a set of undergraduate photographs taken at University of St Andrews in Scotland. Japanese faces were from ATR Lab in Kyoto, Japan. All faces were edited using Adobe Photoshop 7.0®, converted to greyscale and framed with a white oval mask to remove background and hairline. All images were 300 pixels wide. Four additional face pairs (two European and two Japanese faces of both sexes in neutral and happy expression each) were also prepared for practice trials using faces that did not appear in the experimental trials. All images were presented on a computer screen. The size of each face image on screen was approximately 18 x 13cm.

The Embedded Figures Test (Benton and Spreen 1969) was used as a filler task. Fifty images (300 pixels wide) were prepared and presented on a computer screen. The size of each figure on screen was approximately 7 x 7cm.

Design

This study used a mixed within-participants design. The race of participants (European and Japanese) was used as a classification variable. Independent variables examined were the face race (European and Japanese), study expression (happy and neutral) and test expression (novel, same and different expression). The recognition memory performance (hits and false positives) were measured as dependent variables. Hits and false positives were also used to calculate A' scores and bias index separately.

Procedure

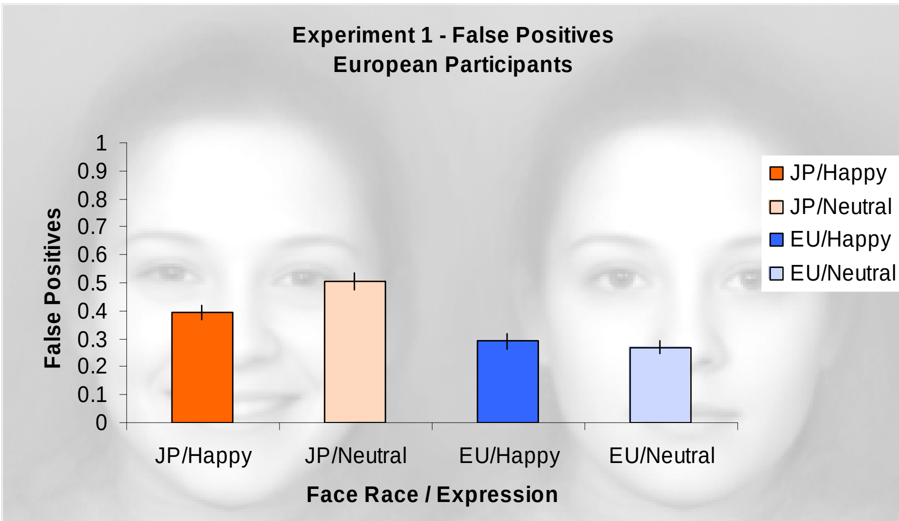
All participants were tested individually using a laptop computer. Participants were told that the aim of the experiment was to investigate the role of facial expressions in attractiveness judgement in faces of two different racial groups. Participants were asked to do three tasks; rating attractiveness of Asian and European faces, Embedded Figures Test and finally a surprise recognition memory test for the faces they rated in the first phase. In the training and the testing phase of the experiment images were presented using SuperLab® (for European participants) or E-Prime® (for Japanese participants), and Microsoft PowerPoint® was used to present Embedded Figures Test. In the training phase, participants were asked to rate the attractiveness of each face on a 7-point Likert scale. Four practice faces (one from each race and gender) preceded the training sets, which were not shown subsequently. Participants were then asked to perform the Embedded Figures Test for five minutes as a filler task. Participants were told that the test was designed to measure participants' general perceptual capacity. One practice trial was given initially, and participants were given five minutes to go through as many figures as possible. There were 24 trials (including one practice trial) in total, and the task was terminated either when five minutes elapsed or when participants completed all 24 trials within 5 minutes. A surprise recognition memory test followed immediately after the filler task and participants were asked to decide whether or not they had seen a particular face during the training phase. Participants were asked to press 1 for 'old/familiar' and 0 for 'new/unfamiliar' faces and response was recorded. All faces were presented in randomised order during each practice, training and testing phase. A short questionnaire followed and participants were thoroughly debriefed at the end. See Appendix A for the questionnaire used, and for examples of face images see Appendix B.

3.2.3 Results

Data from 40 European and 40 Japanese participants regarding their recognition memory performance produced the following descriptive statistics. Mean hits, false positives, A' scores and bias index to European and Japanese faces were calculated separately for European and Japanese participants, and the results were analysed by means of mixed-design ANOVAs. All post-hoc tests of simple main effects using *t*-tests were Bonferroni corrected and results are reported with uncorrected degrees of freedom and the corrected *p*-value.

False Positives

The false positive rate provides a measure of the frequency that new (novel) faces were incorrectly recognised as old (seen). Mean false positives for novel European and Japanese faces with happy and neutral expressions were calculated for each participant. Data from European and Japanese participants were calculated separately. Figure 3.3 shows the mean false positives and the standard errors for novel European and Japanese faces with happy and neutral expressions from 40 European and 40 Japanese participants.



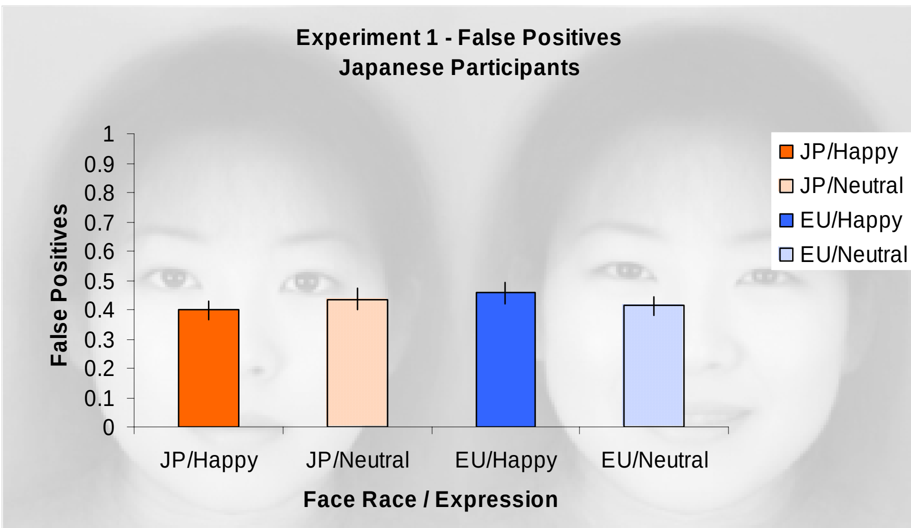


Figure 3.3 Mean false positives (with error bars ± 1 s.e.) for European and Japanese faces with happy and neutral expressions. Top=European participants; Bottom=Japanese participants.

Mean false positives were analysed using a 2 x 2 x 2 mixed-design ANOVA with participant race (European and Japanese) as the between-participants factor and face race (European and Japanese) and expression (happy and neutral) as the within-participants factors. This revealed a significant main effect of face race ($F_{(1,78)}=14.58$, $p<.001$), with higher false positives for Japanese compared with European faces. This main effect was however qualified by a significant interaction between face race and participant race ($F_{(1,78)}=22.13$, $p<.001$). Tests of simple main effects using *t*-test showed that this trend (higher false positives for Japanese faces) was only present in European ($t_{(39)}=6.74$, $p=.002$) and not in Japanese ($t_{(39)}=.57$, $p>1$) participants. Finally there was a significant interaction between face race and expression ($F_{(1,78)}=13.26$, $p<.001$), due to higher false positives for neutral compared with happy Japanese faces ($t_{(79)}=3.80$, $p=.004$). There were no other main effects or interactions (all *ps*>.05) in the false positives analysis.

Hits

The hit rate provides a measure of the frequency that old (seen) faces were correctly recognised as previously seen. Mean hits for European and Japanese faces trained with happy and neutral expressions and tested with same or different expressions were calculated for each participant. Figure 3.4 shows the mean hits and the standard errors from European and Japanese participants.

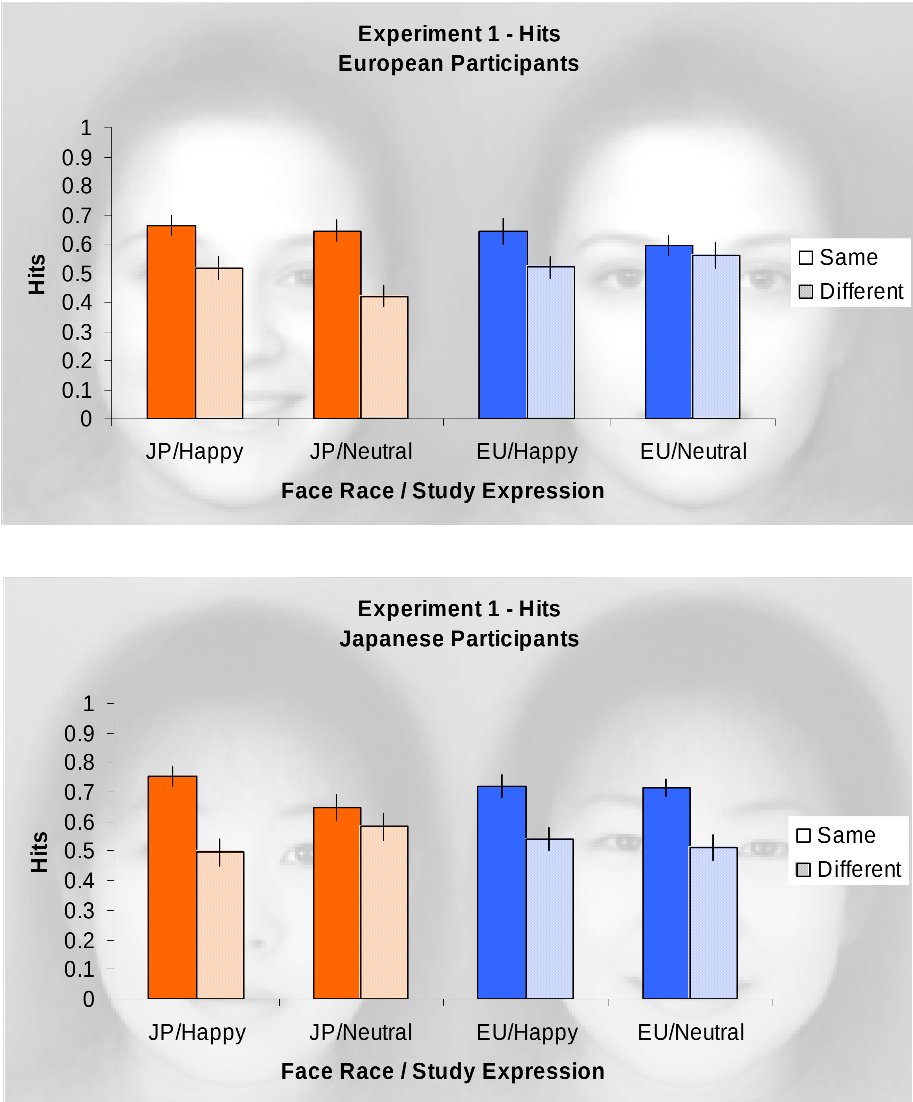


Figure 3.4 Mean hits (with error bars ± 1 s.e.) for European and Japanese faces studied with happy or neutral expression and tested in the same or different expression. Top=European participants; Bottom=Japanese participants.

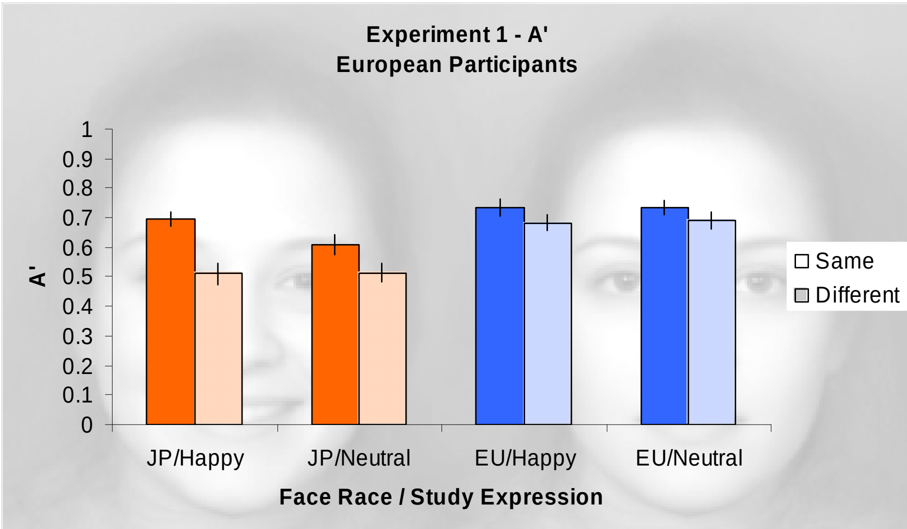
Mean hits were analysed using a 2 x 2 x 2 x 2 mixed-design ANOVA with participant race (European and Japanese) as the between-participants factor and face race (European and Japanese), study expression (happy and neutral) and test expression (same and different) as the within-participants factors. This revealed a significant main effect of test expression ($F_{(1,78)}$=72.68, p<.001), with higher hit rates for faces that were trained and tested in same expressions. The four-way interaction was also significant ($F_{(1,78)}$=10.12, p=.002), which showed that in European participants the same expression advantage (higher hits for faces tested in the same expression) was only present in Japanese faces trained in neutral expression ($t_{(39)}$=4.69, p=.008) but not in the other three face race and study expression combinations (all *ps*>.05). In Japanese participants, however, this advantage was present for all face race and study expression combinations (all *ps*=.008) except for Japanese faces trained in neutral expression ($t_{(39)}$=1.18, p>1). There were no other main effects or interactions (all *ps*>.05) in the hits analysis.

A’

The A’ statistic is a non-parametric measure of signal detection calculated by combining hit (signal) and false positive (noise) rates (Rae 1976). A’ scores ranges between 0 and 1, and the score of 0 indicates an inability to discriminate old from new items, the score of 1 represents perfect discrimination and the score of 0.5 represents a chance performance. Hits and false positives were corrected based on Rae’s correction before calculating A’.

A’ for faces with two different expressions (happy and neutral) with the same or different test expression were calculated as follows. When calculating A’ for faces learned with a happy expression and tested in the same expression, hits and false positives for faces with a happy expression were combined. Similarly for faces learned with a neutral expression and tested in the same expression, hits and false positives for faces with a neutral expression were combined. When calculating A’ for faces whose expression changed at test, hits and false positives were matched in terms of the facial expression shown at test. Thus when calculating A’ for faces learned with a happy expression and tested in a neutral expression, hits and false positives for faces with a neutral expression were combined. Similarly for faces learned with a neutral and tested in a happy expression, hits and false positives for faces with a happy expression were combined. In all cases, therefore, hits and false positives were matched in terms of the facial expression shown at test. It would have been also possible to use the combined false positives (average false positives from happy and neutral faces), but it was felt that this may not represent an accurate representation of the noise distribution. For example, if people have the tendency to falsely recognise faces with a happy expression, using the combined false positives to calculate A’ for faces tested in neutral expression may underestimate the level of signal detection. Thus here it appeared more appropriate to match the expression of hits and false positives in this study.

The mean A' and the standard errors from European and Japanese participants are shown in Figure 3.5.



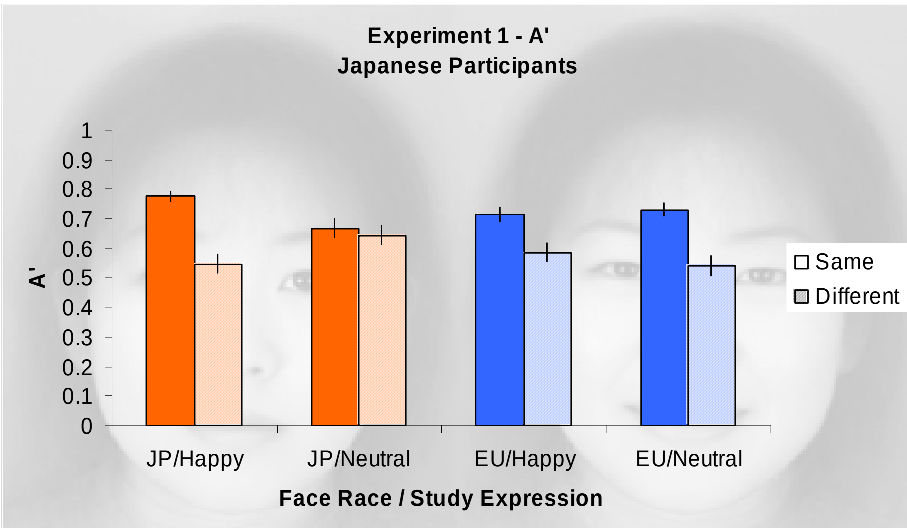
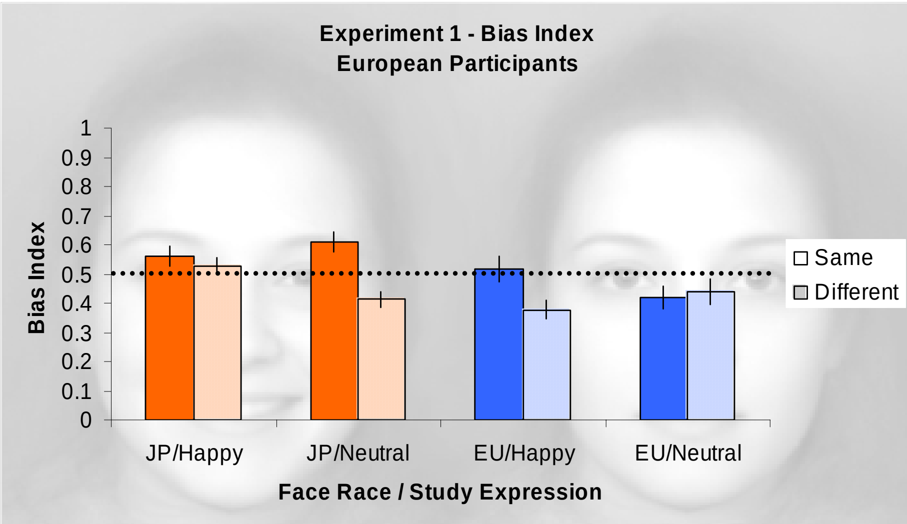


Figure 3.5 Mean A' (with error bars ± 1 s.e.) for European and Japanese faces studied with happy or neutral expression and tested in the same or different expression. Top=European participants; Bottom=Japanese participants.

Mean A' were analysed using a 2 x 2 x 2 x 2 mixed-design ANOVA as before. This revealed a significant main effect of face race ($F_{(1,78)}$=16.97, p<.001) with higher A' for European faces, and also of test expression ($F_{(1,78)}$=82.28, p<.001) showing higher A' for faces that were trained and tested in same expressions. There was a significant interaction between face race and participant race ($F_{(1,78)}$=27.96, p<.001), due to higher A' for European faces in European ($t_{(39)}$=5.96, p=.002) but not in Japanese ($t_{(39)}$=.95, p>.5) participants. There was also a significant interaction between face race, test expression and participant race ($F_{(1,78)}$=5.39, p=.02). In Japanese participants, A' was higher in both race faces that were trained and tested in the same expression (European faces, $t_{(39)}$=6.26; Japanese faces, $t_{(39)}$=4.70, both *ps*=.004), but for European participants this pattern was only present with Japanese faces ($t_{(39)}$=4.52, p=.004). A significant interaction between study expression and test expression ($F_{(1,78)}$=4.30, p=.04) was due to higher A' rates for faces trained in happy expression that were tested in the same expression ($t_{(79)}$=2.65, p=.04). Finally a significant three-way interaction between face race, train and test expressions ($F_{(1,78)}$=9.58, p=.003) reflected a pattern that while A' rates for European faces (in both happy and neutral study expression) were higher when the expression remained unchanged at test (happy, $t_{(79)}$=3.58, p=.004; neutral, $t_{(79)}$=4.18, p=.004), for Japanese faces the same expression advantage was only present in faces trained with happy expression ($t_{(79)}$=7.45, p=.004). There were no other main effects or interactions (all *ps*>.05) in the A' analysis.

Bias Index

Bias index is a measure of response criterion (Snodgrass and Corwin 1988) calculated by combining hits and false positives. Bias index scores range between 0 and 1, and scores above 0.5 indicates a lax response bias (more likely to respond 'yes/seen') whereas scores below 0.5 indicates a conservative response bias (less likely to respond 'yes/seen'). Figure 3.6 shows the mean bias index and the standard errors from European and Japanese participants.



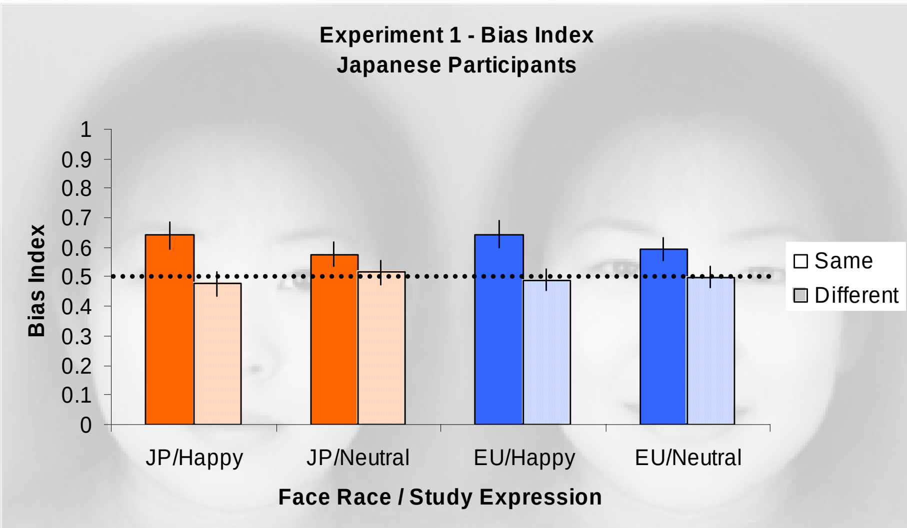


Figure 3.6 Mean bias index (with error bars ± 1 s.e.) for European and Japanese faces studied with happy or neutral expression and tested in the same or different expression. Top=European participants; Bottom=Japanese participants.

As before, mean bias index were analysed using a 2 x 2 x 2 x 2 mixed-design ANOVA. This revealed significant main effects of face race ($F_{(1,78)}$=3.83, p=.05) with higher bias index for Japanese faces, of test expression ($F_{(1,78)}$=55.14, p<.001) showing higher bias index for faces that were trained and tested in the same expression, and of participant race ($F_{(1,78)}$=3.86, p=.05) reflecting higher bias index in Japanese participants. There was a significant interaction between face race and participant race ($F_{(1,78)}$=4.61, p=.04), showing that the pattern of higher bias index in Japanese faces only existed in European ($t_{(39)}$=2.98, p=.01) and not in Japanese ($t_{(39)}$=.13, p>1) participants. There were significant three-way ($F_{(1,78)}$=4.24, p=.04) and four-way ($F_{(1,78)}$=7.07, p=.01) interactions. The three-way interaction reflected a pattern that while bias index for Japanese faces (trained in both happy and neutral expressions) was higher when the expression remained unchanged at test (happy, $t_{(79)}$=3.09, p=.01; neutral, $t_{(39)}$=4.13, p=.004), for European faces this pattern was only present in faces trained with happy expression ($t_{(79)}$=4.94, p=.004) and there was no difference in the bias index in neutral European faces tested in the same or different expressions ($t_{(79)}$=1.27, p=.05). The significant four-way interaction showed that in European participants the pattern of higher bias index for faces tested in the same expression was only present in Japanese faces trained in neutral expression ($t_{(39)}$=5.75, p=.008) but not in the other three face race and study expression combinations (all ps>.05). In Japanese participants, however, the pattern was present for all face race and study expression combinations (all $ps \leq .05$) except for Japanese faces trained in neutral expression ($t_{(39)}$=1.22, p>1). There were no other main effects or interactions (all ps>.05) in the bias index analysis.

3.2.4 Discussion

The results from Experiment 1 indicated that in general the effect of the own-race bias on recognition memory performance was more consistently found amongst European participants. Looking at the results from false positive rates, it showed that overall Japanese faces were more likely to be incorrectly recognised as previously seen. However, this trend was only present amongst European participants, and false positive rates for the two race faces did not differ in Japanese participants. This is consistent with the findings from a meta-analysis of 91 independent samples concerning the own-race bias by Meissner and Brigham (2001), which found that in general lower proportion of false positives were yielded for own-race faces, and overall White participants were more likely to demonstrate this pattern. With regard to the hits measure, Meissner and Brigham (2001) found a general trend of increased hit rates for own-race faces. Results from Experiment 1, however, only showed higher hit rates for faces learned and tested in the same expression, showing that participants were more likely to correctly recognise untransformed faces. The meta-analysis above also showed that own-race faces were more than twice as likely to be accurately discriminated as other-race faces. The examination of A' measure in Experiment 1 revealed that recognition performance was higher for own-race faces only in European participants, and Japanese participants showed equal performance in terms of A' measure for both own and other race faces, which again indicates that the effect of the own-race bias was only present amongst European participants. It was also found that overall A' was higher for untransformed faces than faces that changed between learning and testing. Finally, it was found in the meta-analysis above that other-race faces in general yielded more lax response criterion. The results from the bias index measure in Experiment 1 showed that overall Japanese faces yielded a more lax criterion, but this pattern was only present amongst European participants. Taken together, the results from false positives, A’ and bias index showed the effect of the own-race bias commonly found in the past studies only amongst European participants.

Experiment 1 also examined whether changes in expression would have differential effect for own and other race faces that may parallel the pattern seen in familiar/unfamiliar face recognition. The results showed that in European participants the transformation due to expression change affected recognition performance for Japanese faces only, and there was no difference in A’ for European faces whether they were transformed or untransformed between study and test. The results from Japanese participants, however, showed that expression change affected recognition performance for both European and Japanese faces. Therefore only the results from European participants showed a similar pattern to the recognition of familiar/unfamiliar faces under transformation. Thus at least amongst European participants, differential degree of familiarity with ‘unfamiliar’ own and other race faces seemed to have led to differences in the quality of face representation formation that subserve recognition of transformed faces.

In Experiment 1, the effect of different facial expressions (happy or neutral) on several recognition measures was also examined. The most interesting finding in relation to expression factor was that false positive rates differed depending on face race and expression, in that neutral Japanese faces yielded higher false positives than happy Japanese faces. This indicated that, for both European and Japanese participants, Japanese faces in neutral expression were more confusable and less memorable than smiling Japanese faces. This finding could be useful in understanding how people process different race faces, as it indicates that differentiation of face identities based on a similarity measure may vary depending on whether or not faces are represented in a particular facial expression.

3.3 Experiment 2 – Changing Expression and Recognition Memory 2

3.3.1 Introduction

Experiment 2 was an extension of Experiment 1, and it aimed to minimise the use of pictorial coding which was confounded with structural coding in Experiment 1. This was due to the fact that Experiment 1 used identical pictures for presentation and test when expression did not change. Although most past studies that looked at the own-race bias in face recognition have tended to employ identical pictures at learning and test, some researchers have used different sets of pictures (usually with two different expressions) to ensure people did not rely only on picture matching or mere stimulus recognition (e.g. Chiroro and Valentine 1995; Valentine and Endo 1992). Experiment 2 employed two sets of happy and neutral faces and used different pictures at learning and test for both when expression changed and stayed the same. According to the Bruce and Young (1986) model, successful identity recognition depends on the degree of similarity between the current and the stored structural codes. It was hypothesised that the recognition performance for the expression-same conditions would be higher than the expression-changed conditions, since there will be more overlap between the tenuous structural codes stored from the initial presentation and the expression-same faces at test than there is an overlap between the structural codes and the expression-changed faces. This was not possible to examine in Experiment 1 since in the expression-same conditions it was possible to remember faces on the basis of pictorial coding as well as structural coding and thus better recognition accuracy for the expression-same condition was expected. As in Experiment 1, the own-race bias in overall recognition accuracy was also predicted. However, based on the results from

Experiment 1 it was anticipated that the own-race bias may be more evident amongst European participants.

3.3.2 Method

Participants

Forty European (Caucasian) students (15 males) at University of Stirling (Scotland, U.K.) and 40 Japanese students (13 males) at Ritsumeikan University (Kyoto, Japan) participated in this study. All received payments or course credits for their participation.

Stimuli and Apparatus

Ninety-six European faces (48 males) and 96 Japanese faces (48 males) were used. Four instances of each individual were available, two versions in a full-face happy expression and the other two in a full-face neutral expression, creating 768 faces in total. Here, both the happy and neutral expressions were posed, but the type and the magnitude of facial muscle movement were not controlled, and instead people were asked to pose the facial expression in their own manner. Moreover, the two instances in each expression were obtained in a different way. The first instance was obtained where people who provided the stimuli were asked to pose a certain facial expression (e.g. a happy face). The second instance was obtained where people were asked to imagine or remember an emotion-inducing incident (for both happy and neutral expressions) and pose the appropriate facial expression. Twenty-four European faces (12 males) and 24 Japanese faces (12 males) were used to construct four training sets (with equal number of neutral and happy expressions in each set), where expression with regard to identity and picture version (1 or 2) were counterbalanced across the four sets. The testing sets consisted of the training sets with another 48 novel faces, with equal number of each race, gender and expression as the training set. In the testing sets, half of the original training set changed in their expressions (neutral→happy or happy→neutral), and the rest remained unchanged (neutral→neutral or happy→happy). Whether the expression was changed between training and testing with regard to identity was counterbalanced, creating a total of eight different testing sets. European faces were from a set of undergraduate photographs taken at York University in Toronto, Canada. Japanese faces were from a set of undergraduate photographs taken at Kyoto University in Kyoto, Japan. All faces were edited using Adobe Photoshop 7.0®, converted to greyscale and framed with a white oval mask to remove background and hairline. All images were 300 pixels wide. Four additional face pairs (two European and two Japanese faces of both sexes in neutral and happy expression each) were also prepared for practice trials using faces that did not appear in the experimental trials. All images were presented on a computer screen. The size of each face image on screen was approximately 18 x 13cm.

A modified Stroop colour-naming task was used as a filler task. Eight English nouns (banana, blood, carpet, drum, house, leaf, sea, pot) were chosen. Thirty-two images (100 pixels wide) were created, and each word was presented in four different colours (blue, green, red, yellow) and was presented on a computer screen. The size of each word on screen was approximately 1 x 3cm.

Design

This study used a mixed within-participants design. The race of participants (European and Japanese) was used as a classification variable. Independent variables examined were the face race (European and Japanese), study expression (happy and neutral) and test expression (novel, same and different expression). The recognition memory performance (hits and false positives) were measured as dependent variables. Hits and false positives were also used to calculate A' scores and bias index separately.

Procedure

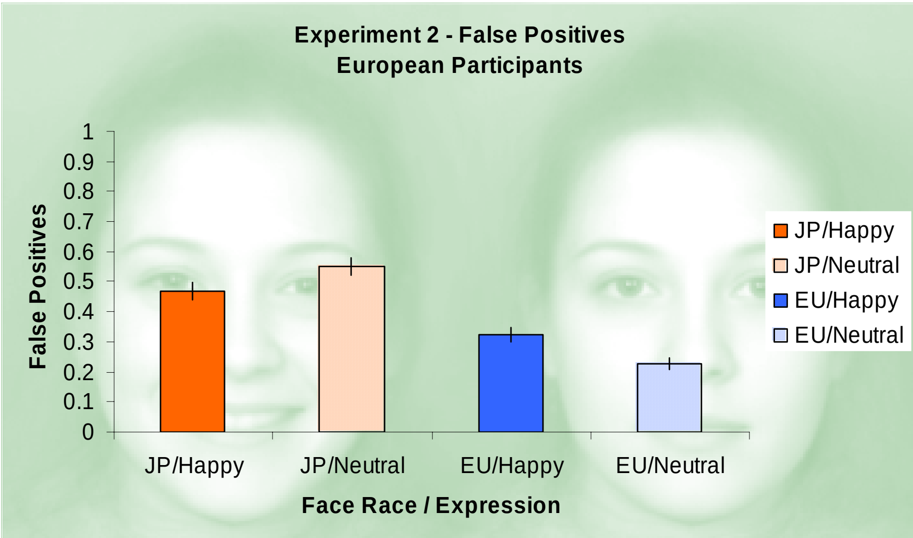
All participants were tested individually using a laptop computer. Participants were told that the aim of the experiment was to investigate the role of facial expressions in distinctiveness judgement in faces of two different racial groups. Participants were asked to do three tasks; rating distinctiveness of Asian and European faces, a modified Stroop colour-naming task and finally a surprise recognition memory test for the faces they rated in the first phase. All images and instructions were presented using E-Prime®. In the training phase, participants were asked to rate the distinctiveness of each face on a 7-point Likert scale. Four practice faces (one from each race and gender) preceded the training sets, which were not shown subsequently. Participants were then asked to perform the modified Stroop colour-naming task as a filler task. Participants were told that the task was designed to measure participants' general perceptual capacity. Participants were presented with letters that were printed in four different colours: red, blue, green and yellow, and their task was to name the ink colour of these letters as fast but as accurately as possible by pressing R for red, B for blue, G for green and Y for yellow. Each image was presented three times creating 96 trials in total, which were presented in randomised order. A surprise recognition memory test followed immediately after the filler task and participants were asked to decide whether or not they had seen a particular face during the training phase. Participants were asked to press 1 for 'old/familiar' and 0 for 'new/unfamiliar' faces. All faces were presented in randomised order during each practice, training and testing phase. A short questionnaire followed and participants were thoroughly debriefed at the end. See Appendix A for the questionnaire used, and for examples of face images see Appendix C.

3.3.3 Results

Data from 40 European and 40 Japanese participants regarding their recognition memory performance produced the following descriptive statistics. Mean hits, false positives, A' scores and bias index to European and Japanese faces were calculated separately for European and Japanese participants, and the results were analysed by means of mixed-design ANOVAs. All post-hoc tests of simple main effects using *t*-tests were Bonferroni corrected and results are reported with uncorrected degrees of freedom and the corrected *p*-value.

False Positives

Mean false positives for novel European and Japanese faces with happy and neutral expressions were calculated for each participant. Figure 3.7 shows the mean false positives and the standard errors from European and Japanese participants.



