

An Investigation of the Contact Hypothesis of the Own-race Bias in Face Recognition

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Although previous studies have demonstrated that faces of one's own race are recognized more accurately than are faces of other races, the theoretical basis of this effect is not clearly understood at present. The experiment reported in this paper tested the *contact hypothesis* of the own-race bias in face recognition using a cross-cultural design. Four groups of subjects were tested for their recognition of distinctive and typical own-race and other-race faces: (1) black Africans who had a high degree of contact with white faces, (2) black Africans who had little or no contact with white faces, (3) white Africans who had a high degree of contact with black faces, and (4) white Britons who had little contact with black faces. The results showed that although on the whole subjects recognized own-race faces more accurately and more confidently than they recognized other-race faces, the own-race bias in face recognition was significantly smaller among the high-contact subjects than it was among the low-contact subjects. Also, although high-contact black and white subjects showed significant main effects of distinctiveness in their recognition of faces of both races, low-contact black and white subjects showed significant main effects of distinctiveness only in their recognition of own-race faces. It is argued that these results support the contact hypothesis of the own-race bias in face recognition and Valentine's multidimensional space (MDS) framework of face encoding.

Laboratory and field studies have consistently shown that people recognize individual faces of their own race more accurately, more quickly, and more confidently than they recognize "other-race" faces (see Brigham & Malpass, 1985; Bothwell, Brigham, & Malpass, 1989; and Valentine, Chiroro and Dixon, in press, for reviews). However, as Brigham (1986) and Valentine (1991) point out, the theoretical basis of this effect is not clearly understood at present. Brigham and Malpass (1985) identify four hypotheses that have been proposed to account for the effect of race on face recognition. First, faces of

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one race may be inherently more difficult to recognize than faces of another race. This hypothesis has not been supported by empirical findings (Goldstein, 1979a, 1979b). Second, it has been suggested that racial prejudice might account for the own-race bias in face recognition. According to this hypothesis, racially prejudiced attitudes lead to poorer recognition of other-race faces. However, Brigham and Barkowitz (1978) and Lavrakas, Buri, and Mayzner (1976) did not find a significant correlation between inter-racial attitudes and subjects' recognition of other-race faces. A third hypothesis proposed by Chance and Goldstein (1981) suggests that superficial orienting to other-race faces at encoding may cause poorer recognition of faces of that race. However, Devine and Malpass (1985) found a significant own-race bias in face recognition under both superficial and inferential encoding conditions.

The fourth hypothesis, which is the focus of the present study, proposes that the own-race bias in face recognition might be due to limited contact with multiple exemplars of other-race faces. Current evidence for the contact hypothesis is mixed. Cross, Cross, and Daley (1971) found that white children from segregated neighbourhoods showed a greater own-race bias in face recognition than did white children from integrated neighbourhoods. However, Cross et al. (1971) did not find a similar difference among black children. Brigham, Maass, Snyder, and Spaulding (1982) reported a weak but significant correlation between subjects' self-reported degree of cross-racial experience and their recognition of other-race faces. However, other researchers have reported contradictory findings. For example, Brigham and Barkowitz (1978), Luce (1974), and Malpass and Kravitz (1969) did not find a significant relationship between self-reported degree of cross-racial experience and recognition of other-race faces. Inadequate cross-racial controls might account for these inconsistencies. Brigham (1986) notes that "... measures of contact and experience which more accurately assess the quality and depth of contact, as well as its frequency, may help us identify the relationship between experience and a cross-race effect if indeed one exists" (p. 175). Another problem that is often encountered in "neighbourhood" and correlational studies of the own-race bias in face recognition is that it is often difficult to control for demand characteristics. For example, the desire to present oneself as non-racist may significantly influence subjects' ratings of their own degree of cross-racial interaction. Also, living in an integrated neighbourhood does not necessarily result in more cross-racial interaction. Mobility between neighbourhoods, the influence of television, and the nature and context of one's employment are all factors that affect an individual's degree of cross-racial experience.

In order to avoid these problems and investigate the contact hypothesis more directly, it was considered critical in designing the present study to find groups of subjects whose degree of cross-racial experience could be more objectively specified. Owing to the multi-racial nature of most contemporary societies, such groups are difficult to find. However, in some parts of Africa (particularly in the remote rural villages), it is possible to locate individuals whose degree of "contact" with white faces is either very low or non-existent. Finding a comparable group of white subjects whose degree of contact with black faces is either very low or non-existent is comparatively more difficult. In spite of this, an attempt was made in this study.

In the present study, the effect of individual differences in degree of contact with "other-race" faces on subjects' recognition of distinctive and typical own-race and other-

race faces was investigated. Distinctiveness was included as a factor in this study for two reasons. (1) Bothwell et al. (1989) have pointed out that in cross-racial studies involving face recognition it is vital to ensure that the stimuli are equated in terms of distinctiveness to prevent spurious interactions that may result from differences in the range of distinctiveness of the faces that are used in the experiment. (2) Including distinctiveness as a factor in this experiment made it possible to test specific theoretical predictions that were derived from Valentine's (1991) multidimensional space (MDS) framework of face encoding, which suggests that faces are encoded as points in a multidimensional space. If it is assumed that this had been based solely on experience with own-race faces, the dimensions of the space in which faces are encoded will be those that are optimal to distinguish own-race faces. However, these dimensions might not serve to distinguish faces of another race efficiently. Ellis, Deregowski, and Shepherd (1975) found that different features are used to describe black faces and white faces. Shepherd and Deregowski (1981) found that different features are used to judge similarity among simultaneously presented black or white faces. On the basis of these findings, Valentine (1991) proposed that a population of other-race faces encoded in the multidimensional space will have a central tendency that differs in the value of at least one dimension from the central tendency of own-race faces. Therefore, the central tendency of own-race and other-race faces will be located at different points in the multidimensional space.

