Independent influences of verbalization and race on the configural and featural processing of faces: A behavioural and eye movement study

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Abstract

Describing a face in words can either hinder or help subsequent face recognition. Here, the authors examined the relationship between the benefit from verbally describing a series of faces and the same-race advantage (SRA) whereby people are better at recognizing unfamiliar faces from their own race as compared with those of other races. Verbalization and the SRA influenced face recognition independently, as evident on both behavioural (Experiment 1) and eye movement measures (Experiment 2). The findings indicate that verbalization and the SRA each recruit different types of configural processing with verbalization modulating face learning and the SRA modulating both face learning and recognition. Eye movement patterns demonstrated greater feature sampling for describing as compared with not describing faces and for other- as compared with same-race faces. In both cases sampling of the eyes, nose and mouth played a major role in performance. The findings support a single process account whereby verbalization can influence perceptual processing in a flexible and yet fundamental way through shifting one's processing orientation.

Introduction

A major issue in psychology has been the relationship between language and cognition and within the domain of face recognition a number of studies have demonstrated that language can influence visual cognition: describing a face in words can either interfere with or facilitate subsequent visual face recognition (for reviews, see Brown & Lloyd-Jones, 2005; Chin & Schooler, 2008; Meissner, Sporer & Susa, 2008; Schooler, 2002). In a seminal study, Schooler and Engstler-Schooler (1990) demonstrated that describing the facial features of a bank robber in a short video can reduce subsequent identification performance as compared with completing an unrelated filler task. Since then, there has been considerable interest in verbal interference, also termed *verbal overshadowing*. However, since the 1990's work on verbal facilitation has been largely neglected.

The rationale for the present research is that a better understanding of complementary positive and negative effects of verbalization will serve to drive theory forward. Thus, the logic of the present set of studies on verbal facilitation of face recognition mirrors that of an early study on verbal overshadowing by Fallshore and Schooler (1995). They explored the role of perceptual expertise in mediating verbal overshadowing by examining its effects on the recognition of same- versus other-race faces. Their premise was that individuals have more experience with, and hence greater expertise in recognizing faces of the same race and this leads to the same-race advantage (SRA) whereby people are better at recognizing unfamiliar faces from their own race as compared with those of other races. In particular, they explored whether verbal overshadowing would result from an increased emphasis on featural processing at the expense of configural processing (i.e., information about the relative positions of features across the face as a whole)[1] when a verbal description of the face was required. The idea was that if configural information was made less available after verbalization and if reliance on configural information differentiated same- and other-race face recognition, then verbal overshadowing should be observed only for same-race faces. This is what they found. Fallshore and Schooler's findings are consistent with verbal overshadowing causing a generalized shift in processing orientation and also the notion that perceptual encoding of configural information underlies our expertise with faces (for a review of theories of verbal overshadowing, see Chin & Schooler, 2008).

Here, we propose that the same mechanism which can induce a shift towards greater featural processing, as described in the Fallshore and Schooler study, can also produce the complementary effect of a shift toward greater configural processing and as a consequence benefit the recognition of both same- and other-race faces. Moreover, in contrast to the findings of Fallshore and Schooler, we propose that verbalization and race can also have independent influences on face recognition. One reason for this is that, all else being equal, verbalization and race likely engage different types of configural processing. In particular, Maurer, Le Grand and Mondloch (2002) have demonstrated the separability of sensitivity to (a) first-order relations, seeing a stimulus is a face because its features are arranged with two eyes above a nose, which is above a mouth; (b) holistic processing, namely glueing together the features into a gestalt; and (c) second-order relations, perceiving the distances between features. On this basis, same-race faces but not other-race faces are likely to be processed in a holistic fashion where the glueing or conjoining of features into a whole has resulted from prolonged visual experience of own-race faces (Michel et al., 2006a). In contrast, we suggest that verbalization may encourage the encoding of subtle variations in the spacing of features, second-order relations, in order to enable the on-line visual differentiation of a relatively large number of highly visually similar stimuli; a process which likely has little effect on holistic processing and so applies equally to both same- and other-race faces. Dissociating the effects of verbalization and race in this way will allow us to specify more precisely the mechanisms by which verbalization can shape visual perception.

Nevertheless, it remains possible that verbal facilitation, like verbal overshadowing, modulates the SRA. Concerning the notion of expertise, work on the influence of training on face recognition suggests that training or experience can reduce the SRA (e.g., Hills & Lewis, 2006; Hugenberg, Miller & Claypool, 2007; Lebrecht, Pierce, Tarr & Tanaka, 2009). Of most relevance here, Weston, Perfect, Schooler and Dennis (2008) found that instructing participants to make personality judgements of honesty prior to learning a group of 8 simultaneously presented faces was more beneficial for the recognition of same-race faces whereas instructing them to make physical judgements in focussing on the eyes was more beneficial for other-race faces. However, these effects were short-lived and observed only on the first recognition trial. Here, we use a more robust paradigm which has demonstrated long-term verbal facilitation effects on face recognition to examine whether verbal facilitation can modulate the SRA. In addition, we will assess whether, in complementary fashion, the SRA can influence the verbal descriptions used to benefit face recognition as there has been little work in the verbal domain and this too will inform our understanding of the relationship between verbalization and the SRA (e.g., Hills & Lewis, 2006).

In the next two sections, we provide a brief overview of behavioural and eye movement evidence on the locus of effects of verbalization and race on face processing and in particular whether these influences reside predominantly in configural or featural processing and during face learning or recognition.

Specific versus General Visual Processing

The present studies will determine whether the benefit of verbalization and the SRA are tied more to configural or featural processing. The influence of verbalization on these processes is not clear (e.g., Berman & Cutler, 1998; Brown, Gehrke & Lloyd-Jones, 2010; Mueller & Wherry, 1980; Wells & Hryciw, 1984). In contrast, there is more substantial evidence that the SRA reflects a superiority in processing configural information for same-race faces (e.g., for a review see Schwaninger, Carbon & Leder, 2003; see also Michel et al., 2006a; Michel, Caldara & Rossion, 2006b; Tanaka, Kiefer, & Bukach, 2004). Nevertheless, Hayward, Rhodes and Schwaninger (2008) have demonstrated that the SRA can benefit featural as well as configural processing and they argue that the SRA reflects a general facilitation in visual processing.

In the only eye movement study of effects of verbalization on face recognition, Bloom and Mudd (1991) observed that as processing depth increased from making no judgement to gender and trait judgements, so the number of participants' eye movements, time spent inspecting the faces and subsequent recognition performance also increased. They suggested that verbalization increased the quantity of features processed. Nevertheless, they presented verbal information while the face was visible whereas here we assess the influence of verbalization on face memories. Furthermore, they did not examine eye movements during recognition. Finally, they did not examine the contribution of individual features and so we do not know whether (a) a greater number of eye movements correlated with sampling a greater range of features or with greater sampling of a small range of features; (b) particular features mediated the effects of verbalization; or (c) the same or different features played a role during recognition as well as learning. Concerning eye movements and the SRA, the findings concerning the importance of individual features are mixed. Blais et al (2008) found that participants from different cultural backgrounds showed different eye movement patterns. Across learning, recognition and categorization by race, Western Caucasian participants fixated mainly on the eyes and partially on the mouth whereas East Asian participants fixated more on the central region of the face around the nose and mouth. In contrast, Goldinger, He and Papesh (2009) found that all participants favoured the eyes during same-race learning and the nose and mouth during other-race learning.

Face Learning and Recognition

We also determine whether the influences of verbalization and the SRA are localized in configural/featural processing during face learning or recognition. For both verbalization and the SRA, accounts have emphasized one or other of these possibilities. Verbal facilitation may arise during learning either through encouraging more configural processing of the face or from attention to more facial features (e.g., Berman & Cutler, 1998; Wells & Hryciw, 1984; Winograd, 1978; 1981). Alternatively, facilitation may be due to the addition of semantic associations to the described face which benefit retrieval (e.g., Anderson & Reder, 1979; Bruce & Young, 1986; Schooler, Ryan & Reder, 1996).[2]

In a similar fashion, it is commonly argued that either learning or recognition differences underlie the SRA. For instance, some have argued that same-race recognition depends more heavily on configural processing during learning whereas other-race recognition depends more heavily on featural processing during learning (e.g., Hancock & Rhodes, 2008; Michel et al., 2006a; Michel et al., 2006b; Rhodes et al., 2009; Rhodes, Tan, Brake & Taylor, 1989; Tanaka , Kiefer & Bukach, 2004). Similarly, social categorization theories have emphasized how simply categorizing a stimulus as an in-group or out-group member during learning can have important cognitive and motivational consequences for subsequent recognition (e.g., Bernstein, Young & Hugenberg, 2007; Hugenberg & Corneille, 2009; Levin, 1996, 2000; MacLin & Malpass, 2001; Michel, Corneille & Rossion, 2007; Sporer, 2001). In contrast, multidimensional scaling or face-space models in which faces are represented on a set of shared dimensions within multidimensional face space emphasize storage and retrieval (e.g., Byatt & Rhodes, 2004; Lewis, 2004; Valentine, 1991). As one example, Byatt and Rhodes (2004) produced an excellent quantitative fit between Nosofsky's (1986) generalized context model (GCM) and their observed SRA in face recognition. We note here that it can be difficult to disentangle perceptual encoding and later retrieval in such models nevertheless we expect our study will shed light on how these processes may interact.

The Present Study

In Experiment 1, we assessed whether (a) verbalization and the SRA exerted independent effects on face recognition; (b) the influence of verbalization and the SRA was tied primarily to configural or featural processing in particular; and (c) these effects were localised in face learning or recognition. In Experiment 2, we went on to examine eye movements in order to determine whether particular features or sets of features (a) mediated the effects of verbalization; (b) provided diagnostic cues for race-specific identification; and (c) were important during face learning or recognition.