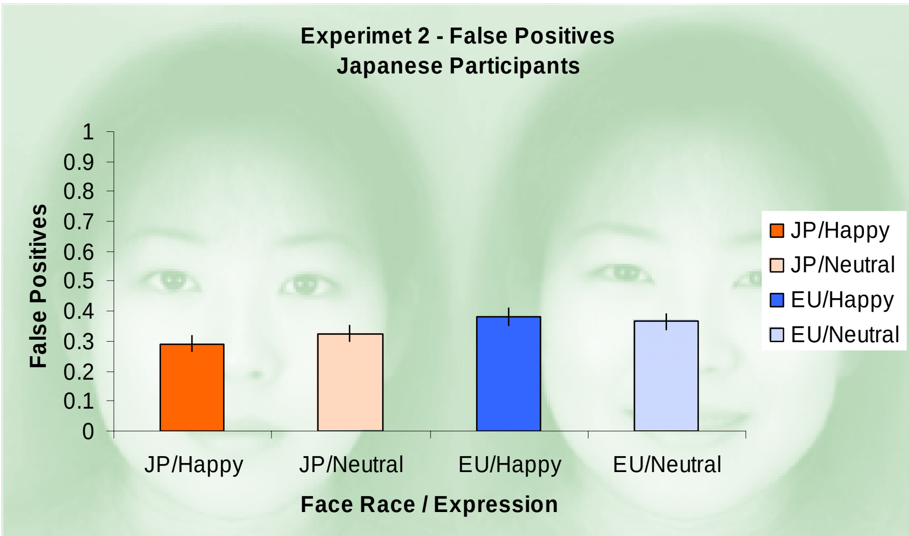
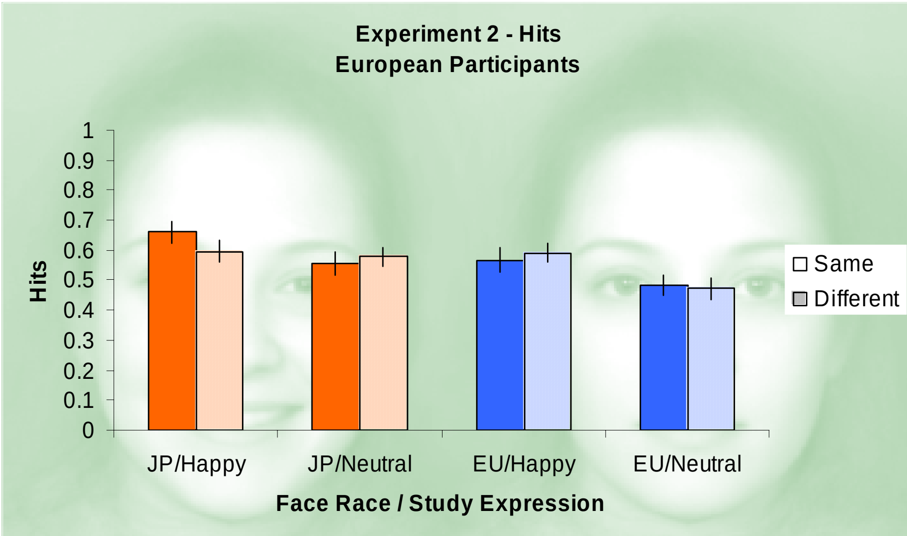


Figure 3.7 Mean false positives (with error bars ± 1 s.e.) for European and Japanese faces with happy and neutral expressions. Top=European participants; Bottom=Japanese participants.

Mean false positives were analysed using a 2 x 2 x 2 mixed-design ANOVA with participant race (European and Japanese) as the between-participants factor and face race (European and Japanese) and expression (happy and neutral) as the within-participants factors. This revealed a significant main effect of face race ($F_{(1,78)}$=21.46, p<.001), with higher false positives for Japanese compared with European faces. This main effect was however qualified by a significant interaction between face race and participant race ($F_{(1,78)}$=67.23, p<.001), which was due to participants having higher false positives for the other-race faces. In European participants, false positives were higher for Japanese faces ($t_{(39)}$=8.74, p=.002) while Japanese participants had higher false positives for European faces ($t_{(39)}$=2.63, p=.02). The main effect of participant race was also significant ($F_{(1,78)}$=3.90, p=.05), due to European participants having higher false positives than Japanese participants. There was a significant interaction between face race and expression ($F_{(1,78)}$=15.44, p<.001), due to higher false positives for happy expression in European faces ($t_{(79)}$=2.73, p=.02) and neutral expression in Japanese faces ($t_{(79)}$=2.71, p=.02). Finally this last interaction was qualified by a 3-way interaction between face race, expression and participant race ($F_{(1,78)}$=4.61, p=.04). Tests of simple main effects using *t*-test showed that this trend (higher false positives for happy European and neutral Japanese faces) was only present in European participants (European faces, $t_{(39)}$=3.47, p=.004; Japanese faces, $t_{(39)}$=2.57, p=.05), and not in Japanese participants (both *ps*>.05). No other main effects or interactions in the false positives analysis was significant (all *ps*>.05).

Hits

Mean hits for European and Japanese faces trained with happy and neutral expressions and tested with same or different expressions were calculated for each participant. Figure 3.8 shows the mean hits and the standard errors from European and Japanese participants.



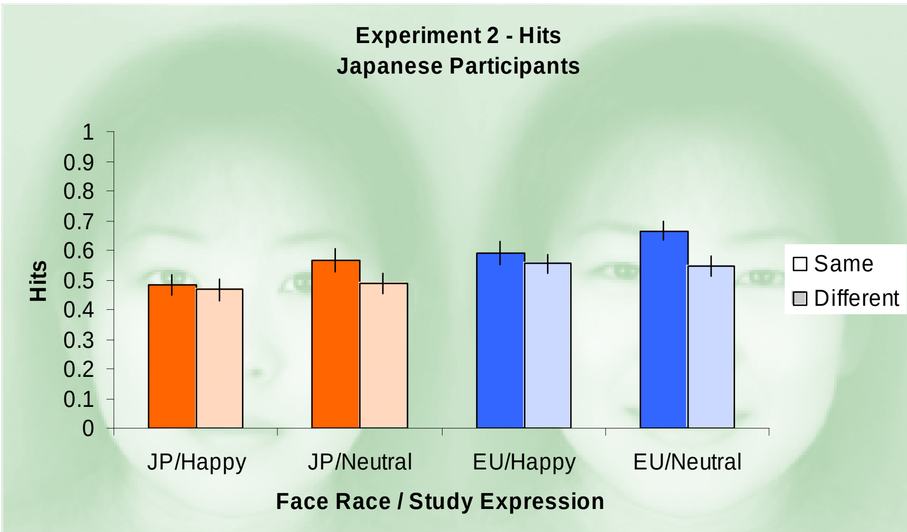


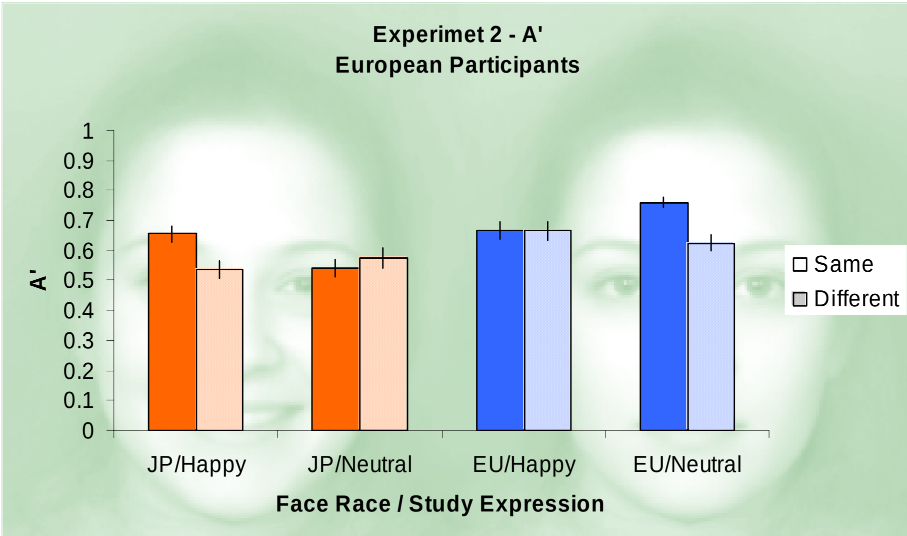
Figure 3.8 Mean hits (with error bars ± 1 s.e.) for European and Japanese faces studied with happy or neutral expression and tested in the same or different expression. Top=European participants; Bottom=Japanese participants.

Mean hits were analysed using a 2 x 2 x 2 x 2 mixed-design ANOVA with participant race (European and Japanese) as the between-participants factor and face race

(European and Japanese), training expression (happy and neutral) and test expression (same and different) as the within-participants factors. This revealed a significant main effect of test expression ($F_{(1,78)}=16.12$, $p<.001$), with higher hit rates for faces that were trained and tested in the same expression. There was a significant interaction between face race and participant race ($F_{(1,78)}=20.67$, $p<.001$), which was due to participants having *higher* hit rates for the *other*-race faces. In European participants, hit rates were higher for Japanese faces ($t_{(39)}=3.32$, $p=.004$) while Japanese participants had higher hit rates for European faces ($t_{(39)}=3.13$, $p=.006$). Finally the interaction between study expression and participant race was significant ($F_{(1,78)}=3.85$, $p=.05$), which was due to a trend of Japanese participants having higher hit rates for faces trained in neutral expression ($t_{(39)}=2.21$, $p=.07$). There were no other main effects or interactions (all *ps*>.05) in the hits analysis.

A'

Mean A' and the standard errors from European and Japanese participants are shown in Figure 3.9.



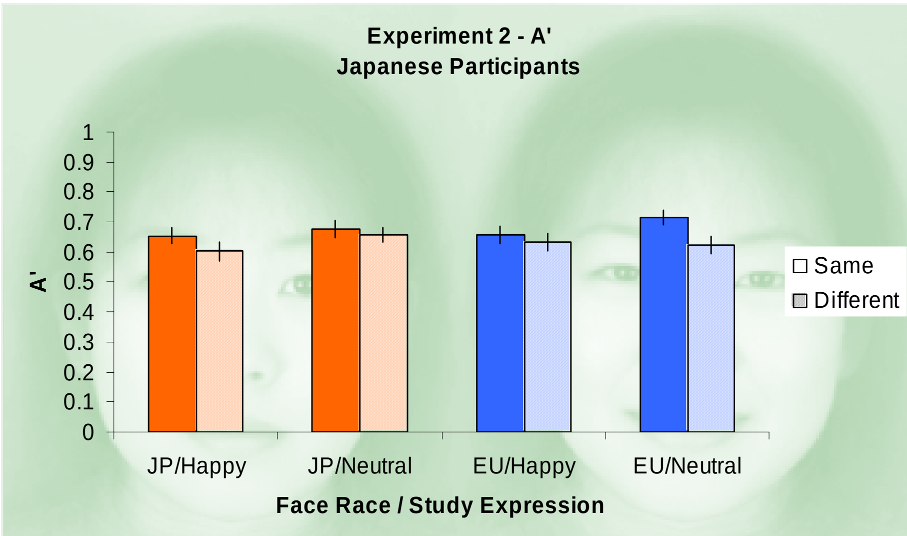
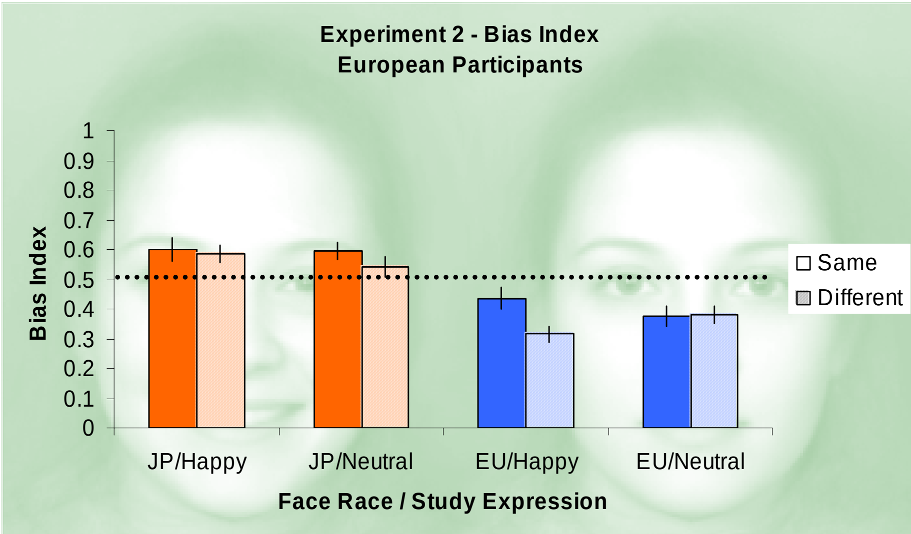


Figure 3.9 Mean A' (with error bars ± 1 s.e.) for European and Japanese faces studied with happy or neutral expression and tested in the same or different expression. Top=European participants; Bottom=Japanese participants.

Mean A' were analysed using a 2 x 2 x 2 x 2 mixed-design ANOVA as before. This revealed a significant main effect of face race ($F_{(1,78)}$=12.80, p<.001) with higher A' for European faces, and also of test expression ($F_{(1,78)}$=16.33, p<.001) showing higher A' for faces that were trained and tested in the same expression. There was a significant interaction between face race and participant race ($F_{(1,78)}$=8.83, p=.004), due to higher A' for European faces in European ($t_{(39)}$=5.16, p=.002) but not in Japanese ($t_{(39)}$=.39, p>1) participants. Finally there was a significant three-way interaction between face race, train and test expressions ($F_{(1,78)}$=14.98, p<.001). This was because the same expression advantage (higher A' for faces trained and tested in the same expression) was only present in European faces trained in neutral expression ($t_{(79)}$=5.12, p=.004) and Japanese faces trained in happy expression ($t_{(79)}$=3.09, p=.01), while in European faces trained in happy and Japanese faces trained in neutral expressions, A' did not differ whether the expression changed at test or remained the same (both happy European and neutral Japanese faces, ps>1). There were no other main effects or interactions (all ps>.05) in the A' analysis.

Bias Index

Figure 3.10 shows the mean bias index and the standard errors from European and Japanese participants.



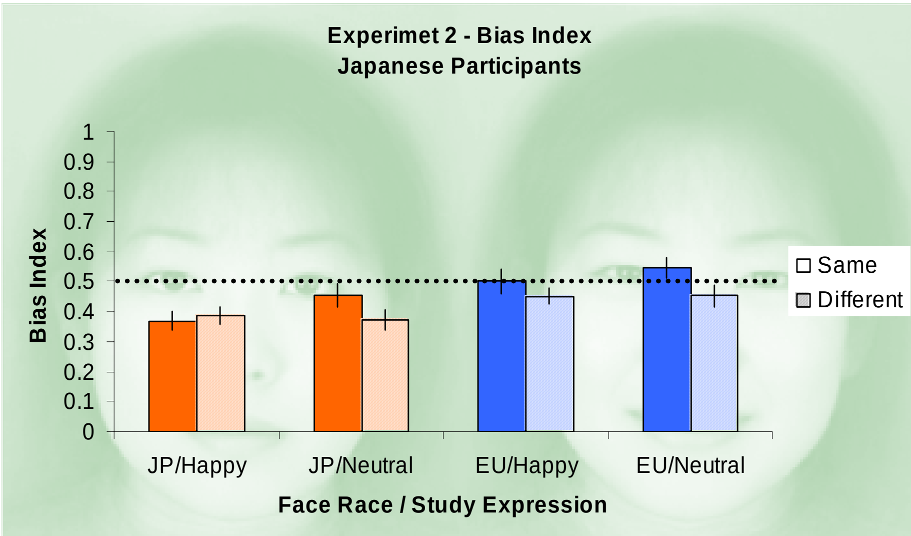


Figure 3.10 Mean bias index (with error bars ± 1 s.e.) for European and Japanese faces studied with happy or neutral expression and tested in the same or different expression. Top=European participants; Bottom=Japanese participants.

As before, mean bias index were analysed using a 2 x 2 x 2 x 2 mixed-design ANOVA. This revealed significant main effects of face race ($F_{(1,78)}$=6.98, *p*=.01) with higher bias index for Japanese faces and of test expression ($F_{(1,78)}$=19.98, *p*<.001) showing higher bias index for faces that were trained and tested in the same expression. There was a significant interaction between face race and participant race ($F_{(1,78)}$=49.45, p<.001), showing higher bias index for the other-race faces. In European participants bias index was higher for Japanese faces ($t_{(39)}$=6.95, p=.002) while Japanese participants had higher bias index for European faces ($t_{(39)}$=3.06, p=.008). Finally the interaction between study expression and participant race was also significant ($F_{(1,78)}$=5.11, p=.03), which was due to a trend of higher bias index in faces trained in neutral than happy expression amongst Japanese participants ($t_{(39)}$=2.09, p=.09). There were no other main effects or interactions (all *ps*>.05) in the bias index analysis.

3.3.4 Discussion

The results from Experiment 2 showed that, unlike the pattern seen in Experiment 1, the effect of the own-race bias on recognition memory performance was in some cases seen for both European and Japanese participants. The examination of the false positive rates showed higher false positive rates for other-race faces in both European and Japanese participants, indicating that the two participant groups tended to incorrectly recognise other-race faces as previously seen. This is consistent with previous findings reported in the meta-analysis by Meissner and Brigham (2001). The analysis of hit rates showed that overall untransformed faces had higher hits, suggesting that the stimulus and context similarity between study and test modulated the likelihood of faces being correctly recognised. Contrary to the findings from the meta-analysis above showing the general trend of higher hits for own-race faces, the two participant groups in Experiment 2 showed higher hit rates for the other-race faces. This is initially surprising as it suggests that people correctly recognised other-race faces more often than previously seen faces of their own racial groups. However, given that false positive rates for other-races were higher, it seems that participants were more likely to respond yes/seen to other-race faces irrespective of whether or not faces were actually recognised. The examination of A' measure in Experiment 2 revealed the same pattern found in Experiment 1, that only European participants showed better recognition performance for own-race faces while Japanese participants showed equal performance for own and other race faces. This again adds to the trend that the own-race bias in face recognition is more pronounced in White European participants. It was also found that overall A' was higher when facial expression was untransformed than when they were transformed between study and test. This suggests that the successful face recognition depends on the degree of similarity between faces presented at study and test, consistent with the model by Bruce and Young (1986). It also indicates that when facial representation (structural codes) for unfamiliar faces is derived, information represented in the structural codes is not likely to be totally expression-invariant but it contains some information about facial expression (if present) when the face is first encountered. As we usually see faces in 3-dimensions and often with rigid and/or non-rigid movements, it is likely that the visual system is optimally designed to process faces in such conditions. Therefore, it may be that one static presentation of a face (as were the case in Experiments 1 and 2) is not sufficient to establish expression-invariant structural codes. Finally, the results from the bias index measure showed that, as in Experiment 1, Japanese faces yielded a more lax response criterion. However, this pattern was qualified as both European and Japanese participants showed a more lax criterion for other-race faces, which is consistent with the past findings showing the effect of the own-race bias in bias index. Taken together, the effect of the own-race bias was present for both participant groups in false positive and bias index measures, but with regard to the A' measure only European participants showed more accurate recognition of own-race faces.

In Experiment 2, the effect of different facial expressions (happy or neutral) on the four recognition measures was also examined. As in Experiment 1, the analysis of false positives revealed that false positive rates differed depending on face race and expression, and here happy European and neutral Japanese faces yielded higher false positive rates. However, unlike in Experiment 1, which found the differential effect of facial expression on false positive rates (higher false positives for neutral Japanese faces) in both European and Japanese participants, results from Experiment 2 found that only European participants showed this trend of higher false positives in happy European and neutral Japanese faces. It is difficult to make any generalisation from these findings alone, but combined results regarding false positive rates in Experiment 1 and Experiment 2 seem to suggest that European participants find it more difficult to differentiate Japanese faces in a neutral expression than Japanese faces in a happy expression. The examination of the A’ measure also showed the differential effect of facial expression regarding face transformation. The results showed that recognition performance for European faces trained in happy expression and Japanese faces trained in neutral expression was not affected by expression transformation. For both European and Japanese participants, happy European and neutral Japanese face were equally recognised whether or not they were shown in the same or in different expression at test. Thus the results showed that it was easier to extrapolate to novel facial expression when European faces were encoded in happy expression and Japanese faces were seen in neutral expression. A possible reason for this pattern of results will be investigated later in Chapter 5, which will examine the relationship between race typicality and facial expression. Finally, the results from the bias index analysis showed that Japanese participants had higher bias index for faces trained in neutral than in happy expression. This suggests that facial expressions seen at encoding may sometimes influence response criterion at recognition.

3.4 General Discussion

The current chapter reported two experiments that examined the effect of expression change on recognition memory for own and other race faces. In Experiment 1 the possible similarity between familiar/unfamiliar and own-race/other-race face processing was examined, based on the hypothesis that the differential degree of familiarity with different race faces may account for the own-race bias, just as it underlies the differential processing of familiar and unfamiliar faces. The main finding in Experiment 1 was that, at least for European participants, the quality of unfamiliar own-race face representations was comparable to that of familiar faces, as they could withstand transformation due to expression change. Here European participants recognised own-race European faces equally well whether or not the facial expression changed between learning and test, but the recognition memory for other-race Japanese faces was worse when faces underwent expression change. The pattern of results from European participants thus indicated that the difference in the degree of familiarity with unfamiliar own and other race faces led to richer face representations in own-race than in other-race faces, similar to the difference between representations of familiar and unfamiliar faces. However, the results from Japanese participants showed that changes in expression led to worse recognition performance for both European and Japanese faces. Thus the combined results showed that the differences between the quality of face representations for own and other races are more pronounced in European than in Japanese people, indicating that the effect of the own-race bias is more evident amongst European participants. Consistent with this, the overall results from false positives, A' and bias index measures also indicated the presence of the own-race bias in European participants only. The fact that the own-race bias was not seen amongst Japanese participants may seem surprising. However, past studies have shown that the own-race bias is more evident amongst Caucasian than Asian or African people (Meissner and Brigham 2001), which is consistent with the present results. This may be due to the differences in the quality/quantity of contact with other-races in the two participant groups, as European faces are widely seen in the media in Japan (e.g. Hollywood films) but in comparison Asian faces may be seen less frequently in the British media.

The similarity between familiar/unfamiliar and own-race/other-race face processing, although the results were somewhat inconclusive in that the pattern was only found amongst European participants, may suggest that a similar process underlies the differential processing of both of these types of faces. The nature of the underlying processes accounting for the differential processing of own and other race faces still remains to be answered. However, findings from studies comparing familiar and unfamiliar face processing may provide some possible answers. For example, several studies have indicated that familiar face processing is qualitatively different from the processing of previously unfamiliar faces, showing the relative importance of internal features in the processing of familiar faces compared with the processing of unfamiliar faces where external features are of greater or equal importance to internal features (Clutterbuck and Johnston 2002; Ellis, Shepherd and Davies 1979; Young, Hay, McWeeny, Flude, and Ellis 1985). The difference between the processing of internal and external features is that the processing of external features can be achieved by encoding the shape of individual features (featural processing) whereas the processing of internal features involves the encoding of spatial relations amongst inner facial features (configural processing) in addition to the featural processing (Maurer, Le Grand and Mondloch 2002). The external features of the face (e.g. hair style) are more variable and less stable over time and with age than internal features (e.g. eyes). The recognition of familiar faces requires reliable cues to identity across longer periods of time and therefore configural processing may be more important in familiar than in unfamiliar face processing (Young 1984; Bruce and Young 1998). A recent study by Megreya and Burton (in press) supports this importance of configural processing in familiar faces. Using an array task to examine face matching ability in familiar and unfamiliar faces, Megreya and Burton found that there was a strong correlation between upright unfamiliar and inverted familiar face processing, but no correlation was found between upright familiar and upright unfamiliar faces, indicating that unfamiliar faces may not engage the processes normally engaged by familiar faces. Since it is known that inverted faces cannot be processed configurally, it was suggested that unfamiliar faces may not support configural processing.

The difference between familiar and unfamiliar face processing thus appears to be the differential role of featural and configural encoding. If a similar process underlies both familiar/unfamiliar and own-race/other-race face processing, it follows that configural processing may be implicated to a greater extent in own-race than in other-race faces. Consistent with this, recently some studies indicated that the own-race bias may be related to less efficient holistic encoding of other-race faces. Holistic encoding is a type of configural processing whereby facial features are encoded as a gestalt (Maurer, Le Grand and Mondloch 2002). For example, Tanaka, Kiefer and Bukach (2004) examined the holistic processing of own and other race faces using Asian and Caucasian faces (presented either whole or in isolation) in a two-alternative forced-choice delayed matching task. The results showed that Caucasian participants were more accurate in matching Caucasian faces shown in the whole face, while with Asian faces there was no difference in performance between the two test conditions, indicating that Caucasian participants processed own-race faces more holistically. In contrast, Asian participants did not show any differential pattern of performance for both race faces between the two test conditions, indicating that the level of holistic encoding in Asian participants were equal for both race faces. Another study by Michel, Rossion, Han, Chung and Caldara (2006) used the face composite paradigm (Young, Hellawell and Hay 1987) with Asian and Caucasian faces. In the face composite paradigm, the top and the bottom half of two different faces are joined together, either aligned (creating a composite face) or misaligned (offset laterally). It has been shown that the recognition of the upper half of a face is disrupted more when the face is aligned to a discrepant lower half than when the lower part is misaligned, indicating that the perception of a novel face configuration as a gestalt interferes with the recognition of constituent parts. The results showed that both Asian and Caucasian participants showed a larger composite face effect for own race than for other race faces, indicating that own race faces are processed more holistically than other race faces. However, Michel *et al.* found no significant correlation between the differential holistic processing and the magnitude of the own-race bias in recognition memory, indicating that differences in the holistic encoding may be necessary but not sufficient in explaining the own-race bias in face processing. Thus it appears that configural encoding is important in explaining the differential processing of both familiar/unfamiliar and own-race/other-race faces. This may suggest that the effect of the own-race bias may be explained partially in terms of the general difficulties people have with faces that are less familiar, as in the difference between familiar and unfamiliar face processing.

In Experiment 2, the effect of expression change on recognition memory was further investigated using different face stimuli at learning and test, in order to minimise the use of pictorial coding at recognition that was confounded with structural coding in Experiment 1. The results showed that overall people from both races recognised untransformed faces more accurately than faces that changed in expression, indicating that successful face recognition depends on the degree of similarity between faces presented at study and test, consistent with the model by Bruce and Young (1986). However, unlike the model by Bruce and Young which postulated a complete dissociation between the processing of facial expression and identity information, the results indicated that the stored facial representations is not entirely expression-invariant but it is likely to contain some information about facial expression. This is consistent with findings from more recent studies showing the interaction between the processing of facial expression and identity (e.g. Kaufmann and Schweinberger 2004;

Schweinberger and Soukup 1998). It may be that expression-invariant structural codes are established after faces have been seen in many different expressions, but for faces that are only seen once both identity and expression information seem to be encoded into memory. In addition, it was found that when happy European and neutral Japanese faces were learned people were more likely to recognise the same faces even when they changed in expression at test. This suggests that successful facial identity recognition depends on the facial expression exhibited at encoding, and people seem to be able to extract identity-specific expression-invariant information more easily from happy European and neutral Japanese faces. Regarding the overall measures of identity recognition, the results from false positive and bias index measures showed that the effect of the own-race bias was present for both participant groups, while with A' measure only European participants showed more accurate recognition of own-race faces, indicating that the own-race bias is more evident in European participants.

Finally, the analysis of false positive measure in Experiments 1 and 2 indicated that different expressions signal a sense of familiarity in different race faces. Participants from both racial groups tended to falsely recognise neutral Japanese faces more often in Experiment 1, and in Experiment 2 European participants were more likely to falsely recognise happy European and neutral Japanese faces. Past studies using Caucasian facial stimuli indicated that a smiling expression often signals familiarity in unfamiliar faces (Baudouin *et al.* 2000; D'Argembeau *et al.* 2003), but the current study showed that this was not the case with Japanese faces.

Chapter 4

The Own-Race Bias and Emotion Processing

4.1 General Introduction

This chapter will describe two experiments which looked at the perception and memory for facial expression in own and other race faces. The aim here was to examine the effect of both the own-race bias and in-group bias on emotion processing in own and other race faces cross-racially. As reviewed in the Introduction, the effect of the own-race bias is not limited to identity processing but the effect is seen in emotion processing as well (Elfenbein and Ambady 2002, 2003; Kito and Lee 2004). These studies showed that the recognition accuracy for emotion was higher when emotions were expressed and perceived by members of the same 'cultural' (national, racial or regional) groups, although this in-group advantage was more evident when processing subtle differences in expressive style and the basic emotions are universally recognised at better than chance levels by all groups. However, no study has looked at whether the own-race bias also affects memory for facial expression. Given the numerous findings showing the influence of the own-race bias on recognition memory for facial identity, it is possible that the same own-race advantage also exists when remembering facial expressions in own and other race faces. Thus in two experiments the current chapter aimed to examine both perception and memory for facial expression in own and other race faces cross-racially, to systematically examine the effect of the own-race bias at these two levels of information processing.

The second aim of this chapter was to examine the possible influence of in-group bias on emotion processing in own and other race faces. Findings from the social-cognition research have shown that people generally hold more positive views about their in-group members, often leading to the biased attribution of socially desirable characteristics towards the in-group (e.g. Johnson 1981). Moreover, this separation of the social world into in-group and out-group categories can be based on any social dimension, such as age, gender and race. Indeed, the effect of in-group bias has been seen regarding the dimension of race, showing biased attribution of positive personality traits (Rustemli, Mertan and Ciftci 2000), subtle and complex emotions unique to humans (Gaunt, Leyens and Demoulin 2002) and positive facial expression (Beaupré and Hess 2003) to own-race members. However, it is not known whether or not in-group bias also affects perception and memory for faces belonging to own and other races. Findings from the social-cognition research showing the effect of in-group bias have never been directly related to the findings from face perception research showing the effect of the own-race bias. As face perception, and social perception in general, entails the combination of perceptual and categorical information (e.g. Sanders, McClure and Zárate 2004; Smith and Zárate 1992), it seems important to study own and other race face perception from both perceptual and social-cognitive perspectives. Thus in this chapter the effect of both the own-race bias and in-group bias was examined in relation to emotion processing in own and other race faces.

4.2 Experiment 3 – Perception of Emotion in Own and Other Races

4.2.1 Introduction

Experiment 3 aimed to examine how people perceive facial expressions in own and other race faces. As reviewed in the Introduction, several findings have indicated the existence of the own-race bias in tasks related to emotion processing. For example, a meta-analysis of emotion recognition by Elfenbein and Ambady (2002) found that emotion recognition accuracy was higher when emotions were expressed and perceived by members of the same national, ethnic or regional groups, although the basic emotions were universally recognised at better than chance levels by all groups. Another study by Elfenbein and Ambady (2003) with American and Chinese participants also showed that emotion recognition performance increased as a function of familiarity with a particular racial group. In-group advantage in interpersonal perception was also shown in a study by Kito and Lee (2004). In this study, British and Japanese people's ability to understand non-verbal, interpersonal relationships depicted by Japanese people in photographs were compared, and it was found that Japanese people were generally better at deciphering subtle information provided by facial expressions depicted in these photographs compared with British participants. All these findings indicate the influence of the own-race bias in emotion processing, that emotion information in own-race faces is processed more accurately than it is processed in other-race faces.

Another factor that may possibly affect emotion processing involving different race faces is the influence of in-group bias. For example, the study by Gaunt, Leyens and Demoulin (2002) showed that Belgian people tended to attribute more subtle and uniquely human emotions to in-group (Belgians) than to out-group (Arabs) members. Another study by Beaupré and Hess (2003) showed that people tended to attribute a smiling expression more often to own-race faces over other-race faces, to which neutral expression was more often attributed. These findings suggest that own-race faces are associated with positive emotions such as a smiling expression. However, whether in-group bias affects perception of different race faces has not been investigated systematically.

Experiment 3 thus examined whether or not the in-group bias and the own-race bias influence perception of different facial expressions in own and other race faces cross-racially. Here, morphed European and Japanese faces with angry, happy, neutral and ambiguous (a morph between angry and happy) expressions were used with both European and Japanese participants. Ambiguous facial expression was added to provide a clear condition where positive in-group differentiation was possible. There were two reasons for using the morphing technique to create the expression stimuli. One was that this study used stimuli showing an ambiguous facial expression, which can only be created by morphing. The reason for using a morphing technique to create stimuli showing the other three expressions was to minimise the idiosyncratic expression variations, as well as making the picture quality similar to the ambiguous expression stimuli. Figure 4.1 shows examples of four different facial expressions in the two race faces used in Experiment 3. Participants were asked to decide whether each face was showing angry, happy or neutral expression.

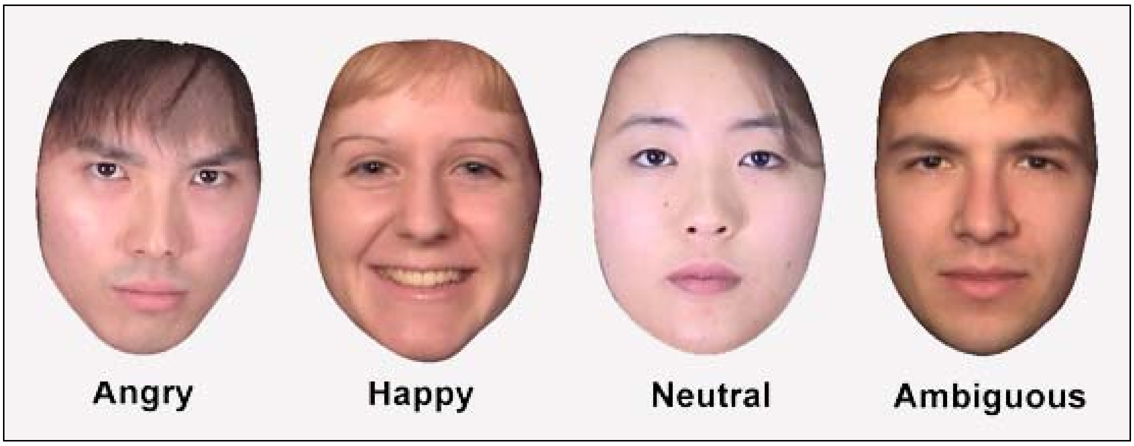


Figure 4.1 Examples of four facial expression categories (angry, happy, neutral and ambiguous) used in Experiment 3.