Many studies have shown that for own-race faces, faces that are rated as typical are more difficult to recognize than are distinctive faces (e.g. Valentine, 1991). The MDS framework assumes that own-race faces are normally distributed around the central tendency. Therefore, the difficulty that is experienced in recognition of typical own-race faces is because of the increased *exemplar density* close to the central tendency, which leads to greater interference effects in memory than when recognition of distinctive faces is involved. Distinctive faces are thought to suffer fewer interference effects in memory because they are encoded further away from the central tendency in regions of the space with low exemplar density. Valentine (1991) argues that although other-race faces are located away from the central tendency of own-race faces, as a group they are more difficult to recognize because they are *more densely clustered* within the multidimensional space. Distinctiveness can only be defined in relation to a specific population of faces. Therefore, in order to show an effect of distinctiveness in recognition memory, subjects must be sufficiently familiar with a relevant population of faces on which the recognition task is based. Subjects with a low degree of contact with faces of another race are less likely to identify the features that make individual faces of that race either typical or distinctive than are subjects who are highly familiar with faces of that race.

It should be noted that in a previous study in which the effects of race and distinctiveness were investigated, Valentine and Endo (1992) found a significant effect of race. Own-race faces were recognized more accurately than were other-race faces. But the effect of distinctiveness did not interact with race of face: subjects recognized distinctive faces of both races more accurately than typical faces. The subjects in this study were British and Japanese college students. Valentine and Endo did not include the degree of experience with other-race faces as a factor in their experiment.

In the experiment that is reported in this paper, four groups of subjects were tested for their recognition of distinctive and typical own-race and other-race faces. Subjects were

either black Africans or whites (resident in Zimbabwe or in England). In each racial group, half of the subjects were deemed to be highly "familiar" with faces of both races (high-contact subjects), and the other half of the subjects in each racial group had little or no exposure to faces of the opposite race (low-contact subjects). Therefore, the experiment employed a split-plot factorial design in which race of subject (black vs. white) and contact group (high vs. low) were between-subjects factors and race of face (black vs. white) and distinctiveness (typical vs. distinctive) were within-subjects factors. The dependent variables were recognition accuracy and confidence ratings to correct responses.

The following predictions were tested. First, a significant crossover interaction between race of subject and race of face was predicted. This result would replicate the advantage for recognition of own-race faces that has been reported in previous studies. Overall, black subjects were expected to be significantly more accurate and more confident in their recognition of black faces than in their recognition of white faces, and white subjects were expected to be significantly more accurate and more confident in their recognition of white faces than in their recognition of black faces. Secondly, subjects in the "high-contact" groups were expected to show a significantly smaller own-race bias in face recognition than subjects in the "low-contact" groups. Thus, a significant three-way interaction involving race of subject, contact group, and race of face was predicted. The third prediction was that the main effect of distinctiveness would be significant. On the whole, subjects were expected to recognize distinctive faces more accurately and more confidently than typical faces. Finally, on the basis of the MDS framework of face encoding, a significant four-way interaction involving race of subject, contact group, race of face, and distinctiveness was predicted. High-contact subjects of both races were expected to show a significant effect of distinctiveness in their recognition of faces of both races, whereas low-contact subjects were expected to show an effect of distinctiveness only in their recognition of own-race faces. This prediction was based on the assumption that the effect of distinctiveness in recognition memory for faces is a function of subjects' degree of contact with faces from a given population.

Method

Subjects

Sixty-eight subjects (34 white and 34 black) acted as subjects in this experiment. Half of the subjects in each racial group had a "high" degree of contact with faces of the opposite race (high-contact subjects); the other half of the subjects in each racial group had a "low" level of contact with faces of the opposite race (low-contact subjects). Subjects were all male.

High-contact Subjects. Two groups of adolescents were selected to serve as the high-contact subjects. These were students at a privately-run multi-racial college in Harare, Zimbabwe. Of the subjects, 17 were white (mean age = 16.02 years, $SD = 1.66$) and 17 were black (mean age = 16.10 years, $SD = 1.52$). The college from which these subjects were selected was chosen because it enrolls students from both racial groups. This made it an appropriate source of subjects who had a high degree of contact with faces of both races.

Low-contact Subjects. Two groups of adolescents were selected to serve as the low-contact subjects. One group consisted of 17 black Africans (mean age = 16.15 years, $SD = 1.37$) who attended a privately run boarding-school located in a remote rural village in Southern Zimbabwe.

There are no televisions in the village, and, except for the village priest, who is white, these students were unlikely to have seen many other white people. The second group consisted of 17 white adolescents (mean age = 16.73, $SD = 1.33$) who were students at a college in a small village in North-East England.