We first examined white participants' recognition of black and white faces using the verbal facilitation paradigm of Brown and Lloyd-Jones (2005).[3] In this paradigm, participants viewed and then described (or not, in the control condition) each of 10 faces. Subsequently, they discriminated the original old faces from an equal number of new distracters in a yes/no recognition task. To examine configural processing, faces were presented either intact or in scrambled format by dividing the four major features of forehead/hairline, eyes, nose and mouth/chin into horizontal strips and re-arranging their order with the logic that relative to intact faces scrambling would disrupt configural but not featural information (e.g., Collishaw & Hole, 2000; Hayward et al., 2008; Rhodes et al., 2009; Schwaninger, Lobmaier & Collishaw, 2002). It should not be assumed that scrambling will eliminate configural information absolutely, nevertheless Collishaw and Hole (2001) have provided evidence that scrambled faces in the form used here were processed using a serial feature-by-feature strategy. We manipulated face format during learning and recognition in four between-participants conditions: (a) intact-intact; (b) intact-scrambled; (c) scrambled-intact; and (d) scramble-scrambled.

We predicted the following outcomes. First, if the benefit of verbalization and the SRA are each mediated by distinct configural processes we would expect better discrimination performance for faces that are described as compared with the control condition and, independently, better discrimination for same- as compared with other-race faces. An alternative possibility was that verbalization would modulate the SRA. For instance, verbalization may increase the perceptual differentiation of other-race faces more than same-race faces through increasing configural processing and hence we would expect verbalization to reduce the difference in discrimination performance between black and white faces. On both accounts, at the very least we would expect verbalization to benefit the recognition of black faces. We also examined the influence of the SRA on verbal descriptions to see if the quality of the verbal descriptions differed according to race and whether description quality correlated with recognition accuracy and amount of verbal facilitation. We examined the amount of information and the proportion of configural and featural information generated by participants (Brown & Lloyd-Jones, 2005; 2006; Sporer, 1991; Winograd, 1981).

Second, we examined whether the benefit of verbal facilitation and the SRA were mediated by configural processing during learning or recognition. If the benefit of verbalization on performance is tied to learning and in particular to encouraging greater configural processing of the to-be-remembered face then we would expect greater benefits of verbalization from learning intact as compared with scrambled faces, as in the former case more configural information is preserved in the stimulus. Nevertheless, it is also possible that verbalization encourages additional visual processing of featural properties during learning, in which case we would expect a benefit on recognition from learning both intact and scrambled faces. An alternative but less likely outcome was that the benefit of verbalization would be evident for both learning and recognition of intact and scrambled faces. For instance, if verbalization encourages the derivation of more semantic associations with intact and scrambled faces this would benefit subsequent retrieval. In this case, the retrieval of additional semantic information about the learning event would benefit the recognition of both intact and scrambled faces that were described and perhaps also lead to the rejection of other intact and scrambled faces which did not encourage retrieval of the same semantic information. For instance, according to the Anderson and Reder (1979) model it is the proportion of relevant to irrelevant semantic information that determines retrieval difficulty for faces.

The SRA appears to have a more pervasive influence on the face processing system than verbalization. For instance, there is evidence that it is due, at least in part, to increased configural processing of same-race faces during face learning. Studies have also demonstrated the SRA for the learning of facial features (e.g., Hayward et al., 2008). In addition, current influential models also suggest a localization of the SRA in recognition (e.g., Byatt & Rhodes, 2004). On this basis, we hypothesized that the SRA would be modulated by the nature of visual processing during both learning and recognition. We predicted that the SRA would arise when learning both intact and scrambled faces and when recognizing intact and scrambled faces. We also expected a stronger effect for intact faces as they comprise both configural and featural information whereas the visual processing of scrambled faces is mediated primarily by featural information alone.

Experiment 1

Method

Participants

Forty-eight White British students from the University of Hull took part in this experiment for a small payment. All were native English speakers with normal or corrected-to-normal vision.

Materials and apparatus

Stimuli consisted of greyscale head-and-shoulder photographs of 80 young White and Black men. There were two views of each face: a full frontal view to be used as a target during the study phase and a 3/4 view to be used as a target or distracter during the test phase. The 40 white faces were taken from the University of Stirling Psychology Department Psychological Image Collection. The 40 black faces were provided by the Department of Psychology and Sport Sciences at the University of Justus-Liebig. None of the faces had any distinctive marks or wore glasses or a beard. Clothing and background cues were removed using Adobe Photoshop CS2. Each set of 40 faces were divided into two stimulus blocks, with each containing 20 faces. Within each stimulus block, the faces were further divided into two sets of 10 resulting in four sets of 10 faces in all. The image size was 9.5cm (w) x 10cm (h). Faces were either presented intact or scrambled by dividing the face into 4 sections each corresponding to the top of the head, eyes, nose, mouth and chin, and re-arranging the features into a new configuration (Collishaw & Hole, 2000; see Figure 1). A PC was used to present stimuli and record responses using Superlab 4 and the stimuli were displayed in the centre of the computer screen.

Design and Procedure

A four factorial design was employed. Verbalization (control vs. description) and race of the face (black vs. white) were within-participants factors. Face format during learning (intact vs. scrambled) and recognition (intact vs. scrambled) was manipulated between-participants. The experiment involved a study phase and a test phase. Prior to the study phase, participants were informed that they would be shown a set of faces to remember for subsequent testing and that views of faces between the study and test phases would be different. During the study phase participants were shown frontal views of 10 target faces one at a time for 2 seconds preceded by a 250ms fixation cross. Following each target there was a 15 second interval during which the participants engaged in one of the post-encoding tasks. In the description condition, the participants were asked to write down a description of the face they had just seen. We used the same description instructions as in Brown and Lloyd-Jones (2005, 2006) namely, 'Please be as complete in your description as possible so that another person seeing only your description could get as accurate an idea as possible of what the face is like'. In the control condition, the participants engaged in a counting task whereby they counted a three-digit-number backwards in intervals of three and wrote down all the numbers they counted. At the end of the 15 second interval a sound alerted the participants to return their attention to the computer screen to see the next face. This sequence was repeated for the remaining 9 faces.

The study phase was followed immediately by an old/new recognition memory test whereby participants were shown 3/4 views of the 10 targets and 3/4 views of 10 distracter faces not presented previously. The task was to indicate whether each face had appeared during the study phase as quickly and accurately as possible by pressing the Z key for 'yes' and the M key for 'no'. For half the participants this key assignment was reversed. Each face remained on the computer screen until a response had been made. On completion of the first experimental condition (either the control or description condition) the participants proceeded onto the second experimental condition. This procedure was the same for black and white faces which were blocked to prevent inter-trial carry-over effects. In total, there were 40 trials per participant. The order of blocked conditions was counterbalanced across participants. Each participant saw 2 different stimulus blocks, with each block containing 10 target faces at study and the 10 targets in 3/4 view plus 10 distracter faces in 3/4 view at test. Four sets of 10 faces were rotated across the conditions so that each set was used equally often as either targets or distracters for an equal number of participants. No single face appeared more than once for any given participant.

Results and Discussion

Signal Detection Analysis: Means and standard deviations for discrimination (*A'*), bias (*B''D*; Donaldson, 1992, 1993) and hit and false alarm proportions are presented in Table 1. For *A'*, a value of 0.5 indicates chance performance and a value of 1 indicates perfect performance. For *B''D*, values above 0 indicate a conservative bias and values below 0 a liberal bias. Performance was analyzed in a 2 (verbalization; control vs. description) x 2 (race of face; black vs. white) x 2 (face format at learning; intact vs. scrambled) x 2 (face format at recognition; intact vs. scrambled) mixed design ANOVA with verbalization and race within-participants and face format at learning and recognition between-participants in order to examine the influence of these factors on discrimination (*A'*) and response bias (*B''D*). Here, and in Experiment 2, only significant or marginally significant ($p<.08$) results are reported. Planned comparisons used the cells means tests procedure advocated by Toothaker (1993, pp74-78).

We observed independent influences of verbalization and the SRA on face discrimination. The benefit of verbalization on face discrimination was modulated by the nature of visual processing whilst learning faces. Verbalization benefited discrimination equally for both black and white faces and intact and scrambled faces, however these effects were dependent upon initially learning intact faces (they did not arise after learning scrambled faces). For *A'* there was a main effect of verbalization (.68 vs. .72, for control and description conditions), $F(1,44)=4.87$, $p<.05$, and a verbalization x face format at learning interaction, $F(1,44)=10.97$, $p<.005$ (which was not qualified by face format at recognition, $F<1$). Verbal facilitation arose for learning intact faces (.64 vs. .75, control and description conditions, $p<.005$) but not scrambled faces (.71 vs. .69, for control and description conditions). This suggests a role for verbalization in learning a configural representation which benefits face recognition. Importantly, the finding of facilitation from describing intact but not scrambled faces is inconsistent with a feature quantity account in which verbalization encourages a greater number of features to be attended to and stored during face learning (e.g., Bloom & Mudd, 1991; Winograd, 1978, 1981) because the same features were present in both intact and scrambled faces. Nor can encoding-specificity or transfer-appropriate-processing (TAP) explain the findings satisfactorily (e.g., Morris, Bransford & Franks, 1977; Tulving & Thompson, 1973). According to such accounts better performance results from a greater match between cognitive operations involved at the time of encoding and retrieval. Thus, one might propose that faces are normally processed configurally at recognition and thus learning the configuration of the face through verbalization provides a better match between learning and retrieval which benefits performance. However, this proposal quickly runs into difficulty as there was an equivalent benefit from verbalization of intact faces on subsequent recognition of both intact and scrambled faces and black and white faces. Furthermore, a number of studies examining the *levels-of-processing effect* on face recognition demonstrated initially by Bower and Karlin (1974) have failed to find strong support for either encoding-specificity or TAP accounts (e.g., Berman & Culter, 1998; Mueller & Wherry, 1980; Wells & Hryciw, 1984). Nevertheless, we note that there was some additional evidence consistent with these accounts; tested with scrambled faces performance was better when faces had been studied initially in scrambled as compared with intact format.

Verbalization benefited the learning and recognition of black and white faces equally and so produced general facilitation rather than, for instance, increased individuation of black faces in particular. Nevertheless, presumably verbalization of black faces alone would reduce the SRA and a 15s description of each black face would be a quick and efficient method of training in comparison with some other studies.

