Own-race bias in facial recognition amongst black, coloured and white participants

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Abstract

Own-race bias in facial recognition manifests in participants' more accurate performance in recognition of own-race faces and less accurate performance in the recognition of other-race faces. An investigation of an own-race bias effect in facial recognition was conducted among a sample of 111 Black, Coloured and White students from the University of Cape Town. The main group of interest was the Coloured racial group since it has rarely been studied for face recognition bias in the past. This study's aim was to investigate how Coloured participants perform in recognition of Black and White faces as well as to investigate whether or not the own-race bias will manifest in the Coloured group. To perform this investigation, participants were asked to study a series of faces on which they were tested after a 15 minute unrelated filler task. The following Signal Detection Theory measures were analyzed: Discrimination accuracy (*d'*) and response bias criterion (*c*). A diminished own-race bias effect was observed, with all three racial groups of participants being less accurate in the recognition of Black faces. The study also found a moderate correlation between the amount of own-race people in the home towns of participants and the relative own-race bias scores of the participants.

Keywords: own-race bias, facial recognition, Coloured participants

Own-race bias in facial recognition amongst Black, Coloured and White participants

Race is a social construct that has become a great influence in how people experience the social spaces they live in; including areas of the legal and justice systems (Villaverde, 1995). Race has an influence in legal matters like eyewitness testimonies. It affects how accurate an eyewitness testimony is by influencing how well an individual recognizes other-race faces, which is usually different from how well they recognize own-race faces (Malpass & Kravitz, 1969; Wright, Boyd & Tredoux, 2003). This influence that race has on face recognition is known as an own-race bias effect. Own-race bias in facial recognition is when people recognize own-race faces better than other-race faces (Chiroro, Tredoux, Radaelli & Meissner, 2008; Valentine & Endo, 1992; Ayuk, 1990; Young, Hugenberg, Bernstein, & Sacco, 2012).

The legal consequences of own-race bias effect in facial recognition are serious. There already have been numerous false criminal convictions as a result of inaccurate eyewitness testimonies involving cross racial identifications (MacLin & Malpass, 2001; The Innocence Project, .n.d.). According to The Innocence Project (n.d.), eyewitness misidentifications are the greatest cause of wrongful convictions in the United States of America. In over 75% of post-conviction DNA exonerations, wrongful eyewitness identification played a role, 40% of which involved cross racial identifications. This has attracted many researchers' attention towards this domain.

There is a significant amount of research on the effects of own-race bias concerning facial recognition and the implications it has for eyewitness testimony. A great quantity of the research empirically supports the effects own-race bias has on facial recognition to an extent that it is no longer considered to be just a hypothesis (Wells & Olson, 2001). A typical study on the effects of own-race bias on facial recognition involves showing faces of various races to participants to learn and later ask them to state if they recognize the faces to test which race they recognize better (see Meissner & Brigham, 2001 for a review). The own-race bias effect has proven to be quite robust (Meissner & Brigham, 2001). It manifests even when faces are blurred and scrambled (Hayward, Rhodes & Schwaninger, 2008). For example, Ayuk (1990) recruited Black and White participants to look at face recognition differences involving transformed and untransformed Black, White and Mixed-race faces (where the transformation involved showing different face poses). He found that there was an own-race bias effect even in transformed faces. This indicates that own-race bias is robust and this suggests that it develops quite strongly within individuals.

Factors Contributing to Own-Race Bias Development

Own-race bias appears to emerge early in the developmental trajectory, and continues in later stages, unless one gets sufficiently exposed to other races to develop mechanisms of remembering and distinguishing other-race faces. Kelly et al. (2005) found that there was preference of own-race faces to other-race faces in infants as young as 3 months old. Bar-Haim, Lamy, and Hodes (2006) found that infants raised in an environment where they were exposed to both own-race and other-race faces attended equally to both own- and other-race faces in a visual preference task. Therefore, it seems that own-race bias is closely related to the amount of contact one has with other-races (Ayuk, 1990; Chiroro et al., 2008; Wright et al., 2003; Balas & Nelson, 2010; Bar-Haim et al., 2006). Studies have indicated that individuals with more interracial contact show a diminished own-race bias effect due to an acquired ability to process other-race faces similarly to own-race faces (Walker &Tanaka, 2003).

There is much consensus on the existence of the effect. However, since the beginning of research on face memory and the own-race bias effect, there has been some disagreement on the theoretical explanations of how own-race bias affects facial recognition (Meissner & Brigham, 2001).

Theoretical Explanations for the Own-Race Bias

Young, Hugenberg, Bernstein, & Sacco (2012) summarized theoretical explanations for the own-race bias effect into three categories: the perceptual expertise account, the social cognitive account, and the hybrid models.

Perceptual expertise models hold that the more contact an individual has with other races, the more processing experience they gain and the better they will be in remembering other-race faces (Young & Hugenberg, 2012). For example, Wright et al. (2003) found that the more self-reported contact the participants had with other races, the higher their accuracy scores on their recognition of other-race faces. MacLin and Malpass (2001) investigated whether the own-race bias effect occurs when using ambiguous-race faces in a facial recognition task, in an attempt to find an explanation for the own-race effect. They found that the own-race bias effect is not necessarily caused by less perceptual learning experience in other-race faces but rather by the perceptual categorization of the race. This suggests that the perceptual learning model does not sufficiently explain the own-race bias effect in facial recognition and hence social cognition models were introduced.

Social cognition models hold that social cognitive phenomena such as emotion, motivation and attitudes moderate the own-race bias effect in memory of other-race faces (Young & Hugenberg, 2012; Young et al., 2012). Allport's intergroup contact theory is also one of the social cognition models and it holds that intergroup contact reduces prejudices (Pettigrew & Tropp, 2006). For example, Johnson and Fredrickson (2005) found that eliciting positive emotions before the learning task in facial recognition significantly reduced own-race bias effects. Young and Hugenberg, (2012) found that lack of perceptual experience in other-race faces can be overcome by motivation to individuate other-race faces. Meissner and Brigham (2001, p. 7) reported that "individuals with less prejudiced racial attitudes are more motivated to differentiate other-race faces". This is referred to as individuation by Hugenberg, Young, Bernstein and Sacco (2010).

Recent explanations for the own-race bias effect have however shifted to hybrid models. This is due to the fact that neither the perceptual learning model nor the social cognitive model can solely explain the own race bias effect in facial recognition. Own race bias is influenced by both perceptual learning and sociocognitive factors (Young et al., 2012).

Hybrid models combine both perceptual expertise and social cognitive models. One such model introduced by Hugenberg et al. (2010) is the confluence of social categorization, motivated individuation and perceptual experience model. According to this model, perceptual learning (expertise) and social cognitive factors (social categorization and individuation motivation) are both important determinants of the own-race bias. For example, Chiroro et al. (2008, p. 1089) mentioned that "racial categorization occurs automatically and early in perceptual encounter with faces of other races, taking attention away from individuating characteristics of the face". This explains why people tend to only accurately distinguish own-race faces rather than other-race faces; they focus more on race of face than on individuation when processing other-race faces. Individuation is the act of discriminating among individual faces within a racial group and categorization is the act of attending to facial characteristics that make a target appear similar to other category members, such as race (Hugenberg et al., 2010). Walker, Silvert, Hewstone and Nobre (2008) found that race of face plays a significant role in face processing in early stages of encoding and social factors play an important role in moderating the effect.