It must be pointed out that although the low-contact group of white subjects were deemed to be "low" in their degree of contact with black faces, they were not an entirely comparable sample to the low-contact group of rural Zimbabweans, because, owing to the influence of television and other media, these subjects were undoubtedly familiar with many of the black British celebrities in sport, art, and the media. However, it was assumed that their overall degree of contact with black faces was substantially lower than that of whites who were born and educated in Zimbabwe, where black Africans constitute more than 90% of the population.

Stimuli

The stimulus set consisted of 32 slides of white faces and 32 slides of black faces. Two slides of each face were prepared, one in a full-face smiling pose and the other in a full-face unsmiling pose. Distinctiveness ratings were collected for each face in an unsmiling pose. (In a separate study, a significant correlation, $r = 0.89$, $p < 0.0001$, was found between distinctiveness ratings to the same set of smiling and unsmiling faces). White faces were rated for distinctiveness by 16 white postgraduate students at the University of Manchester. Black faces were rated by 16 black postgraduate students at the University of Zimbabwe. The procedure used to obtain distinctiveness ratings for each set of faces was similar to the one described in Valentine and Endo (1992). Each subject was given a response form with a scale of 1–9 for each of the original 53 white faces (for white raters) or 48 black faces (for black raters). The raters were asked to imagine they had to meet "each of these people at a busy railway station" and to rate each face for how easy it would be to identify in a crowd by circling the appropriate number on the 1–9 scale. They were instructed to rate "unusual" or distinctive faces that they thought would be easy to spot as 9, and typical faces that they thought would be very difficult to identify as 1. Raters were encouraged to make use of the entire range of the scale, and they proceeded through the list of faces at their own pace. Different random orders were used for each set of 4 consecutive raters of each race.

Mean distinctiveness ratings for each face were calculated and used as a basis for stimulus classification. Of the most distinctive faces, 16 of each race were selected and divided into two matched sets of 8 targets and 8 distractors. Similarly, 16 of the most typical faces of each race were selected and divided into two matched sets of 8 targets and 8 distractors. The mean distinctiveness ratings of each set of faces are shown in Table 1. Paired t -tests confirmed that the mean ratings of distinctive faces were significantly higher than the mean ratings for typical faces: for black faces, $t(30) = 5.91$, $p < 0.0001$; for white faces, $t(30) = 9.62$, $p < 0.0001$.

Apparatus

A Saville PROslide projector fitted with an external Elmo-T2 timer was used to present the slides. The external timer controlled the exposure duration for each slide as well as the interstimulus interval.

Procedure

Two study lists of 16 faces each were constructed. One list consisted of typical faces, the other of distinctive faces. Each study list consisted of 8 slides of black faces and 8 slides of white faces. Half of the subjects in each of the four contact groups were tested for their recognition of distinctive faces

TABLE 1
Mean Distinctiveness Ratings for Black and White Faces Used in the Experiment

<i>Black Faces</i>				<i>White Faces</i>			
<i>Typical</i>		<i>Distinctive</i>		<i>Typical</i>		<i>Distinctive</i>	
<i>Mean</i>	<i>SD</i>	<i>Mean</i>	<i>SD</i>	<i>Mean</i>	<i>SD</i>	<i>Mean</i>	<i>SD</i>
4.35	0.40	6.15	1.04	4.40	0.50	6.60	0.80

Note: The maximum score in each cell is 9; the minimum score is 1.

first, and the rest of the subjects in each group were tested for their recognition of typical faces first. During the study phase of the experiment, subjects were instructed to examine each face carefully in preparation for a subsequent recognition memory test. Each face was shown for 8 sec, and the interstimulus interval was 2 sec. In each study list, half of the faces of each race showed a smiling pose and the other half showed an unsmiling pose.

The recognition test followed immediately after each study list. A random list of 16 targets and 16 distractors was presented to the subjects. Target faces were presented showing a different facial expression at test. Thus, faces that were shown in a smiling pose during study were shown in an unsmiling pose at test and vice versa. Half of the targets and distractors were smiling, and half were unsmiling. The timing was the same as that used during the study phase. Subjects responded to each face by ticking either a "Yes" box (for targets) or a "No" box (for distractors) on individual response forms. Subjects also rated their confidence to each response on a scale of 1–7. They were encouraged to respond to all the faces that were included in the test list and to guess if unsure.

Results

Recognition Accuracy

For each subject, hit and false positive rates in each condition were calculated and combined in A' scores (Rae, 1976). An $F_{\max}$ test of homogeneity of variance (Hartley, 1940, 1950) was applied to the raw data before conducting all of the analyses reported in this paper. Although the data on hits and on false positives did not violate the principle of homogeneity of variance for ANOVA, the A' scores did. Therefore, A' scores were subjected to an arcsin $\sqrt{A'}$ transformation (Kirk, 1968) before being analysed. Hits, false positives and A' scores were analysed separately.

Hits. The mean number of hits obtained by high-contact and low-contact subjects of each race on recognition of distinctive and typical own-race and other-race faces is shown in Table 2.

