A Face in the Crowd: Examining Race Perception and Lightness Contrast

O. Scott Gwinn (scott.gwinn@psy.mq.edu.au)
Department of Psychology, Macquarie University
Balaclava Road, North Ryde, Sydney, New South Wales, Australia, 2109

Kevin R. Brooks (kevin.brooks@psy.mq.edu.au)
Department of Psychology, Macquarie University
Balaclava Road, North Ryde, Sydney, New South Wales, Australia, 2109

Abstract

The aim of the current experiment was to explore the possibility that people's perceptions of race could be altered using lightness contrast effects. To test this, faces ranging from typically Caucasian (white) to typically African (black) were surrounded with either black or white faces. Participants were asked to rate how stereotypically white or black they perceived the central face image to be. A 2x5 repeated measures ANOVA revealed that participants rated faces as looking the same whether presented in white or black surrounds. A second experiment consisting of two parts was conducted in an attempt to explain this lack of an effect. In experiment 2a, the effect of skin tone luminance variations without differences in facial morphology were investigated, while experiment 2b studied the effects of morphology without differences in skin tone. While skin tone alone yielded an effect of perceived lightness, the perceived race of faces was not affected by the morphologically different surrounds. This suggests that although perceptions of skin tone can be altered using lightness contrast effects, this is not sufficient to alter overall racial appearance, questioning the role of skin tone in the perception of race.

Keywords: Race; face; lightness contrast; skin tone.

Introduction

Face Processing and the Perception of Race

Numerous studies have shown that people process Same Race (SR) faces differently to Other Race (OR) faces (see Meissner & Brigham, 2001 for a review). SR faces refer to faces which are the same race as ourselves, while OR faces refer to faces which belong to a different race. This difference in processing is perhaps most clearly seen in recognition tasks using faces from different races. In studies using such tasks it is reliably found that people are more accurate at recognising SR faces compared to OR faces. This is generally referred to as the other race effect (ORE).

Using a facial composite construction kit, MacLin and Malpass (2001) designed a total of twenty faces that were perceived as racially ambiguous, and could appear to be of either Hispanic or African American descent. It was found that when different hairstyles were added to these racially ambiguous faces, they were consistently judged as belonging to the race of which that particular hairstyle was typical. Moreover, when these faces were given African American hairstyles, Hispanic participants showed a reduction in their ability to accurately recognise these faces, compared to when the faces had Hispanic hairstyles (MacLin & Malpass, 2001). These results lead MacLin and Malpass (2001; 2003) to propose a socio-cognitive account of the ORE, suggesting that it is due to a reduction in the depth or level of processing, once a face has been categorised as belonging to another race. This theory gains further support from a paper by Alley and Schultheis (2001). In their study, Alley and Schultheis (2001) created racially ambiguous faces using a kit similar to MacLin and Malpass (2001). However, instead of changing the faces' hairstyle, Alley and Schultheis (2001) produced an ORE by only changing the skin tone of the faces. That is, white participants were less accurate at recognising faces when they had a dark skin tone, compared to a light skin tone. While not explicitly tested, we might assume this effect occurred because participants were categorising the faces as belonging to a race other than their own, once it was given a darker skin tone.

In the current paper we were interested in further exploring the influence of skin tone on judgements of race. However, we wanted to explore whether we could alter participants' perceptions of skin tone, while not making any alterations to that face itself, and simply surrounding it with different sets of faces. Throughout our lives we often view individuals' faces while they are surrounded by others. By using this design we believe that the experiment may be able to investigate possible changes in people's perceptions of race occurring outside the lab, thereby making the findings more ecologically valid than some past studies. To test whether this was possible, we utilised the well-established simultaneous lightness contrast illusion. This phenomenon causes areas of identical luminance to be perceived as different, as a result of being surrounded by inducing backgrounds of different intensities (Agonstini & Galmonte, 2002). A simple and effective example of this can be seen in figure 1.