Concerning race, visual processing during both learning and recognition modulated the SRA. Learning intact faces led to the SRA for both intact and scrambled faces at recognition, with a larger SRA for recognizing intact faces. In contrast, learning scrambled faces resulted in an equivalent-sized SRA for both intact and scrambled faces at recognition. Once again, these findings are not consistent with either an encoding-specificity or transfer-appropriate processing account. Rather, they demonstrate that storing a configural as compared with a featural representation during learning increases the SRA at recognition and in addition the SRA is increased when processing both featural and configural information (in intact faces) as compared with primarily featural information alone (in scrambled faces). For A’, there was a main effect of race demonstrating the SRA (.62 vs. .78, for black and white faces), $F(1,44)=88.86$, $p<.001$ (and no interaction with verbalization, $F<1$).

There was also a race x face format at learning x face format at recognition interaction, $F(1,44)=5.27$, $p<.05$. We analysed this interaction further by conducting separate ANOVAs for learning intact and scrambled faces. For learning intact faces, there was a main effect of race, $F(1,22)=47.23$, $p<.001$, and a race x face format at recognition interaction, $F(1,22)=5.24$, $p<.05$. Pairwise comparisons showed the SRA at recognition for both intact (a black vs. white difference of .21, $p<.001$) and scrambled faces (a black vs. white difference of .10, $p<.01$) with a stronger SRA for intact faces. For learning scrambled faces, there was a main effect of race, $F(1,22)=41.94$, $p<.001$ (a black vs. white difference of .16) and this was equivalent for intact and scrambled faces at recognition (for the interaction, $F<1$).

A subsequent analysis of black and white faces separately showed that the pattern of findings described above was driven predominantly by memory for white faces. For *A'*, white faces, there was a verbalization x face format during learning interaction, $F(1,44)=11.70$, $p<.005$, with verbal facilitation only for learning intact faces (.72 vs. .84, for control and description conditions, $p<.01$). There was also a face format during learning x face format at recognition interaction, $F(1,44)=4.89$, $p<.05$, with the benefit for intact over scrambled face recognition arising from learning intact (.82 vs. .73, for intact vs. scrambled face format at recognition, $p<.05$) but not scrambled faces (.77 vs. .79, for intact vs. scrambled face format at recognition). For black faces there were no significant effects. As expected, performance on black faces was poorer than for white faces nevertheless recognition was significantly above chance (overall vs. .5 chance-level performance, $p<.005$).

Finally, consistent with previous studies, participants' responding was more conservative for the control as compared with the description condition and to white as compared with black faces (e.g., Brigham et al., 2007; Brown & Lloyd-Jones, 2005). We note that this contradicts a criterion shift explanation of the effect of verbalization which would predict that a verbal description would lead to more conservative responding (Clare & Lewandowsky, 2004). For *B''D*, there was a main effect of verbalization (.20 .v .08, for control and description conditions), $F(1,44)=6.30$, $p<.05$ and a main effect of race (-.02 vs. .31, for black and white faces), $F(1,44)=37.40$, $p<.001$ (for the interaction, $F<1$). For verbalization, performance was driven primarily by correct rather than false recognition (for intact faces at study, .52 vs. .67 hits and .33 vs. .28 false alarms for control and description conditions, respectively). For race, the findings follow the general *mirror effect* whereby same-race faces are more likely to be correctly recognized and less likely to be falsely recognized than other-race faces (Brigham et al., 2007). In addition, for visual processing, learning intact faces led to more conservative responding at recognition for intact as compared to scrambled faces. There was a main effect of face format at recognition (.25 vs. .04, for intact vs. scrambled conditions) $F(1,44)=6.85$, $p<.05$, and a face format at learning x face format at recognition interaction, $F(1,44)=6.54$, $p<.05$. Pairwise comparisons showed a significant difference between intact and scrambled faces arising from learning intact (.41 vs. -.005, for intact vs. scrambled face format at recognition, $p<.01$) but not scrambled faces (.09 vs. .09, for intact vs. scrambled face format at recognition).

Description Quality: We examined the nature of the descriptions in detail in order to determine whether (a) the race of the face influenced the verbal descriptions used to benefit face recognition; (b) there was an association between the quality of participants' descriptions and recognition performance. If verbal facilitation was mediated by a memory representation corresponding to verbal activity we would expect to observe such an association (e.g., Meissner, Sporer & Susa, 2008); and (c) verbalization failed to improve the learning of scrambled faces because participants were unaccustomed to seeing scrambled faces and so lacked the vocabulary with which to describe them adequately.

Three independent judges coded the descriptions for each participant for configural versus featural descriptors as well as the total amount of information that was generated for each face. Configural descriptors consisted of judgements concerning hair style, global face structure, face build, facial expression and gender (cf., O'Toole, Deffenbacher, Valentin & Abdi, 1994; Coin & Tiberghien, 1997). Featural descriptors consisted of judgements about isolated facial features including size or shape of chin, lips, nose, eyes, eyebrows, and forehead. Separate t-tests examined whether descriptions of black and white faces differed in terms of the three measures. To maximise power, we conducted these analyses on intact faces at study (combining intact-intact and intact-scrambled conditions) and scrambled faces at study (combining scrambled-intact and scrambled-scrambled conditions):

1. Intact faces. There was a greater number of descriptors for black than white faces [M=30.2, SD=5.6 vs. M=28.4, SD=5.5, respectively, across all participants and described faces, marginally non-significant at $t(23)=-1.98$,

p=.06]. For both black and white faces there was a greater proportion of featural than configural descriptors [black faces, M=.65, SD=.19 vs. M=.35, SD=.19, respectively, $t(23)=3.75$, $p<.001$; white faces, M=.56, SD=.14 vs. M=.44, SD=.14, respectively, $t(23)=2.15$, $p=.04$]. The proportion of configural descriptors was also greater for white than black faces [$t(23)=2.17$, $p=.04$].

2. Scrambled faces. There was an equal number of descriptors for black and white faces [M=25.2, SD=4.9 vs. M=27.1, SD=6.1, respectively, $t(23)=1.87$, $p=.07$]. For both black and white faces there was also a greater proportion of featural than configural descriptors [black faces, M=.76, SD=.13 vs. M=.24, SD=.13, respectively, $t(23)=9.45$, $p<.001$; white faces, M=.62, SD=.15 vs. M=.38, SD=.14, respectively, $t(23)=3.94$, $p<.001$]. The proportion of configural descriptors was also greater for white than black faces [$t(23)=4.99$, $p<.001$].

In addition, we examined the correlation between participants' description quality, that is the proportion of featural and configural descriptors and the total number of descriptors generated, and (1) discrimination performance in the description condition and (2) the amount of verbal facilitation (calculated by subtracting *A'* scores in the control condition from *A'* scores in the description condition; higher scores indicated greater verbal facilitation) separately for black and white faces. Once again, to maximise power we collapsed the data across test conditions. For intact faces, there were no significant correlations for either black or white faces (the strongest correlation was $r=-.32$, $p=.13$). For scrambled faces, an increase in verbal facilitation for black faces was correlated with an increase in the number of descriptors, $r=.56$, $p=.005$, and also an increase in the proportion of featural descriptors, $r=.45$, $p=.03$, and a decrease in the proportion of configural descriptors, $r=-.45$, $p=.03$. (Note, these contrasting effects arise because featural and configural descriptors are not independent; if verbal facilitation is positively correlated with the proportion of featural descriptors it must also be negatively correlated with the proportion of configural descriptors.) However, we should be cautious in our interpretation here given the very small amount of verbal facilitation observed after describing scrambled black faces which was non-significant in the main analyses.

Finally, we examined both the number and range of verbal descriptors for intact as compared with scrambled faces. First, overall there were more descriptors for intact ($M=29.3$, $SD=5.1$) than scrambled ($M=26.2$, $SD=4.8$) faces [$t(46)=2.17$, $p=.03$]. However, this difference was driven by the description of black faces in particular. There were more descriptors for intact ($M=30.2$, $SD=5.6$) than scrambled ($M=25.2$, $SD=4.9$) black faces [$t(46)=3.27$, $p=.002$]. In contrast, there was no difference for intact ($M=28.4$, $SD=5.5$) and scrambled ($M=27.2$, $SD=6.01$) white faces [$t(46)=.73$, $p=.47$]. Second, we examined the range of descriptors by counting the number of different descriptors used by each participant across all the faces they encountered in each of the main conditions (i.e., black intact, black scrambled, white intact, white scrambled). There was a broader range of descriptors for intact ($M=11.9$, $SD=2.6$) than scrambled ($M=9.9$, $SD=1.7$) black faces [$t(46)=3.17$, $p=.003$]. In contrast, there was no difference in the range of descriptors for intact ($M=12.1$, $SD=2.7$) and scrambled ($M=10.9$, $SD=2.9$) white faces [$t(46)=1.43$, $p=.16$]. In sum, there was a greater number and range of verbal descriptors applied to intact as compared with scrambled faces, however this was the case only for the description of black faces. Thus, verbalization may have failed to improve the learning of scrambled black faces because participants lacked the vocabulary with which to describe them adequately. However, this was not the case for learning scrambled white faces.

Experiment 2

One of the main findings from Experiment 1 was that both the benefit of verbalization and the SRA were not restricted to intact faces but extended to recognizing scrambled faces as well. This suggests that they influenced the processing of individual features as well as configurations. In Experiment 2, we examined the processing of individual features in more detail using eye movements to determine whether particular features in intact faces (a) mediated the effects of verbalization; (b) provided diagnostic cues for race-specific identification and (c) were important during learning or recognition.

Eye movements have been shown to play a functional role in learning new faces (Henderson, Williams & Falk, 2005). Furthermore, feature sampling is likely to be an important aspect of face learning even in tasks that engage configural processing (Henderson et al., 2001; Henderson, et al., 2005). For the recognition of same-race faces, there is evidence of a strong bias toward fixating internal facial features such as the eyes, nose and mouth (e.g., Althoff & Cohen, 1999; Henderson et al., 2001). In addition, the eye region in particular seems particularly salient (Henderson, Williams & Falk, 2005; Itier, Villate & Ryan, 2007; Sinha, Balas, Ostrovsky & Russell, 2006). Importantly however, eye movements are highly goal-directed and can vary according to contextual parameters (e.g., Heisz & Shore, 2008; Henderson, 2003; Schyns, Gosselin & Smith, 2008). They may be expected therefore to be influenced by verbalization, race and task. As described earlier, there have been few studies and they show either inconsistent or inconclusive findings (Blais et al., 2008; Bloom & Mudd, 1991; Goldinger et al., 2009). To our knowledge, no study has examined white participants' eye movements to black and white faces. More importantly, no study has examined the interplay between perceptual and attentional processing, higher order verbalization processes and face memory which is central to understanding the relationship between language and visual cognition.