A $2 \times 2 \times 2 \times 2$ split-plot ANOVA in which race of subject and contact group were between-subjects factors and race of face and distinctiveness were within-subjects factors was carried out on hits. The predicted interaction between race of face and race of subject was significant, $F(1, 64) = 13.15$, $p < 0.001$. Tests of simple main effects showed that white subjects made a significantly greater number of hits in their recognition of own-race faces than they made in their recognition of other-race faces, $F(1, 64) = 9.21$, $p < 0.01$.

TABLE 2
Mean Number of Hits Obtained by High-contact and Low-contact Subjects on Recognition of Distinctive and Typical Own-race and Other-race Faces.

		Black Faces				White Faces			
		Distinctive		Typical		Distinctive		Typical	
Race of Subjects	n	Mean	SD	Mean	SD	Mean	SD	Mean	SD
Black									
high-contact	17	5.59	1.37	5.82	1.47	6.29	0.99	6.00	1.23
low-contact	17	7.35	0.71	5.52	1.23	6.00	1.23	5.23	1.44
entire sample	34	6.47	1.04	5.55	1.58	6.15	1.11	5.62	1.34
White									
high-contact	17	5.59	1.06	5.47	1.70	6.06	1.30	6.29	0.85
low-contact	17	5.77	1.48	5.35	1.50	6.71	1.36	6.94	1.25
entire sample	34	5.68	1.27	5.41	1.60	6.39	1.33	6.62	1.05
Overall	68	6.07	1.39	5.54	1.46	6.27	1.22	6.11	1.15

Note: The maximum score is 8; the minimum possible is 0.

However, there was no difference in the number of hits that were made by black subjects to black and to white faces.

The predicted main effect of distinctiveness was significant, $F(1, 64) = 6.52, p < 0.01$. Subjects made more hits to distinctive faces than they made to typical faces. The predicted three-way Race of Subject $\times$ Contact Group $\times$ Race of Face interaction was also significant, $F(1, 64) = 8.85, p < 0.004$. Tests of simple main effects showed that low-contact white subjects made a significantly smaller number of hits in their recognition of black African faces than they made in their recognition of white faces, $F(1, 64) = 7.99, p < 0.01$. High-contact white subjects did not differ significantly in the number of hits made to black vs. white faces. Similarly, high-contact black subjects did not differ significantly in the number of hits made to own-race vs. other-race faces, $F(1, 64) = 0.97, p > 0.05$. However, although low-contact black subjects made a greater number of hits on recognition of own-race faces than they made on recognition of other-race faces, this difference was not significant, $F(1, 64) = 3.36, p > 0.05$. Thus, on the whole, subjects in the high-contact groups showed a smaller own bias in face recognition than did subjects in the low-contact groups. The predicted four-way Race of Subject $\times$ Contact Group $\times$ Race of Face $\times$ Distinctiveness interaction was not significant, $F(1, 64) = 1.73, p > 0.05$.

False Positives. The mean numbers of false positives that were obtained by high-contact and low-contact subjects in each condition are shown in Table 3. A split-plot ANOVA performed on the false positives showed a significant main effect of race of face, $F(1, 64) = 11.59, p < 0.001$. More false positives were made to black faces than to white faces. In spite of this main effect, the Race of Subject $\times$ Race of Face interaction was highly significant, $F(1, 64) = 116.76, p < 0.0001$. Tests of simple main effects showed that white subjects made a significantly smaller number of false positives in their recognition

TABLE 3
Mean Number of False Positives Obtained by High-contact and Low-contact Subjects on Recognition of Distinctive and Typical Own-race and Other-race Faces.

		Black Faces				White Faces			
		Distinctive		Typical		Distinctive		Typical	
Race of Subjects	<i>n</i>	Mean	<i>SD</i>	Mean	<i>SD</i>	Mean	<i>SD</i>	Mean	<i>SD</i>
<i>Black</i>									
high-contact	17	1.82	1.74	2.41	1.18	0.77	1.44	3.12	1.22
low-contact	17	0.94	1.09	1.24	1.09	3.65	1.12	3.29	0.92
entire sample	34	1.38	1.42	1.83	1.14	2.21	1.28	3.21	1.07
<i>White</i>									
high-contact	17	2.65	1.22	3.24	0.83	0.53	0.94	1.24	1.25
low-contact	17	2.17	1.74	2.94	1.56	0.18	1.53	1.59	1.33
entire sample	34	2.41	1.48	3.09	1.20	0.36	0.74	1.42	1.29
Overall	68	2.15	1.43	2.46	1.17	1.28	1.24	2.31	1.48

Note: The maximum score is 8; the minimum possible is 0.

of own-race faces than they made in their recognition of other-race faces, $F(1, 64) = 38.96$, $p < 0.001$. Similarly, black subjects made a significantly smaller number of false positives on recognition of black faces than they made on recognition of white faces, $F(1, 64) = 13.75$, $p < 0.01$. Thus, a significant own-race bias was found for both races of subjects.