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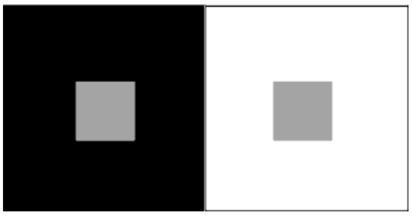

Figure 1: An example of the simultaneous contrast effect. Despite both grey squares having the same luminance, the one on the white background is typically perceived as being darker.

Experiment 1

Experiment 1 was designed to see whether faces' racial appearance can be altered when surrounded by either stereotypically white or black faces. We may expect a face to appear more stereotypically white when surrounded with black faces and more stereotypically black when surrounded with white faces, for two reasons: (1) It has been consistently shown that areas of identical luminance are perceived as different, as a result of being surrounded by areas of different intensity (Agonstini & Galmonte, 2002), and (2) skin tone appears to be a salient feature of race (Alley & Schultheis, 2001).

Methods

Participants Thirty-two undergraduate students from Macquarie University took part in the experiment for course credit.

Stimuli and Apparatus Photographs of African students from the University of Cape Town were used as the original black faces. The white faces were photographs of Caucasian students from the University of Sydney. From this database of faces, 32 black male and 32 white male faces were selected for the study, based on eight criteria: (1) They were unfamiliar to the participant, (2) the image was a frontal shot, (3) the face had a neutral expression, (4) they had no facial hair or paraphernalia (e.g., glasses), (5) no long fringes, (6) approximately of similar age, (7) minimal amount of distinguishing features (e.g., moles and scars) and (8) could be considered typical of their racial group. These 64 faces were then arranged in 32 pairs to be averaged using morphing software. Eleven morphs were of two white faces (WW), 11 of two black faces (BB), while the remaining 10 involved one white and one black face (BW). The WW and BB morphs involved equal weighting (50% each) of the two original faces. Five of the BW morphs were also set at 50%, while the remaining five pairs of faces were first combined with a 25% contribution from the white face, and then again with a 75% contribution. This resulted in a total of five target faces in each morph level, plus six extra at the 0 and 100 levels to be used as surrounds. From this point BB and WW morphs will be referred to as the 0 and 100 levels respectively, and the BW morphs as the 25, 50 and 75 levels.

Morphs were created using Abrosoft Fanatmorph ™ version 4.0.2. All further stimulus editing was performed using Adobe Photoshop™ version 10. The original faces were first cropped to a standard height of 768 pixels and width of 512 pixels, so that their aspect ratio was not altered when they were entered into the program. Importantly; this cropping only removed background information, leaving the faces intact. Sixty-six control points were placed on each original face in areas of high contrast and in a way that attempted to capture the features of the faces. This included 8 for the eyes, 10 for the eyebrows, 12 for the mouth, 19 for the nose and 17 for the outline of the face, including jaw and forehead. The morphed faces were cropped using an ellipse, in order to remove any hair and information outside the jaw line. Faces were then converted into greyscale and standardised to a height of 130 pixels, while keeping their individual aspect ratio.

In a pilot study, 11 participants rated the racial appearance of each face, presented in isolation. Ratings were given out of 10, with 0 indicating the face appeared highly stereotypically black and 10 indicating the face appeared highly stereotypically white. A plot of these ratings can be seen in figure 2.

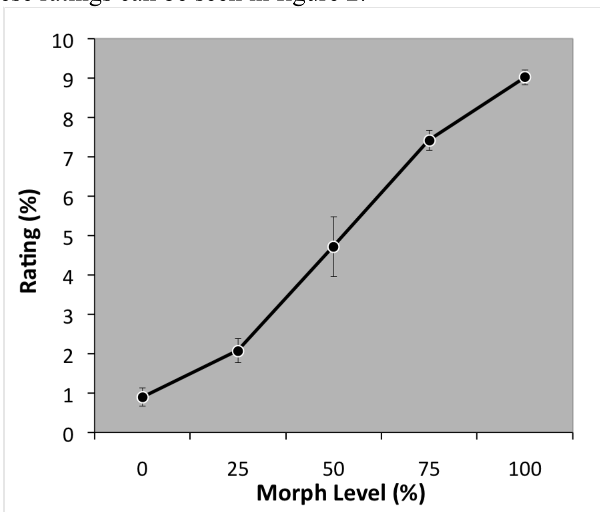

Figure 2: A plot showing participants' ratings (y-axis) of the 5 morph levels (x-axis) for the pilot experiment (no surround). Higher ratings indicate that the face appeared more stereotypically white. Error bars show 95% confidence intervals.