In relation to the possible effect of in-group bias, it was hypothesised that perception of own and other race faces may be distorted to serve self-enhancement. Specifically, it was predicted that happy facial expressions would be associated more often with perception of own-race faces, compared with other-race faces which may be associated with neutral or angry facial expressions. In terms of accuracy in facial expression perception, it was anticipated that there may be an indication of the own-race bias leading to higher accuracy in perceiving emotion in own-race faces. This is based on findings from the meta-analysis by Elfenbein and Ambady (2002) which showed that the recognition accuracy for emotion was higher when emotions were expressed and perceived by members of the same ‘cultural’ (national, racial or regional) groups.

4.2.2 Method

Participants

Forty European (Caucasian) students (10 males; age range 18-52, mean=24.4, s.d.=8.5) at University of Stirling (Scotland, U.K.) and 40 Japanese students (14 males; age range 18-27, mean=20.5, s.d.=1.9) at Nihon University (Tokyo, Japan) participated in this study. All were paid or received course credits for their participation.

Stimuli and Apparatus

Sixteen European morphed faces (8 males) and 16 Japanese morphed faces (8 males) were used, and four versions of each face identity in full-face (angry, happy, neutral and ambiguous expressions, 128 faces in total) were created. These 128 morphed faces were created using 32 European faces (from a set of undergraduate photographs taken at York University, Canada) and 32 Japanese faces (from a set of undergraduate photographs taken at Kyoto University, Japan) with angry, happy and neutral expressions for each identity. Here, all three expressions (angry, happy and neutral) were posed, but the type and the magnitude of facial muscle movement were not controlled. Instead, people who provided the stimuli were asked to pose a certain facial expression (e.g. a happy face) in their own manner. To make the morphed faces, all 192 images (two races, three expressions and 32 identities) were first edited using PsychoMorph 8.3 and 179 feature points were manually marked (delineated). Such feature points define the main facial features (e.g. eyes, nose and mouth) and the outline (e.g. jaw line, hair line) of each face, and the outline points were used to mask each face to remove background and hair. The faces were then made into pairs of two, randomly (16 pairs per race and per expression) and were averaged together to create 96 morphed faces. Angry and happy morphed faces were then used to prepare a further 32 ambiguous expression faces (16 faces per race). This was achieved by first creating 21-frame face-sequences in which a face displaying an angry expression gradually became happy (prepared for all 32 identities), and an interactive image display program developed by D. M. Burt at University of Durham was used to present these sequences. This program presents each sequence on a computer screen and, when participants move the mouse from left to right or right to left, plays the sequence forward or backward, respectively. At pre-test, 22 participants (11 European, 11 Asian) played all 32 face-sequences and were asked to find the frame in each sequence that they perceived was the midway point between the two endpoint expressions (angry and happy). The starting expression of the sequences was randomised. Participants had full control over the number, direction and speed of the sequence presentation, and once participants decided the midpoint position they were asked to click the mouse once, and the program recorded the current frame of the sequence in a data file and advanced to the next stimulus. The average frame chosen for each identity was then selected as ambiguous facial expression faces (see the rightmost image in Figure 4.1 for an example). See Chapter 2 for more details on the averaging and transforming techniques. All morphed faces were converted to greyscale and were sized to 300 pixels wide using Adobe Photoshop 7.0®. All images were presented on a computer screen. The size of each face image on screen was approximately 11 x 8cm.

Design

This study used a mixed within-participants design. The race of participants (European and Japanese) was used as a classification variable. Independent variables examined were face race (European and Japanese) and expression category (angry, happy, neutral and ambiguous). Perceived expression category (angry, happy and neutral) was recorded as the dependent variable.

Procedure

All participants were tested individually using a laptop computer. Participants were informed that they would be shown Asian and European faces with different facial expressions, and their task was to decide what facial expression these faces showed by pressing the appropriate key. All images and instructions were presented using E-Prime®. Participants were shown 128 morphed faces in random order (one at a time) on a computer screen, and were asked to respond by pressing the “a” key for angry, “h” key for happy and “n” key for neutral expression. The face remained on the screen until participants made a response. After finishing categorising all the faces, participants also answered a short questionnaire and a thorough debriefing was given at the end. See Appendix A for the questionnaire used, and for examples of face images see Appendix D.

4.2.3 Results

The mean response rates for each expression category (angry, happy and neutral) for each morphed face category (angry, happy, neutral and ambiguous expression per race, 8 categories) were calculated for each participant. Means for European and Japanese faces were calculated separately for European and Japanese participants. Expression perception accuracy and response rates were analysed by means of mixed-design ANOVAs. When failing the Mauchly’s test of sphericity, the Greenhouse-Geisser correction (Greenhouse and Geisser 1959) was used. All post-hoc tests of simple main effects using *t*-tests were Bonferroni corrected. Results from the main analyses using ANOVAs and post-hoc analyses are reported with uncorrected degrees of freedom and the corrected *p*-value.

Expression Perception Accuracy

Expression perception accuracy for faces presented with angry, happy and neutral expression were analysed separately by means of mixed-design ANOVAs, and α-levels for ANOVAs were Bonferroni adjusted to the probability of .05 / 3 = .02.

Accuracy – Angry Faces

Figure 4.2 shows the mean expression perception accuracy (with error bars ± 1 s.e.) for angry faces (Japanese and European faces) from 40 European and 40 Japanese participants.

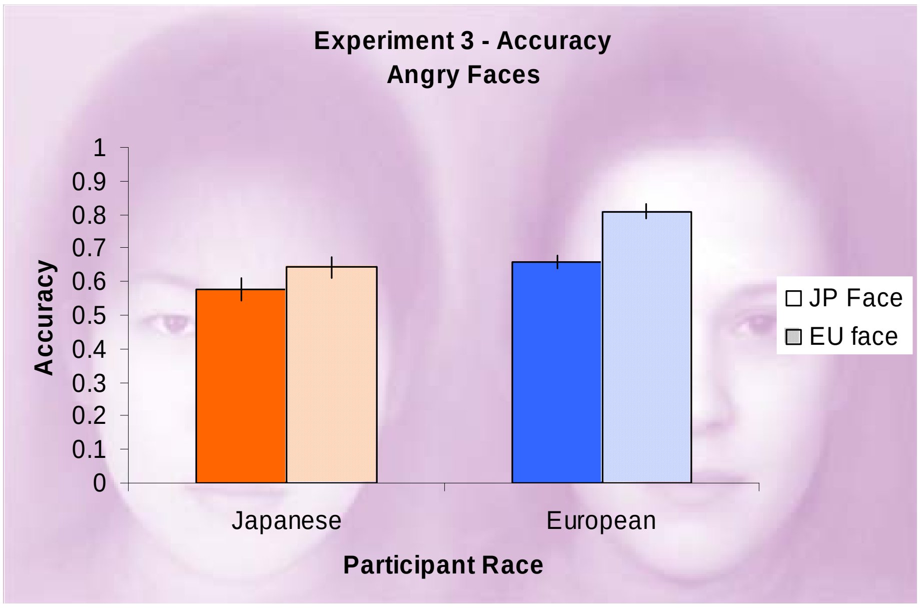


Figure 4.2 Mean expression perception accuracy (with error bars ± 1 s.e.) for angry faces (Japanese and European faces). Left=Japanese participants; Right=European participants.

Mean expression perception accuracy were analysed using a 2 x 2 mixed-design ANOVA with participant race (European and Japanese) as the between-participants factor and face race (European or Japanese) as the within-participants factor. This revealed significant main effects of face race ($F_{(1,78)}$=45.30, p<.001) with higher accuracy in European faces, and of participant race ($F_{(1,78)}$=12.66, p=.001) with higher accuracy in European participants. There was also an interaction between face race and participant race ($F_{(1,78)}$=7.18, *p*=.009). While European participants had higher accuracy in European than in Japanese faces ($t_{(39)}$=3.94, *p*=.004), Japanese participants' accuracy did not differ between the two race faces ($t_{(39)}$=1.82, *p*>.1).

Accuracy – Happy Faces

Figure 4.3 shows the mean expression perception accuracy (with error bars ± 1 s.e.) for happy faces from European and Japanese participants.

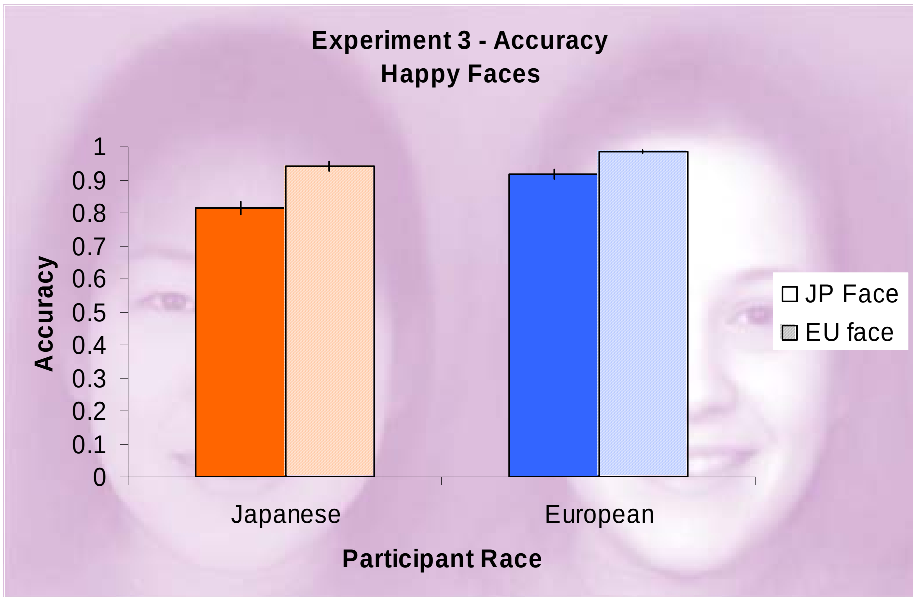


Figure 4.3 Mean expression perception accuracy (with error bars ± 1 s.e.) for happy faces (Japanese and European faces). Left=Japanese participants; Right=European participants.

Mean expression perception accuracy were analysed using a 2 x 2 mixed-design ANOVA as above. This revealed significant main effects of face race ($F_{(1,78)}$=87.53, *p*<.001) with higher accuracy in European faces, and of participant race ($F_{(1,78)}$=17.05, *p*<.001) with higher accuracy in European participants. There was also an interaction between face race and participant race ($F_{(1,78)}$=8.90, *p*=.004). While happy Japanese faces were more accurately perceived in European than in Japanese participants ($t_{(39)}$=4.07, *p*=.004), both European and Japanese participants perceived happy expression in European faces equally accurately ($t_{(39)}$=2.77, *p*>.02). In addition, both

European and Japanese participants had higher accuracy in European than in Japanese faces (both *ps*=.004).

Accuracy – Neutral Faces

Figure 4.4 shows the mean expression perception accuracy (with error bars ± 1 s.e.) for neutral faces from European and Japanese participants.

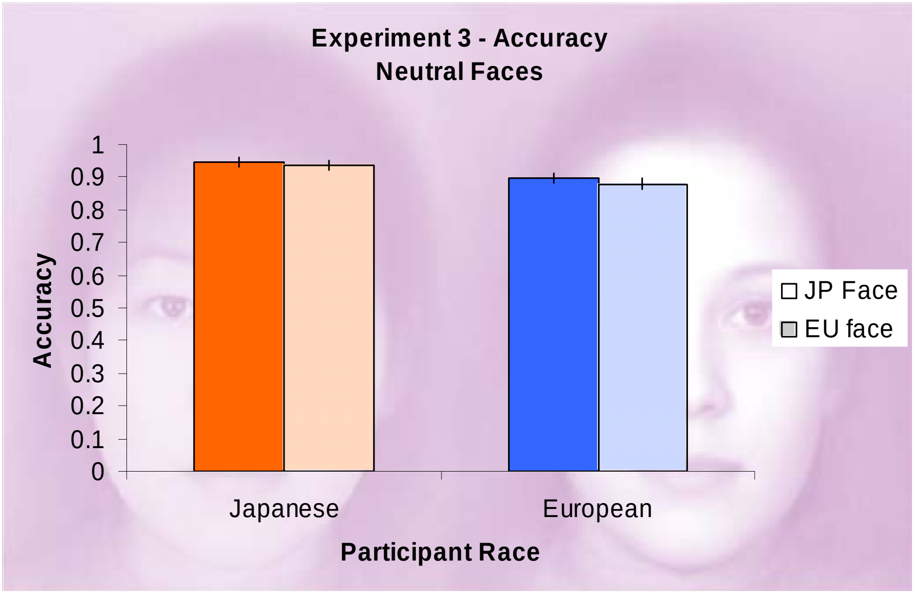


Figure 4.4 Mean expression perception accuracy (with error bars ± 1 s.e.) for neutral faces (Japanese and European faces). Left=Japanese participants; Right=European participants.

Mean expression perception accuracy were analysed using a 2 x 2 mixed-design ANOVA as above. There was a significant main effect of participant race ($F_{(1,78)}$=7.91, *p*=.006) with higher accuracy in Japanese participants. There were no other main effect or interaction (all *ps*>.1).

Response Rates

With regard to the perception of faces showing ambiguous expression, it was not possible to examine accuracy as there was no wrong or correct answer due to the nature of the stimuli. Thus instead participants' response rates regarding their perception of ambiguous facial expression were analysed. Overall response rates were also analysed to see whether or not there was an overall racial difference in response patterns. Overall response rates (combined results from angry, happy, neutral and ambiguous expression) and response rates for ambiguous faces were analysed by means of mixed-design ANOVAs. When analysing response rates for ambiguous faces, α-levels for ANOVAs were Bonferroni adjusted to the probability of .05 / 4 = .01, as here only a quarter of the available data were selected for analysis.

Response Rates – Ambiguous Faces

Figure 4.5 shows the mean response rates (with error bars ± 1 s.e.) for three expression categories in ambiguous faces from 40 European and 40 Japanese participants.

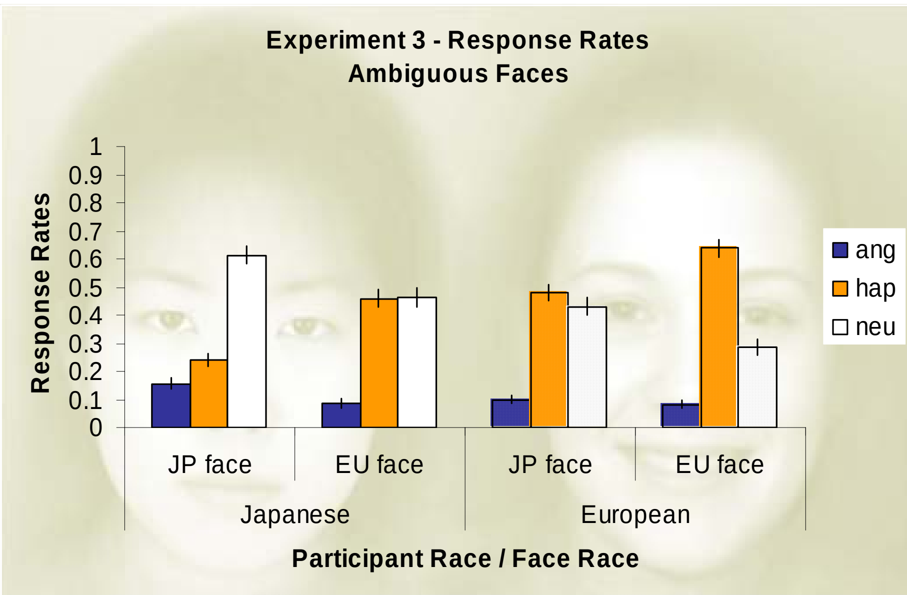


Figure 4.5 Mean response rates (with error bars ± 1 s.e.) for three expression categories (angry, happy and neutral) in ambiguous faces (Japanese and European faces). Left (solid)=Japanese participants; Right (dotted)=European participants.

Mean response rates were analysed using a 2 x 2 x 3 Greenhouse-Geisser corrected mixed-design ANOVA with participant race (European and Japanese) as the between-participants factor and face race (European or Japanese) and expression category (angry, happy and neutral) as the within-participants factors. There was a significant main effect of expression category ($F_{(2,156)}$=93.83, p<.001), reflecting that happy and neutral categories (both 45%) were chosen equally often ($t_{(79)}$=.15, p>1) and the angry category was chosen the least (10%), which significantly differed from both happy and neutral categories (both ps=.003). This main effect was however moderated by a significant expression category by participant race interaction ($F_{(2,156)}$=22.47, p<.001), showing that European participants chose the happy category more often than Japanese participants ($t_{(39)}$=6.35, p=.003) and Japanese participants chose the neutral category more often than European participants ($t_{(39)}$=4.41, p=.003) but the two races chose the angry category equally often ($t_{(39)}$=1.47, p>.1). Finally a significant interaction between face race and expression category ($F_{(2,156)}$=80.19, p<.001) showed that Japanese faces were most likely to be perceived as neutral, followed by happy and least likely as angry, all of which differed significantly from each other (all ps=.006). In contrast, European faces were most likely to be perceived as happy, followed by neutral and least likely as angry, all of which differed significantly from each other (all ps=.006). There were no other main effects or interactions (all ps>.1).

Response Rates – Overall

Figure 4.6 shows the mean overall response rates (with error bars ± 1 s.e.) for three expression categories (angry, happy or neutral) in all four expression categories combined (Japanese and European faces) from European and Japanese participants.

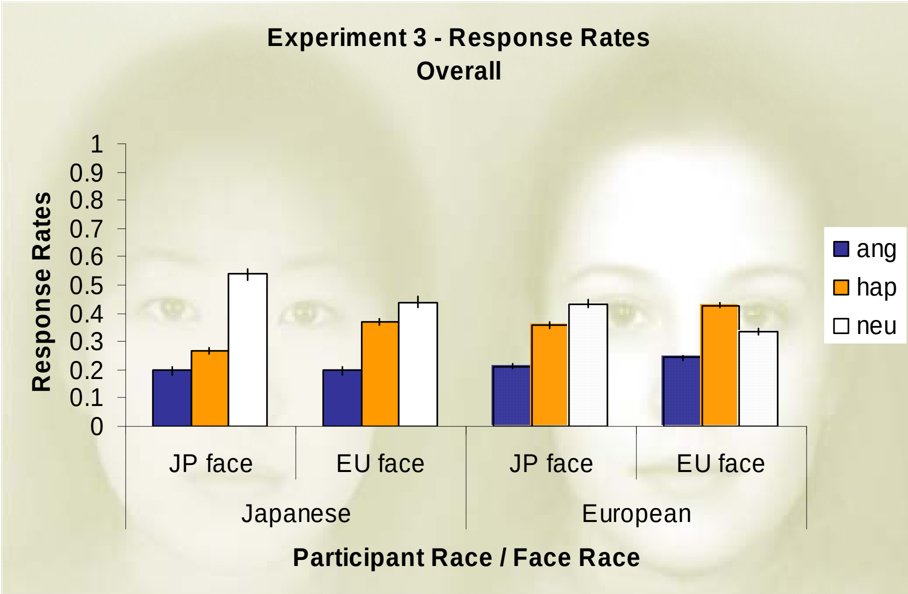


Figure 4.6 Mean overall response rates (with error bars ± 1 s.e.) for three expression categories (angry, happy and neutral) in four expression categories combined (angry, happy, neutral and ambiguous; Japanese and European faces). Left (solid)=Japanese participants; Right (dotted)=European participants.

A 2 x 2 x 3 Greenhouse-Geisser corrected mixed-design ANOVA revealed a significant main effect of expression category ($F_{(2,156)}$=123.05, *p*<.001). Tests of simple main effects using *t*-test showed that overall neutral category was chosen most often (44%), followed by happy (36%) ($t_{(79)}$=4.21, *p*=.003), and then angry (20%) ($t_{(79)}$=15.85, *p*=.003). This main effect was however qualified by a significant interaction between expression category and participant race ($F_{(2,156)}$=20.94, *p*<.001). Japanese participants chose the neutral category most often, happy next and angry the least, all of which differed significantly from each other (all *ps*=.003). European participants, in contrast, chose the neutral and happy category equally often ($t_{(39)}$=.43, *p*>.5) followed by the angry category, which was significantly different from both happy and neutral (both *ps*=.003). A significant interaction between face race and expression category ($F_{(2,156)}$=128.86, *p*<.001) showed that Japanese faces were most likely to receive neutral response, happy next and angry the least, all of which differed significantly from each other (all *ps*=.006). With European faces, however, they received both happy and neutral response equally often ($t_{(79)}$=.57, p>1), which was followed by the angry category which significantly differed from both happy and neutral categories and was chosen least often (both ps=.006). Finally, there was an interaction between face race, expression category and participant race ($F_{(2,156)}$=3.35, p=.04). With Japanese faces, both European and Japanese participants chose the neutral category most often, followed by happy and then angry, all of which differed significantly from each other (all $ps \leq .01$). However with European faces, while Japanese participants were likely to give both neutral and happy response equally ($t_{(39)}$=2.60, p>.05) followed by the angry category, European participants gave European faces a happy response most often, followed by the neutral and angry category, all of which differed significantly from each other (all ps=.006). There were no other main effects or interactions (all ps>.01).

4.2.4 Discussion

The results from Experiment 3 showed several interesting patterns in perception of own and other race faces. First, with regard to accuracy in perception of angry faces, overall European faces and European participants had higher accuracy. However, the interaction between participant and face race showed that only European participants showed higher accuracy in European faces and Japanese participants' accuracy for the two race faces did not differ from each other. Thus there was an indication of the own-race bias in perception of an angry expression amongst European participants. A similar pattern was observed in the perceptual accuracy for happy faces, showing higher accuracy for European faces and European participants. However a significant interaction again qualified this pattern, showing that although happy European faces were equally accurately perceived by both groups of participants, with happy Japanese faces European participants had higher accuracy than Japanese participants. This is surprising, as European participants were better able to perceive emotions in other-race

Japanese faces than Japanese participants, although European participants' accuracy in happy European faces were still higher than that of Japanese faces. In contrast to the pattern seen in the perception of faces with emotional expressions, the pattern from neutral faces revealed that Japanese participants were overall more accurate than Europeans. Together, these results indicated that generally European faces were more expressive than Japanese faces, and when faces showed emotional expressions European participants were generally more accurate in correctly perceiving these emotions in faces. Moreover, European participants correctly perceived angry European and happy Japanese faces more often than Japanese participants, suggesting that European participants were good at perceiving emotions in both own and other race faces. Japanese participants, on the other hand, were more accurate than Europeans in perceiving neutral expression overall.

Although this pattern of results may indicate that European and Japanese participants were good at perceiving different types of emotions (more precisely, perceiving faces with or without emotions), there is another possibility for this pattern of results to occur, which is that the response pattern for choosing different expressions may have differed between the two participant groups. In other words, it may be that European participants were more likely to respond that faces contain emotional expressions and Japanese participants were more likely to respond that faces were neutral. This possibility was therefore examined in the analysis of response patterns. The analysis of the response pattern for faces with ambiguous expressions showed that European participants chose the happy category more often than Japanese people, while Japanese participants chose the neutral category more often than European people. Different race faces were associated with different types of expressions. Out of the three possible expressions (angry, happy and neutral), Japanese faces were most likely to be perceived as neutral while European faces were most likely to be perceived as happy. The analysis of the overall response pattern revealed that, out of the three possible expressions, generally Japanese participants were more likely to choose the neutral category while European participants chose both the neutral and happy categories equally often. However, this pattern was moderated by the race of faces. When shown Japanese faces, both participant groups chose the neutral category most often. However, when shown European faces, Japanese participants were likely to perceive the expression as neutral and happy equally often, while European participants were most likely to see the faces as happy. Therefore there was an indication of increased tendency to perceive faces as happy in Europeans participants, in particular in European faces, compared with Japanese participants who were more likely to see faces as neutral. Different race faces were also associated with different types of expressions. Here, out of the three possible expressions, Japanese faces were most likely to be seen as neutral while European faces were equally likely to be seen as both happy and neutral. It appears that difference in the response pattern mirrors the pattern of association between different race faces and different facial expressions.

To summarise, the results from accuracy and response pattern data showed that there was no consistent influence of the own-race bias in perception of facial expression (in terms of higher accuracy in the perception of own-race facial expression). Instead, it indicated that generally European participants tended to perceive emotions in faces (irrespective of face race) while Japanese participants tended to see faces as neutral. It was also found that different race faces were associated with different types of facial expressions. Out of the three possible expressions Japanese faces were more likely to be perceived as neutral, irrespective of the actual expression exhibited, while European faces were often seen as happy, even when faces were neutral or ambiguous. However, this pattern did not differ between the two participant groups, thus there was no in-group bias (in terms of more positive perception of own-race faces) in perception of facial expression. A possible reason for these results may be that the typical expression that faces show may differ between different races. This possibility will be investigated later in Chapter 5, which examines the relationship between race typicality and facial expression.

One problem with the current study was that the results indicated that the expressiveness of faces may have differed between the two races, that European faces were in general more expressive than Japanese faces. Therefore in future studies it will be interesting to see whether the same pattern (positive perception of European and neutral/negative perception of Japanese faces) would be seen if the expressiveness of faces was fully controlled. One way of achieving this is to utilise the so-called racially ambiguous faces used in the study by MacLin and Malpass (2001). In this study, racially ambiguous faces were created by morphing Hispanic and Black faces, and the ambiguous faces were presented with different racial marker of hair style typically associated with either Hispanic or Black people. The results from race classification task showed that identical but racially ambiguous faces were classified according to the racial marker, that when faces were shown with Hispanic hair style people perceived the face to be Hispanic, while when the same face was shown with Black hair style people categorised the face as Black. Therefore, creating racially ambiguous faces showing different facial expressions (such as angry, happy and ambiguous) and manipulating the race category membership of these faces with different racial marker may be one way to achieve different race categories are equal in terms of expressiveness of emotion.

4.3 Experiment 4 – Memory for Emotion in Own and Other Races

4.3.1 Introduction

Experiment 4 was an extension of Experiment 3, and instead of looking at perception of facial expression in different race faces, Experiment 4 examined memory for facial expressions in different race faces cross-racially. Although there was no consistent indication of the own-race and in-group bias in Experiment 3, a different pattern may be expected when examining cross-racial memory for facial expressions. As reviewed in the Introduction, numerous studies have shown the own-race bias in face recognition, i.e. better identity memory for own-race over other-race faces (e.g. Meissner and Brigham 2001; Sporer 2001). However, it has not yet been investigated whether or not familiarity with one's own-race leads to better expression memory for own-race over other-race faces. The finding in Experiment 3, showing no influence of race expertise in perception of facial expression, is consistent with the idea of independent processing of identity and expression information proposed by Bruce and Young (1986). At the perceptual level of information processing at least, it appears that familiarity with one's own-race does not seem to automatically lead to better processing of facial expression information in own-race faces. However, it is conceivable that memory for facial expressions may be influenced by the familiarity with a particular racial category, because in order to remember facial expression in a particular face people must also recall the identity of the face. Therefore, if people are less accurate in remembering faces of other-race faces and more likely to confuse different identities in other-races, it may follow from this that memory for facial expression would also be less accurate in other-race faces.

Experiment 4 also aimed to examine the possible influence of in-group bias regarding expression memory. The results in Experiment 3 indicated that at perceptual level there was no influence of in-group bias leading to more positive perception of own-race faces. However, research on attribution of emotion to different races found that people generally tended to attribute more positive emotions to in-group members (e.g. Beaupré and Hess 2003; Gaunt, Leyens and Demoulin 2002). It may be possible that such a bias may have some impact when people attempt to recall facial expression in own and other race faces, particularly when people do not actually remember the facial expression. This possibility was therefore also examined in Experiment 4. In addition, as results from Experiment 3 indicated that European faces are in general perceived as more positive whereas Japanese faces are more likely to be seen as neutral, it was anticipated that this differential pattern of association between race and expression perception may also extend to memory for facial expression.

4.3.2 Method

Participants

Forty European (Caucasian) students (10 males; age range 18-52, mean=24.4, s.d.=8.5) at University of Stirling (Scotland, U.K.) and 40 Japanese students (14 males; age range 18-27, mean=20.5, s.d.=1.9) at Nihon University (Tokyo, Japan) participated in this study. All were paid or received course credits for their participation.

Stimuli and Apparatus

The same 128 morphed faces used in Experiment 3 (16 European and 16 Japanese face images with 4 expressions: angry, happy, neutral and ambiguous) were used. Note that here the images were presented in full colour. All faces were edited using Adobe Photoshop 7.0® and resized to 640 pixels wide. The size of each face image on screen was approximately 12 x 9cm. The morphed faces were then used to create testing stimuli for recognition memory test for facial expressions. For testing expression memory, 41-frame computerised interactive face-sequences in which a face displaying an angry expression gradually became neutral and then happy were prepared for all 32 identities (16 identities per race). The size of each face image in the face-sequence was approximately 8 x 5cm. Scores from each sequence ranged from -1 to 0 to 1, where -1 indicating angry, 0 being neutral and finally 1 being happy expression. All images were presented on a computer screen.

Design

This study used a mixed within-participants design. The race of participants (European and Japanese) was used as a classification variable. Independent variables examined were face race (European and Japanese) and expression category (angry, happy, neutral and ambiguous). Expression memory score (ranging from -1 to 0 to 1, indicating angry, neutral and happy) was recorded as the dependent variable.

Procedure

All participants were tested individually using a laptop computer. Participants were informed that they would be shown several Asian and European faces, and their task was to form an impression of these faces in terms of how honest they appeared, and do a recognition test involving these faces later. All study images and instructions were presented using E-Prime®. Participants were shown 8 Asian and 8 European morphed faces with different expressions (angry, happy, neutral and ambiguous per sex and race) in random order for 10 seconds each, and formed an impression of these faces. Once finished, participants were told that their next task would be to remember the *facial expression* the faces exhibited in the earlier trials, using the 41-frame interactive face-sequences in which a face displaying angry expression gradually became neutral and then happy. Sequences for all 16 identities were presented using an image display developed by D. M. Burt at University of Durham (see Chapter 2). This display presented the sequences in random order, and the centre point of each continuum for each identity was also randomised. Each participant saw the image individually and could manipulate the level of transform continuously using a computer mouse, and participants stopped the sequence when the facial expression on the screen matched the expression they remembered from earlier trials. After the recognition tasks, participants also answered a short questionnaire and a thorough debriefing was given at the end. See Appendix A for the questionnaire used, and for examples of face images see Appendix D.

4.3.3 Results

Before describing the results in detail, it should be noted that the stimuli used in Experiment 4 were the same as stimuli used in Experiment 3. The results in Experiment 3 showed that expressiveness of facial stimuli in different expression categories differed between the two race faces, especially in faces with angry expression. Although such differences in stimuli expressiveness was not ideal, the expression recognition memory task in Experiment 4 required participants to try to recreate the facial expressions shown at the study phase and therefore differences in stimuli expressiveness should not have mattered too much in this context. For instance, although potentially participants may have perceived a face with ‘angry’ expression as more ‘neutral’, participants’ perceptual categorisation of facial expression was in effect not directly relevant to the task here, since the task was to match their memory representation of facial expression with the sequence of test stimuli presented. Further, memory performance was analysed by dividing participants’ response into three response categories (for each expression) and analysing the frequency of response in each category. Thus scores from 16 face-sequence trials were re-coded by the following means. Each score (S) was divided into 3 expression categories, where $S \leq -0.4$ indicated angry category, $-0.4 < S < 0.4$ corresponded to neutral category, and $S \geq 0.4$ indicated happy category. The mean response rates for each expression category (angry, happy and neutral) for each morphed face category (angry, happy, neutral and ambiguous expression per race, 8 categories) were calculated for each participant. Means for European and Japanese faces were calculated separately for European and Japanese participants. Expression memory accuracy and response rates were analysed by means of mixed-design ANOVAs. When failing the Mauchly's test of sphericity, the Greenhouse-Geisser correction (Greenhouse and Geisser 1959) was used. All post-hoc tests of simple main effects using *t*-tests were Bonferroni corrected. Results from the main analyses using ANOVAs and post-hoc analyses are reported with uncorrected degrees of freedom and the corrected *p*-value.

Expression Memory Accuracy

Expression memory accuracy for faces presented with angry, happy and neutral expression were analysed separately by means of mixed-design ANOVAs, and α-levels for ANOVAs were Bonferroni adjusted to the probability of .05 / 3 = .02.

Accuracy – Angry Faces

Figure 4.7 shows the mean expression memory accuracy (with error bars ± 1 s.e.) for angry faces (Japanese and European faces) from 40 European and 40 Japanese participants.

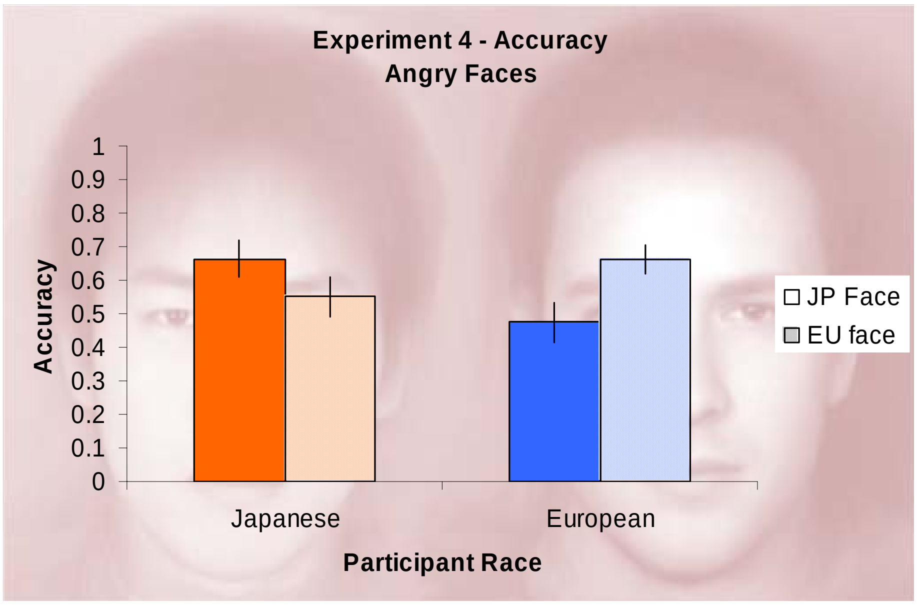


Figure 4.7 Mean expression memory accuracy (with error bars ± 1 s.e.) for angry faces (Japanese and European faces). Left=Japanese participants; Right=European participants.