The predicted main effect of distinctiveness was highly significant, $F(1, 64) = 20.20$, $p < 0.0001$. Fewer false positives were made to distinctive faces than to typical faces. The three-way Race of Subject $\times$ Contact Group $\times$ Race of Face interaction was also significant, $F(1, 64) = 20.16$, $p < 0.0001$. Tests of simple main effects showed that for high-contact black subjects, the difference in the number of false positives made to black vs. white faces was not significant, $F(1, 64) = 0.16$, $p < 0.05$. Low-contact black subjects made a significantly greater number of false positives in their recognition of white faces than they made in their recognition of black faces, $F(1, 64) = 34.88$, $p < 0.001$. Low-contact white subjects made a significantly greater number of false positives in their recognition of black faces than they made in their recognition of white faces, $F(1, 64) = 24.00$, $p < 0.001$. However, contrary to our prediction, high-contact white subjects also made a significantly greater number of false positives on recognition of black faces than they made on recognition of white faces, $F(1, 64) = 15.99$, $p < 0.001$. The predicted four-way Race of Subject $\times$ Contact Group $\times$ Race of Face $\times$ Distinctiveness interaction was significant, $F(1, 64) = 17.13$, $p < 0.0001$. This interaction was also significant on A' scores. To minimize repetition, an analysis of simple main effects for this interaction is reported for A' scores.

A-prime Scores. The mean A' scores for this experiment are shown in Table 4. An ANOVA performed on transformed A' scores showed a significant main effect of race of face, $F(1, 64) = 16.55$, $p < 0.0001$. White faces were recognized more accurately than

TABLE 4
Mean A' Scores Obtained by High-contact and Low-contact Subjects in Recognition of Distinctive and Typical Own-race and Other-race Faces

		Black Faces				White Faces			
		Distinctive		Typical		Distinctive		Typical	
Race of Subjects	<i>n</i>	Mean	<i>SD</i>	Mean	<i>SD</i>	Mean	<i>SD</i>	Mean	<i>SD</i>
<i>Black</i>									
high-contact	17	0.84	0.07	0.79	0.12	0.90	0.05	0.76	0.12
low-contact	17	0.95	0.04	0.85	0.10	0.73	0.12	0.70	0.13
entire sample	34	0.89	0.05	0.81	0.10	0.82	0.10	0.73	0.13
<i>White</i>									
high-contact	17	0.76	0.11	0.70	0.15	0.91	0.09	0.88	0.09
low-contact	17	0.73	0.17	0.71	0.15	0.96	0.05	0.87	0.13
entire sample	34	0.75	0.15	0.71	0.13	0.93	0.07	0.88	0.10
<i>Overall</i>	68	0.82	0.14	0.76	0.15	0.88	0.12	0.81	0.14

Note: The maximum score is 1; the minimum score is 0; a score of 0.5 is chance performance.

were black faces. However, in spite of this main effect, the predicted Race of Subject $\times$ Race of Face interaction was highly significant, $F(1, 64) = 97.17, p < 0.0001$. Subjects of both races showed more accurate recognition of own-race faces than of other-race faces. The predicted three-way Race of Subject $\times$ Contact Group $\times$ Race of Face interaction was significant, $F(1, 64) = 22.98, p < 0.0001$. The nature of this interaction is shown in Figure 1. An examination of the top panel shows that although high-contact black subjects did not show a significant own-race bias in face recognition, $F < 1$, low-contact black subjects recognized white faces less accurately than they recognized black faces, $F(1, 64) = 23.28, p < 0.001$. Although the effect of contact was present for high-contact white subjects, this effect was not significant (see bottom panel). Both the high-contact and the low-contact white subjects were significantly more accurate in their recognition of own-race faces than they were in their recognition of other-race (black) faces. For high-contact subjects, $F(1, 64) = 18.61, p < 0.01$; for low-contact subjects, $F(1, 64) = 30.99, p < 0.001$.

The main effect of distinctiveness was highly significant, $F(1, 64) = 22.46, p < 0.0001$. Overall, distinctive faces were recognized more accurately than were typical faces. It will be recalled that the key prediction regarding the effect of distinctiveness was that for own-race faces, both high- and low-contact groups would show a strong effect of distinctiveness, but for other-race faces, the low-contact group would show a weaker effect than the high-contact group. The results obtained in this experiment supported this hypothesis. First, the four-way interaction involving race of subject, contact group, race of face, and distinctiveness was significant, $F(1, 64) = 11.45, p < 0.001$. The nature of this interaction is shown in Figure 2.

A close examination of the top panels shows that while the low-contact black subjects showed a significant effect of distinctiveness on recognition of black faces, $F(1, 64) =$