Method

Participants

Twelve White British students from the University of Teesside took part in this experiment for a small payment. All were native English speakers with normal or corrected-to-normal vision.

Materials and apparatus

The same experimental stimulus set of 80 greyscale black and white faces were used in Experiment 2 as had previously been used in Experiment 1. The images were displayed at a size of 372(w) x 500(h) pixels in order to allow for accurate eye tracking capabilities as this size approximates that of viewing a real face. Each stimulus image subtended approximately 12.48°(w) x 16.72°(h) of visual angle, which is comparable with similar studies. Eye movements were recorded at a sampling rate of 500 Hz with the EyeLink II head-mounted eye-tracker (SR International) which has an average gaze position error of <.5°, a resolution of 1 arcmin and a linear output over the range of the monitor used. The dominant eye of each participant was tracked although viewing was binocular. For each stimulus a number of non-overlapping regions of interest (ROI) were defined corresponding with the principal facial features at learning and recognition (e.g., Henderson et al., 2001). Figure 2 displays the ROIs used for eye movement analysis during learning and recognition for a single black face. We thought it was important to keep the same image presentation as in Experiment 1 and so the area of each of the ROIs changed from study to test as the image changed from a full frontal to ¾ profile view. As a result, for learning there were 10 non-overlapping ROIs (chin, left cheek, left ear, left eye, mouth, nose, right cheek, right ear, right eye, top of head) and for recognition there were 9 non-overlapping ROIs (chin, left cheek, left ear, left eye, mouth, neck, nose, right eye, top of head).

Design and Procedure

Experiment 2 was identical to Experiment 1 with the following exceptions. First, intact faces were presented during learning and recognition and a 2 factorial design was employed with verbalization (control vs. description) and race of the face (black vs. white) as within-participants factors. Second, there were a number of additions to the procedure that were implemented to allow for eye tracking measures. Participants were seated at a viewing distance of 60cm in a dimmed room and a chin rest was used to maintain the participant's viewing position and distance. Each experimental session began with manual calibration of eye fixations using a nine-point fixation procedure implemented using EyeLink API software. The calibration was then validated or repeated until the optimal calibration criteria were achieved. The experiment then proceeded as detailed in the method of Experiment 1. The experimenter initiated the start of each trial once the participant had fixated to a circle presented at random either to the left or the right of the visual display. This was to ensure that the first saccade was an orienting one. Participants were informed that they were to fixate on the circle before each trial in order for the experiment to proceed and once they had done so the next stimulus image was displayed.

Results and Discussion

Signal Detection Analysis: Means and standard deviations for discrimination (*A'*), bias (*B''D*) and hit and false alarm proportions are presented in Table 2. Performance was analyzed in a 2 (verbalization; control vs. description) x 2 (race of face; black vs. white) ANOVA with verbalization and race within-participants.

In line with Experiment 1, verbalization and the SRA independently influenced face discrimination performance. Verbalization benefitted the learning and recognition of black and white faces equally. For *A'* there was a main effect of verbalization (.59 vs. .67, for control and description conditions), $F(1,11)=6.46$, $p<.05$. There was also a main effect of race demonstrating the SRA (.56 vs. .70, for black and white faces), $F(1,11)=11.54$, $p<.01$, and no interaction with verbalization ($F<1$). As with Experiment 1, the pattern of findings was driven predominantly by memory for white faces although recognition of black faces was above chance (overall vs. .5 chance-level performance, $p<.05$). Additionally, participants' responding was more conservative to white as compared with black faces. For *B''D*, there was a main effect of race (.10 vs. .44 for black and white faces), $F(1,11)=18.98$, $p<.001$. As can be seen in Table 2, the findings were driven strongly by the increased false identification of black faces.

Eye Movement Analysis: We analysed study and recognition trials that resulted in hits in order to ensure that comparisons were not confounded with recognition accuracy. To determine whether fixation patterns differed as a function of a particular manipulation we examined both fixations and fixation time, that is the proportion of trials in which each region of interest was fixated and also the proportion of total dwell time for each region of interest (Henderson, Williams & Falk, 2005). In addition, we examined the order of fixations in order to provide converging evidence on feature salience. The Greenhouse Geisser correction was adopted when the assumption of sphericity was violated (e.g., Mendoza, Toothaker & Crain, 1976). Planned comparisons used the cells means tests procedure advocated by Toothaker (1993, pp74-78). We also report effect sizes, estimated using partial eta-squared (η_p^2), which according to generally accepted criteria were large (Cohen, 1988; .01 = small; .06 = medium; .14 = large). As described in the Method, for full frontal views presented during learning there were 10 non-overlapping ROIs and for ¾ views presented at recognition there were 9 non-overlapping ROIs. This meant there were 8 ROI's shared across learning and recognition. In order to analyse all ROIs for both phases of the experiment and because different cognitive processes were likely at work during learning and recognition we report analyses of each phase separately. Nevertheless, the same general pattern of findings emerges if we analyse learning and recognition together using the 8 ROIs shared across both phases.

The main findings were clear-cut. First, influences of both verbalization and, independently, the SRA were apparent on eye movements when accurately recognizing faces. Second, the influence of verbalization on eye movements was tied to learning whereas the influence of race on eye movements was tied to recognition. Third, both verbalization and race influenced eye movements across all face regions. For verbalization, there were more fixations for the description as compared with the control condition. For race, there were more fixations for other-race as compared with same-race faces. Nevertheless, the most important features in mediating both of these effects were the eyes, nose and mouth. During learning, the eyes and mouth were the predominant mediators of effects of verbalization. For faces that were subsequently described as compared to the control condition, the eyes were associated with fewer fixations and less fixation time whereas the mouth was associated with more fixations and longer fixation time. Similarly, the nose was associated with more fixations. In contrast, during recognition the left eye and mouth were the predominant mediators of race (note, the right eye was only partially visible in the ¾ view). For same-race as compared to other-race faces the left eye was associated with a greater proportion of fixation time whereas the mouth was associated with fewer fixations and a lesser proportion of fixation time.

Learning

Proportion of Trials in Which Each Region of Interest was Fixated: Figure 3 shows that on almost every learning trial participants fixated the eyes (left eye .80, right eye .67), most participants also fixated the nose (.60) and a smaller proportion fixated the mouth (.38). Relatively small proportions of fixations were made to the remaining regions. Performance was analyzed in a 2 (verbalization; control vs. description) x 2 (race of face; black vs. white) x 10 ROI repeated measures ANOVA. Verbalization influenced eye movements overall, $F(1,11)=5.43$, $p<.05$, $\eta_p^2=.33$, with a greater proportion of fixations for the description as compared with control condition. In addition, verbalization was qualified by ROI. There was a main effect of ROI, $F(4,45)=38.74$, $p<.001$, $\eta_p^2=.78$, and a verbalization x ROI interaction, $F(9,99)=3.14$, $p<.005$, $\eta_p^2=.22$. Pairwise comparisons of the major ROIs, namely the eyes, nose and mouth, showed the following pattern. For both left and right eyes, there was a smaller proportion of fixations for the description as compared with the control condition (ps<.05). In contrast, for the nose and mouth the opposite pattern was evident with a larger proportion of fixations for the description as compared with the control condition (ps<.01).

Proportion of Total Dwell Time: Figure 4 shows a similar pattern to Figure 3, as proportionally more time was spent on the eyes (left eye .31, right eye .20), nose (.16) and mouth (.06) as compared with the remaining regions. Performance for each of the main ROIs was analysed in a separate 2 (verbalization; control vs. description) x 2 (race of face; black vs. white) repeated measures ANOVA. For the left eye, there was a main effect of verbalization, with less time for the description as compared with the control condition, $F(1,11)=9.09$, $p<.05$, $\eta_p^2=.45$. In contrast, for the mouth the opposite pattern was evident, there was a main effect of verbalization with more time for the description as compared with the control condition, $F(1,11)=13.88$, $p<.005$, $\eta_p^2=.56$.

Recognition

Proportion of Trials in Which Each Region of Interest was Fixated: Figure 5 shows that on almost every recognition trial participants fixated the left eye (.82) followed by the nose (.52) and mouth (.49). A relatively small proportion of fixations was made to the remaining regions (including the right eye, which is unsurprising given it was only partially visible in the ¾ view). Performance was analyzed in a 2 (verbalization; control vs. description) x 2 (race of face; black vs. white) x 9 ROI repeated measures ANOVA. Race influenced eye movements overall, $F(1,11)=7.02$, $p<.05$, $\eta_p^2=.39$, with a greater proportion of fixations for other-race as compared with same-race faces. In addition, race was qualified by ROI. There was a main effect of ROI, $F(4,42)=29.24$, $p<.001$, $\eta_p^2=.73$, and a race x ROI interaction, $F(4,41)=6.54$, $p<.001$, $\eta_p^2=.37$. Pairwise comparisons of the major ROIs, namely the left eye, nose and mouth, showed that for the mouth there was a smaller proportion of fixations for same-race as compared with other-race faces.

Proportion of Total Dwell Time: Figure 6 shows a similar pattern to Figure 5 as proportionally more time was spent on the left eye (.41), nose (.15) and mouth (.12) as compared with the remaining regions. Performance for each of these main ROIs was analysed in a separate 2 (verbalization; control vs. description) x 2 (race of face; black vs. white) repeated measures ANOVA. For the left eye, there was a main effect of race with a greater proportion of time spent on same-race as compared with other-race faces, $F(1,11)=60.25$, $p<.001$, $\eta_p^2=.85$. In contrast, for the mouth the opposite pattern was evident, there was a main effect of race with a greater proportion of time spent on other-race as compared with same-race faces, $F(1,11)=16.04$, $p<.005$, $\eta_p^2=.59$.