Lack of Research on the Coloured Population

Although theoretically there is a bridge between previously opposing models, there are still a few areas of contradiction and a lack of empirical evidence in some areas in the literature. There is currently a lack of studies looking at how the recognition of other-race faces in racial groups other than Black and White can be affected by the own-race bias. Past research has predominantly studied Black and White racial groups. While other researchers have attempted to look at other racial groups, the definition of race is an issue.

Studies that deviated from the Black versus White racial groups used geographical origins as a definition of race, for example, American, Asian and so forth. The problem with this is that there are Black and White Americans as well as many other racial variations within a particular geographical location. One example is a study conducted by MacLin and Malpass (2001) in which they studied how participants categorize what they termed ‘racially ambiguous’ faces, which were faces that had both Black and White racial markers (e.g. hair that is typical in Black people and a nose that is typical in White people etc.). They found that racially ambiguous faces were perceived according to the marker, for example, if a face was racially ambiguous and had an afro hair feature, it was classified as Black. Willadsen-Jensen and Ito (2008) also used ‘racially ambiguous’ faces which were a mixture of American and Asians (Asian-American faces) to study Event-Related Potentials (ERPs) of participants to see how cognitively sensitive they are and how much attention they pay to the faces at different stages of processing. Their results showed that racially ambiguous faces were differentiated from Asian and Black faces but not White faces.

There are studies that did include other racial groups besides Black and White; however they did not investigate own-race bias effect on facial recognition. One such study was done by Ayuk (1990), who recruited Black and White participants to investigate the recognition differences involving transformed and untransformed Black, White and Mixed-race faces. Results showed an own-race bias when participants were tested on other-race faces except for when tested on Mixed-race faces in which both Black and White participants performed equally. Although this study did look at facial recognition and own-race bias effects, Mixed-race participants were not included in the study. Including Mixed-race participants in the study would have enabled a comparison amongst three racial groups as well as an examination of whether the own-race bias is also present in races other than Black and White.

The Coloured racial group has not been sufficiently studied before. The South African Coloured racial group "forms a unique highly admixed population resulting from the encounter of different peoples from Africa, Europe and Asia." (Quintana-Murci et al., 2010, p. 611). They derive from a massive maternal contribution of Khoisan people and paternal contributions from Khoisan, Bantus, Europeans, Indians and Southeast Asians (Quintana-Murci et al., 2010). They originated from the Cape of Good Hope (which later developed into Cape Town) some 350 years ago (Quintana-Murci et al., 2010). It was through Apartheid racial segregation laws that this admixed population was declared a race on its own, as well as other races like Black, Indian and White (Posel, 2001).

The Coloured racial group in South Africa has always had problems 'fitting in', they were considered to be not Black but not White enough either (Mitchell, 2001). Due to being socially isolated from the Black and White communities, Coloured people would have hypothetically developed more own-race face perceptual learning mechanisms and have less perceptual experience with Black and White faces (Young & Hugenberg, 2012). So it is interesting and useful information for eyewitness testimony evaluations to see how their face recognition for other-race faces manifests.

It is important to study the own-race bias effect in the Coloured racial group particularly in South Africa because a significant amount of the population is Coloured, especially in the Cape provinces (Statistics South Africa (Stats SA), 2011). It is therefore useful to know how accurate their identifications of a perpetrator are when a crime has been committed by a White, Coloured or Black person.

Current Study's Aims and Hypotheses

In an attempt to contribute to a lack in the field of own-race bias in facial recognition, the current study examined the effects of own-race bias amongst three racial groups; Black, Coloured and White. The aim was to investigate whether an own-race bias effect in cross-racial face recognition manifests in the Coloured population. By including Black and White participants, this study controlled for stimulus differences and enabled comparisons on cross-race facial memory amongst the three racial groups. The second aim was to examine which race, if any, Coloured participants recognize less accurately than others. Lastly, this study aimed to examine how accurate black and white participants will be at recognizing the Coloured faces.

In order to fulfill the aims, this study tested the following hypotheses:

(1) Black, Coloured and White participants will recognize own-race faces more accurately than other-race faces. This hypothesis was formulated based on the effect of own-race bias in face recognition as has been supported by previous studies.

(2) Coloured participants will recognize White faces more accurately than Black faces. This hypothesis is based on the amount of contact that Coloured people had with White people historically, which was more than the amount of contact they had with Black people as a result of many reasons including a historical emphasis on their European side of their ancestry during the period of apartheid (Mitchell, 2001).

(3) White participants will recognize Coloured faces more accurately than Black faces. This hypothesis follows from the fact that historically; White people interacted more with Coloured people than with Black people as a result of apartheid laws such as the Group areas Act and the racial rezoning formulated in order to segregate the different races (Mabin, 1992). These laws resulted in White people being located geographically closer to Coloured people than to Black people, causing White people to have less contact with Black people than with Coloured people. The historical geographical segregations by race have resulted in contemporary racialized geographical locations. Black and Coloured people are still predominantly living in low to middle class townships and White people in suburbs (Statistics South Africa, 2011, http://beta2.statssa.gov.za/). This makes the historical racial segregation to still affect the amount of interracial contact in contemporary South Africa, making it possible for there to be an own-race bias in face recognition.

(4) All participants will be more confident in their recognition responses for their own-race faces and less confident in recognition of other-race faces. (5) Participants will be quicker with their responses when tested on own-race faces than when tested on other-race faces. Hypotheses 4 and 5 were formulated based on perceptual learning theoretical model which explains that individuals have more perceptual experience with own-race faces than with other race faces. As a result of this experience, participants are expected to be more confident in their responses and quicker to respond when presented with an own-race face (Young & Hugenberg, 2012).

(6) Amount of own-race people in home town predicts relative own-race bias of the participants. This hypothesis follows from past studies which have investigated the relationship between the amount of interracial contact and an own-race bias effect. These studies have found a diminished own-race bias effect in people with more interracial contact (e.g. Walker &Tanaka, 2003). It is predicted from these past findings, that the amount of contact with own-race people predicts the amount of own-race bias in facial recognition the same way that a diminished own-race bias effect can be predicted by the amount of interracial contact. This prediction is also based the idea behind perceptual learning models as well as intergroup contact theory, which suggests that the more one is exposed to and is in contact with a particular race of people, the more experienced they will be with differentiating and individuating people of the same race (Young & Hugenberg, 2012; Pettigrew & Tropp, 2006).

Methods

Design and Setting

This study was a 3 × 3 repeated measures design, with the first independent variable being race of participants and the second being race of stimuli (Photographs of faces). Both independent variables had three levels, which were Black, Coloured and White.

The study took place at the University of Cape Town in the laboratories of the Psychology Department. The labs were quiet environments with minimal distractions, equipped with enough computers for each participant to be assigned their own computer station.

Sample

A total of 111 students from the University of Cape Town participated in this research. They were recruited via the Student Research Participation Programme (SRPP) site as well as via word of mouth. Most of the students were Psychology undergraduates and therefore received 1 SRPP point for their participation. The SRPP points form part of the requirements for their course grades.

Inclusion criteria. All participants had to be South African. Participants also had to be members of the Black, Coloured or White racial group. Out of the 111, 3 participants did not meet the criteria (see Table 1). The three participants were of the Indian ethnic group and their data was therefore not included in the analysis.