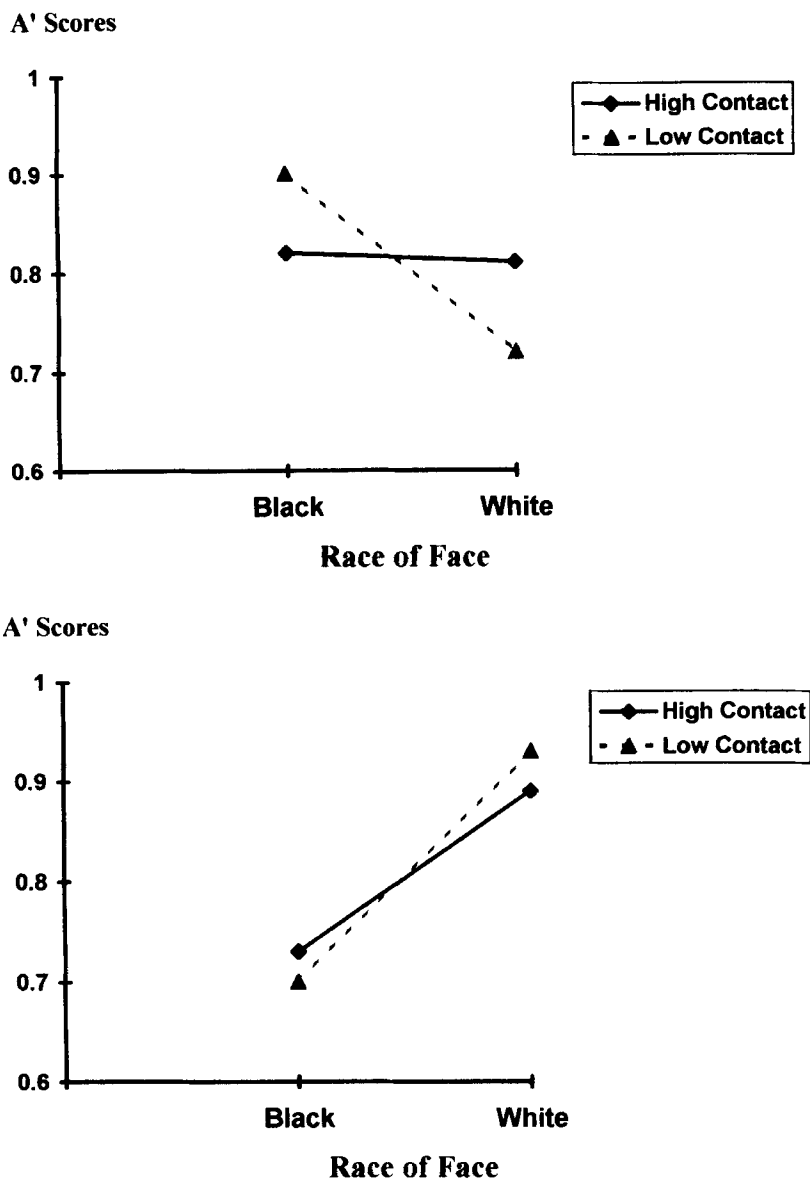


FIG. 1. Graphs showing a significant three-way interaction involving race of subject, contact group, and race of face obtained from an analysis of A' scores. Mean A' scores obtained by black subjects (top panel) and white subjects (bottom panel) on recognition of black and white faces.

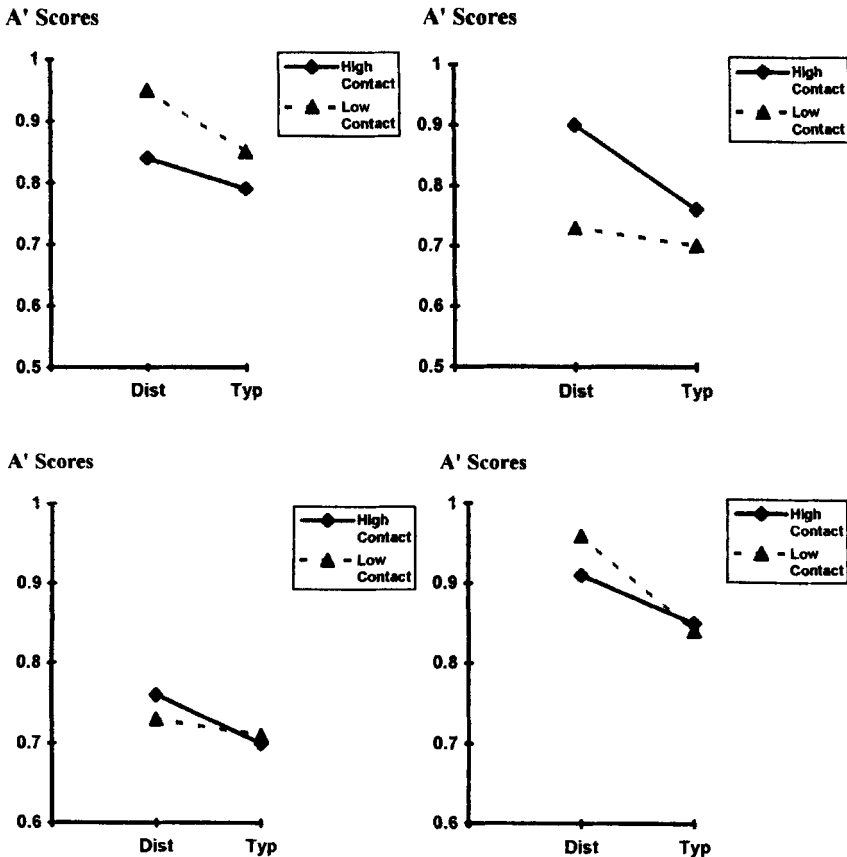


FIG. 2. Graphs showing a significant four-way interaction involving race of subject, contact group, race of face, and face distinctiveness obtained from an analysis of A' scores. Mean A' scores obtained by black subjects (top two panels) and white subjects (bottom two panels) on distinctive and typical black faces (left-hand panels) and white faces (right-hand panels). (Key: Dist = distinctive faces; Typ = typical faces.)