Mean expression memory accuracy were analysed using a 2 x 2 mixed-design ANOVA with participant race (European and Japanese) as the between-participants factor and face race (European or Japanese) as the within-participants factor. This revealed a significant interaction between face race and participant race ($F_{(1,78)}$=10.73, p=.002). While European participants had higher accuracy in European than in Japanese faces ($t_{(39)}$=2.94, p=.02), Japanese participants' accuracy did not differ between the two race faces ($t_{(39)}$=1.71, p>.1). Both main effects were non-significant (both ps>.1).

Accuracy – Happy Faces

Figure 4.8 shows the mean expression memory accuracy (with error bars ± 1 s.e.) for happy faces from European and Japanese participants.

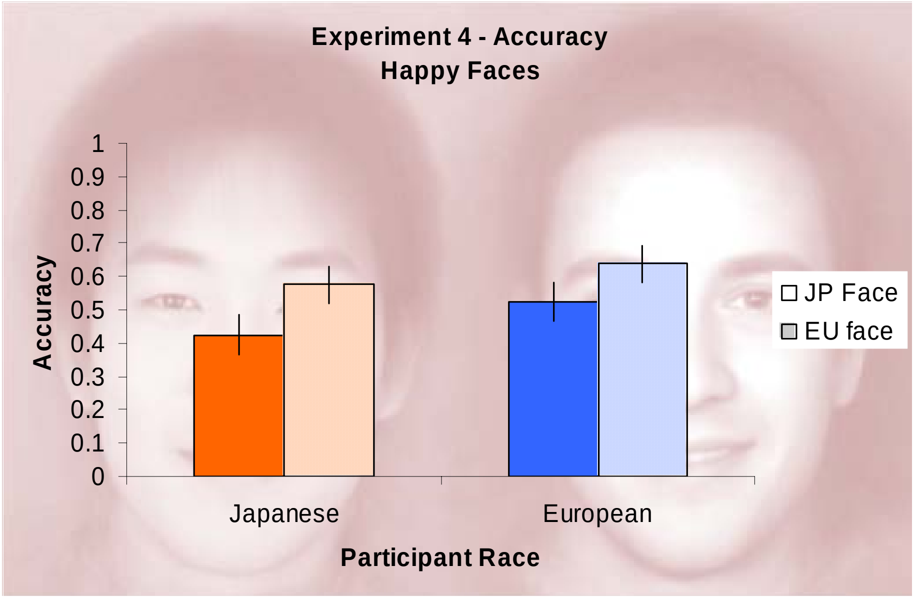


Figure 4.8 Mean expression memory accuracy (with error bars ± 1 s.e.) for happy faces (Japanese and European faces). Left=Japanese participants; Right=European participants.

Mean expression memory accuracy was analysed using a 2 x 2 mixed-design ANOVA as above. This revealed a significant main effect of face race ($F_{(1,78)}$=8.06, p=.006), with higher accuracy in European faces. There were no other main effect or interaction (all *ps*>.1).

Accuracy – Neutral Faces

Figure 4.9 shows the mean expression memory accuracy (with error bars ± 1 s.e.) for neutral faces from European and Japanese participants.

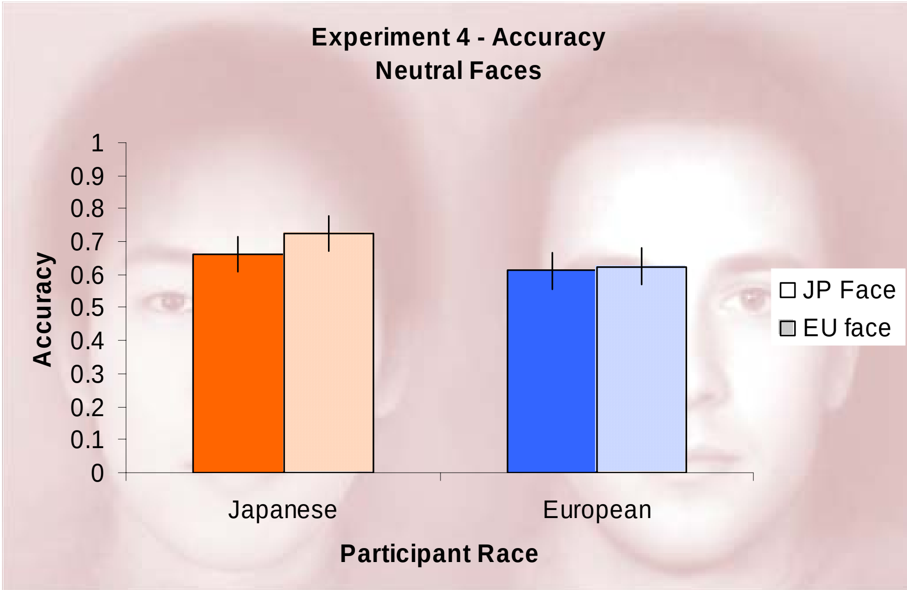


Figure 4.9 Mean expression memory accuracy (with error bars ± 1 s.e.) for neutral faces (Japanese and European faces). Left=Japanese participants; Right=European participants.

Mean expression perception accuracy were analysed using a 2 x 2 mixed-design ANOVA as above. There were no significant main effects or interaction (all *ps*>.1).

Response Rates

With regard to the memory for faces showing ambiguous expression, as in Experiment 3 it was not possible to examine accuracy as there was no wrong or correct answer due to the nature of the stimuli. Thus instead participants' response rates regarding their perception of ambiguous facial expression were analysed. Overall response rates were also analysed to see whether or not there was an overall racial difference in response patterns. Overall response rates (combined results from angry, happy, neutral and ambiguous expression) and response rates for ambiguous faces were analysed by means of mixed-design ANOVAs. When analysing response rates for ambiguous faces, α-levels for ANOVAs were Bonferroni adjusted to the probability of .05 / 4 = .01, as here only a quarter of the available data were selected for analysis.

Response Rates – Ambiguous Faces

Figure 4.10 shows the mean response rates (with error bars ± 1 s.e.) for three expression categories in ambiguous faces from 40 European and 40 Japanese participants.

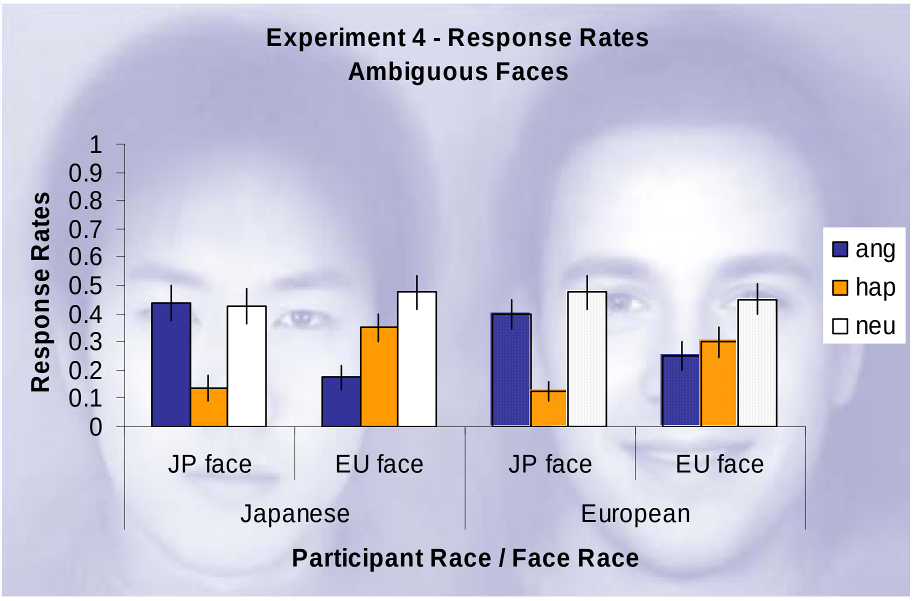


Figure 4.10 Mean response rates (with error bars ± 1 s.e.) for three expression categories (angry, happy and neutral) in ambiguous faces (Japanese and European faces). Left (solid)=Japanese participants; Right (dotted)=European participants.

Mean response rates were analysed using a 2 x 2 x 3 Greenhouse-Geisser corrected mixed-design ANOVA with participant race (European and Japanese) as the between-participants factor and face race (European or Japanese) and expression category (angry, happy and neutral) as the within-participants factors. There was a significant main effect of expression category ($F_{(2,156)}$=13.29, p<.001), reflecting that the neutral category was chosen most often (46%), followed by the angry category (32%) ($t_{(79)}$=2.74, p=.02), and then the happy category (22%) ($t_{(79)}$=2.44, p=.05). A significant interaction between face race and expression category ($F_{(2,156)}$=9.24, p<.001) showed that Japanese faces were equally likely to be remembered as neutral or angry ($t_{(79)}$=.40, p>.1) and least likely as happy, which differed significantly from both neutral and angry (both *ps*=.006). In contrast, European faces were equally likely to be remembered as neutral or happy ($t_{(79)}$=2.00, p>.1) and least likely as angry, which significantly differed from neutral ($t_{(79)}$=3.86, p=.006) but not happy ($t_{(79)}$=2.03, p>.1). There were no other main effects or interactions (all ps>.1).

Response Rates – Overall

Figure 4.11 shows the mean overall response rates (with error bars ± 1 s.e.) for three expression categories (angry, happy or neutral) in all four expression categories combined (Japanese and European faces) from European and Japanese participants.

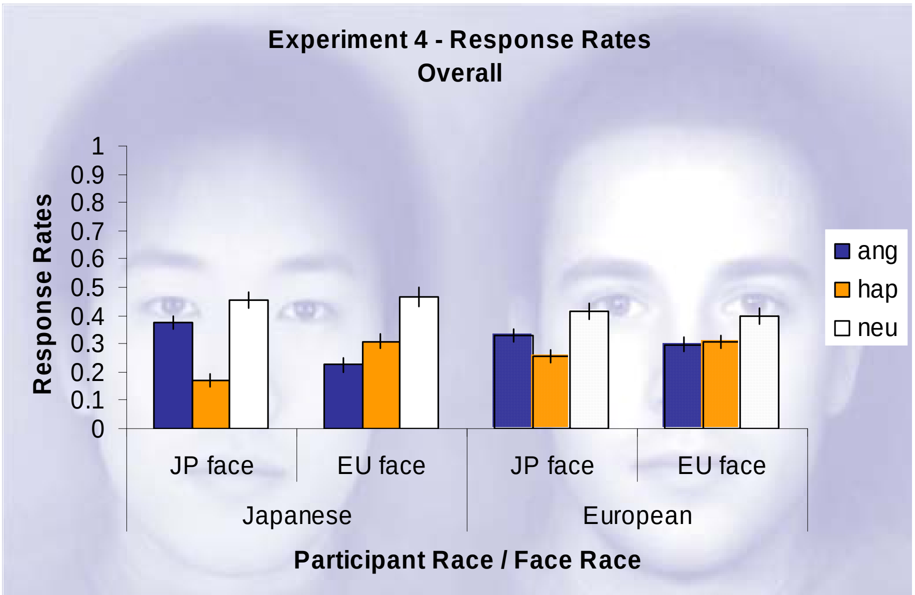


Figure 4.11 Mean overall response rates (with error bars ± 1 s.e.) for three expression categories (angry, happy and neutral) in four expression categories combined (angry, happy, neutral and ambiguous; Japanese and European faces). Left (solid)=Japanese participants; Right (dotted)=European participants.

A 2 x 2 x 3 Greenhouse-Geisser corrected mixed-design ANOVA revealed a significant main effect of expression category ($F_{(2,156)}$=123.05, p<.001). Overall, the neutral category was chosen most often (43%), followed by the angry category (31%) and then the happy category (26%), all of which differed significantly from each other (all ps≤.04). A significant interaction between face race and expression category ($F_{(2,156)}$=11.42, p<.001) showed that Japanese faces were equally likely to be remembered as neutral or angry ($t_{(79)}$=2.48, p>.05) and least likely as happy, which differed significantly from both neutral and angry (both *ps*=.006). In contrast, European faces were most likely to be remembered as neutral, which was significantly different from both happy and angry (both *ps*=.006), however response rates for happy and angry expressions did not differ from each other ($t_{(79)}$=1.78, p>.5). Finally, this last interaction was qualified by an interaction between face race, expression category and participant race ($F_{(2,156)}$=3.81, p=.03). With Japanese faces, both European and Japanese participants remembered in a neutral and angry expression equally often (both *ps*>.1), followed by a happy expression. However, while Japanese participants were more likely to remember Japanese faces with an angry expression significantly more often than with a happy expression ($t_{(39)}$=5.41, p=.006), European participants chose the angry and happy categories equally often ($t_{(39)}$=1.99, p>.1). With European faces, while European participants were equally likely to remember the faces in all three expressions (all *ps*>.1), Japanese participants remembered European faces in the neutral expression most often followed by the happy ($t_{(39)}$=2.84, p=.04) and angry ($t_{(39)}$=4.66, p=.006) categories, but there was no difference between the response rates for the happy and angry expressions ($t_{(39)}$=2.35, p>.1).

4.3.4 Discussion

The pattern of results found in Experiment 4 concerning memory for facial expression showed that there was a slight indication of the own-race bias in expression memory accuracy, at least amongst European participants. The analysis of expression memory accuracy for angry faces showed that European participants had higher accuracy in remembering angry expression in European than in Japanese faces. However, Japanese participants' accuracy for an angry expression did not differ between the two race faces. Expression memory accuracy for happy and neutral faces did not reveal any race group differences, although happy European faces were in general remembered more accurately than happy Japanese faces. The pattern of expression memory accuracy for angry faces was similar to that of expression perception accuracy seen earlier in Experiment 3. The comparison of the results in Experiments 3 and 4 revealed that European participants had higher accuracy for angry own-race faces in both perception and memory tasks. Japanese participants, on the other hand, did not show such a difference in either task.

Given that the pattern is similar in both perception and memory tasks, it is likely that European participants' lowered ability to recall angry expressions in Japanese faces was due to their failure in successfully encoding facial expression information, and it is unlikely to be the result of European participants not remembering Japanese face identities. If the effect of the own-race advantage in angry expression memory was due to Europeans' general inability to successfully differentiate Japanese face identities in memory and confusing different Japanese identities, it would be expected that the own-race advantage in emotion memory would be seen in all three expression conditions. This was not the case, however, and the race-bias was only observed in memory for angry Japanese faces. Thus it seems that the own-race advantage was due to European participants' inability to successfully encode particular emotion information (angry expression) in Japanese faces. This may be partially due to the fact that, as found in Experiment 3, angry Japanese faces used in this study seemed to have been less expressive than angry European faces. However, as mentioned earlier, the expression memory task used in Experiment 4 involved participants to *recreate* the facial expression previously seen, and therefore the difference in expressiveness is unlikely to be the sole reason for the pattern of results observed here.

Analysis of the response pattern for ambiguous faces showed that, out of the three possible expressions, European faces were more likely to be remembered as neutral or happy. This was slightly different from the pattern seen in Experiment 3 which showed that European faces were most likely to be perceived as happy. In contrast, Japanese faces were equally likely to be remembered as neutral or angry, again slightly different from the results in Experiment 3 which showed that Japanese faces were most likely to be perceived as neutral. Thus European faces were generally associated with a neutral or a positive emotion, whereas Japanese faces were generally associated with a neutral or a negative emotion. The results from emotion memory generally mirrored the results in expression perception, and suggested that there was a general association between different groups of races and different kinds of emotions. This point will be further examined in Chapter 5 next. The analysis of the overall response pattern revealed that, out of the possible three expressions, Japanese faces were most likely to be remembered as either neutral or angry, while European faces were most likely to be remembered as neutral. However, this pattern was moderated by the race of participants. Here, Japanese participants were more likely to remember Japanese faces as angry significantly more often than as happy, while European participants were equally likely to remember Japanese faces as angry or happy. In contrast, although Japanese participants showed a tendency to remember European faces as neutral most often, European participants did not show any tendency to remember European faces in any particular expression. Therefore Japanese faces were likely to be remembered as angry (in particular in Japanese participants), and when faces were ambiguous European faces were more likely to be remembered as either neutral or happy. The general response pattern between perception and memory task was different, as in Experiment 3 Japanese faces were overall seen as neutral most often, while European faces were equally likely to be perceived as happy and neutral. If memory for expression is only based on the perceptual encoding of these facial expressions, it is expected that a similar pattern would be seen in both the expression perception and memory tasks. The fact that there were differences suggests that the encoding of facial expression into long-term memory is influenced by other factors, which affect the association between different race faces and different facial expressions.

One problem with the current study was that it did not explicitly check whether or not participants actually remembered the identity of faces during the test phase when participants tried to recall the expression. Successful emotion memory for one face implied that the identity of this face was also remembered. However, when participants did not remember the facial expression it was not clear whether errors in emotion memory task was due to participants failing to remember the facial expression or if it was due to people failing to recognise a particular facial identity. Because the number of stimuli used was quite small (16 faces in total) and the exposure time was relatively long (10 seconds per face), it was assumed that participants would not have much difficulty in remembering the identity of all the faces. However, for future studies it would be better to directly examine identity memory performance at the same time when testing memory for facial expressions to see how often people actually recognise a face but fail to remember the emotional expression.

4.4 General Discussion

The current chapter reported two experiments which examined the possible effect of the own-race bias and in-group bias on perception and memory for facial expressions in own and other race faces. Experiment 3 examined how people perceived facial expressions in own and other race faces. The analysis of the overall response patterns and response patterns for faces with ambiguous facial expression showed that, irrespective of the race of faces, in general European participants were likely to see faces as exhibiting a happy expression while Japanese participants were likely to choose a neutral expression. This differential pattern of response between the two participant groups may be related to the difference in the social desirability of showing emotions in public in respective countries, as in Japan expressing emotions in public is often considered less desirable than it is in Britain, an expectation which may influence how people perceive emotions in faces generally.

There was also a difference in the response pattern for different race faces. Regarding the response pattern for faces showing an ambiguous expression, the results showed that ambiguous Japanese faces were likely to be perceived as angry or neutral, while ambiguous European faces were likely to be perceived as happy, where both participant groups showed this pattern. The analysis of the overall response pattern, however, showed a sign of an in-group bias in emotion perception, at least in European participants. Here, European participants gave European faces a happy response most often, while Japanese participants were equally likely to give a neutral or a happy response to European faces. With Japanese faces, the response pattern did not differ between the two participant groups and both European and Japanese participants chose the neutral category most often. It is difficult to determine whether this pattern was due to the presence of an in-group bias in European participants only (leading to a positive perception of emotion in own-race faces), or whether it was due to differences in the expressiveness of facial expression stimuli between the two race faces. The expressiveness of the face stimuli was not controlled for in the current study, and therefore it is possible that generally European faces showed a stronger happy emotion than Japanese faces. The difference in the social desirability of expression emotion in public between Japan and Britain makes this a likely possibility, as the stimuli used here were not spontaneous but posed facial expressions. However, although posed, the type and the magnitude of facial muscle movement were not fully controlled here, because people who provided the expression stimuli were simply asked to pose a certain facial expression (e.g. a happy face). The facial expression stimuli used in the study were therefore modified by morphing two individual faces showing a certain expression, in order to minimise the idiosyncratic differences in facial expressions. However, the intensity of the facial expressions between the two race faces was not matched, and thus for future studies it will be better to match the expressiveness of facial expressions between different race faces more systematically.

Although the possible difference in the expressiveness of facial expression stimuli between two race faces is problematic, it is still possible that in-group bias was present amongst European participants only, and not in Japanese participants. This interpretation would be likely if there is a difference between European and Japanese participants regarding their levels of contact with other races. Looking at the recognition memory performance in own and other race faces, results from Experiments 1 and 2 showed that generally the effect of the own-race bias was more evident amongst European participants whereas Japanese participants did not show the own-race bias consistently. Based on past findings showing the effect of the quality/quantity of contact on the magnitude of the own-race bias (e.g. Chiroro and Valentine 1995; Wright, Boyd and Tredoux 2003), it was speculated that the levels of contact with other-race faces may have differed between European and Japanese participant groups, leading to the lack of the own-race bias in Japanese participants. It appears that other-race faces are more often seen in the media in Japan compared with the frequency Asian faces are seen in the British media, so it will not be surprising if there is a difference in the level of contact (real-life or through media) between the two participant groups. In a similar manner, the difference in the quality/quantity of contact with other-race faces may also affect the direction/magnitude of in-group bias. It appears that Caucasian actors are widely used in the Japanese media (such as TV adverts or magazines) because generally European culture is associated with affluence in Japanese society and the media often takes advantage of this positive association. If it is the case that in Japan the out-group (European) is portrayed positively, Japanese people may associate European faces with positivity. In turn, if the out-group European people are generally associated with positivity, then Japanese people may not readily differentiate the social world into in-group and out-group based on the 'race' dimension, because such a division will not lead to self-enhancement. Moreover, results from a longitudinal study of the effects of inter-group friendships on ethnic attitudes indicated that increased inter-group contact reduced the magnitude of in-group bias (Levin, van Laar and Sidanius 2003). Therefore, it may be that Japanese participants did not show in-group bias in emotion perception because of their increased experience with the other-race category. In comparison, the portrayal of Asian (Japanese) people in the British media seems to be fewer in number, and this may be the reason why the effect of in-group bias was only present in British and not in Japanese participants when perceiving emotion in own and other race faces.

In Experiment 3 the expression perception accuracy was also examined. The results showed that at least with the perception of angry faces there was an indication of the own-race bias amongst European participants. However, European participants were better than Japanese in correctly perceiving a happy expression in Japanese faces, thus it seems that European people were generally better at perceiving emotional expressions compared with Japanese, who showed a higher accuracy in perception of neutral faces than European participants. However, the results showing different response patterns between the two races (showing that Japanese participants were likely to choose a neutral category while European participants were likely to choose a happy category) makes the interpretation difficult. However, European participants were more accurate in perceiving an angry expression in own-race faces even though their response pattern was biased towards a happy expression. This suggests that an in-group advantage in emotion perception may have been present at least in European participants regarding the perception of angry expression.

In Experiment 4, memory for facial expressions in own and other race faces was examined. The analysis of the overall response pattern and the response pattern for faces showing an ambiguous expression showed that ambiguous European faces were generally remembered as neutral or happy, while ambiguous Japanese faces were generally remembered as neutral or angry. Thus it appears that the memory for facial expression in Japanese faces was biased towards the neutral/negative expression, whereas that of European faces was biased towards the neural/positive expression. This pattern of results was similar to the response pattern observed in the perception of facial expression in Experiment 3. Here, the results showed that Japanese faces were likely to be perceived as angry or neutral, while European faces were likely to be perceived as happy. Taken together, the results indicate that there seems to be a tendency to associate European faces with more positive emotion and Japanese faces with more neutral or angry expression in both perception and memory for facial expressions.

The expression memory accuracy was also examined in Experiment 4. Similar to the results in Experiment 3 which showed a possible own-race advantage in the perception of angry expression in European participants, the results here indicated a possible influence of the race expertise on expression memory for angry faces in European participants. Here, it was found that European participants were better at remembering angry expression in own-race faces. In contrast, Japanese participants remembered the angry expression equally well in both race faces (although the direction of results was consistent with better expression memory in Japanese faces). This may suggest that European participants were unable to successfully encode subtle emotion information exhibited in angry Japanese faces. However, the problem with the current study is that the expressiveness of facial expression was not fully controlled, and it may be that the angry expression shown in Japanese faces was less expressive than that of European faces, which may have led to the pattern of results observed. However, if the difference in expressiveness between angry European and angry Japanese faces was so big, it is likely that Japanese participants would have perceived and remembered angry expression in European faces more accurately than in Japanese faces. However, Japanese participants' accuracy for an angry expression did not differ between the two race faces for both perception (Experiment 3) and memory (Experiment 4) tasks. This suggests that the effect observed is more likely to be due to the own-race advantage in emotion processing.

The current chapter aimed to examine the effect of both the own-race bias and in-group bias in emotion perception and memory involving own and other race faces. Overall the results showed some indication of both in-group and the own-race bias in expression perception and memory, but this was only seen in European participants. However, these results were often difficult to interpret conclusively, as it is also possible to explain the results in terms of the differences in expressiveness of the facial expression stimuli between European and Japanese faces, the point which needs be addressed in future studies. There are several ways to address this problem of stimuli expressiveness. One possibility would be to use posed stimuli where a certain facial expression is re-created by moving particular facial muscles to control for the type and intensity of facial expression. One such system that is widely used in cross-cultural studies of emotion recognition is the Facial Action Coding System (FACS), originally developed by Ekman and colleagues (Ekman and Friesen 1976). Matsumoto and Ekman (1988) used the FACS system to create stimuli in faces of two races, called Japanese and Caucasian Facial Expressions of Emotion (JACFEE). Since the current study involved Japanese and European participants, using the JACFEE stimuli may have been a possibility. However, Elfenbein and Ambady (2002) argued that the use of facial expression stimuli based on the FACS system may not be ideal in examining in-group advantage in emotion processing, because the FACS system was originally created using the facial expressions of American posers and thus it may largely reflect emotional expressions specific to American culture. However, the FACS system is thought to represent universal emotional expressions (Ekman, Friesen and Tomkins 1971) and the reliability data for the JACFEE stimuli showing high agreement across people from different countries (e.g. Hungary, Japan and the US) in identifying the specific emotions seems to confirm this (Biehl, Matsumoto, Ekman, Hearn, Heider, Kudoh and Ton 1997). However, not all studies that used the FACS system to examine cross-cultural emotion recognition support the universality of the FACS system, as in some cases an out-group advantage in emotion recognition was observed (Kilbride and Yarczower 1983). Moreover, the extent of the universality of the FACS system has also been questioned, as in one study a lower agreement rate was found in Asian participants when identifying expressions posed by Asian people in JACFEE (Huang, Tang, Helmeste, Shioiri and Someya 2001). Thus it appears that the use of posed stimuli, such as those based on the FACS system, needs to be treated with caution when conducting cross-cultural studies of emotion.

Another way to control for the expressiveness of the stimuli is to use a morphing technique, as will be seen in Chapter 6. By using morphing, it is possible to apply a particular facial expression (which is not specific to any particular racial group) to both

European and Japanese faces thereby controlling for the intensity or expressiveness (see Chapter 6 for more details). However, it is not known whether or not a morphed facial expression is a realistic example of facial expression. Moreover, this technique controls for the type and intensity of facial expression by applying expressions that are not specific to any race categories. This may present some problems in itself, because the recognition of subtle differences in expressive style across different cultural groups is thought to underlie the in-group advantage in emotion processing (Elfenbein and Ambady 2002). Thus when conducting cross-cultural studies of emotion processing, it may be more ideal to use stimuli showing spontaneous emotional expressions. In such cases, the type and the intensity level of emotions could be validated by rating from own and other race raters, and faces of different races could be matched based on the rating accordingly.

Chapter 5

Race Typicality and Facial Expression

5.1 Experiment 5 – Perception of Race Typicality and Expression

5.1.1 Introduction

Results from Experiments 1 to 4 examined above indicated that different types of emotional expression may be linked with different race categories. Results from Experiment 1 and 2, which looked at identity recognition memory in European and Japanese faces, found an interaction between face race and expression in false positive rates. Here, it was found that happy European and neutral Japanese faces yielded higher false positive rates, though this trend was more consistent amongst European participants and also for Japanese faces. This may be due to differences in the typical facial expression associated with different races, and it may be that generally it is more likely to see European faces in happy expression than it is to see smiling Japanese faces. If it is the case that typical facial expression is different for European and Japanese faces, this could explain why people are more likely to incorrectly recognise a face with a certain expression. Moreover, results from Experiment 3 and 4, which looked at facial expression perception and memory in European and Japanese faces, also indicated a link between facial expression and race. Here, the results showed that European faces were generally perceived and remembered as happy, while Japanese faces were likely to be perceived and remembered as angry or neutral, suggesting again that there may be a general tendency to associate different groups of races with different kinds of facial expressions.

These findings may suggest that the representations of different race faces may be linked with typical facial expressions they tend to exhibit and Experiment 5 directly examined this possibility. Here, the effect of facial expression on perception of race typicality was examined in Japan and the U.K. using Japanese and European faces with happy and neutral expressions. Based on the results from Experiments 1 to 4, a higher typicality rating was predicted for European faces with happy expression and Japanese faces with neutral expression.

5.1.2 Method

Participants

Thirty European (Caucasian) students (8 males; age range 18-35, mean=20.6, s.d.=3.3) at University of Stirling (Scotland, U.K.) and 30 Japanese students (18 males; age range 18-25, mean=22.1, s.d.=1.5) at Nihon University (Tokyo, Japan) participated in this study. All were paid or received course credits for their participation.

Stimuli and Apparatus

Stimuli used in Experiment 1 and Experiment 2 were also used in this experiment. Ninety-six European faces (48 males) and 96 Japanese faces (48 males) were used. European faces were from a set of photographs taken at University of St Andrews in Scotland and York University in Toronto, Canada. Japanese faces were from a set of photographs taken at ATR Lab and Kyoto University in Kyoto, Japan. Of the 96 European and 96 Japanese faces, two pictures of each individual from half of the images (48 European and 48 Japanese) were available, one in a full-face happy expression and the other in a full face neutral expression, totalling 192 images. Of the remaining 48 European and 48 Japanese faces, half (24 European and 24 Japanese) faces were in happy expression and the rest were in neutral expression. Two stimuli lists were constructed, each containing 192 images with equal number of race, gender and expression. In addition, faces with both happy and neutral expression (from the same individuals) were divided into two separate lists so that no participants saw the same individual face with both happy and neutral expressions. All faces were edited using Adobe Photoshop 7.0®, converted to greyscale and framed with a white oval mask to remove background and hairline. All images were 200 pixels wide. All images were presented on a computer screen. The size of each face image on screen was approximately 11 x 8cm.

Design

This study used a mixed within-participants design. The race of participants (European and Japanese) was used as a classification variable. Independent variables examined were the face race (European and Japanese) and expression (happy and neutral). Mean rating scores were recorded as the dependent variable.

Procedure

All participants were tested individually using a laptop computer. Participants were informed that they would be shown Asian and European faces, and their task was to rate each face on a 7-point Likert scale in terms of how typical these faces looked for the particular racial group the faces belonged to (Asian or European). The scale ranged from 1 (very typical), 4 (neither typical nor atypical) to 7 (very atypical). All images and instructions were presented using E-Prime®. Participants were shown 192 images (with equal number of race and expression), one at a time in random order, and responded by pressing the appropriate number key. The face remained on the screen until participants made a response, and the question ("How typical is this face for this particular racial group?") and the rating scale remained on screen throughout the trials. After finishing rating all the faces, participants also answered a short questionnaire and a thorough debriefing was given at the end. See Appendix A for the questionnaire used, and for examples of face images see Appendix B and Appendix C.

5.1.3 Results

The mean rating scores for each face race (European and Japanese) and expression (happy and neutral) were calculated for each participant. Means for European and Japanese faces were calculated separately for European and Japanese participants and results were analysed by means of a mixed-design ANOVA. All post-hoc tests of simple main effects using *t*-tests were Bonferroni corrected. Results from the post-hoc analyses are reported with uncorrected degrees of freedom and the corrected *p*-value.

Race Typicality Rating

Figure 5.1 shows the mean rating scores (with error bars ± 1 s.e.) for two race faces (European and Japanese) with two expressions (happy and neutral) from 30 European and 30 Japanese participants. The scale ranges from 1 (very typical) to 7 (very atypical).

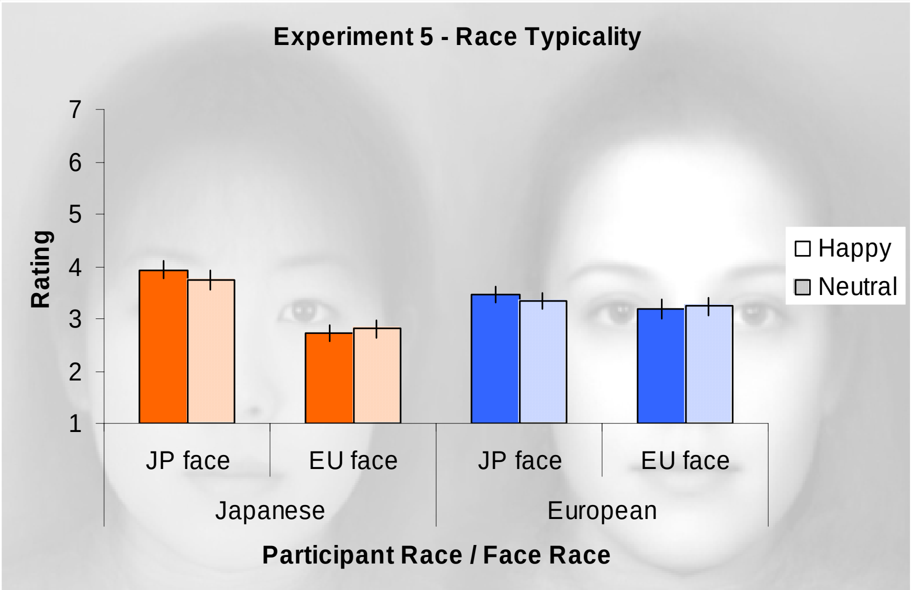


Figure 5.1 Mean rating scores (with error bars ± 1 s.e.) for Japanese and European faces with happy and neutral expressions. Left=Japanese participants; Right=European participants. The scale ranges from 1 (very typical) to 7 (very atypical).