Table 1
Sample Demographics

	Ethnic groups			
Gender	Black (*n* = 32)	Coloured (*n* = 33)	White (*n* = 43)	Other (*n* = 3)
Female	19	29	40	2
Male	13	4	3	1

Apparatus and Stimuli

Each participant was assigned to a computer equipped with E-prime software. E-Prime version 2.0 was used to present the faces to the participants and record their responses as well as their reaction times. E-Prime has high timing precision, which enabled for the images to all be presented for the same amount of time with consistent inter-stimuli intervals throughout the session.

The stimuli for this study consisted of a total of 60 photographs: 20 Black, 20 Coloured, and 20 White faces of young adult males. For the encoding phase, all photographs were front-facing head-and-neck colour photographs and for the recognition phase, all photographs were facing ¾ to the left, still head-and-neck colour photographs. This was done to prevent participants from memorizing photographs instead of remembering the actual faces. Photographs were carefully selected to ensure that none of them had distinctive features that would influence the recognition of the faces (e.g. scars, unusual facial expressions, facial hair, jewellery or spectacles). A graphics editing programming, Adobe® Photoshop® CS5 Extended version12.0, was used to cut out the clothing from the photographs. Using the same graphics editing program, all faces were removed from their original background and placed against a black background to ensure that the experiment was testing memory for faces and not for photographs (Bruce, 1982). All images were re-sized and aligned using their interocular distances to ensure that they were the same size and in the same position when presented to the participants on the screen.

Procedure

An experimental session took 30 minutes to complete. In each session, there were a maximum of four participants, each allocated their own computer. Participants read and signed the informed consent forms before they began the experiment.

At the beginning of the experiment, participants were asked to enter their demographic details (age, race, nationality and the town they spent most of their lives in). Since there are controversies around defining race (Posel, 2001), this study relied on the participants' self-reported racial identification as an accurate description of their races.

After the participants provided their details, the instructions slide was presented. It informed the participants how the experiment was going to unfold and which keys they should press to respond and to continue to the next phases. Following this, the first stage of the experiment was the encoding phase where participants were instructed to pay attention to the faces. After a three-second delay, the presentation of the faces begun. Participants were presented with a total of 30 faces; 10 Black, 10 Coloured and 10 White. E-Prime was programmed such that no three faces of the same race were presented consecutively. Each participant saw the faces in a unique order. Each face was presented for 3 seconds with an inter-stimulus interval of 1.5 seconds.

After seeing all 30 faces, participants were instructed to complete a word-search puzzle as an unrelated distractor task which was placed on the desk for them. They were instructed to press a key that would start a timer before proceeding. After starting the timer, participants completed the puzzle for 15 minutes. The computer monitor turned red to indicate that the 15 minutes had elapsed and that the participant should begin the recognition phase.

In the recognition phase, participants were presented with 60 faces: 30 'Old' faces (those that they studied at the encoding face) and 30 'New' faces (those that were not in the encoding phase). Faces were presented one at a time. Under each face was a message asking the participant if they saw the face before or not. It instructed them to press 1 on the keyboard to indicate that they saw the face before (recognition) or 0 to indicate that they did not see the face before (non-recognition). Each face was presented until the participant responded. After responding to the recognition question, participants were asked to rate on a scale from 1 to 9 how confident they were with their response, by pressing the appropriate key on the key board. This was done for all 60 faces and after that the experiment was terminated. E-Prime recorded the responses of the participants and how long they took to respond for each face.

Ethical considerations

The researcher obtained ethical approval from the Ethics Committee of the Department of Psychology at the University of Cape Town. Participation was entirely voluntary. The names of the participants were only used so that they can be allocated their SRPP points after completion of their participation. Otherwise their information was kept strictly confidential. They were assigned subject numbers as their identity in the experiment, their names were not used anywhere in the study. Only the researcher had access to the information provided by the participant. All this information was included in an informed consent form that the participants read and signed before they begun the experiment (see Appendix A). This study posed no risks to the participants.

Data Management and Statistical Analysis

The outcome variables measured in this study were the accuracy of responses, reaction times (RTs) and confidence ratings. E-Prime recorded all the participants' responses and data was exported from E-Prime to SPSS version 21 (Statistical Programme for the Social Sciences) for analysis. Specific details of analyses are explained in more detail in the results section.

Results

Signal Detection Theory (SDT) measures of discrimination accuracy (*d'*) and response criterion (*c*) were analyzed. Analyses of participants' confidence in their responses and reaction times were also performed. A linear regression to test the relationship between proportion of own-race people in home town and own-race bias score was also run.

Analysis of *d'*. To obtain the first SDT measure, *d'*, I first had to get hit rates and false alarm rates. A hit rate is the proportion of faces that the participant correctly identified as 'Old' (faces that they saw at encoding) and a false alarm rate is the proportion of faces that the participant incorrectly identified as 'Old' when they were actually 'New' faces (faces that were not presented at encoding) (Macmillan & Creelman, 1991). Hit rates and false alarm rates were calculated for each participant for black, coloured and white faces. Hit rates were calculated by dividing the number of hits by the sum of hits and misses (number of ‘Old’ faces that the participants incorrectly identified as ‘New’), while false alarm rates were calculated by dividing the number of false alarms by the sum of false alarms and correct rejections (number of faces that the participant correctly identified as ‘New’) (Macmillan & Creelman, 1991). The hit rates and false alarm rates were then converted into z-scores. The z-scores for the hit rates and z-scores for the false alarm rates were used to calculate *d’* by subtracting z-scores of the false alarm rates from the z-scores of the hit rates. Figure 1 shows the mean *d’* with 95% confidence intervals for Black, Coloured and White faces.