17.19, $p < 0.01$, these subjects did not show an effect of distinctiveness on recognition of white faces ($F < 1$). However, high-contact black subjects showed significant effects of distinctiveness on recognition of own-race faces, $F(1, 64) = 7.32$, $p < 0.01$, as well as on recognition of other-race faces, $F(1, 64) = 23.41$, $p < 0.001$. The data obtained from low contact white subjects (see bottom panels) also showed a significant effect of distinctiveness on recognition of own-race faces, $F(1, 64) = 10.40$, $p < 0.01$, and no effect of distinctiveness on recognition of black faces, $F < 1$, while the high-contact white subjects showed significant effects of distinctiveness on recognition of black faces, $F(1, 64) = 5.85$, $p < 0.05$, and white faces, $F(1, 64) = 12.75$, $p < 0.01$.

Confidence Ratings

Mean confidence ratings to hits were calculated for each subject on recognition of each category of faces. The mean scores obtained in this experiment are shown in Table 5.

A $2 \times 2 \times 2 \times 2$ split-plot ANOVA in which race of subject and contact group were between-subjects factors and race of face and distinctiveness were within-subjects factors was carried out on the mean confidence data. The predicted Race of Subject $\times$ Race of Face interaction was significant, $F(1, 64) = 22.95, p < 0.0001$. Subjects were significantly more confident in their correct responses to own-race target faces than they were in their correct responses to other-race target faces. The main effect of distinctiveness was significant, $F(1, 64) = 22.32, p < 0.0001$. Subjects were significantly more confident in their correct responses to distinctive faces than they were in their correct responses to typical faces. Also, the predicted three-way Race of Subject $\times$ Contact Group $\times$ Race of Face interaction was significant, $F(1, 64) = 10.41, p < 0.002$. This interaction is shown in Figure 3.

It is apparent from the top panel of Figure 3 that although the low-contact black subjects were significantly more confident in their correct responses to black faces than to white faces, high-contact black subjects showed comparable levels of confidence in their correct responses to both black and white faces. Similarly, low-contact white subjects were significantly more confident in their correct responses to own-race faces than they were in their correct responses to black faces, whereas the high-contact white subjects did not differ significantly in their confidence ratings to correct responses to black vs. white faces (see bottom panel, Figure 3).

TABLE 5
Mean Confidence Ratings of Hits Obtained by High-contact and Low-contact Subjects on Recognition of Distinctive and Typical Own-race and Other-race Faces.

		Black Faces				White Faces			
		Distinctive		Typical		Distinctive		Typical	
Race of Subjects	<i>n</i>	Mean	SD	Mean	SD	Mean	SD	Mean	SD
<i>Black</i>									
high-contact	17	5.69	0.99	4.21	1.02	5.19	0.94	4.32	0.77
low-contact	17	5.41	0.65	4.76	0.85	4.14	0.90	3.94	0.79
entire sample	34	5.55	0.82	4.49	0.93	4.67	0.92	4.13	0.78
<i>White</i>									
high-contact	17	4.41	0.81	4.07	1.35	5.32	0.85	4.37	0.86
low-contact	17	4.90	0.56	4.60	0.83	6.41	0.73	6.43	0.55
entire sample	34	4.66	0.69	4.33	1.09	5.87	0.79	5.40	0.71
Overall		5.10	0.96	4.66	1.18	5.27	1.17	4.76	1.23

Note: The maximum score is 7; the minimum score is 1.