Mean rating scores were analysed using a 2 x 2 x 2 mixed-design ANOVA with participant race (European and Japanese) as the between-participants factor and face race (European and Japanese) and expression (happy and neutral) as the within-participants factors. There was a significant main effect of face race ($F_{(1,58)}$=26.51, p<.001) with higher rating for Japanese faces, indicating that Japanese faces were rated more atypical looking than European faces. This main effect was however qualified by a significant interaction between face race and participant race ($F_{(1,58)}$=12.39, p=001).

Tests of simple main effects using *t*-test showed that this trend (higher rating for Japanese faces) was only present in Japanese ($t_{(29)}$=6.96, p=.002) and not in European ($t_{(29)}$=1.04, p>.1) participants. The interaction between face race and expression was also significant ($F_{(1,58)}$=14.79, p<.001). This was due to higher rating for happy than neutral expression in Japanese faces ($t_{(59)}$=2.61, p=.05) but there was no difference in rating between the two expressions for European faces ($t_{(59)}$=1.64, p>.1). There were no other main effects or interactions (all *ps*>.05).

5.1.4 Discussion

The results from Experiment 5 showed that Japanese participants rated Japanese faces as more atypical looking than European faces, though typicality rating from European participants did not differ between the two race faces. This may be an indication of in-group heterogeneity effect (and its mirror effect, out-group homogeneity effect), which is the tendency to perceive members of in-group as more individuated than out-group members that are perceived to be more similar (Brown 2000), a cognitive bias which results from a social categorisation process. Partially confirming the prediction, the results also showed that neutral Japanese faces were perceived to be more typical than happy Japanese faces, but there was no difference in typicality ratings for European faces between the two expressions. Thus the difference in typical facial expressions associated with different races cannot fully account for the patterns seen in Experiments 1 to 4. It may be that the link between European faces and positive facial expression may derive from positive cognitive bias (stereotypes) associated with European races. It would not be surprising if European people hold positive stereotypes about other European people, as this would lead to the enhancement of their self-esteem. Social comparison theory by Festinger (1954) suggests that there is a universal human drive to evaluate oneself, which can be achieved by comparing one with others who are perceived to be similar in relevant aspects of comparison, and one of the reasons people engage in this act is said to be its function of self-enhancement (Sedikides 1993). As for Japanese people, it is also not surprising if Japanese people hold positive stereotypes about European people, as generally Western 'White' culture is highly valued in Japanese society especially amongst younger generation. In future studies, therefore, it would be interesting to examine the possible differences in the cognitive evaluations of different races to see whether the differential pattern of associations between different race faces and expressions can be explained by differences in racial stereotypes.

Chapter 6

The Own-Race Bias and Face Perception

6.1 General Introduction

This chapter will describe two experiments which looked at the possible effect of the own-race bias on perception of identity and expression information in own and other race faces. As reviewed in the Introduction, the influence of the own-race bias is not limited to identity recognition memory but the effect has also been observed in face perception tasks (e.g. Lindsay, Jack and Christian 1991; Walker and Tanaka 2003). Moreover, the own-race bias has been shown to influence the processing of emotion information (e.g. Elfenbein and Ambady 2002, 2003; Kito and Lee 2004; see also the results in Chapter 4). However, past studies tended to consider the effect of race expertise on the processing of facial identity and expression information separately, and the two effects are rarely studied in the same framework, although both are examples of the same race expertise effect. Thus the effect of the own-race bias on the perceptual processing of both identity and expression information was examined together in this chapter.

One aim of the current chapter was to further examine the possible similarity between familiar/unfamiliar and own-race/other-race face processing at the level of face perception. The results from Chapter 3 indicated that, at least amongst European participants, the quality of unfamiliar own-race face representations was comparable to that of familiar faces, as European participants' identity recognition performance was unaffected by transformation due to expression change. Thus the difference in the degree of familiarity with unfamiliar own-race and unfamiliar other-race faces seemed to have led to differences in the richness of face representations in own and other race faces, similar to the differences between the representations of familiar and unfamiliar faces. Whether the same pattern would be seen in the perceptual processing of own and other race faces remains to be seen. Thus Experiment 6 aimed to examine the effect of familiarity with a particular race on perceptual matching of facial identity and expression information cross-racially.

The second aim of the current chapter was to examine whether race expertise would favour the processing of own race faces even when an identical type/amount of information is present in both own and other race faces. Findings from several studies have suggested that the own-race bias affects many different types of face processing tasks, including face identity recognition (e.g. Meissner and Brigham 2001; Sporer 2001), face perception (e.g. Lindsay, Jack and Christian 1991; Walker and Tanaka 2003) and emotion recognition (e.g. Elfenbein and Ambady 2002, 2003; Kito and Lee 2004). However, it is not yet known precisely what contributes to the phenomenon of the own-race bias in face processing. Findings from emotion recognition studies have indicated that differences in expressive style of the facial stimuli between different racial groups (Elfenbein and Ambady 2002) and motivational biases of the decoder that leads to the enhanced decoding of faces belonging to the groups they identify with (Thibault, Bourgeois and Hess 2006) both seem to contribute to the phenomenon of in-group advantage in emotion recognition. Similarly, it may be the case that both facial identity variations in own and other races and perceiver differences (e.g. differences in decoding ability, decoding strategy or motivational factor) contribute to the own-race bias in identity recognition and perception.

However, the variability in physical anthropological measures of human faces (e.g. lip thickness, interocular distance) has been shown to be comparable between different races (Goldstein 1979a, 1979b). The lack of race-related facial identity variations in physical measurements of faces does not discount the existence of facial variations between races in other dimensions (e.g. skin tone, eye colour, skin texture, skeletal and muscular structure), but it seems that the possible stimuli variations between different races may have a lesser effect on the magnitude of the own-race bias in face processing. Moreover, recent studies have suggested that the own-race bias may be related to less efficient holistic encoding of other-race faces (e.g. Michel, Caldara, Rossion 2006; Tanaka, Kiefer and Bukach 2004), indicating the significant role perceiver differences has in mediating the phenomenon of the own-race in face recognition and perception.

One weakness of the past research examining the own-race bias in face processing is that often the possible effect of facial variations between races and perceiver differences are not explicitly addressed and controlled. Thus it is not known whether the effect of the own-race bias would still be observed when facial variations are set equal between own and other race faces. This possibility was examined in a study that examined the in-group advantage in emotion recognition (Thibault, Bourgeois and Hess 2006), but it has not been examined in relation to facial identity processing. Experiment 7 therefore aimed to assess the role of perceiver biases in both identity and expression processing, while controlling for the race-related facial variations in identity and expression information, to see race expertise still favours the processing of own-race faces. If own and other race faces containing identical facial information are still processed differently, it would indicate that perceiver differences have a significant role in the differential processing of identity and expression information in own and other race faces.

6.2 Experiment 6 – Matching Identity and Facial Expression

6.2.1 Introduction

Experiment 6 aimed to examine how familiarity with a particular race may influence the perceptual matching of identity and facial expression information in own and other race faces. Experiment 6 echoed the study by Young *et al.* (1986) which found that the reaction times for matching identity but not expression was influenced by face familiarity, showing that reaction times to familiar faces were faster than that of unfamiliar faces when matching identity while such an effect of familiarity was not present when matching expression (see Figure 6.1).

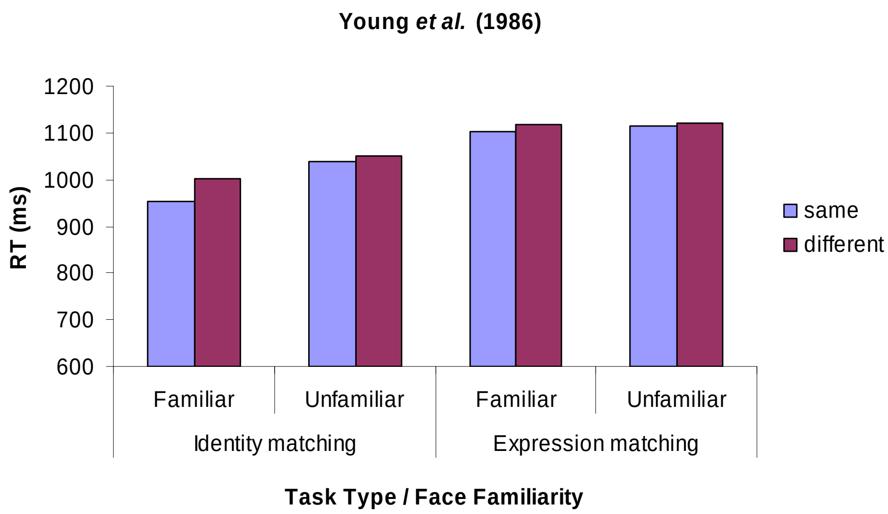


Figure 6.1 Adapted from Young et al. (1986) – RT (milliseconds) in identity and expression matching tasks for familiar and unfamiliar faces.

Young *et al.* (1986) explained their results in terms of the independent processing of identity and expression information postulated in the model by Bruce and Young (1986). This is because in this model, familiarity is thought to be determined by face recognition units (FRUs) that have no direct effect on expression analysis or on the initial structural encoding which serves as the starting point for the analysis of expression. In identity analysis, on the other hand, the model predicts faster reaction times in familiar than unfamiliar faces since successful identity processing depends on the richness of structural codes in FRUs, which are more elaborated for familiar than unfamiliar faces due to frequent exposure to familiar faces. Experiment 6 modified the study by Young *et al.* (1986) and substituted race for familiarity. Thus instead of using familiar and unfamiliar faces, unfamiliar European and Japanese faces with happy and neutral expression were used in identity and expression matching tasks with European and Japanese participants. As indicated in the results from Experiment 1 which showed a parallel pattern between familiar/unfamiliar and own-race/other-race face recognition (at least in European participants), increased familiarity with one's own-race faces may lead to better processing of facial identity information (and formation of richer structural codes) in 'unfamiliar' own-race compared with 'unfamiliar' other-race faces. With regard to the processing of expression information, if identity and expression information are processed independently familiarity with a particular race should not influence expression processing. Moreover, although the meta-analysis of emotion recognition by Elfenbein and Ambady (2002) indicated that emotion recognition was more accurate when emotions were expressed and perceived by the same racial (cultural) groups, it was also found that in general the basic emotions (such as anger and happiness) were universally recognised. Given that Experiment 6 used a relatively simple matching task with stimuli showing basic emotions (happy and neutral), it was hypothesised that familiarity with one's own race may not affect the processing of facial expression.

In Experiment 6, reaction times and error rates in identity and expression matching tasks using European and Japanese faces were examined cross-racially with European and Japanese participants. It was predicted that the reaction times and error rates when matching identity but not expression would be influenced by the race of the faces. Specifically, regarding reaction times it was predicted that own-race faces will be processed faster compared with other-race faces when matching identity, but there will be no difference in the two race faces in terms of reaction times when matching expression. The same pattern was anticipated for error rates, and it was predicted that own-race faces will have lower error rates compared with other-race faces in identity matching task, but there will be no difference between the two race faces regarding error rates in expression matching task. In addition, based on previous research showing the effect of the own-race bias in several face processing tasks including identity recognition (e.g. Meissner and Brigham 2001; Sporer 2001) and face perception (e.g. Lindsay, Jack and Christian 1991) an overall processing advantage for own-race faces was also predicted between the two participant groups concerning reaction times and error rates in identity matching. Thus it was predicted that when matching identity European faces will be processed faster and more accurately in European compared with Japanese participants, and vice versa for Japanese faces. The overall own-race advantage was not predicted in expression matching, since this study used faces showing basic emotions and the past findings indicated that there is no racial difference in the recognition of the basic emotions (Elfenbein and Ambady 2002).

6.2.2 Method

Participants

Forty European (Caucasian) students (13 males, age range 17-44, mean=23.6, s.d.=5.6) at University of Stirling (Scotland, U.K.) and 40 Japanese students (8 males; age range 19-40, mean=23.3, s.d.=4.8) at Ritsumeikan University (Kyoto, Japan) participated in this study. All received payments or course credits for their participation.

Stimuli and Apparatus

Forty-eight European faces (24 males) and 48 Japanese faces (24 males) with happy and neutral expressions were used. All were in full-face and two instances of each individual per expression were prepared, creating 384 faces in total. European faces were from a set of undergraduate photographs taken at York University in Toronto, Canada. Japanese faces were from a set of undergraduate photographs taken at Kyoto University in Japan. These were the same stimulus sets used in Experiment 2. All faces were edited using Adobe Photoshop 7.0®, converted to greyscale and framed with a white oval mask to remove background and hairline. All images were 250 pixels wide.

These faces were used to create four sets of 16 pairs of faces for each race and gender, with no person's face occurring in more than one of the total of 64 pairs. Half were happy and the rest were in a neutral expression. Forty different variations of the 64 pairs of faces were prepared, in order to counter-balance identity (same or different), expression (same or different), instances of faces used (out of two instances per expression) and the side of presentation (left or right), and each was used once for one of the 40 participants in each country tested. Two additional face pairs (one of European male and one of Japanese female faces in neutral and happy expression) were also prepared for practice trials using faces that did not appear in the experimental trials. All images were presented on a computer screen. The size of each face image on screen was approximately 16 x 11cm.

Forty Mooney face images (250 pixels wide) were prepared for the filler task. The Mooney faces are black and white photographs of faces that were either perceived as a face or a collection of ink blobs (Mooney 1957). Twenty upright and twenty inverted Mooney faces were used and presented on a computer screen. The size of each image on screen was approximately 15 x 10cm.

Design

This study used a mixed within-participants design. The race of participants (European and Japanese) was used as a classification variable. Independent variables examined were face race (European and Japanese) and type of response (same and different). Reaction times and error rates were measured as dependent variables. Data for identity and expression matching tasks were analysed separately.

Procedure

All participants were tested individually using a laptop computer. Participants were told that the aim of the experiment was to examine whether facial expressions and facial identity were processed differently in faces of two different racial groups. Participants were asked to do three tasks; identity matching, expression matching and the Mooney Closure Faces Test. All images and instructions were presented using E-Prime®. In identity matching, participants were asked to decide whether or not photographs of pairs of simultaneously presented faces were pictures of the same identity. In expression matching, the task was to decide whether or not simultaneously presented faces showed the same expression, and participants were also told that there were two types of expressions (happy and neutral). Participants were asked to press 1 for 'same' and 0 for 'different' responses for both identity and expression matching tasks. Reaction times and error rates were recorded. Identity and expression matching tasks were blocked together and the order of the tasks was counterbalanced across participants. Within each matching condition the total of 64 face pairs appeared only once and the same 64 face pairs were used for both matching tasks. Tasks with European and Japanese face pairs were blocked within each matching condition and each race condition was further divided into two European and two Japanese race blocks of 16 trials (8 male and 8 female face pairs) each. Following the procedure used in Young *et al.* (1986), within each matching task these four race blocks were given in ABBA or BAAB orders which were counterbalanced within and across participants. Within each race block, the order of the same or different identity or expression pair was random. For identity matching, each race block of 16 face pairs consisted of 8 'same' pairs (4 same identity and same expression, 4 same identity and different expressions) and 8 'different' pairs (4 different identities and different expressions, 4 different identities and same expression). For expression matching, each race block of 16 face pairs consisted of 8 'same' pairs (4 same identity and same expression, 4 different identity and same expression) and 8 'different' pairs (4 different identities and different expressions, 4 same identity and different expressions). As in Young *et al.* (1986), each matching task was preceded by two practice trials using face pairs that did not appear in the rest of the experiment.

The Mooney Closure Faces Test was used as a filler task and was performed in between the two matching tasks. This differed from the original study by Young *et al.* (1986), which had three days interval between the two matching tasks. Participants were told that the Mooney Closure Faces Test was designed to measure participants' general perceptual capacity. Participants were presented with 20 upright and 20 inverted Mooney faces in random order one at a time, and were asked to press 1 if the face was upright and to press 0 if it was inverted. After the two matching tasks and the Mooney Closure Faces Test, participants answered a short questionnaire and a thorough debriefing was given at the end. See Appendix A for the questionnaire used, and for examples of face images see Appendix C.

6.2.3 Results

Data from 40 European and 40 Japanese participants regarding their reaction times and error rates in identity and expression matching tasks produced the following descriptive statistics. Mean reaction times and error rates for identity and expression matching tasks were analysed separately, and the results were analysed by means of mixed-design ANOVAs. All post-hoc tests of simple main effects using *t*-tests were Bonferroni corrected and results are reported with uncorrected degrees of freedom and the corrected *p*-value otherwise specified.

Reaction Times

Identity Matching

Mean reaction times (in milliseconds) for correct responses to same and different pairs in identity matching task were calculated for each participant. Reaction times to

European and Japanese faces were calculated separately for European and Japanese participants. Figure 6.2 shows the mean reaction times (in milliseconds) and the standard errors for correct responses to same and different pairs of European and Japanese faces from 40 European and 40 Japanese participants in identity matching task.

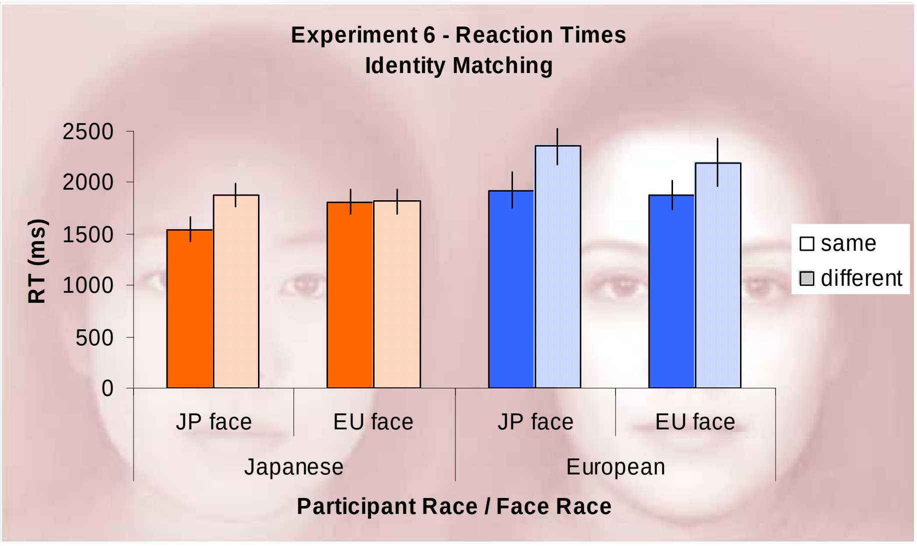


Figure 6.2 Mean reaction times in milliseconds (with error bars ± 1 s.e.) for correct responses to same and different pairs of European and Japanese faces in identity matching task. Left=Japanese participants; Right=European participants.

Mean reaction times were analysed using a 2 x 2 x 2 mixed-design ANOVA with participant race (European and Japanese) as the between-participants factor and face race (European and Japanese) and response (same and different) as the within-participants factors. This revealed a significant main effect of response ($F_{(1,78)}$=18.37, p<.001) with faster reaction times for same than for different pairs. There was a significant face race by response interaction ($F_{(1,78)}$=6.42, p=.01) due to faster reaction times for same than different pairs in Japanese ($t_{(79)}$=4.79, p=.004) but not in European ($t_{(79)}$=2.09, p>.1) faces. Finally, there was a trend for an interaction between face race and participant race ($F_{(1,78)}$=3.62, p=.06). This reflected a tendency for faster reaction times for Japanese faces in Japanese compared with European participants ($t_{(39)}$=2.10,

p=.04, uncorrected), but there was no difference in the reaction times between the two races for European faces ($t_{(39)}$=.97, p>.1, uncorrected), nor were there differences in the reaction times between the two race faces in the two participant groups (both ps>.05, uncorrected). No other main effects or interactions were significant (all ps>.05).

Expression Matching

Figure 6.3 shows the mean reaction times (in milliseconds) from European and Japanese participants in expression matching task.

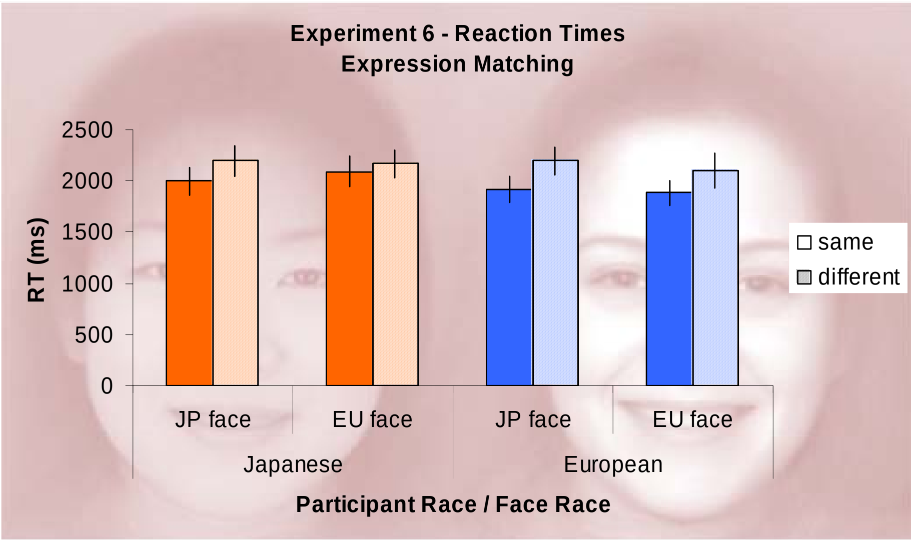


Figure 6.3 Mean reaction times in milliseconds (with error bars ± 1 s.e.) for correct responses to same and different pairs of European and Japanese faces in expression matching task. Left=Japanese participants; Right=European participants.

As above, mean reaction times were analysed using a 2 x 2 x 2 mixed-design ANOVA. This only revealed a significant main effect of response ($F_{(1,78)}$=15.56, p<.001) with faster reaction times for same than for different pairs. There were no other main effects or interactions (all ps>.05).

Error Rates

Identity Matching

Mean error rates for same and different pairs in identity matching task were calculated for each participant. Reaction times to European and Japanese faces were calculated separately for European and Japanese participants. Figure 6.4 shows the mean error rates and the standard errors for same and different pairs of European and Japanese faces from 40 European and 40 Japanese participants in identity matching task.

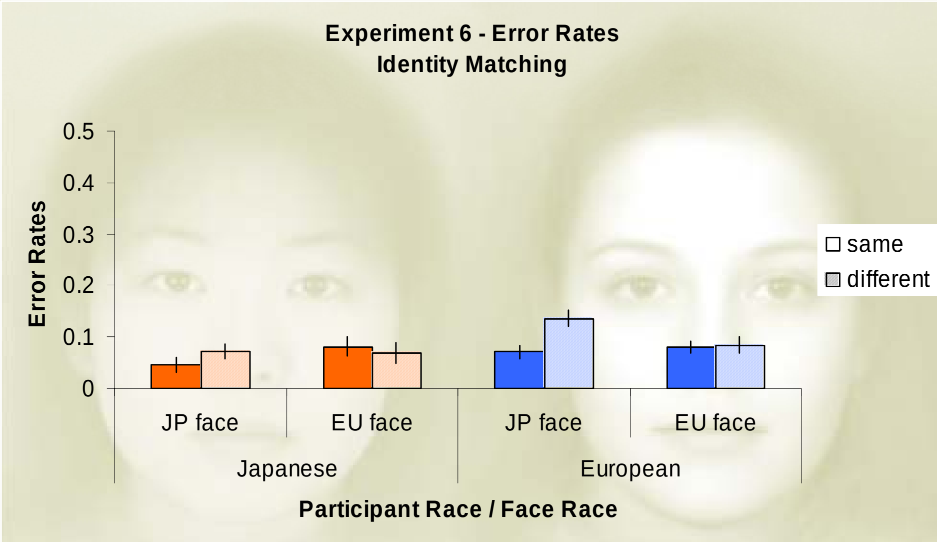


Figure 6.4 Mean error rates (with error bars ± 1 s.e.) for same and different pairs of European and Japanese faces in identity matching task. Left=Japanese participants; Right=European participants.

Mean errors were analysed using a 2 x 2 x 2 mixed-design ANOVA with participant race (European and Japanese) as the between-participants factor and face race (European and Japanese) and response (same and different) as the within-participants factors. This revealed a significant interaction between face race and participant race ($F_{(1,78)}$=7.24, *p*=.009), due to lower error rates for Japanese faces in Japanese participants compared with European participants ($t_{(39)}$=2.58, *p*=.06) but there was no difference in the error rates between the two participant groups for European faces ($t_{(39)}$=.42, *p*>2) nor there were difference in the error rates between the two race faces in the two participant groups (both *ps*>.1). There was also a significant interaction between face race and response ($F_{(1,78)}$=13.04, *p*=.001), due to lower error rates for same than different pairs in Japanese faces ($t_{(79)}$=3.68, *p*=.004) and European compared with Japanese faces in trials with different face pairs ($t_{(79)}$=2.54, p=.05). No other main effects or interactions were significant (all ps>.05).

Expression Matching

Figure 6.5 shows the mean error rates from European and Japanese participants in expression matching task.

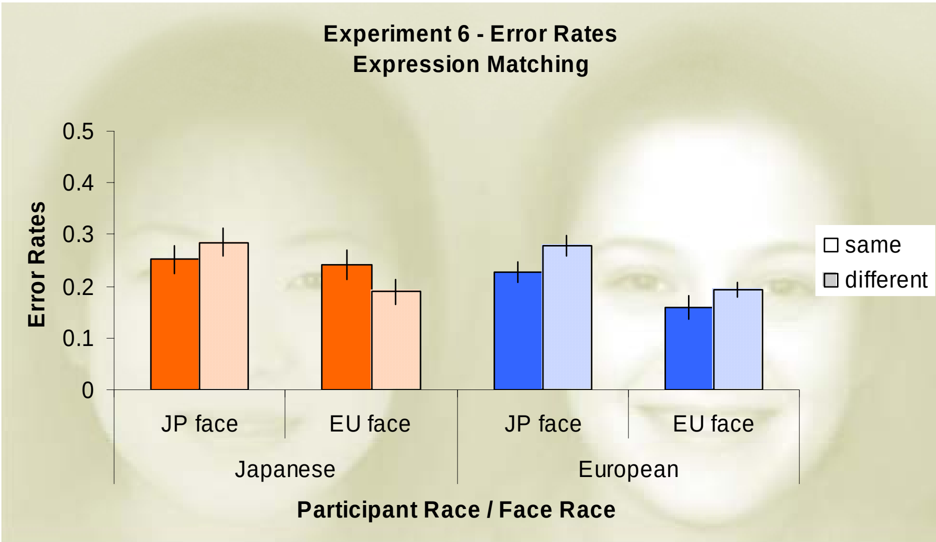


Figure 6.5 Mean error rates (with error bars ± 1 s.e.) for same and different pairs of European and Japanese faces in expression matching task. Left=Japanese participants; Right=European participants.

As above, mean errors were analysed using a 2 x 2 x 2 mixed-design ANOVA. This revealed a significant main effect of face race ($F_{(1,78)}$=31.94, p<.001) with lower error rates for European than Japanese faces, and a significant interaction between face race and response ($F_{(1,78)}$=4.82, p=.03), due to lower error rates for European compared with Japanese faces in trials with different face pairs ($t_{(79)}$=2.54, p=.05). No other main effects or interactions were significant (all ps>.05).

6.2.4 Discussion

The results from Experiment 6 showed that familiarity with one's own race did not modulate the processing in both identity and expression tasks. Concerning the results from reaction times measure, the results from identity matching tasks showed that there was no difference in reaction times for own and other race faces in both European and Japanese participants. The results from expression matching tasks also showed the same pattern, and there was no difference in reaction times for own and other race faces in the two participant groups. The same pattern was found in an error rates measure, and for both identity and expression matching tasks, there was no difference in error rates in own and other race faces in both European and Japanese participants. Therefore, contrary to the prediction, the results indicated that familiarity with one's own race did not affect identity processing in a similar way as seen in the processing of familiar and unfamiliar faces.

The results however, confirmed the prediction of the effect of the own-race bias in overall reaction times and error rates in identity matching, at least in European participants. It showed that reaction times for Japanese faces in identity matching were slower in European participants than in Japanese participants, and error rates for Japanese faces were also higher in European compared with Japanese participants. However, there was no difference between the two participant groups in both reaction times and error rates for European faces, indicating that both European and Japanese participants processed European faces equally accurately and efficiently. Consistent with the prediction, the results from expression matching showed no sign of the own-race advantage in both reaction times and error rates measures in European and Japanese participants. Thus the own-race bias was only seen amongst European participants, for identity matching. As discussed earlier, this pattern is consistent with the findings from a meta-analysis of 91 independent samples concerning the own-race bias by Meissner and Brigham (2001), which found that in general White participants were more likely to demonstrate the own-race bias in face recognition. The same pattern was also found in Experiments 1 and 2 which examined identity recognition memory. It is not clear why European people are more likely to show the own-race bias than people from other racial groups. However, regarding participants in the current studies, it could be that the pattern resulted from the difference in the amount/quality of experience with other-races for Japanese and European participants, as past studies (e.g. Chiroro and Valentine1995; Wright, Boyd and Tredoux 2003) found that inter-racial contact influences the magnitude of the own-race bias. Although the current study was carried out both in Japan and the U.K. with native Japanese and British participants, the amount of contact with other races was not systematically examined. However, given the popularity of Western 'White' culture in Japan it could well be that Japanese participants had more experience with European faces, and this possibility should be systematically investigated in future studies.

6.3 Experiment 7 – Detection of Identity and Expression Differences

6.3.1 Introduction

Experiment 7 aimed to examine people's ability to detect small differences related to identity and expression in own and other race faces. The basic structure of Experiment 7 is based on the study by Walker and Tanaka (2003) that showed the effect of the own-race bias at the encoding stage of face processing. Walker and Tanaka (2003) created a continuum of images by morphing an East Asian face with a Caucasian face, and Asian and Caucasian participants were asked to do a same/different discrimination task on these images. The results showed that Asian and Caucasian participants were better at discriminating small differences in own-race faces than in other-race faces (see Figure 6.6).

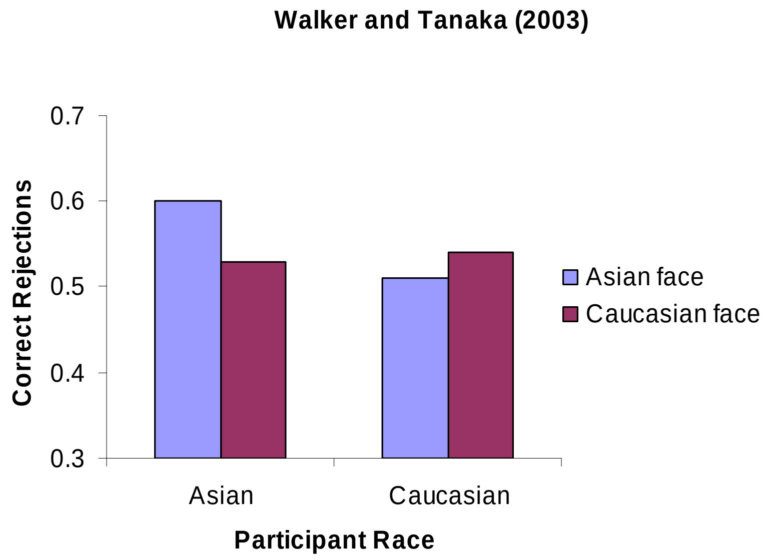


Figure 6.6 Adapted from Walker and Tanaka (2003) – Mean correct rejections for Asian and Caucasian faces in Asian and Caucasian participants.

In the study by Walker and Tanaka (2003), several continua of images were created by morphing faces of two distinct race categories, and thus faces in these continua differed in terms of racial facial characteristics. Although the results showed that people could detect racial facial differences in own-race faces better than in other-race faces, it has not yet been tested whether the same pattern would be seen in the detection of non-racial facial differences. However, given that past studies indicated the effect of the own-race bias in many types of face processing tasks, it may be that the same pattern would also hold here. Therefore in Experiment 7, using a two-alternative forced-choice delayed matching paradigm, non-racial differences in facial identity and facial expression were applied to Japanese and Caucasian faces and tested with European participants. Only European participants were tested here due to difficulty in recruiting sufficient number of Japanese participants. It should be noted that, because Experiment 7 manipulated differences not directly related to different racial categories, it was possible to apply identical differences based on identity and expression transformation to both race faces, the point which was not controlled in Walker and Tanaka (2003)'s study.

In Experiment 7 in addition to measuring accuracy, reaction times were also measured to examine whether European participants were more accurate and/or faster at detecting changes made to own-race faces that were based on identity and expression differences. Note that Experiment 7 used a two-alternative forced-choice delayed matching task, and therefore the task had memory as well as perceptual component. However, a short delay (500ms) was used and thus the memory component of the task was minimised here. It was predicted that changes made to own-race faces would be detected more accurately and faster than changes made to other-races for both identity and expression changes. The own-race bias in the detection of identity-related changes was predicted based on past studies showing better memory for own-race faces in identity recognition tasks (e.g. Meissner and Brigham 2001; Sporer 2001). Regarding expression-related changes, past research showed that recognition of subtle differences in expressive style is better for own-race faces (Kito and Lee 2004) although there is no racial difference in the recognition of the basic emotions (Elfenbein and Ambady 2002). Although the expression variations used in Experiment 7 did not differ in *type* between the two races, it still looked at the detection of *subtle differences* related to facial expressions. Therefore, it was predicted that the effect of own-race bias would be seen in the detection of changes related to facial expression.

6.3.2 Method

Participants

Sixteen European (Caucasian) students (6 males; age range 16-48, mean=27.9, s.d.=8.8) at University of Stirling (Scotland, U.K.) participated in this study. All were paid or received course credits for their participation.