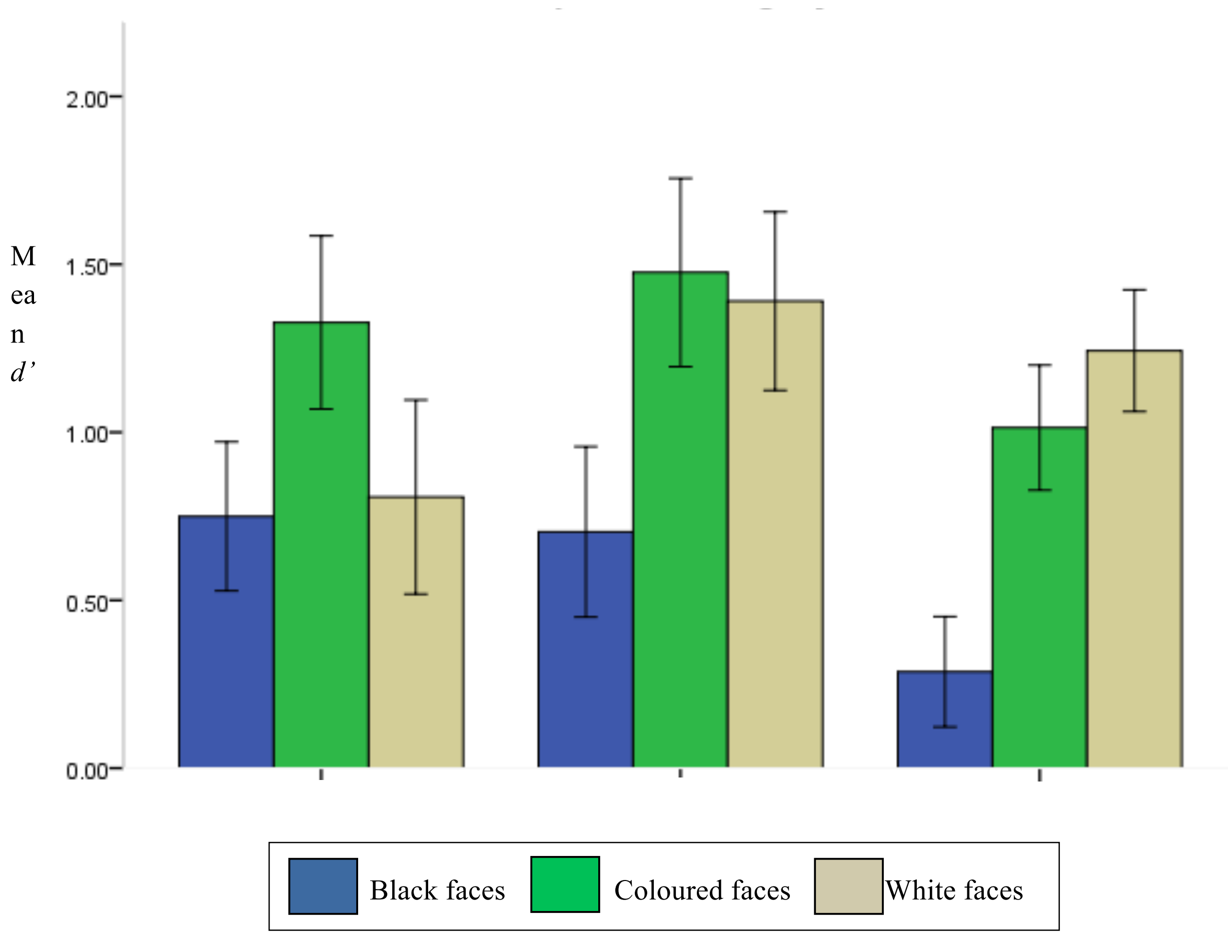

Figure 1: Mean discrimination accuracies (d’), with 95% between subjects confidence intervals for black, coloured and white faces

Before running a mixed-design ANOVA, assumptions were checked. P-p plots were computed on SPSS and for all three means of *d’* the points lay close to the normal line, indicating that the assumption of normality was met. The three groups of participants are independent of one another; therefore the assumption of independence is met. Levene's test of equality of variance was not statistically significant. Therefore, the assumption of homogeneity of variance was met. The assumption of sphericity was also met, Mauchly's test of sphericity was not statistically significant, $F(2) = 3.09$, $p = .214$.

A mixed-design ANOVA indicated that there was a significant Race of face × Race of participant interaction, $F(4, 210) = 5.58$, $p < .001$, $\eta^2 = .09$ a significant main effect of race of participant, $F(2, 105) = 5.61$, $p < .01$, $\eta^2 = .10$, as well as a significant main effect of race of face, $F(2, 210) = 37.06$, $p < .001$, $\eta^2 = .26$.

Simple effects analysis was run on SPSS to investigate which groups differed significantly on *d'*. The results show that on all levels of *d'* (*d'* for Black, Coloured and White faces) the three groups of participants differed significantly. There was a significant difference between the Black and White participants in the discrimination accuracy (*d'*) for Black faces. Black participants were significantly more accurate than White participants in recognizing Black faces ($p < .01$). Coloured participants were also more accurate than White participants in recognizing Black faces ($p < .01$). For Coloured faces, there was only a significance difference between Coloured and White participants, with Coloured participants being more accurate than White participants ($p < .01$). The performance of Black participants and Coloured participants differed significantly in the recognition of White faces, with Black participants being less accurate than Coloured participants ($p = .001$). White participants were found to be more accurate than Black participants in recognizing White faces ($p < .05$).

A repeated-measures ANOVA for each racial group was run in order to break down of main effect of race of face. Black participants were found to be significantly better at recognizing Coloured faces than black faces ($p < .01$). They were also significantly better at recognizing Coloured faces than White faces ($p < .05$) and there was no significant difference between their performance on Black and White faces ($p = 1.0$). Coloured participants were significantly better at recognizing Coloured faces than at recognizing Black faces ($p < .001$). They were also significantly more accurate for White faces than they were for Black faces ($p = .001$). There was no statistically significant difference between their recognition of Coloured and White faces ($p = 1.0$). White participants were worse at recognizing Black faces than at recognizing Coloured faces ($p < .001$). They were also worse at recognizing Black faces than at recognizing White faces ($p < .001$). There was no statistically significant difference between recognition of White and Coloured faces amongst White participants ($p = .20$).

Analysis of *c*. The second SDT measure of response bias *c* was also analysed. To obtain *c*, the following formula was used:

$$c = - .058*[z(H) + z(F)]$$

with $z(H)$ being z-scores of the hit rates and $z(F)$ being z-scores of false alarm rates (Macmillan & Creelman, 1991).

When participants have a response bias towards saying '*yes*' to a recognition question, the values of *c* will be negative and when participants have a response bias towards saying '*no*' then the values of *c* will be positive (Stanislaw & Todorov, 1999). For all the participants in all three levels of the race of face factor, *c* was positive (see Figure 2), meaning the participants were biased towards responding '*no'* to the recognition test.

Before running a mixed-design ANOVA, assumptions were checked. P-p plots were computed on SPSS and for all three means of *c* the points lay close to the normal line, indicating that the normality assumption was met. The three groups of participants were independent of one another; therefore the assumption of independence is met. The assumption of sphericity was also met, Mauchly's test of sphericity was not statistically significant, $F(2) = .990$, $p = .606$. Levene's test of homogeneity of variances was significant for *c* for White faces. Therefore the assumption was not met. However, ANOVA is a robust test and since the other three assumptions were met (Field, 2009), analysis was continued.