The final stimulus arrays consisted of one central face surrounded by either six 100 level/white faces or six 0 level/black faces (see figure 3). Five different white and five different black surrounds were created by repositioning the faces, so that each target face within a particular morph level appeared in a differently arranged surround. The targets and surrounds were positioned in a standard 227x340 pixel display with a small degree of overlap, and no visible background between them. These arrays were then placed on a grey background which was the average luminance of all the faces used in experiment 1. Arrays were presented using Psychophysics Toolbox (Brainard, 1997; Pelli, 1997) extensions for Matlab on a 21" colour monitor (1024x768 pixels at 94Hz). When viewed from the

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viewing distance of 114cm, these displays subtended 4x6.5 degrees of visual angle.

Procedure Participants were informed that they would be shown a series of crowds of faces and would be required to rate the racial appearance of the central face. Participants were tested individually. The experiment began with five practice trials. Each array remained on the screen for three seconds, during which subjects simply observed the display. After three seconds the display disappeared and the mouse cursor appeared. Participants then made their response by moving a slide further to the left if they thought the face looked more stereotypically black and further right if they thought it looked stereotypically white. These responses were then converted into a numeric rating out of 100. Throughout the experiment, the slide scale remained on the screen with the words 'Stereotypically Black' at the far left and 'Stereotypically White' at the far right. There was no time limit on responding and participants could change their answer as many times as they liked. Once they were satisfied with their answer, participants clicked on a 'Confirm' button and their answer was recorded. After an inter-stimulus interval of one second the next array appeared. During this time, participants saw a grey screen with the slide at the bottom. After the practice trials, participants gave ratings for the 50 different arrays in a single block of testing. By the end of the experiment participants had seen each of the 25 target faces twice; once in a white surround and once in a black surround. A minimum of 10 arrays appeared in between repetitions of the same face.

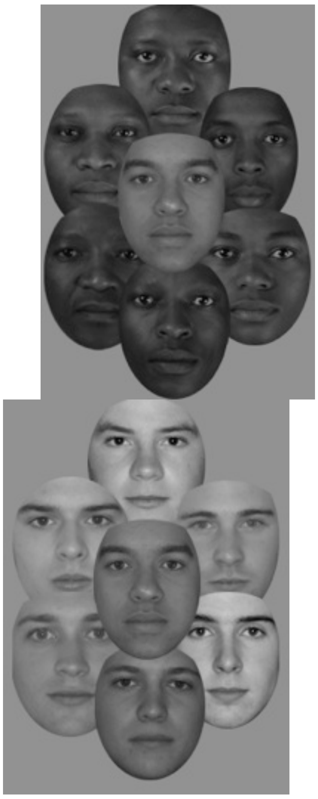

Figure 3: An example of the final stimulus arrays for experiment 1, with the same face from figure 1 as the target.

Results

For each participant an average score was calculated for each morph level in a white and black surround. Mean ratings for the five morph levels are plotted separately for the two surrounds in figure 4. Here we can see that participants' ratings are very similar whether a face appears in a white or black surround. Statistical tests found no difference between ratings when faces appeared in a white or black surround (repeated measures 2x5 ANOVA: $F(1, 31) = 1.43$, $p = .24$). From the analysis it was also found that overall, participants rated each of the five morphs levels differently ($F(4,28) = 290.94$, $p < .0005$). As in the pilot study, these ratings showed a progressive increase from the 0 to 100 morph levels (see figure 4).