Stimuli and Apparatus

Eight mixed-race pairs of faces (half male; 16 mixed-race faces in total) were created using 16 European faces (half male; from a set of undergraduate photographs at York University, Canada) and 16 Japanese faces (half male; from a set of undergraduate photographs at Kyoto University, Japan). To make the mixed-race morphed faces, all 32 original images were first edited using PsychoMorph 8.3 and 179 feature points were manually marked (delineated). Such feature points define the main facial features (e.g. eyes, nose and mouth) and the outline (e.g. jaw line, hair line) of each face. There were two types of mixed-race face pairs: identity and expression. Identity pairs consisted of two different mixed-race face identities with neutral expressions, and expression pairs consisted of one mixed-race face identity with neutral and happy expression. To make identity pairs, 8 European and 8 Japanese faces were made into pairs of European and Japanese faces of the same sex (4 pairs per gender) and were averaged together to create 8 mixed-race faces. These 8 mixed-race faces were further made into pairs of two randomly per gender, creating 4 identity mixed-race pairs in total. Figure 6.7 shows an example of mixed-race identity pair construction process.

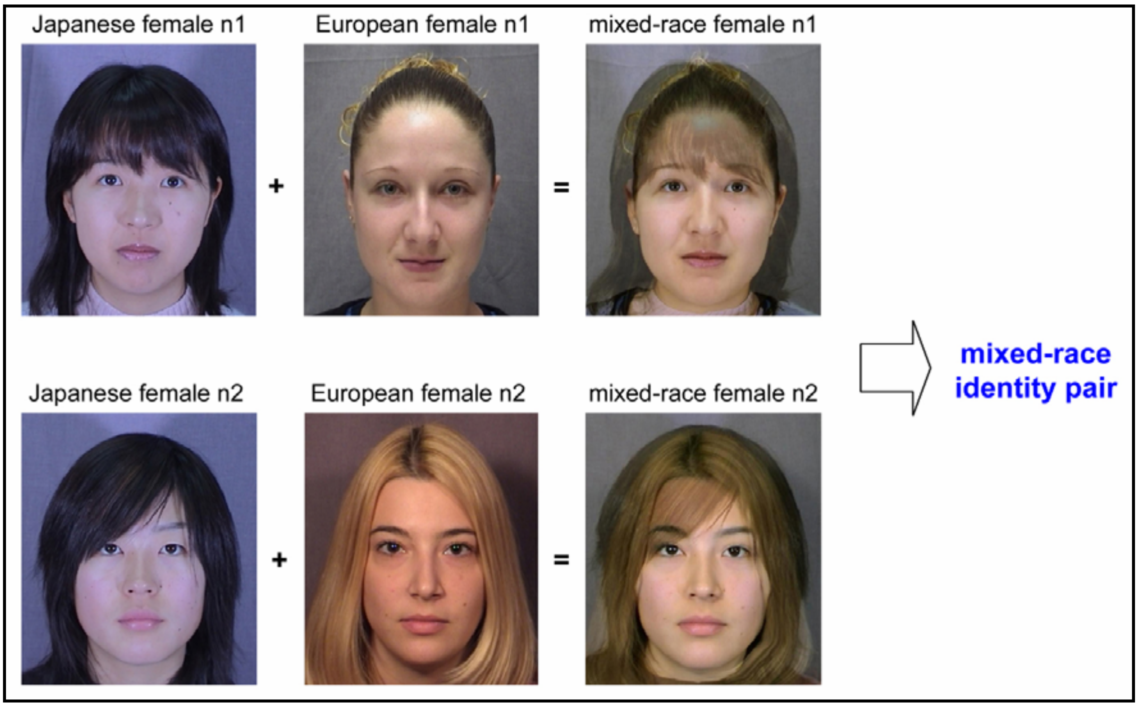


Figure 6.7 An illustration of a mixed-race identity pair construction: Top=neutral Japanese female 1 (n1 denotes neutral identity 1) is morphed with neutral European female 1 to create mixed-race female1, Bottom=neutral Japanese female 2 is morphed with neutral European female 2 to create neutral mixed-race female 2. Two mixed-race faces are then paired to create a mixed-race identity pair.

Similarly, to make expression pairs, 4 European and 4 Japanese face identities with neutral and happy expressions (16 images in total) were made into pairs of European and Japanese faces of the same sex and expression (4 pairs per gender) and were averaged together to create 8 mixed-race faces. These 8 mixed-race faces were further made into pairs within the same mixed-race identity (with happy and neutral expressions) creating 4 expression mixed-race pairs in total. Figure 6.8 shows an example of mixed-race expression pair construction process.

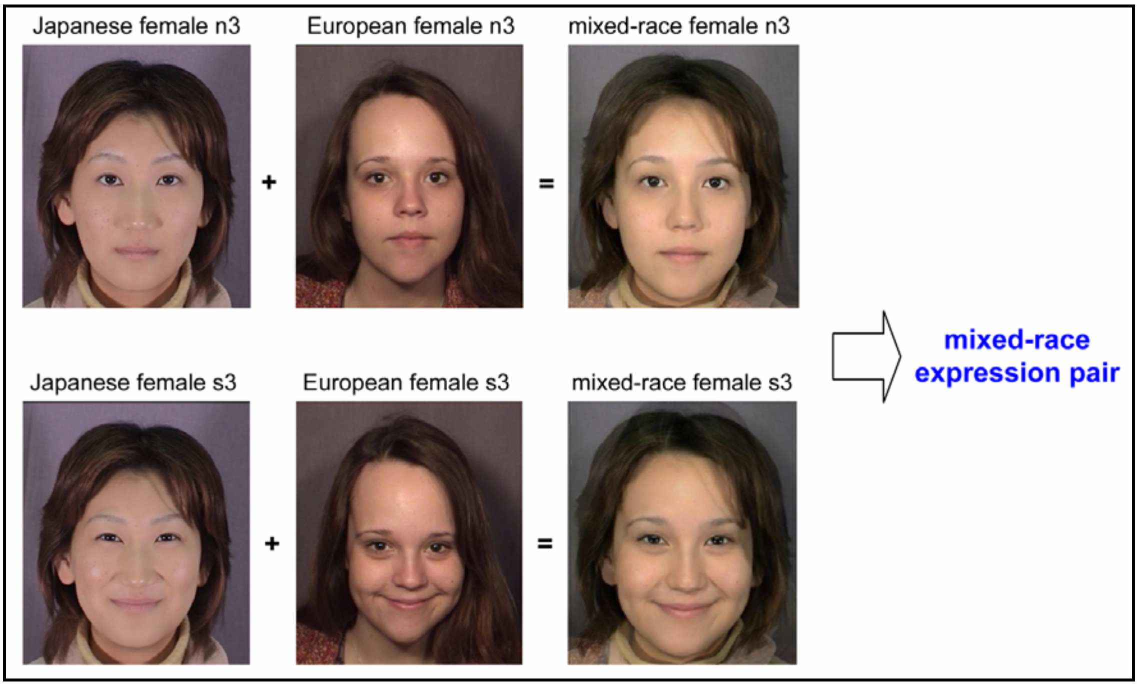


Figure 6.8 An illustration of a mixed-race expression pair construction: Top=neutral Japanese female 3 (n3 denotes neutral identity 3) is morphed with neutral European female 3 to create mixed-race female 3, Bottom=happy Japanese female 3 (s3 denotes smiling identity 3) is morphed with happy European female 3 to create happy mixed-race female 3. Two mixed-race faces are then paired to create a mixed-race expression pair.

The 4 identity and 4 expression mixed-race pairs were then applied to 16 new images (4 identities in each race and gender) to create transforms based on identity and expression changes (11 steps numbered 0 to 10; 10% increment), creating 64 continua (16 identities; two transform types, two race and two gender) and 704 images in total. Figure 6.9 shows the steps involved in identity transform construction. First, a transform between faces from a mixed-race identity pair (here, mixed-race female faces) was created. This transformation was then applied to European and Japanese original images of the same gender to create sequences of images based on identity transformation. Here, three steps from each sequence are shown for each race for illustration purposes. Note that for each step in the sequence, both European and Japanese original faces received identical amount of identity transformation. A similar process applied to the construction of expression transforms, shown in Figure 6.10.

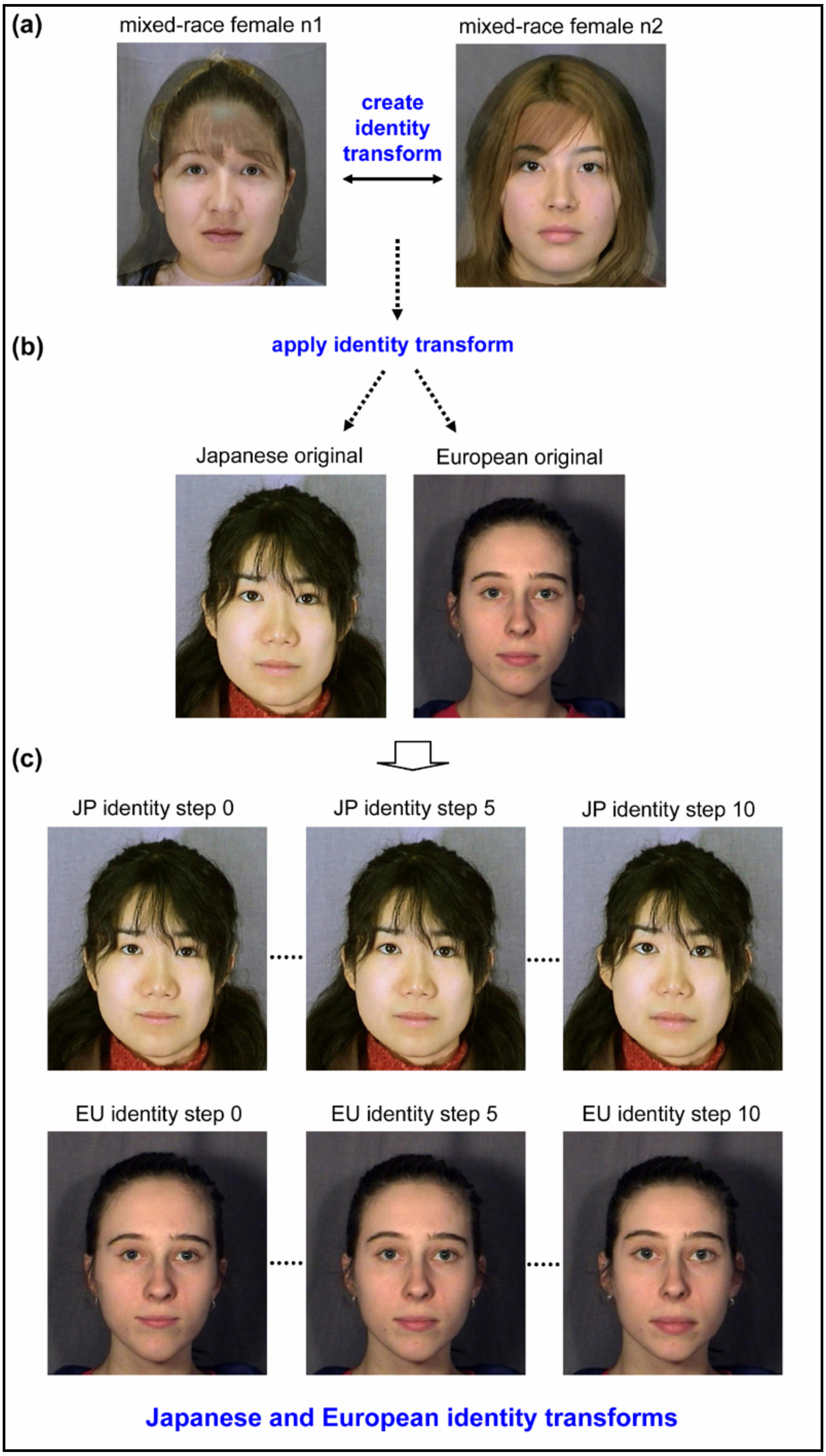


Figure 6.9 An illustration of identity transform construction process: (a) a transform between mixed-race identity pair is created, and (b) applied to Japanese and European original images to create (c) Japanese and European identity transforms.

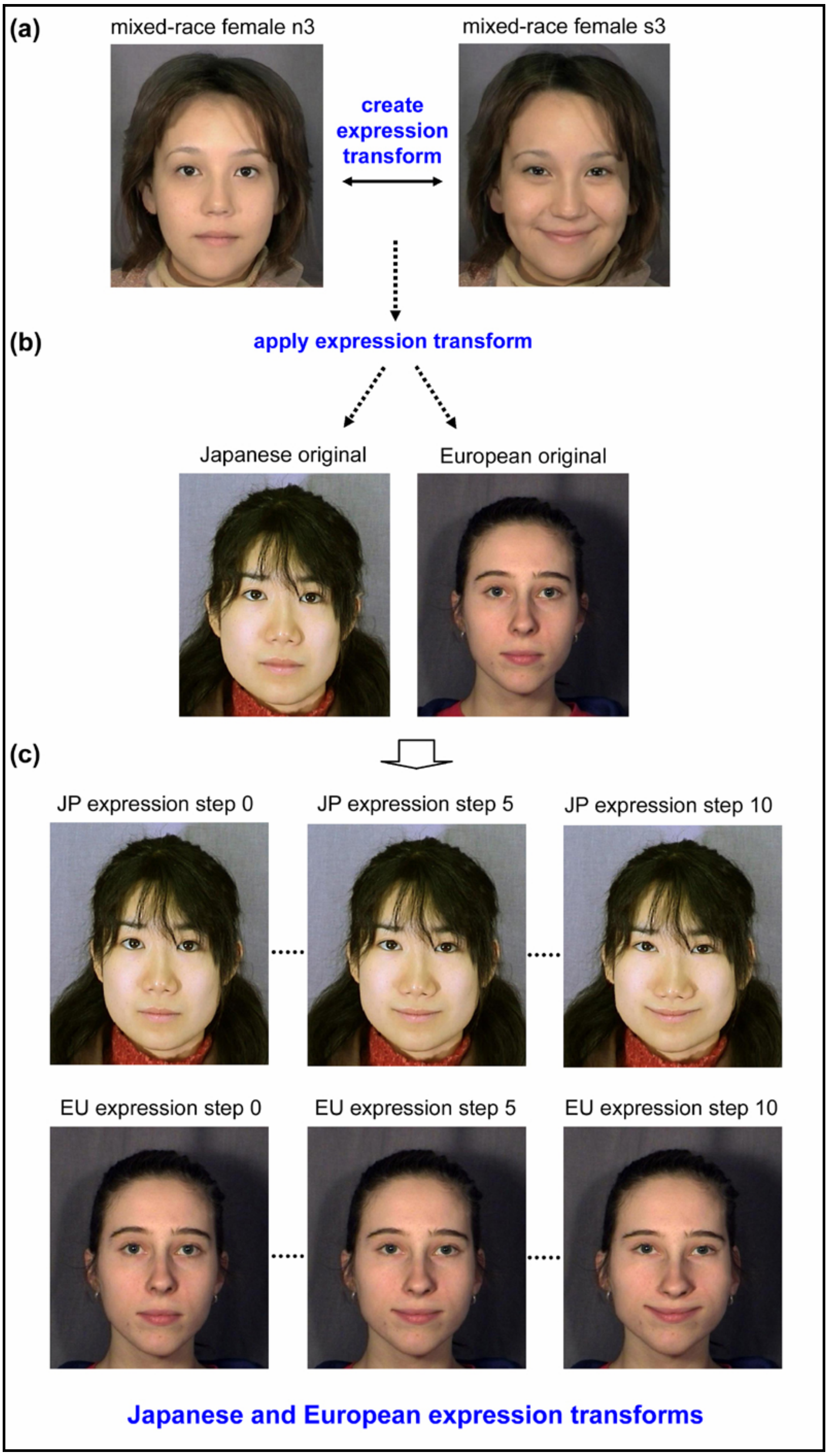


Figure 6.10 An illustration of expression transform construction process: (a) a transform between a mixed-race expression pair is created, and (b) applied to Japanese and European original images to create (c) Japanese and European expression transforms.

The images in the 11-step continua were numbered starting 0 to 10, and two images that were 30% apart (three steps along the linear continuum) were paired, creating 8 pairs (pairs 0-3, 1-4, 2-5, 3-6, 4-7, 5-8, 6-9, 7-10) from each continuum. See Chapter 2 for more details on the averaging and transforming techniques. During analysis, 8 pairs per continuum (identity and expression) and face race (European and Japanese) were further divided into two change types. For the identity transform, the two change types were identity 1 (pairs 0-3, 1-4, 2-5, 3-6) and identity 2 (pairs 4-7, 5-8, 6-9, 7-10). For the expression transform, the change types were neutral (pairs 0-3, 1-4, 2-5, 3-6) and happy (pairs 4-7, 5-8, 6-9, 7-10). All 704 images were edited using Adobe Photoshop 7.0®, converted to greyscale and framed with a black oval mask to remove background and hairline. All images were 450 pixels wide. Four additional face pairs (two identity and two expression transforms per race per gender) were also prepared for practice trials using faces that did not appear in the experimental trials. All images were presented on a computer screen. The size of each face image on screen was approximately 11 x 7cm.

Design

This study used a within-participants design. Independent variables examined were face race (European and Japanese) and change type (identity 1 and identity 2 for identity transform; happy and neutral for expression transform). Accuracy rates and reaction times were measured as dependent variables. Data for identity and expression morph tasks were analysed separately.

Procedure

All participants were tested individually using a laptop computer. Participants were presented with a two-alternative forced-choice delayed matching task. All images and instructions were presented using E-Prime®. On each trial, participants saw a fixation cross for 1000ms, followed by a target face shown for 2000ms, which was masked by a blank screen shown for 500ms and was then followed by two test faces (A and B) shown side by side. The two test faces (A and B) always differed by 30%, or three steps along the linear continuum. The target face was always the same as one of the two test images. Participants pressed a key on the keyboard to indicate whether the target image was the same as the left or the right test images. The two test images remained on the screen until participants made a response. A feedback was given after each response for 500ms. All eight two-step pairings (pairs 0-3, 1-4, 2-5, 3-6, 4-7, 5-8, 6-9, 7-10) of the 11 images per continuum were presented in each of four orders (AAB, ABA, BAB, BBA) totalling 32 combinations per continuum. Participants were shown 32 combinations of images derived from 8 continua (two transform types, two race and two gender), totalling 256 trials which were fully randomised. Combinations of identity and expression transforms with regard to face identity were counterbalanced across participants using 8 different trial lists. For examples of face images see Appendix E.

6.3.3 Results

Data from 16 European participants regarding their accuracy rates and reaction times in identity and expression transform tasks produced the following descriptive statistics. The mean accuracy and mean reaction times for two race faces (European and Japanese) and 8 pair types (0-3, 1-4, 2-5, 3-6, 4-7, 5-8, 6-9, 7-10) were calculated for each participant. Further, data from 8 pair types were divided in half into two change types per face race and transform type. For the identity transform, the two change types were identity 1 (pairs 0-3, 1-4, 2-5, 3-6) and identity 2 (pairs 4-7, 5-8, 6-9, 7-10), based on the two mixed-race identities used in the transform. For the expression transform, the change types were neutral (pairs 0-3, 1-4, 2-5, 3-6) and happy (pairs 4-7, 5-8, 6-9, 7-10), based on the neutral and happy expression transformation used in the transform.

Results for identity and expression transforms were analysed separately by means of within-participants ANOVAs, and α-levels for ANOVAs were Bonferroni adjusted to the probability of .05 / 2 = .03. All post-hoc tests of simple main effects using *t*-tests were Bonferroni corrected. Results from the main analyses using ANOVAs and post-hoc analyses are reported with uncorrected degrees of freedom and the corrected *p*-value.

Accuracy

Identity Transform

Figure 6.11 shows the mean accuracy (with error bars ± 1 s.e.) for two race faces (European and Japanese) and two change types (identity 1 and identity 2) in identity transform task from 16 European participants.

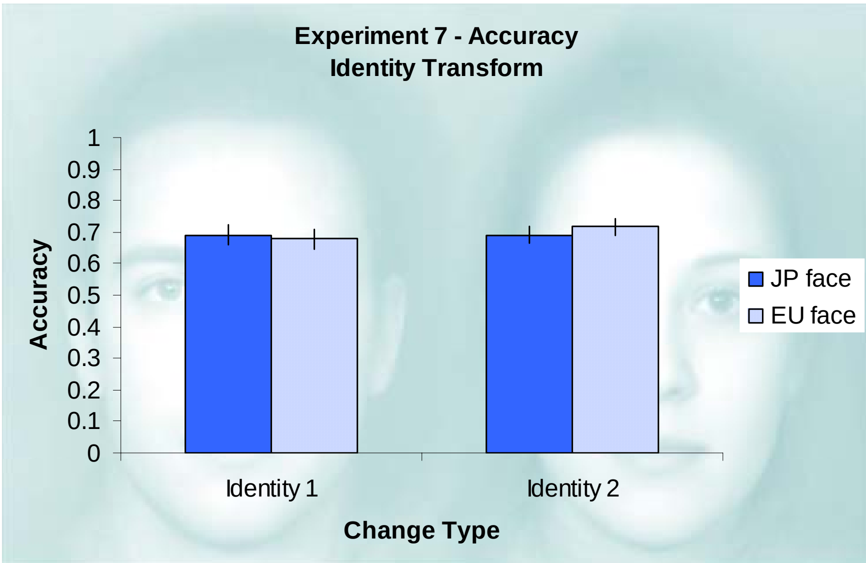


Figure 6.11 Mean accuracy (with error bars ± 1 s.e.) for Japanese and European faces with two change types in identity transform task from European participants.

Mean accuracy was analysed using a 2 x 2 within-participants ANOVA with face race (European and Japanese) and change type (identity 1 and identity 2) as the within-participants factors. The main effects of face race ($F_{(1,15)}$=.12, p>.1) and change type

($F_{(1,15)}$=.61, p>.1) were both non-significant. The interaction between face race and change type ($F_{(1,15)}$=1.24, p>.1) was also non-significant.

Expression Transform

Figure 6.12 shows the mean accuracy (with error bars ± 1 s.e.) for two race faces (European and Japanese) and two change types (neutral and happy) in expression transform task from 16 European participants.

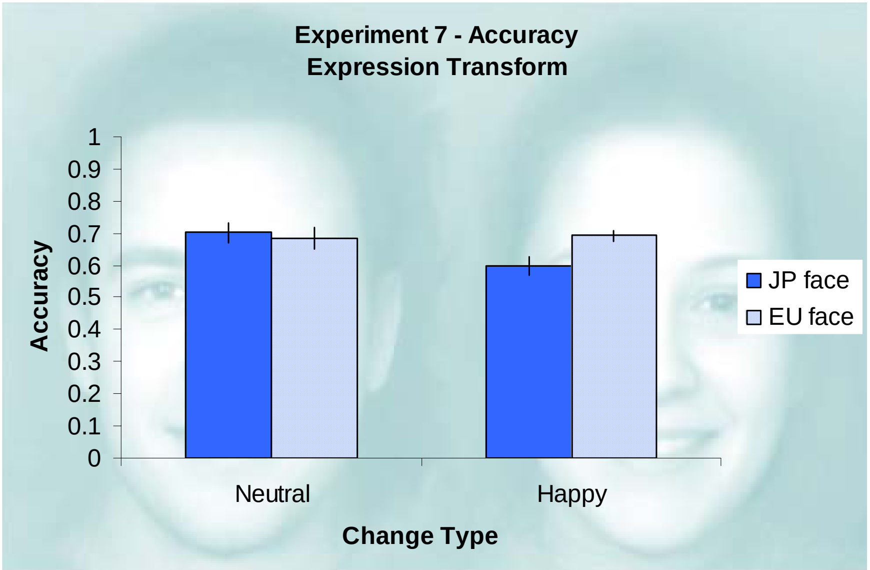


Figure 6.12 Mean accuracy (with error bars ± 1 s.e.) for Japanese and European faces with two change types in expression transform task from European participants.

As above, mean accuracy was analysed using a 2 x 2 within-participants ANOVA. There was a weak trend for a main effect of face race ($F_{(1,15)}$=3.73, p=.07), with higher accuracy for European faces. The main effect of change type also approached significance level ($F_{(1,15)}$=5.18, p=.04), with higher accuracy for neutral change type. However, these main effects were qualified by a significant interaction between face race and change type ($F_{(1,15)}$=6.17, p=.03). Tests of simple main effects using *t*-test showed that the interaction was due to higher accuracy for neutral compared with happy change type shown in Japanese faces ($t_{(15)}$=3.12, p=.03) and also for happy change type shown in European compared with Japanese faces ($t_{(15)}$=2.88, p=.05).

Reaction Times

Identity Transform

Figure 6.13 shows the mean reaction times in milliseconds (with error bars ± 1 s.e.) for two race faces (European and Japanese) and two change types (identity 1 and identity 2) in identity transform task from 16 European participants.

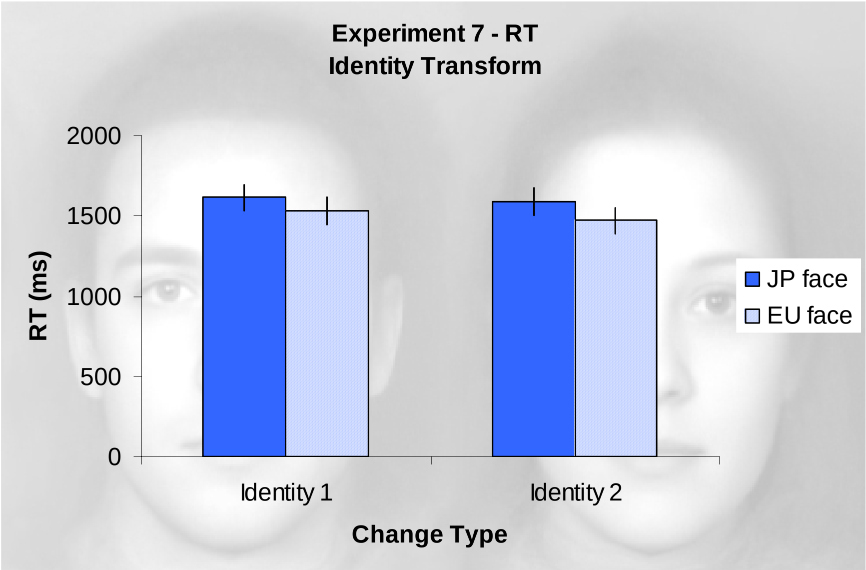


Figure 6.13 Mean reaction times in milliseconds (with error bars ± 1 s.e.) for Japanese and European faces with two change types in identity transform task from European participants.

Mean reaction times was analysed using a 2 x 2 within-participants ANOVA with face race (European and Japanese) and change type (identity 1 and identity 2) as the within-participants factors. This revealed a significant main effect of face race ($F_{(1,15)}$=7.97, *p*=.01) with faster reaction times to European faces. The main effect of change type ($F_{(1,15)}$=3.15, *p*>.1) was non-significant. The interaction between face race and change type ($F_{(1,15)}$=.27, *p*>.1) was also non-significant.

Expression Transform

Figure 6.14 shows the mean reaction times or two race faces (European and Japanese) and two change types (neutral and happy) in expression transform task from 16 European participants.

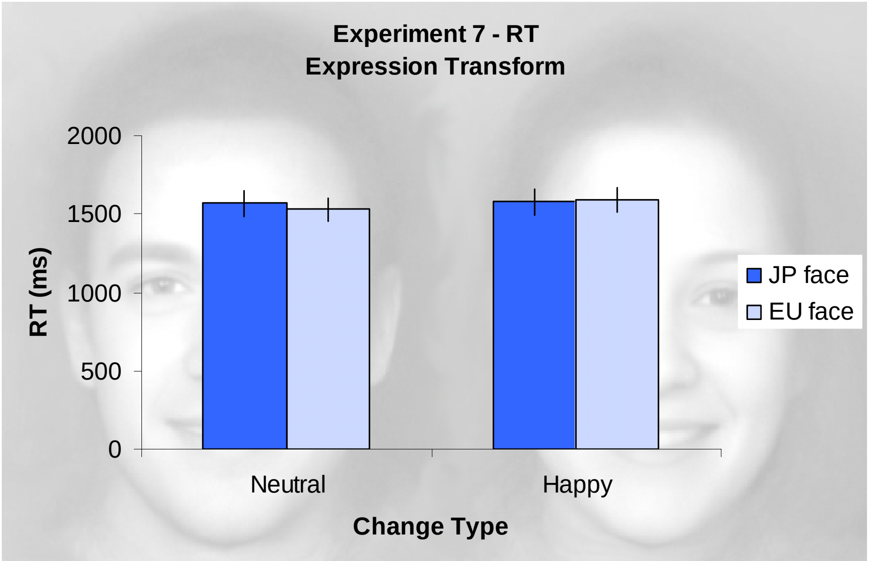


Figure 6.14 Mean reaction times in milliseconds (with error bars ± 1 s.e.) for Japanese and European faces with two change types in expression transform task from European participants.

As above, mean reaction times was analysed using a 2 x 2 within-participants ANOVA. The main effects of face race ($F_{(1,15)}$=.40, *p*>.1) and change type ($F_{(1,15)}$=1.78, *p*>.1) were both non-significant. The interaction between face race and change type ($F_{(1,15)}$=.70, *p*>.1) was also non-significant.

6.3.4 Discussion

The results from Experiment 7 showed that the detection of changes not related to racial characteristics was faster/more accurate in own-race faces. With regard to the accuracy measure, the results from trials involving the detection of expression-related changes showed that the happy change type was detected more accurately in European than in Japanese faces, showing the effect of the own-race bias. It was also found that in Japanese faces the neutral change type compared with the happy change was detected more accurately, while both happy and neutral change types were detected equally accurately in European faces. In contrast, there was no sign of the own-race bias in accuracy for the detection of identity-related changes. However, the results from the reaction times measure in identity change detection showed that European participants in fact detected identity-related changes in European faces faster than they detected the identical identity-related changes in Japanese faces. There was no sign of the own-race bias in reaction times for the detection of expression-related changes. Taken together, the results showed some indication of the own-race bias in change detection in two types of facial information that is not directly related to racial characteristics. The results also showed that the detection of expression-related changes is influenced by the type of expression change and face race. It is important to stress that the effect of the own-race bias was seen in the present study even though the exactly the same amount of identity and expression changes were applied to the two race faces. This suggests that identical feature changes made to faces are nevertheless less differentiated and/or less efficiently encoded in face representation in other-race faces.

One problem with the current study was that only European participants were available to take part. This was not ideal, and the one-sided design left open the possibility that the effect observed was due to some unknown differences in the stimuli used, which led to differential difficulty of the stimuli for different race faces. If this were the case, the same pattern (better performance in European faces) may be found in Japanese participants. However, it should be noted that the base faces used in the current study were taken from the same stimulus sets used in Experiments 2, 3, 4 and 6 described above, which found a general trend of the own-race bias in European but not in Japanese participants. Therefore the pattern of results found in European participants in the current study was similar to the pattern found in earlier experiments which used the same faces. Thus having observed a consistent pattern of results in European participants in these studies, one might predict the same pattern in Japanese participants (i.e. no effect of the own-race bias). It will be interesting to repeat the same study and examine the results in Japanese participants in future research.

6.4 General Discussion

The current chapter reported two experiments that examined the effect of the own-race bias on perception of identity and expression information in own and other race faces. One general aim of this chapter was to consider the effect of the own-race bias on both identity and expression processing in a single framework. Past studies on the own-race bias have shown the race expertise effect on the processing of both identity and expression information (e.g. Elfenbein and Ambady 2002, 2003; Kito and Lee 2004; Lindsay, Jack and Christian 1991; Walker and Tanaka 2003). However, these effects have been studied separately, and the two have rarely been integrated into an overall framework. However, as both effects are examples of the own-race bias, it was felt useful to formally address the effects of race expertise on identity and expression information processing in a single experimental setting, the point which was addressed in the current chapter.

Experiment 6 examined the possible similarity between familiar/unfamiliar and own-race/other-race face processing at the level of face perception, following the findings from a recognition memory study in Experiment 1 which showed that, at least in European participants, the quality of unfamiliar own-race face representations was comparable to that of familiar faces. In Experiment 6, reaction times and error rates in identity and expression matching tasks were examined using European and Japanese faces cross-racially. The results showed that, unlike the patterns seen in Experiment 1, familiarity with one's own race did not modulate the performance in identity and expression matching tasks. Here, both reaction times and error rates measures showed that European and Japanese participants could match faces in terms of identity and expression information in own and other race faces equally fast and accurately. However, there was an overall difference in the performance for the identity matching task with Japanese faces, as European participants were slower and made more errors when matching identity in Japanese faces compared with Japanese participants, while the performance for matching European faces did not differ between the two participant groups. So again the effect of race expertise was found amongst European participants, although the differences in the quality of face representations for own and other race faces were not comparable to the representational differences between familiar and unfamiliar faces.

One way to explain the difference in the pattern of results between the face recognition study (Experiment 1) and face matching task (Experiment 6) may be found in a recent study by Megreya and Burton (in press), which indicated that unfamiliar face matching may be achieved in a qualitatively different way from the process underlying matching familiar faces. This study used an array task to examine face matching ability in familiar and unfamiliar faces. Participants were shown a target face and ten additional face images in an array directly below, and were told that the target may or may not be one of the ten in the array. The task was to find the target if present, and participants performed this task with both familiarised and unfamiliar face arrays. For the familiarised faces, half the participants saw the arrays upright, and the other half inverted, while the unfamiliar arrays were always presented upright. The target face was always presented upright. The results showed that there was a strong correlation between upright unfamiliar and inverted familiar face processing, but no correlation was found between upright familiar and upright unfamiliar faces, indicating that unfamiliar faces may not engage the processes normally engaged by familiar faces. Since it is known that inverted faces cannot be processed configurally, it was suggested that unfamiliar faces may not support configural processing. The face matching task in Experiment 6 used unfamiliar own and other race faces, and it may be that participants in this study did not engage face processing because all faces were unfamiliar. This may be why the results from the current study did not show the expected interaction between face race and participant race in identity matching task. To overcome this problem, for future research it would be better to include a familiarisation stage (for both own and other race faces) in the matching task to see whether increased familiarity with one's own-race faces may lead to better processing of identity and expression information in familiarised own-race compared with familiarised other-race faces. It may be that people are faster at learning to differentiate unfamiliar own-race than unfamiliar other-race faces.