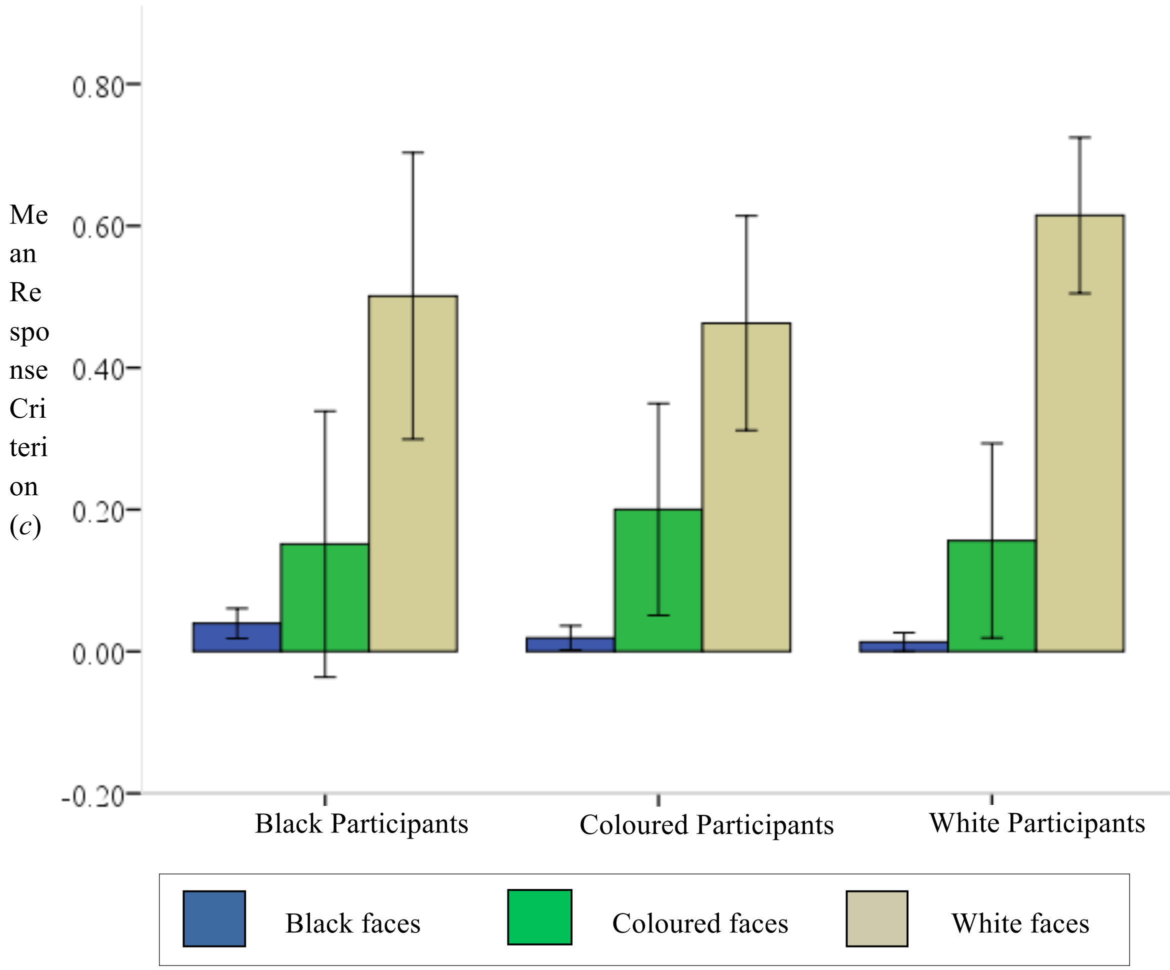

Figure 2: Mean response criterion (c) with 95% between subjects confidence interval for Black, Coloured and White faces.

A mixed-design ANOVA indicated that there was no significant Race of face × Race of participant interaction, $F(4, 210) = 1.16$, $p = .33$, $\eta^2 = .02$, and no main effect of race of participant, $F(2, 105) = 0.19$, $p = .83$, $\eta^2 = .00$. There was however, a significant main effect of race of face, $F(2, 210) = 70.99$, $p < .001$.

A Bonferroni *post hoc* test for the main effect of race of face revealed that there were significant differences amongst all groups. Overall, (see Figure 2), *c* for Black faces differed significantly to *c* for Coloured faces ($p < .01$), *c* for Black faces differed significantly from *c* for White faces ($p < .001$) and *c* for Coloured faces differed significantly from *c* for White faces ($p < .001$). There was a tendency to respond *'no'* mostly to White faces in each group of participants. A tendency to respond *'no'* for Coloured faces was significantly higher than for Black faces.

Analysis of participants' confidence in their responses. Participants were asked after each face at recognition how confident they were with their response on a scale from 1 to 9. Figure 3 shows mean confidence in responses for all participant groups for each race of face.

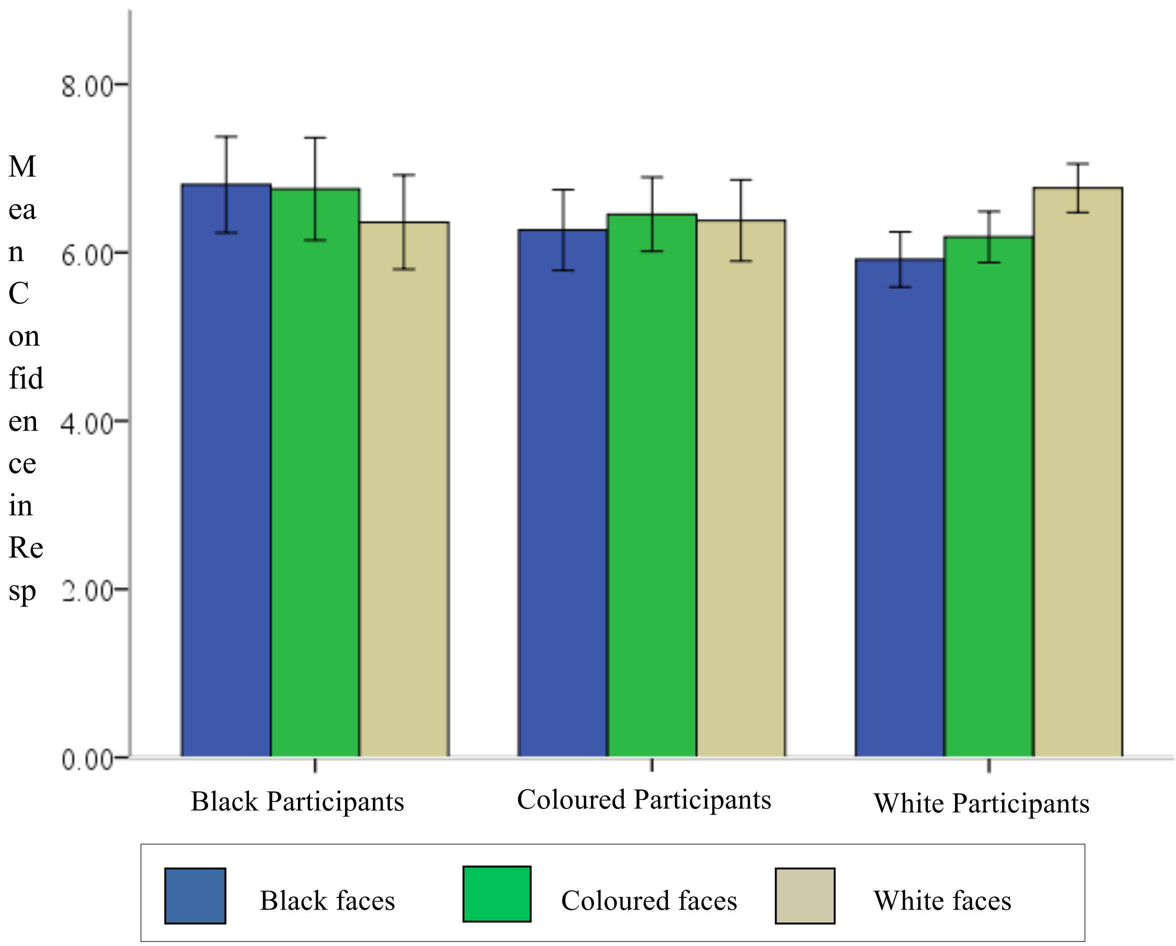

Figure 3. Mean confidence responses with 95% confidence interval for black, coloured and white faces. For each response at the recognition phase, participants rated how confident they were with their decision on a scale from 1 to 9. Averages were calculated for each group on each racial group of faces.

Assumptions were checked before mixed-design ANOVA was run for the average confidence in responses for Black, Coloured and White faces. The assumption of normality was assed using P-p plots. The points lay close to the line, therefore this assumption was met. All three racial groups of participants are independent of each other, so the assumption of independence is also met. Mauchly's test for sphericity was non-significant, $F(2) = .98$, $p = .27$, therefore sphericity was assumed. Levene's test of homogeneity of variance was statistically significant for mean confidence for coloured and white faces. The assumption of homogeneity was not met, but ANOVA is a robust test and can be run if only one of the assumptions was not met (Field, 2009), the analysis was continued.