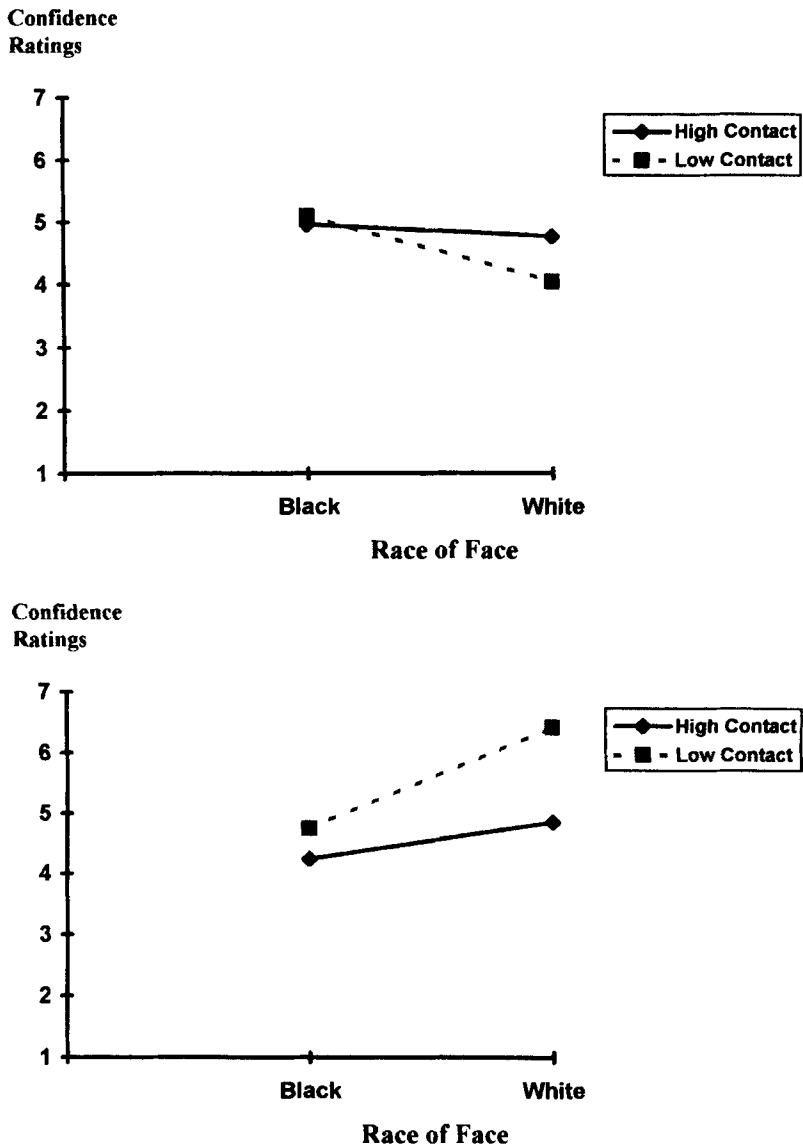


FIG. 3. Graphs showing a significant three-way interaction involving race of subject, contact group, and race of face obtained from an analysis of confidence ratings to hits. Mean confidence ratings to hits obtained by black subjects (top panel) and white subjects (bottom panel) on recognition of black and white faces.

Discussion

The main objective of this study was to test the contact hypothesis of the own-race bias in face recognition and to establish whether the effect of distinctiveness in recognition memory for faces interacts significantly with race of subject, contact group, and race of face. Four predictions were tested: (1) that there would be a significant crossover interaction between race of subject and race of face; (2) that there would be a significant three-way interaction involving race of subject, contact group, and race of face, (3) that there would be a significant main effect of distinctiveness, and (4) that there would be a significant four-way interaction involving race of subject, contact group, race of face, and distinctiveness.

The predicted cross-over interaction between race of subject and race of face was significant on all the three measures of recognition accuracy and on confidence ratings. Black subjects were significantly more accurate and more confident in their recognition of black faces than they were in their recognition of white faces. Similarly, white subjects were significantly more accurate and more confident in their recognition of white faces than they were in their recognition of black faces. Thus, a significant own-race bias in face recognition was found among subjects of *both* races.

The predicted three-way interaction involving race of subject, contact group, and race of face was significant on hits, false positives, and A' scores and on confidence ratings to hits. Evidence for the contact hypothesis of the own-race bias in face recognition was particularly strong among black subjects. High-contact black subjects were significantly more accurate and more confident in their recognition of white faces than were low-contact black subjects. However, high-contact black subjects showed an unexpectedly lower level of recognition performance on black faces. The predicted four-way interaction involving race of subject, contact group, race of face, and distinctiveness was significant on false positives and on A' scores. For the low-contact black subjects, the effect of distinctiveness was confined to recognition of own-race faces, whereas for high-contact black subjects significant effects of distinctiveness were found on recognition of faces of both races. Also, whereas for the low-contact white subjects the effect of distinctiveness was confined to recognition of own-race faces, high-contact Caucasian subjects showed significant effects of distinctiveness on recognition of faces of both races. This interaction supports Valentine's (1991) proposition that the effect of distinctiveness in recognition memory for faces is a function of subjects' degree of contact with faces of a given population of faces.

It should be noted that there was a significant main effect of race of face on false positives and on A' scores. Overall, white faces were better remembered than were black faces. This result is not altogether surprising. Valentine and Endo (1992) also found a significant main effect of race of face in a study involving recognition of white British and Japanese faces by white British and Japanese subjects. This may be evidence that black faces and Oriental faces are inherently more difficult to recognize than are white faces. However, such a conclusion cannot be justified on the basis of the results obtained in the present study. First, the interaction between race of subject, contact group, and race of face was significant on false positives, hits, and A' scores. A closer examination of the data revealed that this interaction resulted from the fact that high-contact black subjects were

significantly more accurate than were low-contact black subjects in their recognition of white faces, but they were significantly less accurate than were low-contact black subjects in their recognition of black faces, and no effect of contact was observed for white subjects. Thus, the significant main effect of race of face could be explained in terms of the rather unexpected poor recognition of black faces by high-contact black subjects.

In conclusion, these results clearly support the existence of an own-race bias in face recognition. They also support the contact hypothesis of the own-race bias in face recognition in the case of black subjects, but not in the case of white subjects. The reduction in the own-race bias demonstrated by high-contact black subjects on recognition of white faces appears to have been achieved at a cost of reduced recognition accuracy for own-race (black) faces. Although this effect was not predicted, it might follow from an implementation of the multidimensional space framework in terms of connectionist models using distributed representations (e.g. Valentine & Ferrara, 1991; O'Toole, Deffenbacher, Abdi, & Bartlett, 1991; O'Toole, Deffenbacher, Valentin, & Abdi, 1994). Having learnt own-race faces, if a large number of faces from a different population are then encoded within the same network, the statistical structure of the sample of all faces stored in the network might change. This change might benefit recognition of the "minority" race of faces encountered but be less optimal for encoding faces of the "majority" race that existed previously.

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