Order of Fixations: Tables 3 and 4 show the order of fixations for learning and recognition trials that resulted in correct recognition (i.e., hits). During learning, the vast majority of first fixations were to the left eye (.48), followed by the right eye (.19) and nose (.16). The majority of second fixations were to the nose (.23), right eye (.22) and left eye (.19). For verbalization, it is worth noting that for the description condition the majority of first fixations were to the left eye (.48) and the majority of second fixations were to the nose (.30). In contrast, for the control condition the majority of first fixations were to the left eye (.48) and the majority of second fixations were to the left (.22) and right (.29) eyes (for the nose the proportion was .16).

At recognition, the vast majority of first fixations were to the left eye (.55) followed by the nose (.13). The majority of second fixations were to the nose (.25) followed by the mouth (.21). The left eye (.43) and nose (.18) received the most final fixations prior to the recognition response. For race, it is of note that for both same- and other-race faces the vast majority of first fixations were to the left eye although the proportion was larger for same-race (.62) as compared to other-race faces (.49). For same-race faces the majority of second fixations were clearly to the nose alone (.25). In contrast, for other-race faces the majority of second fixations were to the nose (.26) and mouth (.28) equally.

Generally, there was an emphasis on the eyes, nose, and to a lesser extent the mouth, which is consistent with the salience of these regions observed in our previous analyses. Importantly, a ‘centre of gravity’ effect did not appear to strongly influence first fixations (i.e., saccadic endpoints frequently land on or near to the centre of gravity of the luminance distribution of all the elements in the display, e.g., Coren & Hoenig, 1972; Findlay, 1982). If this were the case, we would have expected the majority of first fixations to land in the nose region (for learning faces) or left cheek region (for recognizing faces) and they did not. Note also, if we normalize the data by taking into account region of interest size (i.e., by calculating the proportion of fixations divided by the proportion of the whole stimulus covered by particular region of interest) the main findings are unchanged.

General Discussion

We examined the locus of influences of verbalization and race on long-term memory for faces using converging evidence from behavioural and eye movement measures. Complementing previous research on verbal overshadowing, the primary issue was whether verbalization and the SRA could benefit face recognition independently or whether verbal facilitation modulated the SRA and vice versa. We also determined whether verbalization and the SRA were tied to different types of configural processing or instead provided a more general visual processing benefit on performance. In addition, we asked whether these beneficial effects on performance were localized primarily during face learning or recognition. Finally, through the examination of eye movement patterns we assessed whether particular features or sets of features mediated the effects of verbalization, provided diagnostic cues for race-specific identification and were important during learning or recognition. Let us first summarize the main findings:

1. Verbalization and the SRA each provided independent contributions to face recognition performance.

2. The benefit from verbalization was modulated by the nature of visual processing whilst learning faces. Verbalization benefited the recognition of both black and white and intact and scrambled faces. However, verbal facilitation arose only when describing visually intact faces during learning. This suggests a role for verbalization in encoding a configural face representation as such information was more available in intact as compared with scrambled faces. Indeed, the intact-scrambled difference has been taken as a hallmark of configural processing (e.g., Collishaw & Hole, 2000; Hayward et al., 2008; Schwaninger et al., 2002; Zhao & Hayward, 2010). Eye movement patterns indicated further that when learning intact faces there was greater sampling over all regions for describing as compared with not describing faces. In particular however, sampling of the eyes, nose and mouth appeared to play a major role in constructing a robust configural representation for subsequent recognition. These findings were driven predominantly by performance on white faces where we also observed better recognition of intact as compared with scrambled faces. For black faces there was no intact-scrambled difference suggesting they were processed primarily using a feature-by-feature strategy (Collishaw & Hole, 2000).

3. In contrast, the SRA was modulated by visual processing during both learning and recognition. Learning intact faces led to the SRA for both intact and scrambled faces at recognition with a larger SRA for recognizing intact faces. However, learning scrambled faces resulted in a similar SRA for recognizing both intact and scrambled faces. Thus, the size of the SRA was larger when encoding a configural representation and when both configural and featural information were available during recognition. When configural information was disrupted by scrambling and participants likely relied more on a serial feature-by-feature processing strategy the SRA was reduced but nevertheless still present. Here, eye movement patterns emphasized the importance of featural processing during recognition rather than learning. There was greater sampling across all regions for recognizing other-race faces. However, sampling of the left eye and mouth in particular played an important role in the recognition of black as compared with white faces.

Overall then, both verbalization and race influenced visual processing during face recognition. Nevertheless, in doing so they recruited independent processes. Let us now interpret the findings in more detail and discuss their broader theoretical significance.

Configural and Featural Processing

Verbalization enhanced configural processing during face learning. In addition, eye movement patterns suggested that verbalization encouraged a greater sampling of the regions around a small set of features, namely the eyes, nose and mouth, which led to the storage of a robust configural representation of the spatial relationships between those key features. One way in which this might have occurred was through extracting metric information on the relative distances between the eyes and nose (cf., Goffeaux & Rossin, 2007; Maurer, Le Grand & Mondloch, 2002). For instance, Goffeaux and colleagues have shown that detrimental effects of inversion on face processing are driven predominantly by disrupted processing of vertical as compared with horizontal spatial relationships between features (Goffeaux & Rossion, 2007; Goffeaux, Rossion, Sorger, Schlitz & Goebel, 2009). Here, the order of fixations during learning and describing faces emphasized the importance of a vertical downward trajectory from the eyes to the nose. In this way, verbalization enhanced the visual representation of each face in memory and as a consequence produced general facilitation in the recognition of both black and white and intact and scrambled faces. Feature sampling therefore appears to be an important aspect of face learning and relations amongst features are likely to be learned through foveal analysis (Henderson et al., 2001; Falk, Henderson, Hollingworth, Mahadevan & Dyer, 2000; Henderson, Williams & Falk, 2005). Importantly, our findings are not consistent with accounts based solely upon either featural or configural processing alone (e.g., Courtois & Mueller, 1979; Winograd, 1978, 1981). It was not the case that verbalization encouraged the encoding and storage of a greater range of facial features as argued by a number of authors (e.g., Bloom & Mudd, 1981; Winograd, 1978, 1981). Rather, verbalization encouraged greater sampling of a small set of features. The findings also argue against the notion that the extraction of configural information was supported solely by coarse information, for instance as provided by low spatial frequencies, rather than local featural information (cf., Goffeaux & Rossion, 2006; Oliva & Schyns, 2000; Sergent, 1986). Finally, the evidence can be explained by an alteration to visual processing and does not necessitate postulating the additional formation of richer semantic associations with the face in order to account for the effects of verbalization (e.g., Anderson & Reder, 1979; Bruce & Young, 1986; Schooler, Ryan & Reder, 1996).

Concerning race, we observed the SRA for both configural and serial feature-by-feature processing as indexed by the recognition of intact and scrambled faces, respectively. An analysis of eye movements also emphasized the importance of individual features. This confirms recent work, also using a recognition memory paradigm, which demonstrates that the SRA is due to a general facilitation across both configural and featural information (e.g., Hancock & Rhodes, 2009; Hayward et al., 2008). In addition, the SRA was stronger when a configural representation was encoded and when both featural and configural cues were available during retrieval. This is consistent with a stronger SRA arising from both configural processing during learning and engaging more than one kind of information as a retrieval cue. Importantly, whereas previous accounts have emphasized either learning or retrieval as the locus of the SRA, here we provide evidence of the importance of both (cf., Byatt & Rhodes, 2004; Goldinger et al., 2009; Levin, 1996, 2000; Sporer, 2001). An analysis of eye movements emphasized further the importance of retrieval in observing the SRA. Sampling particular feature locations around the left eye and mouth during recognition likely helped to encode those features in order to match input efficiently with a stored representation of the face.

Our findings on the SRA share both similarities and differences with recent eye movement studies which have employed Asian and Caucasian participants and faces. Goldinger et al. (2009) demonstrated the importance of face learning for observation of the SRA although they did not examine the SRA at recognition. They found that participants from both groups made fewer but longer fixations when encoding other-race faces as compared with same-race faces. In addition, for other-race faces participants attended more to the nose and mouth whereas for same-race faces they paid more attention to the eyes and hair. We did not find any eye movement evidence for an encoding-based SRA although we did find evidence at retrieval whereby participants made more fixations when recognizing other-race faces. The lack of an effect at encoding can be explained straightforwardly by a difference in design between the two studies. Goldinger et al., presented faces for 5s and 10s during learning and found that the increase in learning time exaggerated differences in eye movement patterns for the different race faces. Here, we presented each face for 2 seconds in order to replicate our original behavioural design from Experiment 1. We can be reasonably confident therefore that with an increase in encoding time we would have observed an SRA for eye movements during learning as well as recognition. For individual facial features we saw a similar pattern to Goldinger and colleagues. For the eyes, they observed proportionally more fixations for same-race faces and for the nose and mouth they observed more fixations for other-race faces (Goldinger et al., 2009, Figure 2). Similarly, although during recognition in our study, for the left eye we observed more fixations for same-race faces whereas for the nose and mouth we observed more fixations for other-race faces.

We should mention here that the study by Goldinger and colleagues used full frontal views during both learning and recognition. Face recognition was therefore equated with image recognition which, as they note, may not wholly reflect face recognition processes (e.g., Baddeley & Woodhead, 1983; Megreya & Burton, 2006; Sporer, 1991). We presented full frontal views during learning and ¾ profile views during recognition in order to ensure we were assessing face rather than image recognition. A consequence of this was that the right eye was only partially visible at recognition which would account for the relatively small number of fixations it received.

Finally, as described earlier, Blais et al. (2008) found that Caucasian participants attended mostly to the eyes and Asian participants mostly to the nose and mouth, for both Caucasian and Asian faces. To the extent that we replicated their study these findings were not observed. Goldinger et al. (2009) also failed to replicate this pattern and it is likely due a particular aspect of the Blais et al., design, namely that they presented faces expressing emotions and these facial expressions played a role in determining eye movements.