The results indicated that there was a significant Race of face × Race of participant interaction, $F(4,210) = 22.60$, $p < .001$, $\eta^2 = .30$ as well as a significant main effect of race of face, $F(2, 210) = 4.51$, $p = .01$, $\eta^2 = .04$There was however, no main effect of race of participant, $F(2, 105) = 0.76$, $p = .47$, $\eta^2 = .01$.

A simple effects analysis was run to unpack the interaction between race of face and race of participant. The results show that Black and White participant's confidences in their responses when tested for recognition of Black faces differed significantly ($p < .01$). Black participants were more confident in their responses for recognition of Black faces than were White participants. There were no other statistically significant contrasts.

A repeated measures ANOVA was run for each participant group to investigate the contrasts amongst their confidence for each race face. Black participants were more confident with their responses for Black faces than they were for White faces ($p < .01$). They were also more confident with their responses for Coloured faces than they were for White faces ($p < .01$). There was no statistically significant difference between Black participants' confidence in their responses for Black and in their responses for Coloured faces ($p = 1.0$).

Coloured participants' confidence was not significantly different across the three races of the faces.

White participants were more confident in their recognition responses for White faces as compared to Black faces ($p < .001$). They were also more confident with their responses for White faces as compared to Coloured faces ($p < .001$). These results show an own-race bias in confidence in the White participants group. There was no statistically significant difference between White participants' confidence in their responses for Black and Coloured face recognition ($p = .098$).

Analysis for reaction times (RTs). The time between the onset of each face and the participants' response was recorded to the millisecond accuracy. These times are called reaction times (RTs). An average RT for each race of face was calculated for each participant group. The assumptions were checked for the raw data of RTs. Assumptions of sphericity and independence were met except for normality (average RTs were positively skewed) and homogeneity of variance. To correct this, a log transformation for average RTs for responses for Black, Coloured and White faces were computed. After transformation the skewness of average RT for Black, Coloured and White faces were 0.14, 0.38 and 0.38 respectively. The assumption of normality was met. A mixed design ANOVA was then be carried out for average RTs.

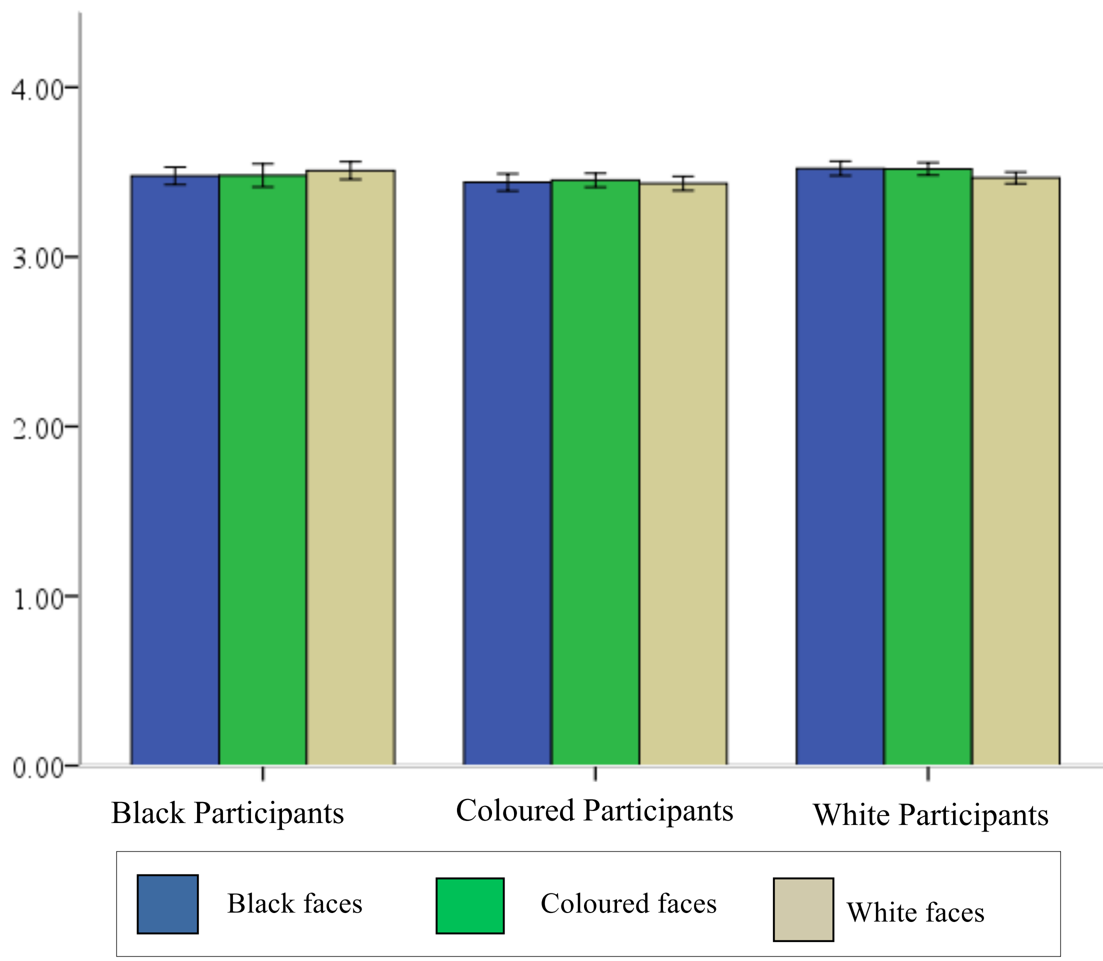

Figure 4: Mean Log transformed Reaction Times (RTs) with 95% between subjects' confidence intervals. The RTs for each response at recognition phase was averaged for each participant group for each race of face.

The three groups of participants are independent; therefore the assumption of independence is met. Mauchly's test of sphericity was non-significant, $F(2) = .98$, $p = .41$, therefore this assumption is met. Levene's test of homogeneity of variances was significant for the log transformed average RT for coloured faces. Therefore the assumption is not met. However, ANOVA is a robust test and since the other three assumptions were met, analysis was continued.

The results of a mixed-design ANOVA indicated a significant Race of Face × Race of participant interaction, $F(4,210) = 3.78$, $p < .01$, $\eta^2 = .07$, but no significant main effects of race of face ($p = .37$, $\eta^2 = .01$) and race of participants ($p = .09$, $\eta^2 = .04$). Simple effects analysis was run on SPSS to investigate which groups differed significantly on various levels of average RT. On RTs for responses for Black faces, only White and Coloured participants differed significantly ($p < .05$). For Coloured faces RTs were not significantly different amongst the three participant groups. For White faces, only Black and Coloured participants differed significantly ($p < .05$).

Repeated-measures ANOVA was run for each group of participants to examine the differences between average RTs for their responses for the three races of faces.

Black and Coloured participants were not significantly different in how quick they were with their responses amongst the three races of faces. White participants were significantly quicker to respond when they were tested for recognition of Black faces compared to White faces ($p < .05$), and significantly quicker to respond when tested for recognition of Coloured faces compared to White faces ($p < .01$).

Analysis of the relationship between proportion of own-race people in home town and own-race bias score. In order to test the hypothesis that own-race bias is a result of more contact with own-race faces and less contact with other race faces, data on percentage racial compositions of the home towns of each participant was obtained from Stats SA. The data was published in 2011 (http://beta2.statssa.gov.za/) (see Table 2 below).