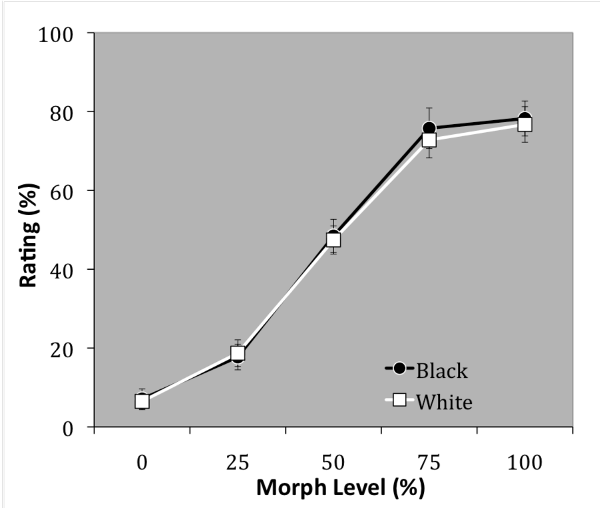

Figure 4: A plot showing participants' ratings of faces when appearing in a surround of white or black faces. Mean ratings (y-axis) are shown for each of the 5 morph levels (x-axis). Higher ratings indicate faces which appeared more stereotypically white. Error bars show a 95% confidence interval.

Discussion

In experiment 1 it was found that surrounding a face with either stereotypically white or black faces does not alter its racial appearance. This could possibly be the result of participants remembering having previously seen the same face and simply giving them the same rating once again. However, this would seem unlikely given the large number of faces being shown to the participants and the fact that the same face did not appear again until a minimum of ten different arrays had appeared in between. Also, we intentionally used a scale that did not include discreet levels, making it difficult to remember exact ratings given. This would suggest that in order to gain some insight as to why no effect was found, we need examine the stimuli used rather than the design of the experiment.

That no significant effect of surround was found in experiment 1 is somewhat surprising given the previous work of Alley and Schultheis (2001), who showed that the ORE can be produced by changing skin tone. One might assume that to produce an ORE a face must be made to look less typical of one's own race. Hence, it would seem logical that Alley and Schultheis (2001) were making faces appear more or less typical of a specific race, when they altered the faces' skin tone. This raises the possibility that we found no effect in experiment 1 because people's perceptions of a face's skin tone cannot be altered through the use of contrast effects, using other faces as inducers. That is, it is possible that there simply isn't enough variation in luminance levels between black and white faces to induce a contrast effect. It is also possible that a perceived change in skin tone was present, but that there was a perceived change in facial morphology in the opposite direction to skin tone. That is, when surrounded with black faces, a central face's morphology may be perceived as being more stereotypically black. We might expect this as Michel, Corneille and Rossion (2007) have previously shown that Caucasian participants process the exact same Asian/Caucasian morphs less holistically when presented in a block containing mostly Asian faces. That is, when these racially ambiguous morphs are presented in an Asian block, Caucasian participants experience a reduced composite effect, suggesting that these morphs were now being categorised as Asian. While the present design differs from Michel *et al.*'s (2007), it is clear that under certain conditions a racially ambiguous face can be assimilated into the racial group it is presented with. If some form of assimilation occurred in the present study, it is possible that the two opposing effects of skin tone and facial morphology countered each other; resulting in the faces being rated the same in both surrounds. To test these propositions, experiments 2a and 2b were conducted. These experiments were run concurrently and in a counterbalanced order across participants.

Experiment 2a

Experiment 2a was designed to determine whether there is enough variation in the luminance of the faces' skin tone to induce a contrast effect. To test this, the facial features were made unrecognisable by averaging the luminance of all the pixels in each face separately. This meant that participants would be basing their ratings on luminance variations alone. As these stimuli no longer resemble faces of different races, they will simply be referred to as targets and surrounds, targets being the equivalent of the central face in experiment 1.

Methods

Participants Thirty three undergraduate students from Macquarie University took part in the experiment for course credit.