In sum, both effects of verbalization and the SRA were mediated by an alteration to visual processing. However, the influence of verbalization was restricted to face learning whereas the influence of race was evident during both learning and recognition. Effects of race were therefore more widespread throughout the recognition memory system than those of verbalization. Furthermore, although both verbalization and race engaged configural processing mechanisms their effects on performance were independent. This suggests that each recruited a different type of configural processing (e.g., Maurer et al., 2002; Schwaninger et al., 2003). Maurer et al., (2002) have demonstrated the separability of three forms of configural processing, namely (a) first order relations, the arrangement of the features with two eyes above a nose which is above a mouth; (b) holistic processing of the faces as a gestalt; and (c) second order relations, the encoding of subtle variations in the spacing of features. In the present study, it is likely that verbalization encouraged the processing of second-order relations, that is the encoding of fine distinctions in the distances between features. This would have enabled the on-line visual differentiation of a relatively large number of unfamiliar and highly visually similar stimuli. In contrast, whereas other-race faces were processed primarily by means of individual features, or a serial analysis of facial structures, same-race faces were likely processed in a holistic fashion. For instance, *the composite effect*, where the recognition of the upper half of a face is disrupted by a discrepant lower half relative to an isolated half-face, has been taken as a hallmark of holistic processing and is exaggerated for same- as compared with other-race face recognition (Michel et al., 2006b). This differential holistic processing or glueing together of features is most likely a by-product of prolonged visual experience with own-race faces.

Positive and Negative Effects of Verbalization

Of central importance, our findings on verbal facilitation and the SRA differ from those on verbal overshadowing and in particular the study by Fallshore and Schooler (1995) outlined in the Introduction. Fallshore and Schooler demonstrated that verbal overshadowing can modulate the SRA: verbal overshadowing was observed for same- and not other-race faces. In contrast, we have demonstrated verbal facilitation which is independent from the SRA and benefits equally the recognition of both same- and other-race faces.

There are two main accounts which have the potential to explain these complementary positive and negative effects of verbalization. The first is a single process account whereby verbalization shifts participants' visual processing orientation. Verbalization may produce either a more feature-based or more configural-based visual processing style depending on task constraints. Importantly, for the present findings, we are proposing a shift in visual processing which is tied to each individual face rather than a general shift in visual processing across all faces as proposed in previous accounts of verbalization (e.g., Schooler, 2002; see also Macrae & Lewis, 2002). The reason for this is that using the same paradigm, Brown and Lloyd-Jones (2005, Experiment 2) demonstrated verbal facilitation which was tied to the recognition of faces that had been previously described but not to faces intermingled with the described faces.

Developing this line of reasoning, the most apparent difference between our paradigm and that of Fallshore and Schooler is that here participants described each of a series of faces whereas in their paradigm participants described a single face following a series of to-be-remembered faces. In the present paradigm therefore, participants likely adopted a strategy of using the description process to enhance the visual processing of facial qualities that were unique to each face. For instance, by attending more to the particular spatial relationships between the eyes or eyes and mouth the distinctiveness of each face was enhanced in memory. Our finding that verbalization encouraged configural processing which benefited recognition is wholly consistent with this account. In contrast, when describing a single face after presentation of a series of faces in the verbal overshadowing paradigm participants may be more likely to adopt a visual processing strategy that emphasizes similarities across faces rather than their unique qualities. This in turn would have detrimental effects on performance in a recognition memory paradigm.

This account is plausible. Nevertheless, an added complexity is that there were other methodological differences between the present study and that of Fallshore and Schooler, namely stimulus encoding time (2s vs. 5s), the duration of the description task (15s vs. 5 mins) and the use of recognition versus line-up identification tasks.

Indeed, there is considerable variability in the methodology of studies in this research area. Of most relevance here, Meissner, Sporer and Susa (2008) investigated the role of the verbal description in influencing face recognition performance. They conducted a meta-analysis of the relationship between description and face recognition accuracy across 33 research articles and found evidence for a small but significant relationship between the description measures of accuracy, number of incorrect descriptors, and congruence (i.e., the similarity between a description and the face that was described) with that of recognition accuracy. Importantly, a number of variables moderated this relationship. Of particular interest, both an increasing number of targets and the use of a recognition rather than line-up identification task strengthened the magnitude of this relationship. Consistent with our account, Meissner and colleagues suggest that generating descriptions in a multiple-face recognition paradigm may provide individuals with the opportunity to create elaborate individuated encodings for each face which in turn help to preserve memory against interference from other faces. Finally, we note that whilst included as factors in their study there was no influence of either stimulus encoding time or duration of the description task.

The second account concerns a form of representational recoding (e.g., Brandimonte, Hitch & Bishop, 1992; Brandimonte & Collina, 2008; Huff & Schwan, 2008; Schooler & Engstler-Schooler, 1990). According to this view, verbally describing and memorizing a previously encountered face leads to the creation of a novel representation based on the verbal description. Depending on task constraints this novel representation may then either interfere with or facilitate retrieval of the initial visual representation of the face. In particular, Huff and Schwan (2008) found that when a verbal description followed an event (i.e., a video of a ball moving either away from or towards the observer) recognition performance decreased whereas when a verbal description preceded the event, recognition improved. They argued that reduced recognition arose from source confusion between the two representations whereas improved recognition was produced by participants using the verbal description to guide attention during the subsequent viewing of the event. In this way, the verbal description shaped the nature of the visual representation derived from the stimulus and a better match between the two representations benefited performance.

Huff and Schwan’s account does not fit well with the present findings as we observed verbal facilitation from a description which followed rather than preceded presentation of the face and according to their account we would have expected to observe verbal overshadowing. Moreover, on their account we might have expected an association between the content of the descriptions and performance (e.g., Chin & Schooler, 2008; Meissner et al., 2008). However, we found no association between either the number of descriptors or the proportion of featural or configural descriptors generated and either subsequent recognition or verbal facilitation of normally presented faces (although we did find a relationship for scrambled faces). For instance, there were more configural descriptors for white than black faces and yet verbal facilitation was equivalent for the different face types. Indeed, there has often been a weak and variable association between the contents of verbal descriptions and later attempts at identification which is problematic for a representational recoding account.

In conclusion, we have demonstrated independent influences of verbalization and race on configural processes recruited during face learning and recognition. These influences can be distinguished both behaviourally and through eye movement patterns and their effects are mediated by different types of configural mechanism. In particular, verbalization can increase sensitivity to second order relations; subtle variations in the spacing of the eyes, nose and mouth. More broadly, our findings support the notion that both positive and negative influences of verbalization can mediate perceptual processing in a flexible and yet fundamental way though shifting one's processing orientation towards either a particular face or a group of faces.

Notes

1. This type of information is also referred to as *holistic* in the literature on the basis that it cannot be decomposed into smaller units. For ease of exposition we are referring here to both kinds of information.

2. We acknowledge that there are other potential benefits of verbalization on performance but for reasons of space we do not develop them here. These include increased visual or verbal rehearsal (e.g., Sporer, 2007; Wogalter, 1996), encoding both visual and verbal information as compared with visual information alone (e.g., Paivio, 1971) and inducing a shift in response criterion (e.g., Clare & Lewandowsky, 2004; Sauerland, Holub & Sporer, 2008).

3. There is a limitation in this design namely the exclusive sampling of white participants. For full control of stimulus sets we would also need to examine black participants' recognition of black and white faces. Related to this, we note that Chiroro, Tredoux, Radaelli and Meissner (2008) have demonstrated that white and black may not be perceptually homogenous racial categories. They found that white South Africans showed a recognition advantage for white South African but not white U.S. faces and black South Africans showed a recognition advantage for black South African but not black U.S. faces. This suggests that the categories black and white are not homogenous and the SRA is ethno-geographically specific. Nevertheless, as we note in the main text the findings presented here were driven predominantly by performance on white faces and it is these that are of primary theoretical significance. Our main aim was to investigate the influence of verbalization on visual processes engaged during face recognition and to that end we examined performance on intact versus scrambled and own versus other-race faces during learning and recognition.

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Figures

Figure 1. Examples of a same-race scrambled face presented during learning (top) and recognition (bottom).

Figure 2. The regions of interest for an other-race face used for analysis of eye movements during learning (top) and recognition (bottom). The yellow lines were not visible during presentation.

Figure 3. Mean proportion of trials in which each region of interest (ROI) was fixated during learning as a function of verbalization and race.

Figure 4. Mean proportion of total dwell time on each region of interest (ROI) during learning as a function of verbalization and race.

Figure 5. Mean proportion of trials in which each region of interest (ROI) was fixated at recognition as a function of verbalization and race.

Figure 6. Mean proportion of total dwell time on each region of interest (ROI) at recognition as a function of verbalization and race.