Table 2

Percentage racial compositions of participants' home towns

		% Racial composition		
Town	*n*	Black	Coloured	White
Caledon	1	26.4	62.9	9.4
Cape Town	64	38.6	42.4	15.7
Durban	8	73.8	2.5	6.6
Ixopo	1	97	1.2	0.8
Johannesburg (JHB)	10	76.4	5.6	12.3
Kimberley	1	61.2	27.4	7.5
Kroonstaad	2	87.2	2.9	9.3
Malamulele	2	99.3	0.1	0.1
Mtata	1	99.4	0.3	0.1
Nelspruit	1	89.4	0.9	8.7
Pietermaritzburg	1	81.1	2.9	6
Polokwane	2	92.9	0.9	5.2
Port Elizabeth	1	60.1	23.6	14.4
Pretoria	1	75.4	2	20.1
Qwa-Qwa	2	98	0.2	1.3
Rusternburg	2	88.5	0.9	9.4
Siyabuswa	1	99.4	0.1	0.1
Stellenbosch	1	28.1	52.2	18.5
Thembisa (JHB)	1	78.7	2.7	15.8
Thohoyandou	2	99.3	0.1	0.1
Uitenhage	1	60.1	23.6	14.4
Vereeniging	1	85.4	1.2	12
Victoria West	1	21.3	69.8	7.6

Note. *n* represents the number of participants in the sample who come from that town

A relative own-race bias score was calculated using this formula: Relative own race bias score = *d'* for own-race face – average of *d'* for cross race faces

The two variables (Relative own-race bias score and proportion of own-race people in home town) were explored using a scatterplot to investigate the possibility of a correlation (see Figure 5 below).

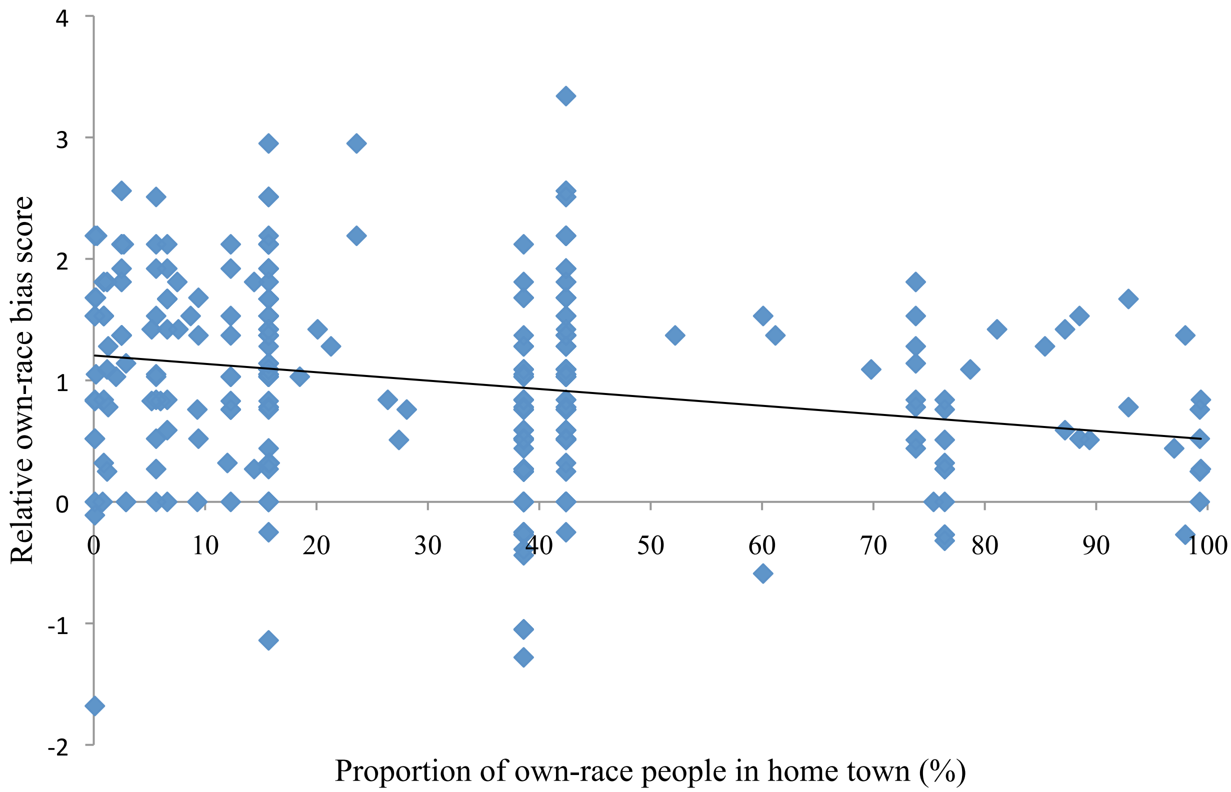

Figure 5. Scatter plot of relative own-race bias scores plotted against proportion of own-race people in home town. Most of the participants were from the same towns. The points aligned in a vertical line represent participants from the same town with different own-race bias scores. For example, at 38.6% proportion of own-race people in town, there are various participants from the same home town (Cape Town).

The scatter plot linear trend line suggests a moderate negative relationship is negative. To test the significance of this possible relationship, a one-tailed forced entry linear regression was run to determine a correlation between relative own-race bias scores and percentage of own-race people in home towns of all the participants.

The assumptions were checked. The p-p plot and the histogram of standardized errors indicated that the errors were normally distributed and therefore the assumption of normal distribution of errors was met. The assumption of independence of regression errors was also met; the Durbin-Watson value was 1.88. Case wise diagnostics reveal three cases but none of them were a cause of concern as none of their standardized residuals was greater than 3. None of the cases had a Mahalanobis value of more than 1, none of the cases had a Cook's distance greater than 1 and none of the cases had a Leverage of greater than .4. Therefore there were no cases with extreme influence on the model that needed to be excluded.

The results indicated that the percentage of own-race people in home town significantly predicts the relative own-race bias score for the participants (R = .393, R^2 = .154, $F(1, 106)$ = 19.347, p < .0001). This model explains 15.4% of the variance in relative own-race bias scores and the correlation is moderate. The intercept is .744, b = -.011, β = -.393. The equation of this correlation is as follows:

Relative own-race bias score = -0.011 percentage own-race people in home town + 0.744.*

Discussion

The hypotheses for this study were not all supported, however, for those that were not supported, the findings were in line with what has been found in the past.

The first hypothesis predicted that all participants will recognize own-race faces more accurately than other-race faces. A full cross-over own-race bias effect in recognition accuracy was not observed. Black participants recognized other-race faces better than own-race faces. Coloured participants performed similarly on own-race faces as they did on White faces. They performed significantly worse on black faces. White participants also performed similarly on own-race faces as they did on Coloured faces and were also significantly worse in recognizing Black faces. Instead of an own-race bias effect, the results showed a recognition bias against Black faces. An own-race bias effect is observed in people with less interracial contact (Ayuk, 1990; Chiroro et al., 2008; Wright, Boyd & Tredoux, 2003; Balas & Nelson, 2010; Bar-Haim et al., 2006). Although the first hypothesis was not supported, the results are in line with what previous studies have indicated, which is that more interracial contact leads to a diminished own-race bias effect (Walker &Tanaka, 2003). The participants are from a university community which is racially integrated and therefore offers ample opportunity for interracial contact, which could have led to the results not indicating an own-race bias effect. The participants may have acquired the ability to process other-race faces according to the perceptual learning models (Young & Hugenberg, 2012).