Stimuli and Apparatus Arrays in experiment 2a were the same as in experiment 1, except that the facial features were made unrecognisable by averaging the luminance of all the pixels in each face separately. This results in the faces appearing as various shades of grey, and can be seen in figure 5.

Procedure The procedure in experiment 2a was the same as experiment 1 except for two aspects. Firstly, as the stimuli no longer resembled faces of different races, the labels on the response scale were changed from 'Stereotypically White' and 'Stereotypically Black' to simply 'Black' and 'White'. The second change was that participants completed both experiments 2a and 2b in the same session.

Results

For each subject an average score was calculated for each condition as in experiment 1. A plot was again created showing the average rating for each morph level and can be seen in figure 6.

From the plot we can see that participants rated targets as being darker when in a white surround and lighter when in a black surround. Output from the 2x5 ANOVA indicated this difference between ratings was significant, $F(1,32) = 12.46$, $p = .001$. From the analysis it was also found that a significant interaction between surround and morph level was present, $F(4, 29) = 5.66$, $p = .002$. Follow up analyses were conducted to determine at what morph levels surround was having a significant effect. Results from these analyses showed that the effect of surround was significant at morph levels 50 ($t(32) = 3.87$, $p < .0005$), and 100 ($F(1, 32) = 12.49$, $p = .001$). However, it is worth noting that without making a Bonferroni adjustment for the five t tests, the effect of surround at the 25 level would be considered significant, $t(32) = 2.42$, $p = .02$.

From the ANOVA it was again found that overall, participants rated the five morph levels differently ($F(4, 29) = 109.52$, $p < .0005$). However, unlike the pilot study and experiment 1, in experiment 2a the morphs in the 75 level received the highest ratings and not those in the 100 level (see figure 6).

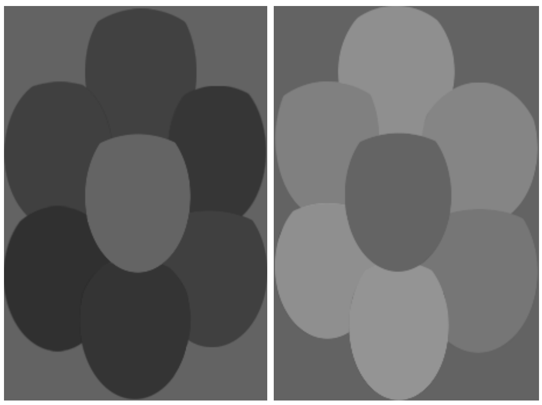

Figure 5: Example stimuli from experiment 2a. The same arrays as seen in figure 3, with all pixels within each face averaged.

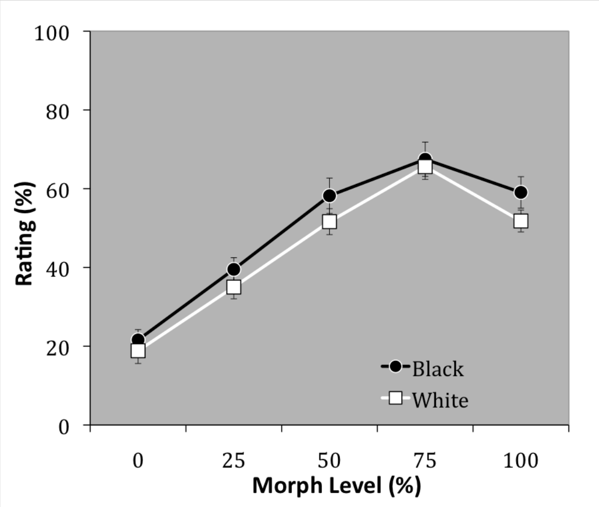

Figure 6: A plot showing participants' ratings of targets appearing in a white or a black surround. Mean ratings (y-axis) are shown for each of the 5 morph levels (x-axis). Higher ratings indicate targets which appeared lighter. Error bars show a 95% confidence interval.