Figure 1

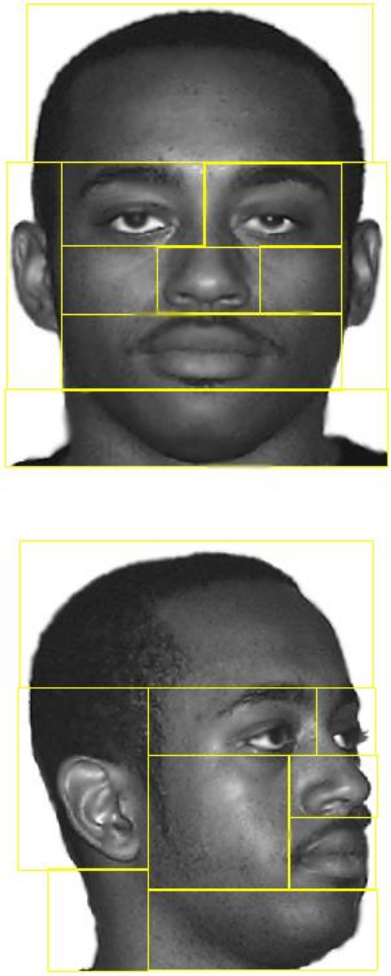
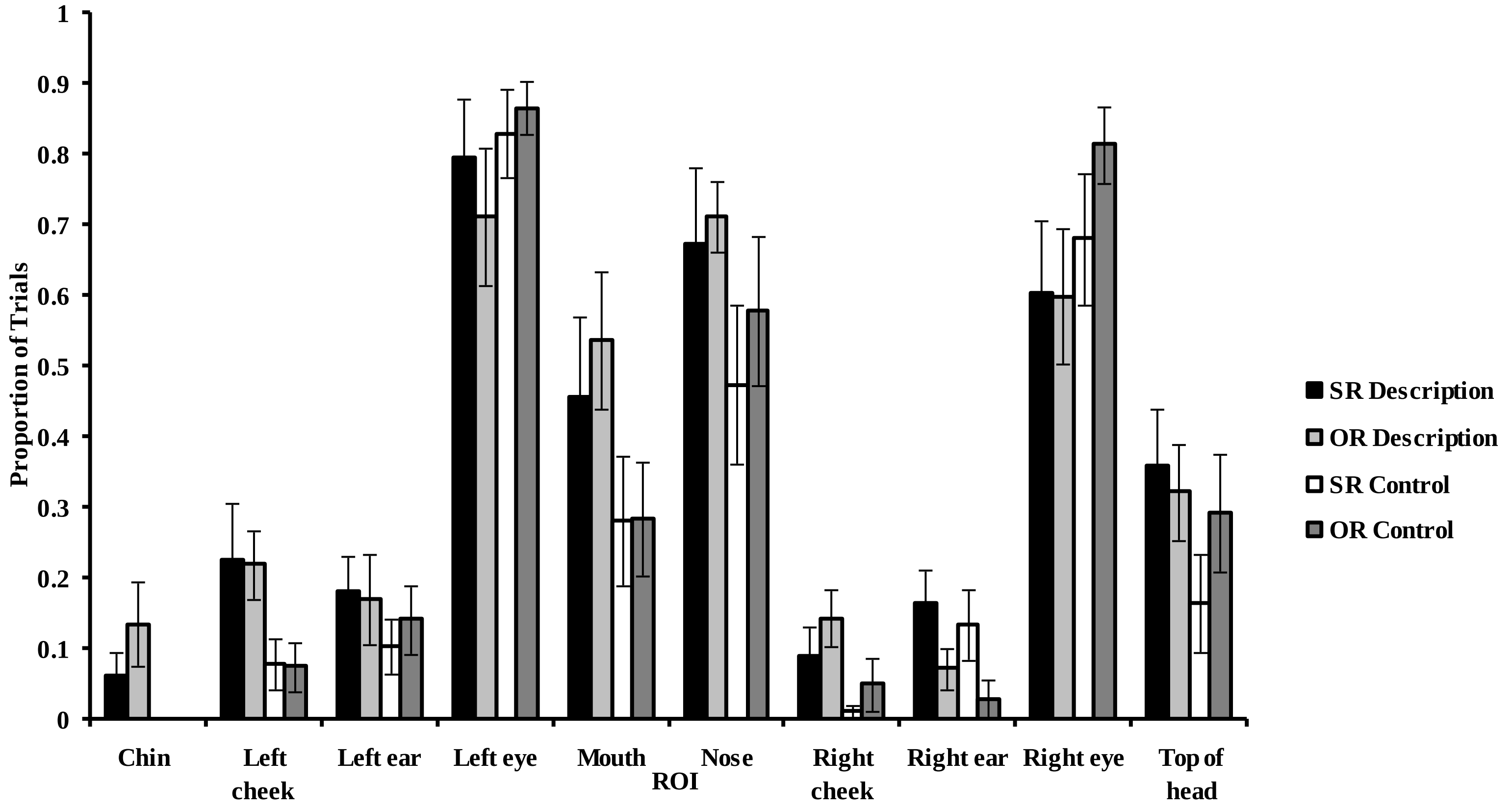
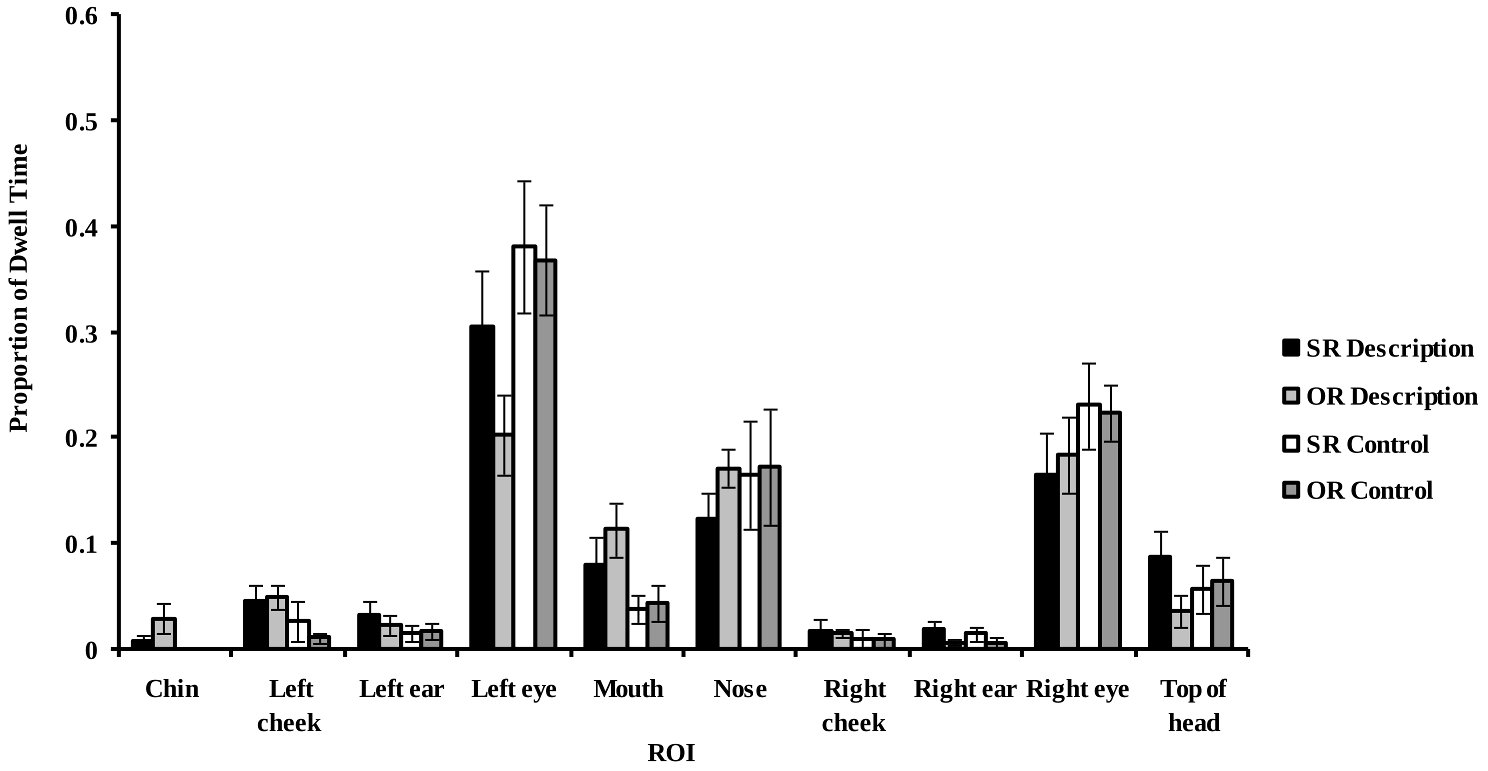


Figure 2



Proportion of Trials
1
0.9
0.8
0.7
0.6
0.5
0.4
0.3
0.2
0.1
0
Chin
Left cheek
Left ear
Left eye
Mouth
Nose
Right cheek
Right ear
Right eye
Top of head
ROI
SR Description
OR Description
SR Control
OR Control

Figure 3


0.6
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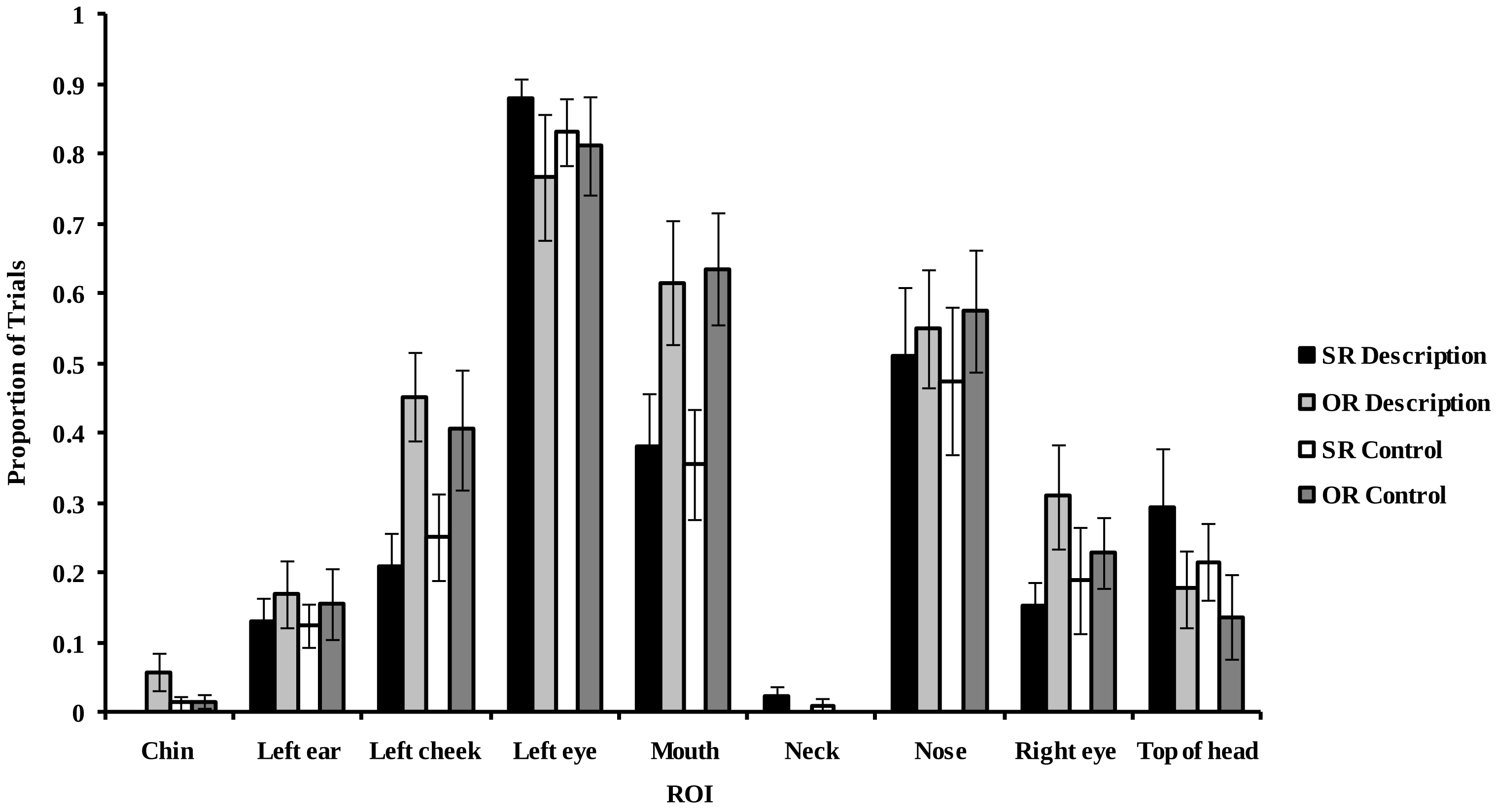
Proportion of Dwell Time
Chin
Left cheek
Left ear
Left eye
Mouth
Nose
Right cheek
Right ear
Right eye
Top of head
ROI
SR Description
OR Description
SR Control
OR Control