In Experiment 7, people's ability to detect small differences related to identity and expression changes in own and other race faces was examined. An identical amount of non-race related differences based on identity and expression transformation were applied to both own and other race faces, to control for the possible effect of race-related facial variations on the magnitude of the own-race bias. Here only European participants were tested. The results showed that, even after controlling for the type and amount of facial variations between own and other race faces, the identical facial feature transformations based on identity and expression changes were processed differently in own and other race faces. Here, European participants detected the happy change type more accurately in own-race faces, although no difference was found in the reaction times measure for the two race faces. In contrast, identity-related changes were detected equally accurately in both race faces, yet the reaction times measure showed that European participants nonetheless detected identity changes faster in own-race faces. Thus the results indicated that the own-race bias can be observed without any race-related stimuli variations, and suggested that perceiver differences seem to have a significant role in mediating the own-race bias in face perception.

One interesting pattern observed in Experiment 7 was that European participants could differentiate subtle variations in the neutral change type equally accurately in both own and other race faces, but they were less able to differentiate slight variations in the happy change type in Japanese compared with European faces. Thus the effect of race expertise on emotion processing depended on the type of expression variations. This may be explained by the finding from Experiment 5 that Japanese faces seem to be more typically observed in neutral than in happy expression. Here, both European and Japanese participants rated neutral Japanese faces to be more typical looking than happy Japanese faces. Thus the difference in the frequency Japanese faces are seen in different expressions may have a significant role in modulating the degree of race expertise in emotion processing. In contrast, the results showed that there was no difference in accuracy when differentiating non-race related identity changes in own and other race faces. This suggests that the effect of the own-race bias on identity recognition accuracy frequently observed in many recognition memory studies (e.g. Bothwell, Brigham and Malpass 1989; Meissner and Brigham 2001) may be based on race-related facial identity variations between own and other races. Thus in future studies it would be useful to examine the possible dimensions different race faces vary.

What needs to be addressed in future research seem to be the exact nature of perceiver differences that underlie the own-race bias in detecting non-race related identity and expression changes. Regarding the processing of expression-related changes, the current results indicated that subtle differences in expressive style, suggested by

Elfenbein and Ambady (2002) to underlie in-group advantage in emotion recognition, is not necessary to demonstrate the own-race bias in emotion processing. One potential perceiver difference that has been implicated in previous research on the race expertise effect in emotion processing is the motivational biases of the decoder (Thibault, Bourgeois and Hess 2006). However, whether the difference in motivation alone could explain the differential processing of emotion information in own-race faces, or if other types of perceiver differences also play a role, remains to be answered. In a similar regard, the possible perceiver differences underlying the processing of identity-related changes also need to be examined. Although the differential holistic encoding of own and other race faces has been implicated in the effect of the own-race bias in identity processing (Michel, Caldara, Rossion 2006; Tanaka, Kiefer and Bukach 2004), no study has explicitly examined the potential role of participants' motivational biases in mediating the own-race bias in identity processing. Therefore in future studies the possible perceiver differences (e.g. motivational biases, differential holistic encoding) should be examined systematically when studying the effect of the own-race bias on identity and expression processing.

Chapter 7

The Own-Race Bias and Attention to Faces

7.1 Experiment 8 – Attention and Change Blindness

Declaration

Experiment 8 was conducted in collaboration with Peter J. B. Hancock, whose contribution included a creation of a program used for stimuli presentation using an eye-tracker, and the conversion of raw data from the eye-tracker for subsequent analysis. All the other aspects of Experiment 8 were conducted by the author. An amended version of the current chapter is to appear in Visual Cognition.

7.1.1 Introduction

Numerous studies have shown that people often fail to notice large changes made to objects and scenes across different views. This so-called ‘change blindness’ occurs when an aspect of a visual scene is altered while at the same time the motion signals that usually accompany the change are disrupted, leading to the loss of attention drawn to the change (e.g. Simons and Levin 1997; Simons and Rensink 2005). The suppression of motion signals in change detection tasks can be achieved in several ways, for example changes could be made across eye movements (e.g. during saccades or eye blinks) and during brief visual occlusions as well as during artificial disruptions in the absence of any eye movements (for an overview see Rensink 2002). One technique that simulates visual events without eye movements is the ‘flicker’ paradigm, a task which involves repeated alternate presentation of an original and modified scene, separated by a blank interval to simulate visual suppression caused by a saccadic movement, until observers detect the change. Observers can usually find most changes eventually, but often take a long time to do so even when the changes are relatively large (e.g. Hollingworth, Schrock and Henderson 2001; Rensink, O’Regan and Clark 1997). Findings from change blindness studies showing our poor ability to detect large and significant changes have inspired questions about the nature of internal representation of the world, leading some researchers to adopt the view that visual representation of the perceptual world may be relatively sparse, with successful change detection depending on the allocation of visual attention to the changing region (Rensink 2000; Rensink, O'Regan and Clark 1997). Recently, however, an alternative view that the existence of change blindness does not necessarily indicate a lack of detailed visual representation has become more prominent, and successful change detection is thought to be the result of a failure to maintain and/or compare existing representations across alternative scenes (Mitroff, Simons and Levin 2004; Simons, Chabris, Schnur and Levin 2002; Simons and Rensink 2005). However, the precise nature of representation to explain the phenomenon of change blindness still remains to be answered.

One of the important findings established through the change blindness studies is the role of visual attention in change detection. For example, using a flicker paradigm, Rensink, O'Regan and Clark (1997) showed that changes to areas of central interest (semantically) were detected faster than changes made elsewhere, leading to the conclusion that semantically central items were preferentially selected by visual attention. Another important factor that affects the selection of visual information is the overt movement of the eyes, and studies have shown that change detection was more likely if observers fixated on the changing region both before and after the change occurred (Henderson and Hollingworth 1999; Hollingworth, Schrock and Henderson 2001). Findings such as these suggest that both the orienting of eyes and visual attention are important in successful change detection.

Studies on change blindness have also revealed the influence of individual and group differences on successful change detection, and one modulating factor is known to be the prior expertise and group membership of observers. For example, Werner and Thies

(2000) showed that American football experts were better able to detect meaningful changes made to football scenes than non-players. A similar finding was found in a study that compared change detection ability in chess configurations amongst expert and novice chess players, showing better change detection in experts when the configuration was meaningful rather than random (Reingold, Charness, Pomplun and Stampe 2001). In addition, Reingold *et al.* (2001) also examined eye movements of expert and novice chess players during a task that required observers to decide whether a King was under attack, and found that experts had larger visual span and required fewer fixations than novices to complete this task. Several factors that affect eye movements in change detection tasks have also been discovered, and manipulations of both the number and the orientation similarity of the changed objects have been shown to increase the number of fixations during change detection (Zelinsky 2001). However, the possible influence of expertise on visual behaviour of eye movements during change detection tasks still remains to be empirically examined.

Recently, change detection ability in the domain of face and person perception was investigated in relation to one specific type of expertise: the racial membership of the observers (Humphreys, Hodsoll and Campbell 2005). It has long been documented that people are generally more accurate in perceiving and recognising differences amongst the faces of their own race than those belonging to other racial groups. This effect, the so-called the own-race bias (also known as the other-race effect or cross-race effect) is robust, and has been shown in numerous experimental studies (for meta-analyses see Bothwell, Brigham and Malpass 1989; Meissner and Brigham 2001). Typically, findings showing the own-race bias come from recognition memory tasks in which people are shown to recognise faces of their own racial group more accurately (e.g. Chiroro and Valentine 1995; Furl, Phillips and O'Toole 2002; Valentine and Endo

1992). However, the own-race bias does not only affect recognition memory, but it has been shown to influence other visual processes such as the recognition of emotional facial expressions (e.g. Elfenbein and Ambady 2002, 2003; Kito and Lee 2004) and the perceptual discrimination of faces in own and other races (e.g. Lindsay, Jack and Christian 1991; Walker and Tanaka 2003).

Following much face perception research showing the effect of the own-race bias and change-blindness studies indicating the effect of expertise, the study by Humphreys, Hodsoll and Campbell (2005) examined the effect of the own-race bias during the attentional stage of face processing to determine whether there would be a general bias in attention to faces of own racial group. Here, the own-race bias in face perception was examined in a change blindness study using a flicker paradigm. Caucasian and Indian Asian participants viewed original and modified scenes displayed in alternation, separated by a blank interval. Each scene contained Caucasian and Indian Asian people and objects, and the corresponding modified scene contained one change made either to a face (Caucasian or Asian), to body parts (Caucasian or Asian) or to objects in the background. Participants were asked to respond when they detected the change made to the scenes and reaction times were recorded. It was found that changes made to faces were detected faster than changes in body parts, which were detected faster than changes in the background. This was consistent with past findings showing that changes made in the background are more difficult to detect (e.g. Rensink, O'Regan and Clark 1997). More importantly, however, it was found that both Caucasian and Indian Asian people detected changes made to own race faces faster than changes in other race faces, but there was no racial difference in detecting changes made to body parts. Based on the results showing that participants of both races attended equally to the changes in body parts of own and other races, Humphreys *et al.* (2005) concluded that the crossover effect in detecting changes in faces was due to participants attending to both own and other race faces equally, but were less sensitive to changes made in other race faces. It was suggested that change detection requires perceptual mechanisms that allow visual information to be differentiated in memory, as well as attention to this visual information, and such perceptual mechanisms are thought to be more suited to process own race than other race faces. A multidimensional 'face-space' framework proposed by Valentine (1991) is consistent with this idea. He suggested that individual faces are represented in a space defined by dimensions that serve to discriminate faces we encounter and, because people generally have more experience with own race faces, these dimensions are thought to differentiate own race faces better than faces of other races.

Given that the own-race bias is already present at the encoding stage of face processing (e.g. Lindsay, Jack and Christian 1991; Walker and Tanaka 2003), the conclusion reached by Humphreys *et al.* (2005), that slower detection of changes in other race faces was due to people being poorer at discriminating other race faces, is a very probable one. However, there is an alternative explanation, namely that people attend preferentially to their own race faces. Humphreys *et al.* showed that participants were equally sensitive to changes in own and other race body parts and argued that this implied equal attention to both race bodies and by extension to both race faces. However, it has been shown that faces and eye direction capture attention (e.g. Friesen and Kingstone 1998; Theeuwes and Van der Stigchel 2006) and there is also evidence that particular types of faces, for example faces showing negative expression, draw attention (e.g. Eastwood, Smilek and Merikle 2001; Hansen and Hansen 1988). It therefore remains possible that attention might differ between the two face types and that this might explain why observers detect changes more quickly in their own race faces. Put simply, if they look at their own race faces first, they will see changes there sooner.

The current study aimed to examine this possibility directly, by monitoring observers' eye movements using an eye-tracker during a change detection task to observe their attention to faces. The study by Humphreys *et al.* (2005) was replicated using the same stimuli, with new groups of Indian Asian and European Caucasian participants. In addition to recording reaction times, eye movements during the task were continuously monitored to determine whether or not observers differentially attended to own race faces over other races. Such a difference might be manifested in looking sooner, or more often, or longer at own race faces (or some combination of these).

7.1.2 Method

Participants

Thirteen Indian (Asian) students (8 males; age range 18-28, mean=23.3, s.d.=2.7) and 14 European (Caucasian) students (6 males; age range 18-49, mean=27.2, s.d.=9.8) at University of Stirling (Scotland, U.K.) and University of Glasgow (Scotland, U.K.) participated in this study. All participants had normal or corrected-to-normal vision. All provided informed consent and were paid or received course credits for their participation.

Stimuli and Apparatus

All stimuli used in this study (excluding practice images) were identical to the stimuli used in Humphreys *et al.* (2005). The stimuli consisted of 60 "parent" images in colour (640 x 480 pixels), containing four female actors (two White Caucasian and two Indian Asian). For each "parent" image, five additional images were created (thus creating 300 additional images in total), each containing one change relative to the "parent" image. These five changes were categorised into three types, the first change type made to one of the faces (one to a White Caucasian face and one to an Indian Asian face), the second change type made to one body part (one to a White Caucasian body part and one to an Indian Asian body part), and the third change type made to a neutral background object. The face changes involved a substitution of a face with another face of the same racial group in the image. The body part changes involved the duplication, deletion, or colour change of one part of either Caucasian or Asian actors. The background objects changes involved the duplication, deletion, or colour change of one of the background objects in the scene. One practice "parent" image and two additional changed images were created for practice trials. The "practice parent" image contained four Caucasian males, and two additional images consisted of one image containing a face substitution and the other image containing a change made to one body part. For more details regarding the stimuli images see Humphreys *et al.* (2005). Examples of images can also be found in Appendix F. The stimulus exposures and response recording were controlled by E-Prime®, and in addition eye-movements were recorded using a Tobii® 1750 eye-tracker, which has no interference with the user environment of the experimental participants and gives freedom of head movement. Participants were calibrated prior to the experiment using ClearView eye-gaze analysis software (supplied with the eye-tracker), with its standard 9-point calibration procedure.

The location of each of the four faces was identified by defining a rectangle (usually almost square) around the head. This rectangle, not visible to participants, varied between 2cm and 3.2cm in width, depending on how large the figures were in the scene. At a typical viewing distance of about 55cm (head restraint was not used, since the Tobii® system does not require it) this corresponds to an angle of view of between 2 and 3.3 degrees. This compares with a rated accuracy of 0.5 degrees for the Tobii® system, so a fixation on the face should be securely recorded as such. The four defined face regions together covered between 2.7% and 6.7% of the total image area, which was 27 x 21.8cm, so by far the majority of image fixations would not be recorded as a hit on a face.

The eye-tracker works at 50Hz, so returning a location every 20ms. We defined a fixation within one of the face regions as being three or more consecutive hits, i.e. 60ms minimum. If the eyes left the region, but returned within 60ms, it was considered to be the same fixation. Thus if the eyes moved away for three or more tracking sample, it was regarded as a new fixation elsewhere, but one or two missed samples were regarded as noise.

Design

This study used a mixed within-participants design. The race of participants (Asian and European) was used as a classification variable. The independent variable examined was face race (Asian and European). Reaction times for correct responses and eye-movements during trials including face changes were recorded as dependent variables.

Procedure

All participants were tested individually. Participants were informed that they would be shown several images containing people and objects, and their task was to detect changes made to these scenes as quickly and as accurately as possible, while having their eye-movements recorded at the same time. Following the counter-balancing procedure used in Humphreys *et al.* (2005), the 60 scenes (360 images in total; 60 "parent" images and 60 x 5 changed images) were divided into five sub-groups, each containing 12 instances of each of the five change type (two face changes, two body part changes and one background object change) and the corresponding "parent" images, totalling 60 trials per sub-group. All images were presented in a random order. After the initial 9-point calibration procedure, participants were first presented with two practice trials using images not used in the main trials. The trial began with a fixation cross, which disappeared after the participants fixated for 200ms, as determined by the eye tracker software. This was followed by two alternating images (either the "parent" or the changed image) shown for 200ms each, with a blank screen in between (shown for 100ms). This cycle of scene-blank-scene continued until the participant pressed the space bar to indicate they detected the change between the two scenes, when the participants reported the change they detected verbally to the experimenter. The time from the onset of the first scene until the response was recorded as reaction times. When participants failed to detect the correct change or when failing to respond within 60 seconds, the trial ended and an error was recorded. Eye-movements were continuously recorded while participants performed the tasks.

7.1.3 Results

Trials where participants failed to detect the correct change or when failing to respond within 60 seconds were recorded as errors and not used in the analysis. Only the data from trials containing face changes are reported. The mean error rates for two participant groups per change type are shown in Figure 7.1.

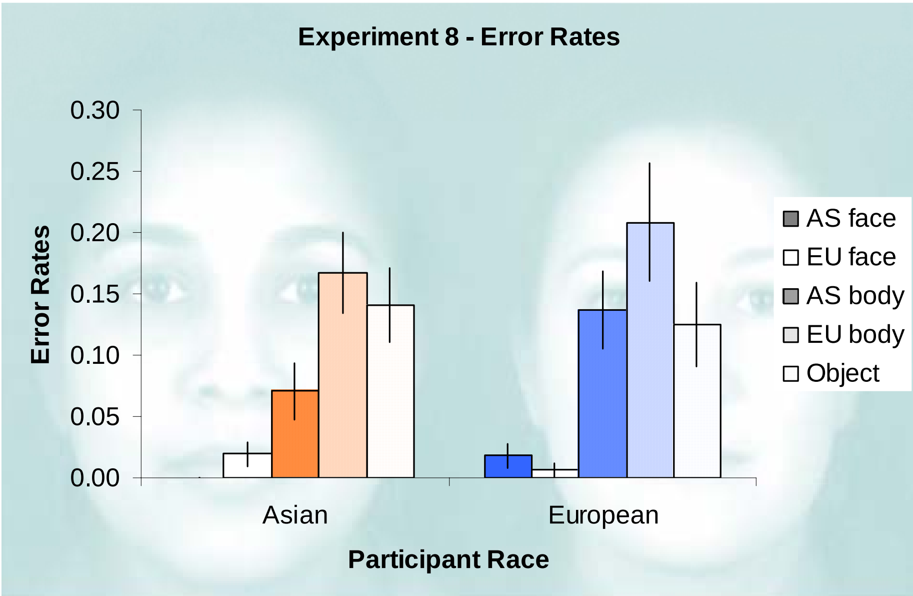


Figure 7.1 Mean error rates (with error bars ± 1 s.e.) for five change types. Left=Asian participants; Right=European participants.

Mean reaction times and eye-movement data for correct responses for face changes were analysed by means of mixed-design ANOVAs. When failing the Mauchly's test of sphericity, the Greenhouse-Geisser correction (Greenhouse and Geisser 1959) was used. All post-hoc tests of simple main effects using *t*-tests were Bonferroni corrected. Results from the main analyses using ANOVAs and post-hoc analyses are reported with uncorrected degrees of freedom and the corrected *p*-value.

Behavioural Data

Reaction Times

Mean reaction times, shown in Figure 7.2, were analysed using a 2 x 2 mixed-design ANOVA with participant race (Asian and European) as the between-participants factor and face race (Asian face and European face) as the within-participants factor. On average changes in European faces were detected faster than in Asian faces ($F_{(1,25)}$=4.41, *p*=.05, r=.39). In addition, a significant interaction between face race and participant race ($F_{(1,25)}$=5.41, *p*=.03, r=.42) was due to faster reaction times for European faces in European participants ($t_{(13)}$=3.19, *p*=.007, r=.66) but not in Asian participants ($t_{(12)}$=.16, *p*>.5, r=.05).

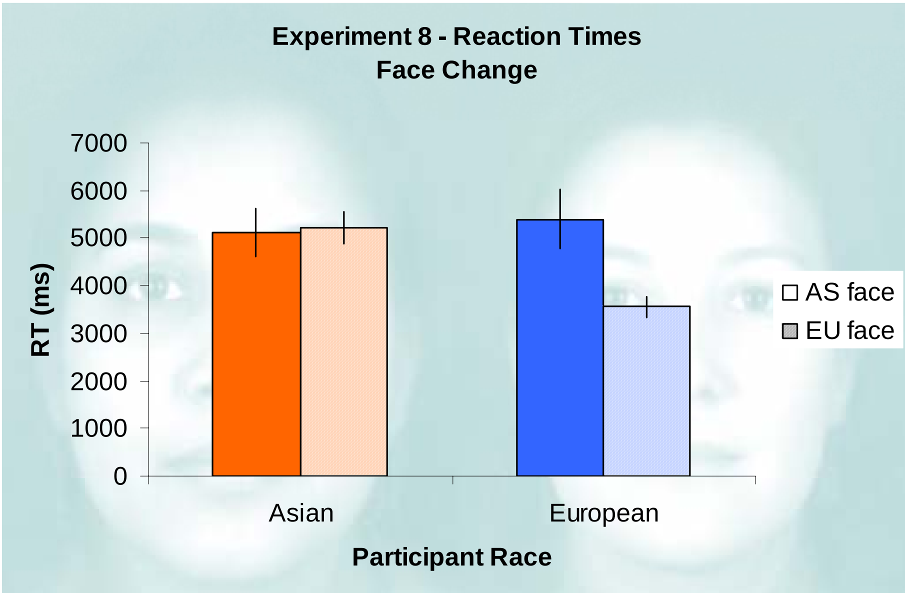


Figure 7.2 Mean reaction times in milliseconds (with error bars ± 1 s.e.) for face changes. Left=Asian participants; Right=European participants.

Eye Movement Data

Fixation Order

The order in which participants looked at each face was computed. They sometimes looked back at a face, e.g. they might look at one European face, then at the second one and go back to the first before looking at the two Asian faces. Since we were interested in evidence for selective attention, we took account of this and in this example the two Asian faces would be recorded as fourth and fifth, thereby emphasising any order effect and explaining why the mean results shown in Figure 7.3 do not sum to 4. The figure indicates a general tendency to look at the European faces first. This was confirmed using a 2 x 2 mixed-design ANOVA with participant race (Asian and European) as the between-participants factor and face race (Asian face and European face) as the within-participants factor. Only the main effect of face race was significant ($F_{(1,25)}$=21.21, *p*<.001, r=.68).

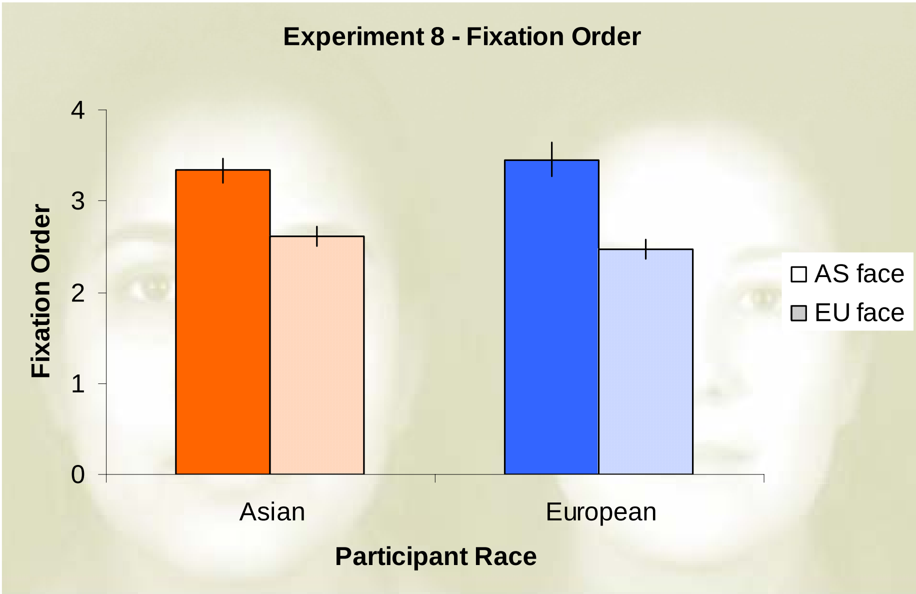


Figure 7.3 Mean fixation order (with error bars ± 1 s.e.) for face changes. Left=Asian participants; Right=European participants.

Fixation Number

A similar analysis was conducted on mean fixation number, for which mean values are shown in Figure 7.4. Again only the main effect of face race was significant ($F_{(1,25)}$=5.86, *p*=.02, r=.44), reflecting the pattern that overall participants tended to fixate more often on European than Asian faces.

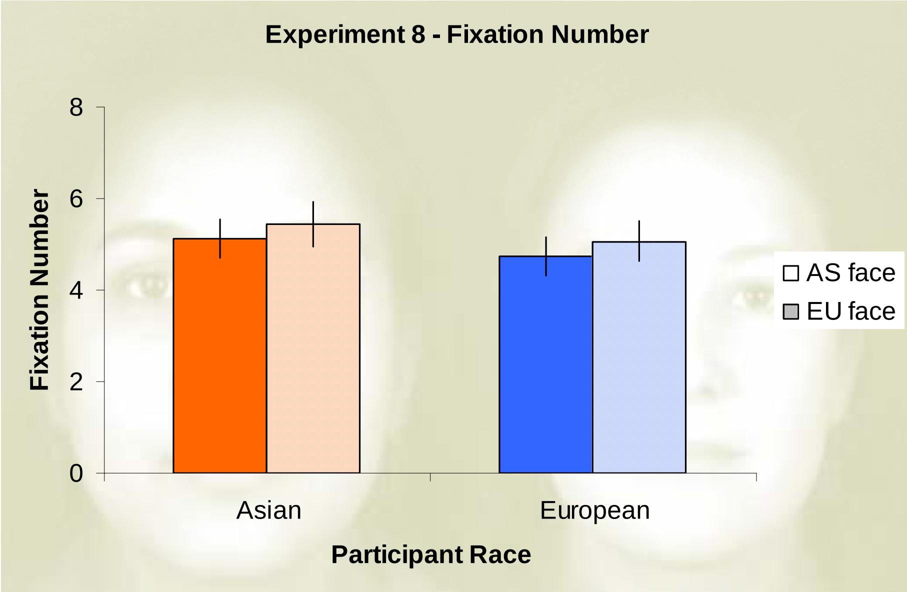


Figure 7.4 Mean fixation number (with error bars ± 1 s.e.) for face changes. Left=Asian participants; Right=European participants.

Fixation Duration

No significant main effects or interaction were found in the analysis of mean fixation duration (all *ps*>.1), illustrated in Figure 7.5.

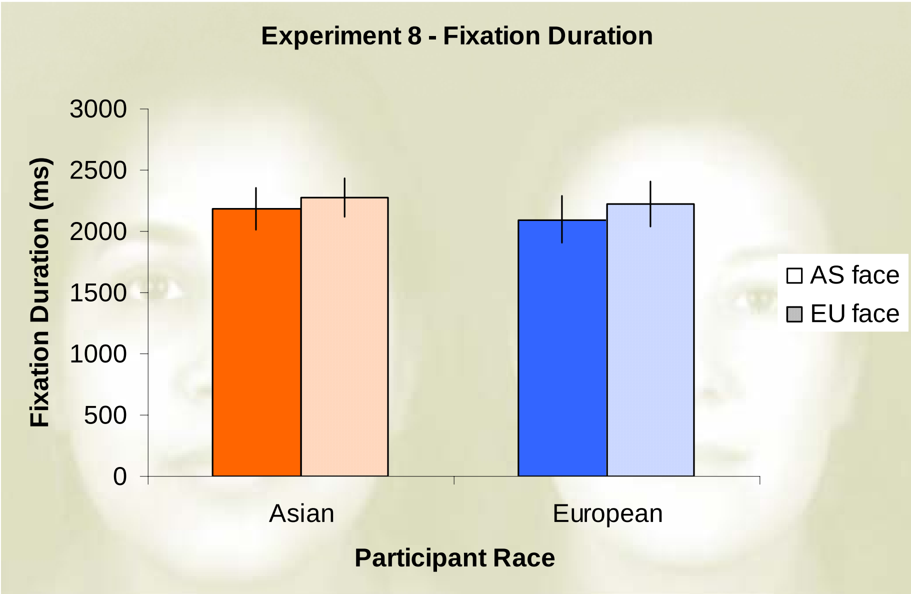


Figure 7.5 Mean fixation duration in milliseconds (with error bars ± 1 s.e.) for face changes. Left=Asian participants; Right=European participants.

Time after Correct Fixation (Detection Delay)

Finally, we considered the time taken from when a participant first fixated on the correct face (if it was a face change condition) to the time they pressed the space bar, which we term the detection delay. The mean values are shown in Figure 7.6. There were no main effects, but a significant interaction between face race and participant race ($F_{(1,25)}$=8.43, *p*=.008, r=.50). European participants detected changes in European faces faster than in Asian faces ($t_{(13)}$=2.26, *p*=.04, r=.53) and similarly there was a trend for faster change detection for Asian faces in Asian participants ($t_{(12)}$=1.85, *p*=.09, r=.47).

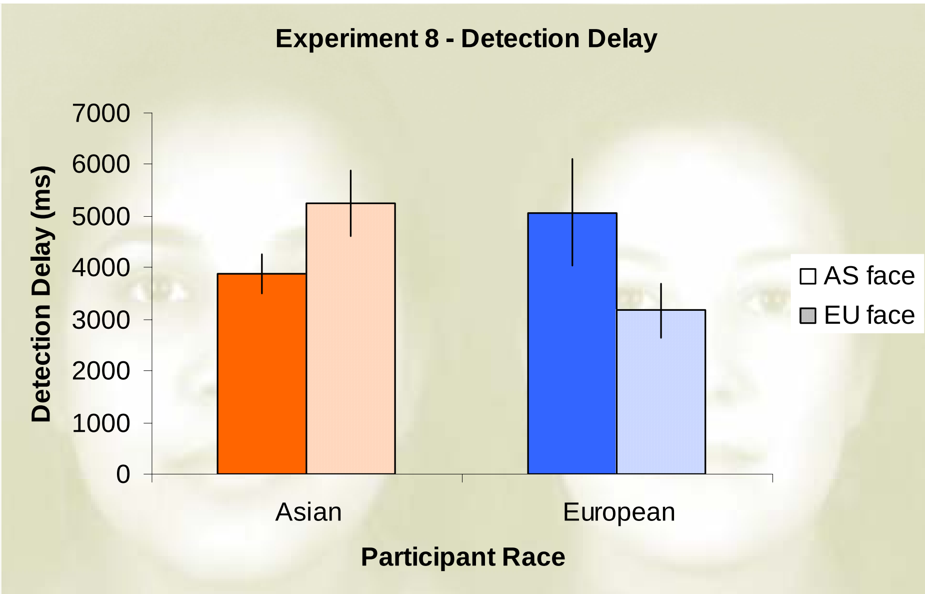


Figure 7.6 Mean detection delay in milliseconds (with error bars ± 1 s.e.) for face changes. Left=Asian participants; Right=European participants.

7.1.4 Discussion

The current study extended the study by Humphreys *et al.* (2005) and examined the eye movements of observers during change detection tasks involving own and other race faces, to see whether or not people differentially attended to own race over other race faces. The results clearly showed that there was no attentional bias towards the processing of own race faces (which was analysed in terms of fixation order, number and duration), but people still detected changes in own race faces faster than in other race faces, confirming the original conclusion of Humphreys *et al.* that people are less sensitive to changes made in other race faces.

Unlike the results from the original study by Humphreys *et al.* which showed the complete crossover interaction in facial change detection in reaction time data (showing faster change detection in own race faces), the reaction time data from the present study only showed this pattern in European participants, and Asian participants did not show any racial difference in terms of reaction times during change detection involving own and other race faces. This difference in the pattern of data may seem problematic. However, although the own-race bias has been shown in numerous experimental studies (Bothwell, Brigham and Malpass 1989; Meissner and Brigham 2001), a complete crossover interaction between race of stimulus face and participant group is not universal and has only been shown in some studies. Sporer (2001) maintains that differences in response criterion between two participant groups or differential item difficulty in the facial stimuli used could lead to an asymmetric interaction and potentially mask the crossover interaction, and thus a complete crossover interaction is not regarded as a necessarily prerequisite for demonstrating the own-race bias (Bothwell, Brigham and Malpass 1989). Therefore an asymmetric interaction found in the present study is likely to reflect the differences between our Asian participant group and that of Humphreys *et al*. The analysis of the eye movement data in the current study showed that both Asian and European participants were in fact faster at detecting changes made to own race faces once they fixated on the correct face that the change was made to. That Asian participants were not faster overall on Asian faces is presumably because they, like the European participants, actually attended preferentially to the European faces, as measured by fixation order and number. This preference might be for a number of reasons, from social to low level image differences, as the slightly paler skin might yield a higher average contrast for the European faces. Overall therefore, the general pattern of the data in the present study and in Humphreys *et al.* is the same, confirming the original conclusion that faster change detection in own race faces was due to differences in processing ability for own and other race faces.

The results from the current study clearly indicated that the own-race bias in change detection does not result from differential attentional bias to own race faces. However, the question regarding the specific processes that underlie the differential ability to process own race faces still remains to be answered. The changes made to the faces here are not subtle alterations to a feature: the whole face is exchanged for one of the others. Recently, some studies indicated that the own-race bias may be related to less efficient holistic encoding of other-race faces (Michel, Caldara, Rossion 2006; Tanaka, Kiefer and Bukach 2004). For example, the study by Tanaka *et al.* (2004) examined the holistic processing of own and other race faces by using Asian and Caucasian faces (presented either whole or in isolation) in a two-alternative forced-choice delayed matching task. The results showed that Caucasian participants were more accurate in matching Caucasian faces shown in the whole face than in isolation, while with Asian faces there was no reliable difference in performance between the two test conditions, indicating that Caucasian participants processed own-race faces more holistically than Asian faces. Asian participants, on the other hand, did not show differential pattern of performance for both race faces whether shown in whole or in isolation, indicating that the level of holistic encoding in Asian participants were equal for both race.

Another study by Michel, Rossion, Han, Chung and Caldara (2006) used the face composite paradigm (Young, Hellawell and Hay 1987) with Asian and Caucasian faces to examine the extent to which own and other race faces are perceived holistically. In the face composite paradigm, the top and the bottom half of two different faces are joined together, either aligned (creating a composite face) or misaligned (offset laterally). It has been shown that the recognition of the upper half of a face is disrupted more when the face is aligned to a discrepant lower half than when the lower part is misaligned, indicating that the perception of a novel face configuration as a gestalt interferes with the recognition of constituent parts. Thus this paradigm is an ideal way to observe the integration of facial features into a whole representation (holistic processing of faces). The results showed that both Asian and Caucasian participants showed a larger composite face effect for own race than for other race faces, indicating that own race faces are processed more holistically than other race faces. In the same study the recognition ability for own and other race was also examined and it was found that participants indeed recognised own race faces better than other race faces. However, there was no significant correlation between the differential holistic processing and differential recognition ability of own and other race faces, suggesting that differences in the holistic encoding may be necessary but not sufficient in explaining the own-race bias in face processing.

A recent study also indicated that race expertise also affects local encoding of facial configuration. Schuchinsky and Murray (2005) showed that the processing of local representation of configural information (which can be accessed independent of face orientation) is also influenced by expertise in processing own-race faces. Here, a simultaneous paired-comparison paradigm was used, and Caucasian participants saw Caucasian and Chinese faces in which interocular distance was either unaltered or distorted, and participants made same-different decisions for pairs of faces. For both race faces, stimuli were varied in terms of face version (whole or partial) and orientation (upright or inverted). Results from Caucasian participants showed that accuracy was higher for own-race faces than other-race faces, irrespective of face version or orientation. Thus these findings suggest that race expertise not only influences holistic encoding of configural information but it also affects the local encoding of facial configuration.