Discussion

In experiment 2a it was found that participants rated targets as appearing significantly lighter when in a black surround and darker when in a white surround. This isn't completely surprising, as with the features removed the stimuli become very similar to the previously presented demonstration of the simultaneous lightness contrast effect seen in figure 1. Nevertheless, this significant result is important, as it verifies that there is sufficient variation between the faces' luminance values to induce a lightness contrast effect. Given this finding, it now seems even more likely that the surrounds may have been having an opposite effect on the perception of facial morphology, with the two effects countering each other in experiment 1.

A significant interaction was also found between surround and morph level in experiment 2a, indicating that the effect of the surrounds was different at different morph levels. Closer inspection of the data revealed that only the 50 and 100 levels showed significant effects of surround. We would suggest that the reason why no effect was found at the 0 and 75 levels is because of the presence of ceiling and floor effects. That is, participants may have been reluctant to give ratings above and below a certain level, so even though targets may have appeared lighter or darker, this was not reflected in the ratings. While the same reasoning cannot be used to explain the lack of a significant effect at the 25 level, it is important to note that we found a *p* value of .02 at this level, but chose to make Bonferroni corrections and establish a critical alpha level of .01. The presence of a ceiling effect seems especially likely, given that the effect returns in the 100 level, which was rated lower than the 75 level. The finding that ratings for the 100 level were lower than the 75 level will be further examined in the general discussion.

Experiment 2b

The results of experiment 2a suggest that there are sufficient variations in the skin tone luminance of the faces used to induce a simultaneous contrast effect. Given that Alley and Schultheis (2001) have shown that changes in skin tone can produce an ORE and that this may be indicative of a face appearing more stereotypical, it is possible that contrast effects for facial morphology were occurring in the opposite direction. That is, it is possible that a central face's morphology is seen as being more similar to that of the faces in the surround. This may result in two opposite effects for skin tone and facial features cancelling each other out and producing no effect in experiment 1. To examine the effect of surrounds on facial features, all the faces in experiment 2b were given the same average luminance as each other. This was done in an attempt to give all the faces the same skin tone so that participants would be basing their ratings on the facial features alone.

Methods

Participants Thirty three undergraduate students from Macquarie University took part in the experiment for course credit.

Stimuli and Apparatus Arrays in experiment 2b were the same as in experiment 1 except that faces were given the same average luminance as each other, while retaining the luminance variations within each face[1]. An example of the stimuli can be seen in figure 7.

Procedure The procedure was the same as experiment 2a.

Results

For each participant an average score was calculated for each condition, as in experiment 1 and 2a. From the plot in figure 8 it can be seen that there is very little separation in the lines representing ratings in white and black surrounds, indicating that participants' perceptions of the faces' racial appearance was not influenced by the surrounds. This was confirmed by the output from the 2x5 ANOVA, $F(1, 32) = 2.38$, $p = .133$. Again the ANOVA revealed that overall participants rated the five morph levels differently ($F(4, 28) = 293.60$, $p < .0005$), with ratings progressively increasing from the 0 morph level to the 100 morph level (see figure 8).

[1] It should be noted that although this process causes a change in the Michelson contrast, the appropriate measure for periodic stimuli, it causes no change in the RMS contrast, the customary metric of image intensity for complex images such as ours.

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Figure 7: Example stimuli from experiment 2b. The same arrays as seen in figure 3, with all faces set to the same average luminance.