The second prediction was that Coloured participants will recognize White faces better than Black faces. This hypothesis was supported, Coloured participants were significantly better at recognizing White faces than recognizing Black faces. This finding indicates the lingering effects of the historical relations of the three races, with Coloured people being closer to White people, geographically and in terms of status, than they were to Black people (Mabin, 1992;

Mitchell, 2001). This finding is unique to this study as it was the first to investigate own-race bias effects in facial recognition in Coloured people.

The third hypothesis predicted that White participants would recognize Coloured faces more accurately than Black faces. This hypothesis was also based on the historical relations of the three racial groups and this hypothesis was supported. White participants were significantly better at recognizing Coloured faces than they were at recognizing Black faces. This finding also indicates the possibility of resonating effects of the history of the country, were the racial segregation laws and restructuring of residential areas resulted in Black people being isolated further from the White community than the Coloured community was (Mabin, 1992; Mitchell, 2001). This suggests that there is possibly still less contact between White and Black people.

The fourth prediction was that all participants will be more confident in their recognition responses for their own-race faces and less confident in recognition of other-race faces. This prediction was based on the idea that each participant will be more experienced with own-race faces and therefore more confident in their responses. This prediction was only partially met as an own-race bias was only observed in the White participant group. White participants were significantly more confident in their responses for own-race faces than they were for other-race faces. Coloured participants' confidence was not significantly different across the three race faces. Black participants were more confident in their responses for Black faces compared to White faces but not significantly different between Black and Coloured faces. They were however more confident in their responses for Coloured faces than they were for White faces.

The fifth hypothesis was that participants will be quicker with their responses when tested on own-race faces than when tested on other-race faces. This hypothesis was also based on the idea of own-race bias and therefore expected that the experiences in own-race faces would come through. However, this was not observed in all of the three groups of participants. What was found instead was an other-race bias in the White participants group. They tended to respond significantly quicker for other race faces as compared to own-race faces.

An analysis of response criterion c was examined and also did not indicate a full cross-over own-race bias effect. The result showed that there was a tendency for the participants to respond '*no*' towards a recognition question about White faces (i.e. Do you recognize this face?) as compared to all other faces. So the bias here was towards a particular racial group instead of an own-race bias.

This study also aimed to explore how accurate Black and White participants will be at recognizing the Coloured faces. Black participants recognized Coloured faces better than own-race faces as well as White faces. White participants recognized Coloured faces better than Black faces but there was no significant difference in their recognition accuracy for White and Coloured faces. This shows that both Black and White participants are sufficiently experienced with Coloured faces; for Black people, seemingly more experienced than with own-race faces and for White people, equally experienced with Coloured faces to own-race faces.

Overall, this study did not find an expected disordinal interaction indicating a strong own-race bias in facial recognition. However, there was a significant ordinal interaction, indicating the presence of a diminished own-race bias effect. The study's findings are in line with that of past research (see Meissner & Brigham, 2001; Wright et al., 2003) where interracial contact leads to a diminished own-race bias effect. It can also be explained by the social cognition models which hold that social cognitive phenomena such as emotion, motivation and attitudes moderate the own-race bias effect in memory of other-race faces (Pettigrew & Tropp, 2006; Young & Hugenberg, 2012; Young et al., 2012). (Meissner & Brigham, 2001; Pettigrew & Tropp, 2006). The sample of this study maybe has less prejudice, more perceptual experience, more motivation to pay attention to individuating factors of other-race faces as well as positive emotions towards other-race faces. Interracial friendships could be one of the factors creating an opportunity for all these sociocognitive phenomena to occur, leading to a diminished own-race bias in face recognition amongst the university students.

The most interesting findings of this research were results for the last hypothesis. It was hypothesized that the amount of own-race people in the home towns of the participants will have a relationship with the own-race bias score of the participants. Although this study deviated from using the most common measure of inter-racial contact, which is self-reported, the findings supported the hypothesis. Past studies have found a weak relationship between the amount of interracial contact and an own-race bias. This is perhaps due to the measure of interracial contact being subjective (self-report). The measure used in this study, which was the racial compositions of the home towns of the participants, was a more objective measure. It yielded to a moderate negative correlation between interracial contact and own-race bias. The proportion of own-race people in home town was found to be a significant predictor of a relative own-race bias score.

The findings of this study overall were significant in that they give new information about a group of people which has not been studied before, which is the Coloured. This study also used a more objective measure of interracial contact and found a stronger correlation than has been found in the past. There were however one major limitation of this study.

Limitations and recommendations for future research. The results did not exhibit an expected clear indication of an own-race bias in recognition accuracy. This is attributed to the sample being drawn from an environment that is not representative of the rest of the South African population. The sample was entirely students from the University of Cape Town and they experience a social environment that is different to and is more integrated than the social environments experienced by the rest of the population in the country. Future research may benefit from conducting this research at a larger scale, including populations that are not exclusively university students, in order to get a more accurate picture of how own-race bias manifests in the South African population.

Summary and Conclusions

Own-race bias in facial recognition is a well-researched area. However, there are still many unknowns and this study served as a stepping stone to furthering knowledge in this domain. It is important to understand the things that affect face recognition as face recognition is very often heavily relied on in legal cases. It can be a determinant of whether or not someone will spend some time of their life in prison. This study has investigated how own-race-bias manifests in the Coloured racial group. It also showed how accurate Black and White racial groups are in the recognition of Coloured faces. This is vital in South Africa because these three racial groups have a long history and they are the top three races in the country in terms of their numbers. It is therefore important to know how they perform in facial recognition so that in the future this information can be considered in eyewitness testimony cases. From speculation, it seems that the more integrated the country becomes the more diminished the effect becomes. Maybe in future it will be even more diminished to an extent that the impact it will have on recognition memory will be negligible, but this will probably take centuries. In the meantime, there is still much to learn in how people learn and remember faces as well as factors affecting their memory in this regard.

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APPENDIX A:

INFORMED CONSENT FORM:

University of Cape Town

Department of Psychology

Consent to participate in a research study

Title of research project: Testing memory with faces

Study purpose

This is a face memory study. The researcher is interested in the accuracy of face recognition memory. Should you decide to participate, you will be taking a facial recognition task which is a simple experiment where you will be presented with a face and then later tested for the recollection of the face. You will press a key on the keyboard of the computer to respond to questions.

Possible risks and benefits:

This study poses no risk to any of the participants in anyway. For participating, each participant will be awarded **1 SRPP point** for their time and efforts.

Voluntary participation:

Participation in this research is completely voluntary and should you feel the need to, you may withdraw from the study at any point without any consequences. However, SRPP points will only be awarded for full participation in the research.

Confidentiality and Anonymity:

Your personal identification information and demographic data will be kept strictly confidential and your name is guaranteed to not appear anywhere on the reports.

I (the participant) agree that I have read and understood the information about this research and agree to participate in this study

Student number:

e-mail address:

Course code:

For further questions, please contact the princip researcher Grace Seutloali via e-ma stlmas004@myuct.ac.za or via cell: 078 640 846

Supervisor: Dr. Annelies Vredeveldt
Co-supervisor: Prof. Colin Tredoux

………………………..   …………………

Signature of participant   Date