With present knowledge, it is still unclear what factors contribute to the differential processing of own and other race faces. Future studies will be needed to clarify this, in particular the relationship between the differential holistic and local encoding of faces and the own-race bias. The findings from the present study examining eye movements, however, clarified that the own-race bias is unlikely to be due to attentional bias towards own race faces, at least in a change detection paradigm. There was no difference in fixation order, number and duration for own and other race faces during change detection tasks but nevertheless participants still detected changes made to own race faces faster than in other races. However, this does not necessarily suggest that attentional bias towards own race faces does not exist in other face processing tasks such as face identity recognition or face matching tasks, and therefore future studies should investigate this possibility. The analysis of the eye movement data in the current study also allowed more precise examination of the effect of the own-race bias in face processing that was not reflected in behavioural data. Therefore, analysing eye movements could be a useful and informative way to examine patterns of visual processing that may be masked by unrelated factors, and eye movement analysis may have great potential in future researches.

Chapter 8

General Discussion

8.1 Summary

The central aim of the current thesis was to examine how the presence of facial expression and racial identity information affect face processing involving different races, and this was addressed by studying different types of face processing tasks including face recognition, emotion perception/recognition, face perception and attention to faces. Furthermore, the effect of facial expressions on the differential processing of own and other race faces was examined from two perspectives, looking at the own-race bias both at the level of perceptual expertise favouring the processing of own-race faces and in-group 'ethnocentric' bias influencing face processing in terms of a self-enhancing dimension.

8.1.1 Face Recognition Memory

Two experiments examined the effect of expression change on recognition memory for own and other race faces. Experiment 1 examined the possible similarity between familiar/unfamiliar and own-race/other-race face processing. The results indicated that the quality of unfamiliar own-race face representations was comparable to that of familiar faces, but this pattern was only present in European and not in Japanese participants. Thus the differences in the quality of face representations for own and other races seem to be more pronounced in European participants, indicating that the effect of the own-race bias is more evident in European participants. Consistent with this, the overall measures of recognition performance (false positives, A' and bias index) showed the effect of the own-race bias in European participants only.

Experiment 2 improved the design used in Experiment 1 by minimising the use of pictorial coding that was confounded with structural coding. The main finding was that successful face recognition depends on the degree of similarity between faces presented at study and test, consistent with the Bruce and Young (1986) model. However, unlike the Bruce and Young model which postulated the independent processing of identity and expression, the results indicated that the stored facial representations is not entirely expression-invariant but contain some information about facial expression. This is consistent with findings showing an interaction between the processing of facial expression and identity (e.g. Kaufmann and Schweinberger 2004; Schweinberger and Soukup 1998). In addition, the effect of the own-race bias was found in both participant groups regarding the false positive and bias index measures. However, with A' measure only European participants showed the own-race bias, indicating that similar to Experiment 1 the own-race bias was more evident in European participants.

Finally, the combined results from Experiments 1 and 2 indicated that different expressions may signal familiarity in different race faces. In Experiment 1 both European and Japanese participants tended to falsely recognise neutral Japanese faces more often than happy Japanese faces, and in Experiment 2 European participants were more likely to falsely recognise happy European and neutral Japanese faces. Past studies using Caucasian facial stimuli indicated that a smiling expression often signals familiarity in unfamiliar faces (Baudouin *et al.* 2000; D'Argembeau *et al.* 2003), but the current studies showed that this was may not be the case with Japanese faces.

8.1.2 Facial Expression Perception and Memory

Two experiments looked at perception and memory for facial expressions in own and other race faces. Experiment 3 examined how people perceive facial expressions in own and other race faces. Here, the analysis of the response pattern showed that European participants were likely to see faces as exhibiting a happy expression while Japanese participants were likely to see faces as exhibiting a neutral expression. The possible difference in the social desirability of showing emotions in public between Japan and Britain may influence how people perceive emotions in faces. A difference in the response pattern for different race faces was also found. Out of the three possible expressions Japanese faces were likely to be perceived as angry or neutral, while European faces were often perceived as happy. However, this pattern did not differ between the two races, thus there was no indication of in-group bias in facial expression perception. The examination of expression perception accuracy showed that there was an indication of the own-race bias in European participants regarding the perception of angry faces. However, this pattern may be due to differences in the expressiveness of faces between the two races, which were not controlled in this experiment.

In Experiment 4, memory for facial expressions in own and other races was examined. A possible influence of race expertise on expression memory for angry faces was found in European participants. However caution should be taken, as differences in the expressiveness of the facial stimuli were not fully controlled. Similar to the pattern seen in Experiment 3, European faces were generally remembered as neutral or happy, while Japanese faces were generally remembered as neutral or angry. Taken together, the results indicated that there seems to be a tendency to associate European faces with neutral or positive emotion and Japanese faces with neutral or angry expression in both perception and memory for facial expressions.

8.1.3 Perception of Race Typicality

Experiment 5 looked at the relationship between facial expression and perception of face typicality in own and other race faces. Results from Experiments 1 to 4 indicated the possible link between different race faces and facial expression, where European faces were associated with a happy expression and Japanese faces with a neutral expression. This may suggest that the representations of different race faces may be linked with typical facial expressions they tend to exhibit, and Experiment 5 examined this possibility. The results showed that neutral Japanese faces were perceived to be more typical than happy Japanese faces, but there was no difference in the typicality rating for European faces between the two expressions. Thus the difference in typical facial expressions associated with different races only partially accounted for the patterns seen in Experiments 1 to 4. It may be that people in general hold more positive stereotypes about European faces which in turn affect the processing of these faces.

8.1.4 Face Perception

Two experiments looked at the effect of the own-race bias at the encoding stage of face processing, manipulating both identity and expression information. Experiment 6 examined the perceptual matching of identity and expression information in own and other race faces. The results showed that familiarity with one's own race did not modulate performance in identity and expression matching tasks, and both reaction times and error rates measures showed that European and Japanese participants could match identity and expression in both race faces equally fast and accurately. However, the effect of the own-race bias was seen in an identity matching task with Japanese faces, as European participants were slower and made more errors compared with Japanese participants, while the performance for matching European faces by identity did not differ between the two races. So again the effect of race expertise was seen amongst European participants.

Experiment 7 examined the ability to detect small differences related to identity and expression changes in own and other race faces. Identical amount of non-race related differences based on identity and expression were applied to the two race faces, and only European participants were tested. The results showed that European participants detected small changes in a happy expression more accurately than when the same changes were applied to Japanese faces. Moreover, European participants detected identity-related changes faster when they were applied to European than to Japanese faces. Together, this study showed that identical facial feature transformations based on identity and expression changes were processed differently whether the change was applied to own-race or to other-race faces.

8.1.5 Attention to Faces

Experiment 8 used eye-tracking to see whether people preferentially attend to own-race faces during a change detection task. The results showed that European participants were faster at detecting changes in own-race faces, although Asian participants detected changes in both race faces equally fast. However the eye movement data showed that, once participants fixated on the correct face that changed, they were faster to respond if the change was made to own-race than to other-race faces. In contrast, the examination of fixation order, number and duration showed no signs of preferential attention to own-race faces. Thus this study showed that people were less sensitive to changes made to other race faces, although own and other race faces were equally attended.

8.2 Thesis Contributions

There were several contributions that the current thesis provided to the research concerning own and other race face processing. All of these offered further understanding of both the effects and the mechanisms underlying the phenomenon of the own-race bias in face perception.

8.2.1 The Own-Race Bias from Perceptual and Categorical Perspectives

The first contribution of the current thesis was that it provided an overall framework for the own-race bias as the combination of both perceptual and categorical biases. Past researches that examined the own-race bias in face processing showed that generally people are more accurate in processing facial information in own-race faces (perceptual bias) and also people tend to favour their own-racial group when social judgements about others are required (categorical bias). However, these two perspectives have never been integrated to provide an overall view of the own-race bias before. Because face perception is based on the combination of both perceptual and categorical (social-cognitive) information, it was felt necessary to formally address the phenomenon of the own-race bias from these two perspectives together. Moreover, the effect of in-group bias on face processing was never examined before. Thus the current research integrated the two perspectives by manipulating racial identity and facial expression information as common variables that could affect the own-race bias at perceptual and categorical levels. The manipulation of facial expression was in particular an important contribution. Past studies on the own-race bias as perceptual expertise usually examined the effect by using faces in neutral expression, although in real life faces are seen in a variety of expressions. Moreover, past studies on in-group bias only examined the effect in relation to the attribution of positive emotions to own-race faces, but whether in-group bias affects perception and memory for different race faces has never been investigated before.

8.2.2 Comparison of Familiar and Own-Race Face Processing

The second contribution was the investigation of the own-race bias with reference to the model of face processing by Bruce and Young (1986). Specifically, whether the effect of race expertise can be explained by the difference in the degree of familiarity with own and other race faces was addressed, to see if a similar process underlies both familiar/unfamiliar and own-race/other-race face processing. This possibility was examined by replicating studies that showed better identity processing in familiar than unfamiliar faces, and applied the same technique to own and other race faces. The results were somewhat mixed, in that a similarity between familiar and own-race face processing was found for the face recognition but not in the face matching task, and only from European participants. Although the results showed an inconclusive pattern, it was still worthwhile because it was the first attempt to examine the possible processes underlying the own-race bias in relation to the current model of face processing, and examined whether a specific process is responsible for the phenomenon of the own-race bias or if it can be explained by a general process underlying all types of face processing.

8.2.3 The Own-Race Bias and Attention to Faces

Another contribution was the examination of a possible bias in directing visual attention to own-race faces. Past studies showing the effect of race expertise in the processing of own and other race faces have never directly examined the possibility that the effect may be wholly or partially due to differences in the amount of visual attention people give to own and other race faces. This possibility was directly examined for the first time by using an eye-tracker and recording eye-movements while people performed a change detection tasks involving own and other race faces. The finding showing that people did not show any bias towards directing visual attention to own or other race faces was a significant one. At least in a change detection task, it discounted the possibility of any attentional bias leading to the own-race bias.

8.2.4 The Use of Novel Techniques

Finally, the current thesis employed several novel techniques for preparation and presentation of the experimental stimuli. Image transformation software was used to morph facial images in several ways (e.g. morphing between different types of facial expressions, different facial identities and across different races), to apply facial transformations and also to create facial sequences based on facial transformations. The use of image transformation made it possible to control for the amount and magnitude of race and expression related information in facial stimuli in a precise manner, which is practically impossible when using standard photographic stimuli. Past studies on the own-race bias tended not to control for the possible influence of differences in stimuli between different racial groups on the effect of the own-race bias, and thus the use of image transformation offered some improvement in this regard. In addition, the current studies used an interactive image display was used for displaying facial sequences. Unlike past studies that used static presentations of faces, this technique offered a new and more dynamic way to test recognition memory in more sensitive manner.

8.3 Remaining Issues and Future Directions

The current thesis used a broad range of paradigms to examine the own-race bias in face processing from both perceptual and social-cognitive viewpoints. As discussed above, the thesis offered several important contributions to the growing knowledge in the research on the own-race bias. However, one of the limitations of the current thesis was that the exact nature of the processes underlying the own-race bias still remains unknown. The analysis of attentional bias to own and other race faces and also the comparison of familiar/unfamiliar and own-race/other-race face processing from the present research provided the first step into delineating the possible processes underlying the own-race bias. The results from the former clearly discounted the possibility that the own-race bias is due to any attentional bias to either own or other race faces, although future studies using other types of face processing tasks are still needed to see whether or not this is a general pattern in all types of face processing. The results from the latter were however somewhat inconclusive and the similarity between familiar and own-race face processing was found only in some cases. Thus the question still remains as to whether a general process underlying all types of face processing can explain the phenomenon of the own-race bias, or if a specific process mediates the own-race bias.

Several recent studies however have started to investigate the nature of the processes underlying the own-race bias directly, and some indicated that the own-race bias may be related to less efficient holistic encoding of other-race faces (Michel *et al.* 2006; Tanaka *et al.* 2004). Holistic encoding is a type of configural processing of faces (Maurer, Le Grand and Mondloch 2002) and as examined above the differential role of configural and featural information has been implicated in the difference between familiar and unfamiliar face processing (Bruce and Young 1998; Clutterbuck and Johnston 2002; Ellis, Shepherd and Davies 1979; Megreya and Burton in press; Young 1984; Young *et al.* 1985). The role of featural and configural information in face processing has been described in the dual-mode hypothesis (e.g. Bartlett and Searcy 1993; Searcy and Bartlett 1996). This hypothesis was inspired by the so-called Thatcher effect (Thompson 1980) showing that the detection of local feature changes is more difficult when changes are applied to an inverted face than when applied to an upright face. According to the dual-mode hypothesis there are two modes for processing faces, one specialising in the encoding of spatial-relational information (configural encoding) and the other specialising in the encoding of facial components (featural encoding). It is suggested that, unlike the featural encoding, experience is needed to develop the ability to process configural information in faces, and because faces are usually seen in an upright position the configural encoding only develops for upright faces. The dual-mode hypothesis explains the Thatcher illusion in terms of the difference in the mode of processing for upright and inverted faces, as the generic featural encoding is available for both upright and inverted faces but the expert configural encoding is only available for upright faces (Bartlett and Searcy 1993; Maurer, Le Grand and Mondloch 2002). The dual-mode hypothesis can also be used to describe other types of expertise-related phenomenon in face processing, such as familiar and unfamiliar face processing where differential role of configural and featural encoding has been shown (e.g. Megreya and Burton in press; Young *et al.* 1985). The fact that one type of configural processing, namely the holistic encoding, has been implicated in explaining the difference between own-race and other-race face processing is promising, because it may suggest that similarly the dual-mode hypothesis can also be used to explain the processes underlying the phenomenon of the own-race bias. This may indicate that the phenomenon of the own-race bias is not caused by a specific process, but can be explained by a general process underlying all types of expertise-related face processing. However, it has also been shown that there is no significant correlation between the differential holistic processing and differential recognition ability of own and other race faces, suggesting that differences in the holistic encoding may be necessary but not sufficient in explaining the own-race bias (Michel *et al.* 2006). Thus the possibility still remains that the own-race bias is based on a specific process. Future studies are therefore needed to better understand the nature of the processes underlying the own-race bias. To this end, a systematic examination of the dual-mode hypothesis relating to the own-race bias may be useful, which could be achieved by examining the role of featural and configural encoding in the processing of own and other race faces. In addition, how well the differential featural/configural encoding can explain the phenomenon of the own-race bias in face processing should also be examined to see whether or not other processes are also involved in the effect of the own-race bias.

The dual-mode hypothesis described above is one possible cognitive process that may underlie the phenomenon of the own-race bias. Another possible factor that has been discussed is the motivational biases of the decoder leading to a more effortful processing of the members of groups people identify with (Thibault, Bourgeois and Hess 2006). Both of these describe the possible causes of the own-race bias that relate to the perceiver differences, but there is another factor that may underlie the phenomenon of the own-race bias, which is the possible differences in facial features or facial characteristics between own and other races. Although past studies found no difference in the variability in physical anthropological measures of human faces between different races (Goldstein 1979a, 1979b), the lack of race-related facial variations in physical measurements does not totally discount the existence of other facial variations in different dimensions (e.g. skin texture or skeletal structure). However, another limitation of the current thesis was that the possible role of facial stimuli differences was not directly examined. Although the effect of the own-race bias on identity and expression processing was found even after controlling for potential facial variations between different races (Experiment 7), it is not known if and how much the stimuli differences contribute to the effect of the own-race bias. Future studies therefore should address these points, and systematically examine the possible facial variations between different racial groups and if and how much these possible variations mediate the differential processing of own and other race faces.

8.4 Conclusions

The current experiments examined the influence of facial expression and racial identity information on the processing of own and other race faces from two perspectives (the own-race bias and in-group bias), using different types of face processing tasks from face recognition, emotion perception/recognition, face perception and attention to faces. Although in-group bias did not seem to affect the perception and memory for own-race faces in shifting perception/memory to facial representations with positive facial expression, the effect of the own-race bias was observed using many different types of tasks, in particular amongst European participants. Research on cross-racial face processing has been an important and active area of research for several researchers for many years, and many studies have also shown the influence of race expertise in different types of face processing tasks. However, one of the most important research areas in this particular field now seems to be not finding out where the differences lie, but understanding the mechanisms underlying these differences. The research aiming to delineate the processes involved in the differential processing of own and other race faces has just started, but it is very likely to be the main area of focus in face research involving own and other races for many researchers in the immediate future. As societies in many parts of the world are becoming more multicultural every day, with people from different racial groups travelling and settling more often in different countries, a better understanding of one basic means of human contact (looking at faces) involving different races will certainly be useful for many people. There will always be differences between different racial groups, but a better understanding of face processing involving different races will be able to offer people the means to interact with each other more easily and learn the similarities and differences between different races. To this goal, it is hoped that findings from the present research has contributed to the growing knowledge regarding own and other race face processing, and will be the basis of further studies in this interesting and ever-evolving area of research.

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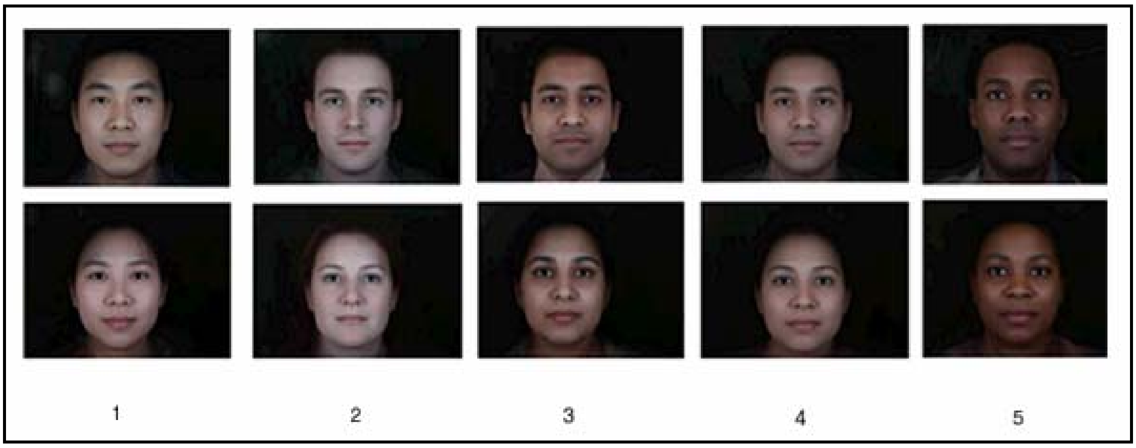
Appendices

Appendix A Questionnaire used in Experiments 1 to 6

Q1: Which ethnic group do you belong to?

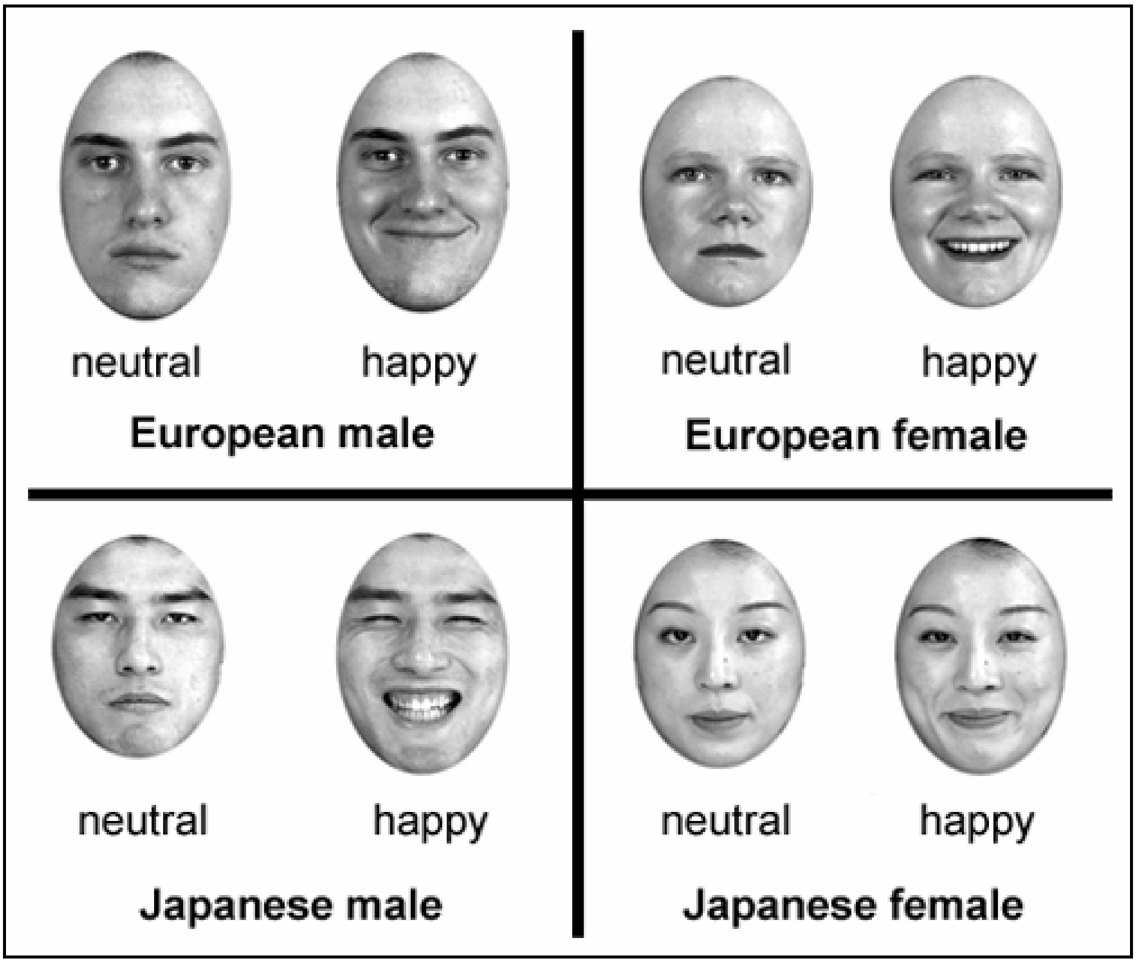
1. Asian
2. Black
3. Mixed
4. White
5. Other

Q2: Which face category do you think your own face is most similar to?

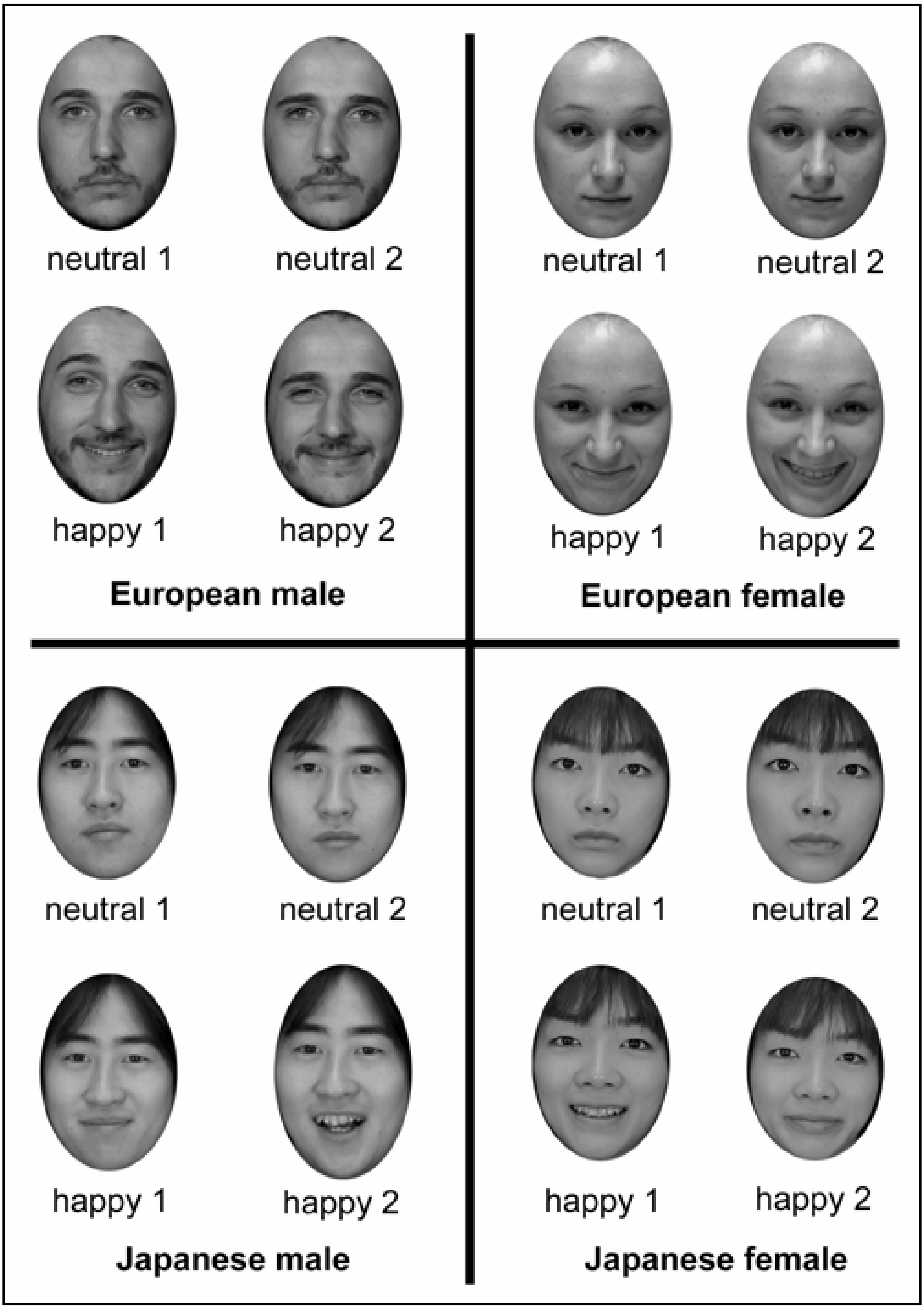


Note that these questions were asked to check participants' race.

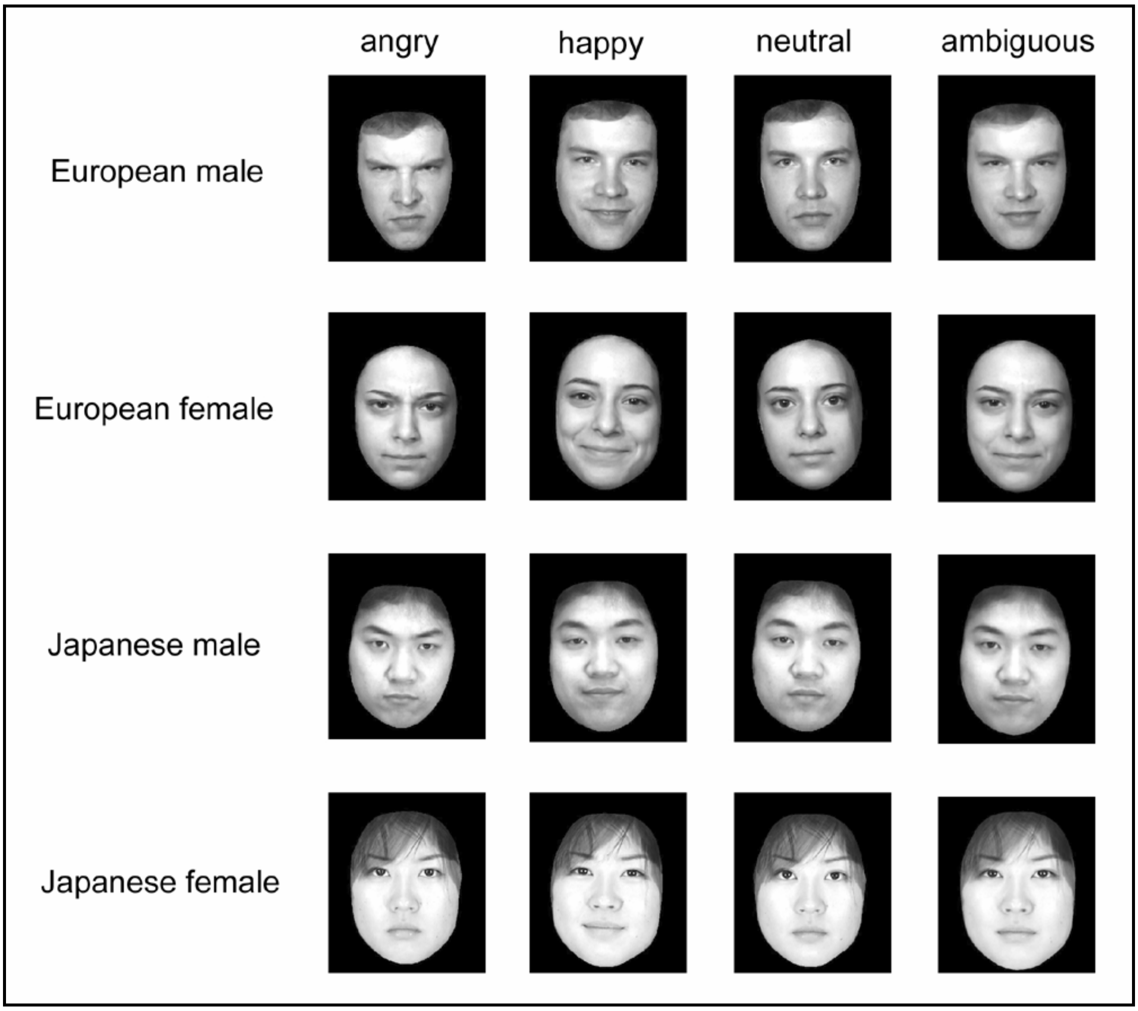
Appendix B Examples of facial stimuli used in Experiment 1 and 5



Appendix C   Examples of facial stimuli used in Experiment 2, 5 and 6

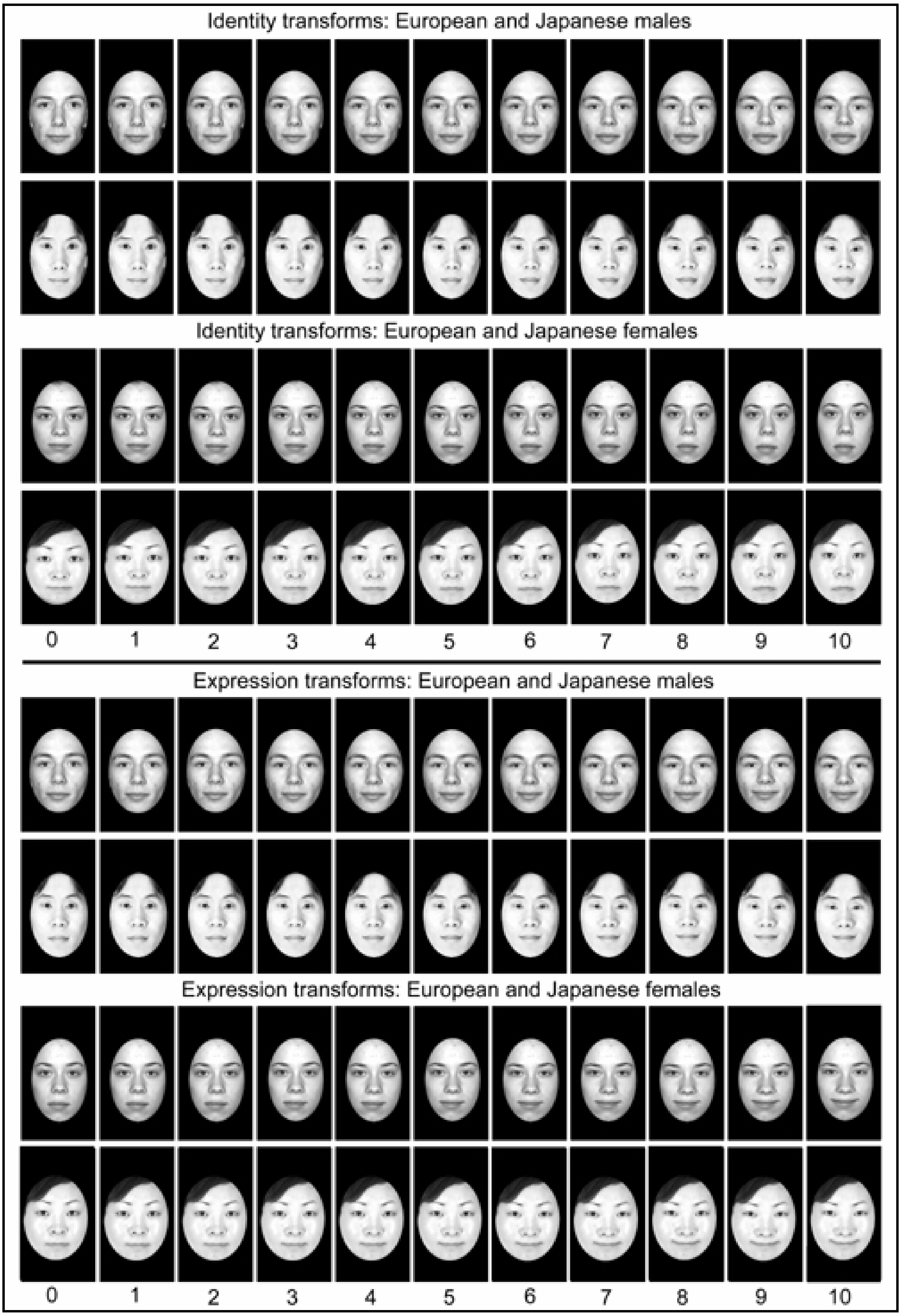


Appendix D Examples of facial stimuli used in Experiment 3 and 4



Note that in Experiment 4 the stimuli above were presented in full colour.

Appendix E Examples of facial stimuli used in Experiment 7



Appendix F Examples of stimuli used in Experiment 8

Experiment 8 used the stimuli used in Humphreys *et al.* (2005), provided by courtesy of G. W. Humphreys. The following images are adapted from Humphreys *et al.* (2005) with permission.

(a) original

(b) Asian face change


(c) European face change


(d) Asian body change

(e) European body change

(f) object change