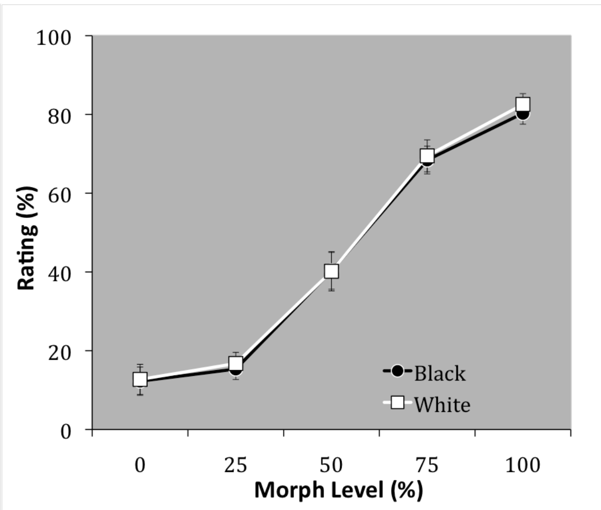

Figure 8: A plot showing participants' ratings of faces appearing in a white or a black surround. Mean ratings (y-axis) are shown for each of the 5 morph levels (x-axis). Higher ratings indicate faces which appeared more stereotypically white. Error bars show a 95% confidence interval.

Discussion

In experiment 2b it was found that participants gave faces the same rating whether they appeared in a white surround or a black surround. These results suggest that the overall racial appearance of facial morphology cannot be altered through the use of simultaneous contrast effects, using other faces as inducers. If a significant effect of surround had been found in experiment 2b in the opposite direction to the effect found in experiment 2a, this may explain the lack of an effect in experiment 1. As no such effect was found, possible reasons for these results will be explored in the general discussion.

General Discussion

Summary of Results

The stimuli used in experiment 1 included both morphological and luminance variations between faces. Using these stimuli it was found that participants rated faces the same whether they appeared in a black or white surround. From this we can conclude that under the present conditions, contrast effects are not effective in making a face appear more stereotypically white or black. The stimuli used in experiment 2a had the facial features rendered unrecognisable by averaging the luminance of all pixels within each face. This meant that participants were basing their ratings on perceived luminance. Using these stimuli it was found that participants rated targets as appearing lighter when presented in a black surround, and darker when presented in a white surround. The stimuli used in experiment 2b all had the same average luminance, which means that participants were basing their ratings on the morphological characteristics of the faces. Using these stimuli it was found that participants rated faces the same whether presented in a white or black surround, as in experiment 1.

Implications

The current experiment was designed on the premise that skin tone was a salient and important feature of race. This is not an overly abstract notion given the commonly used racial labels "black" and "white", as well as the evidence showing that an ORE can be produced by changing a face's skin tone (Alley & Schultheis, 2001). However, results from the current study suggest that it is not necessary for a face to have a light skin tone in order to be considered stereotypically white. We are able to draw this conclusion based on the conflicting pattern of results found when experiment 2a is compared to experiment 1, 2b and the pilot study. When considering the plot of the pilot study in figure 2, one can see how participants' ratings show a progressive increase from the 0 to 100 level in the absence of surrounding faces. The same pattern can also be seen in the results of experiment 1 (figure 4) with surrounding faces included. Importantly, both of these plots are based on ratings of faces with differences in skin tone and facial morphology present. In experiment 2b a very similar pattern can be seen, when ratings are based on facial morphology alone (figure 8). However, in experiment 2a when ratings are based on luminance variations alone, we can see from figure 6 that faces at the 100 level, which previously received the highest ratings (indicating that they appeared highly stereotypically white), are now rated lower than those faces in the 75 level (indicating that they appear darker). This outcome highlights the fact that in the pilot study, faces were only rated on overall racial appearance and not skin tone. Coincidently, the faces that appeared the most stereotypically white had skin tone that was comparable to faces which were rated as being more racially ambiguous.

Conclusions

From the current study we can conclude that, under the present conditions, lightness contrast effects do not influence racial appearance. While it appears that there is an adequate difference between the skin tone luminance of white and black faces to produce a simultaneous contrast effect, this is not sufficient to bring about a change in overall racial appearance. The finding that it was not necessary for a face to have the lightest skin tone in order to be considered the most stereotypically white may suggest that perceptions of racial appearance are predominantly based on facial morphology and less on skin tone. Future studies may wish to determine precisely what percentage of total racial appearance can be attributed to skin tone. The results reported here would suggest that this percentage is relatively small.

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