Figure 4


1
0.9
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0.7
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0.4
0.3
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0.1
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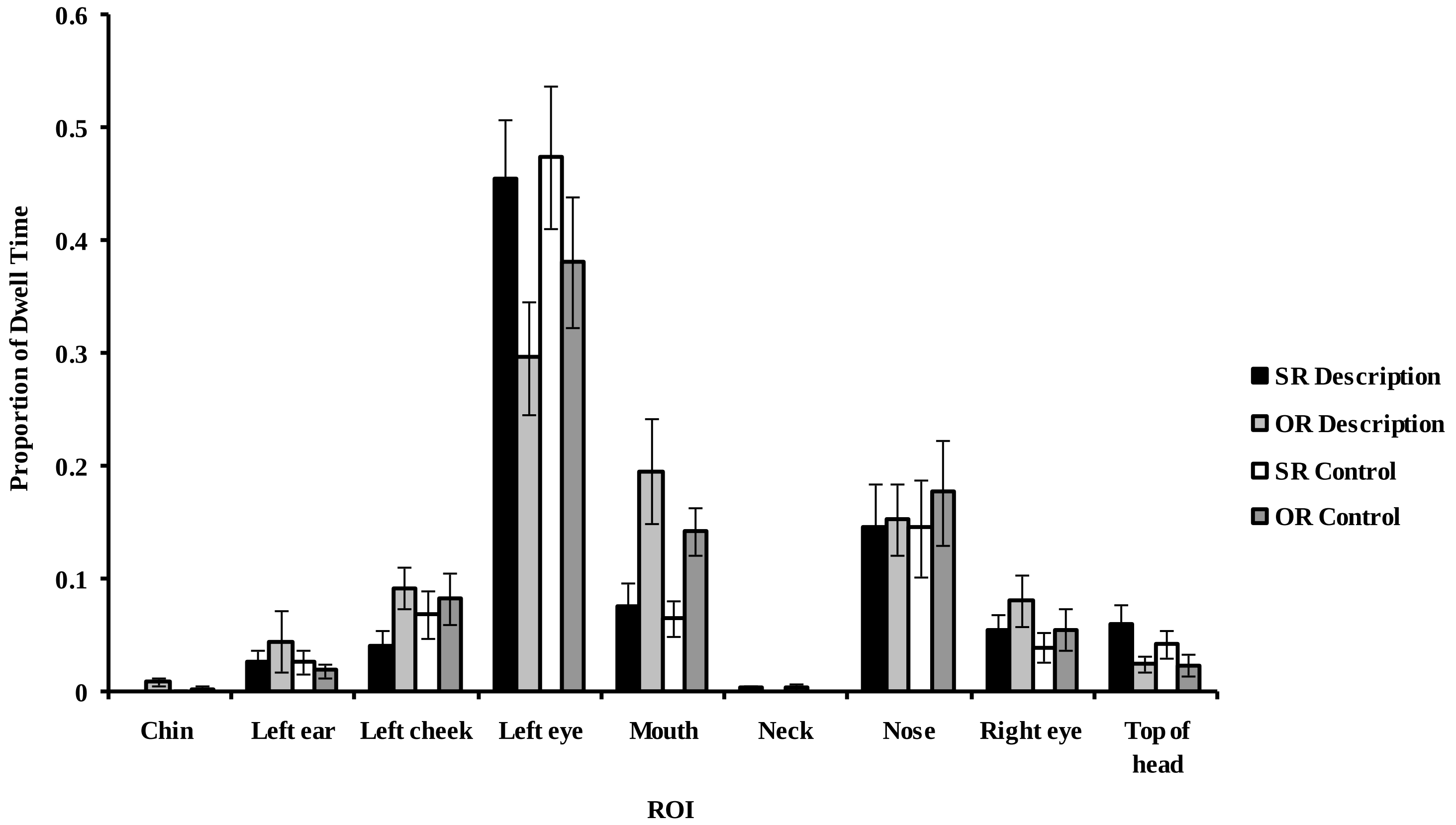
Proportion of Trials
Chin
Left ear
Left cheek
Left eye
Mouth
Neck
Nose
Right eye
Top of head
ROI
SR Description
OR Description
SR Control
OR Control

Figure 5


Proportion of Dwell Time
0.6
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0.2
0.1
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Chin
Left ear
Left cheek
Left eye
Mouth
Neck
Nose
Right eye
Top of head
ROI
SR Description
OR Description
SR Control
OR Control

Figure 6

Table 1: Experiment 1 Means and Standard Deviations for Discrimination (A'), Response Bias (B''D), Hits and False Alarms

	Black				White			
	Control		Description		Control		Description	
	M	*SD*	M	*SD*	M	*SD*	M	*SD*
Intact-intact (N=12)								
A'	.57	.12	.65	.14	.75	.12	.90	.08
B''D	.40	.27	.11	.35	.63	.34	.48	.46
Hits	.43	.12	.57	.11	.51	.11	.79	.10
False alarms	.35	.07	.36	.15	.18	.16	.10	.11
Intact-scrambled (N=12)								
A'	.56	.13	.69	.09	.69	.17	.77	.07
B''D	-.13	.36	-.22	.29	.14	.46	.19	.43
Hits	.57	.14	.68	.11	.59	.20	.65	.13
False alarms	.50	.10	.42	.09	.31	.15	.25	.11
Scrambled-intact (N=12)								
A'	.62	.14	.65	.11	.78	.12	.75	.11
B''D	.00	.35	-.06	.35	.25	.51	.17	.45
Hits	.57	.12	.61	.11	.65	.13	.64	.13
False alarms	.42	.13	.41	.11	.24	.16	.27	.14
Scrambled-scrambled (N=12)								
A'	.63	.11	.58	.17	.81	.12	.76	.08
B''D	-.09	.38	-.17	.54	.44	.48	.19	.35
Hits	.60	.13	.60	.11	.66	.13	.64	.12
False alarms	.44	.11	.50	.23	.18	.15	.26	.10

Table 2: Experiment 2 Means and Standard Deviations for Discrimination (A’), Response Bias (B’’D), Hits and False Alarms

	Black				White			
	Control		Description		Control		Description	
	M	*SD*	M	*SD*	M	*SD*	M	*SD*
A’	.53	.19	.60	.16	.65	.14	.75	.11
B’’D	.13	.35	.06	.37	.39	.36	.48	.27
Hits	.48	.12	.55	.15	.49	.17	.55	.09
False alarms	.44	.18	.39	.15	.28	.11	.21	.12

Table 3: Order of fixations during learning as a proportion of total fixation frequency, across regions of interest for same-race and other-race faces as a function of description or counting (in brackets).

Same-race Face Learning

Region of Interest	First Fixation	Second Fixation
Left eye	.53 (.50)	.18 (.26)
Right eye	.14 (.18)	.15 (.35)
Nose	.09 (.20)	.28 (.07)
Mouth	-	.09 (.10)
Chin	-	-
Left cheek	.11 (-)	.06 (.06)
Right cheek	.02 (-)	.03 (-)
Left ear	.03 (.01)	0 (.01)
Right ear	-	-
Top of head	.03 (.08)	.11 (-)
Other	.05 (.03)	.10 (.15)

Other-race Face Learning

Region of Interest	First Fixation	Second Fixation
Left eye	.43 (.46)	.16 (.18)
Right eye	.19 (.27)	.15 (.23)
Nose	.17 (.19)	.32 (.25)
Mouth	.01 (-)	.11 (.12)
Chin	-	-
Left cheek	.08 (1.67)	.10 (.03)
Right cheek	.03 (-)	0 (.01)
Left ear	-	.02 (-)
Right ear	-	.02 (-)
Top of head	.01 (.04)	.08 (.06)
Other	.04 (-)	.04 (.12)

Table 4: Order of fixations at recognition as a proportion of total fixation frequency, across areas of interest for same-race and other-race faces as a function of description or counting (in brackets)

Same-race Face Recognition

Region of Interest	First Fixation	Second Fixation	Last Fixation
Left eye	.64 (.60)	.12 (.12)	.39 (.48)
Right eye	.06 (.04)	.08 (.05)	.06 (.05)
Nose	.11 (.13)	.26 (.24)	.20 (.17)
Mouth	.01 (.02)	.13 (.16)	.13 (.09)
Chin	-	-	-
Left cheek	.11 (.12)	.03 (.08)	.04 (.04)
Ear	.01 (.04)	.02 (.01)	.03 (.04)
Neck	.01 (-)	.01 (.01)	.01 (-)
Top of head	.03 (.02)	.13 (.07)	.07 (.08)
Other	.02 (.03)	.22 (.26)	.07 (.05)

Other-race Face Recognition

Region of Interest	First Fixation	Second Fixation	Final Fixation
Left eye	.48 (.50)	.14 (.11)	.39 (.48)
Right eye	.01 (.03)	.13 (.09)	.07 (.07)
Nose	.16 (.13)	.23 (.29)	.18 (.16)
Mouth	.02 (.02)	.28 (.29)	.13 (.11)
Chin	.01 (-)	.00 (-)	.02 (-)
Left cheek	.25 (.23)	.08 (.06)	.06 (.06)
Ear	.06 (.05)	.02 (-)	.02 (.01)
Neck	-	-	-
Top of head	-	.02 (.02)	.05 (.04)
Other	.01 (.04)	.10 (.13)	.07 (.06)