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Dissociating positive and negative influences of verbal processing on the recognition of pictures of faces and objects

Kazuyo Nakabayashi[1], A. Mike Burton[2], Maria A. Brandimonte[3], and Toby J. Lloyd-Jones[4]

[1]University of Hull, UK
[2]University of Aberdeen, UK
[3] Suor Orsola Benincasa University, Italy
[4]Swansea University and the Wales Institute of Cognitive Neuroscience, UK

Address correspondence to

Kazuyo Nakabayashi
Department of Psychology,
University of Hull,
Cottingham Road,
Hull,
Hull 6 7RX,
UK

Email: K.Nakabayashi@hull.ac.uk
Tel: +44 (0)1482 46 2056
Fax: +44 (0)1482 46 5599

Abstract

Four experiments investigated the role of verbal processing in the recognition of pictures of faces and objects using an adapted picture recognition memory paradigm. We used: (a) a *stimulus-encoding* task where participants learned sequentially presented pictures in control, articulatory suppression, and describe conditions and then engaged in an old-new recognition test; and (b) a *post stimulus-encoding* task where participants learned the stimuli without any secondary task and then either described or not (in the control condition) a single item from memory prior to the recognition test. The main findings were as follows. First, verbalization influenced picture recognition. Second, there were contrasting influences of verbalization on the recognition of faces as compared with objects which were driven by (a) the stage of processing during which verbalization took place (as assessed by the stimulus-encoding and post stimulus-encoding tasks); (b) whether verbalization was sub-vocal (whereby one goes through the motions of speaking but without making any sound) or overt; and (c) stimulus familiarity. During stimulus-encoding there was a double dissociation whereby sub-vocal verbalization interfered with the recognition of faces but not objects whilst overt verbalization benefited the recognition of objects but not faces. In addition, stimulus familiarity provided an independent and beneficial influence on performance. Post stimulus-encoding, overt verbalization interfered with the recognition of both faces and objects and this interference was apparent for unfamiliar but not familiar stimuli. Together these findings extend work on verbalization to picture recognition and place important parameters on stimulus and task constraints which contribute to contrasting beneficial and detrimental effects of verbalization on recognition memory.

Keywords: Picture recognition, face recognition, object recognition, verbal overshadowing, language

In recent years, there have been a number of studies investigating either positive or negative effects of verbally describing a stimulus on subsequent recognition, particularly in the area of face recognition research (for reviews, see Brown & Lloyd-Jones, 2005; Chin & Schooler, 2008; Meissner, Sporer, & Susa, 2008; Schooler, 2002). In contrast, we focus on picture recognition and examine both beneficial and detrimental effects of verbal processing on the recognition of two classes of stimuli, faces and objects, in order to understand more fully the different roles that verbalization may play in the process of recognizing pictures. The theoretical impetus for this research comes from recent suggestions that the influence of verbalization on visual memory may be a flexible and multifaceted phenomenon arising from different sources (e.g., Chin & Schooler, 2008; Lloyd-Jones, Brandimonte, & Bäuml, 2008; Meissner, Sporer, & Susa, 2008). The goal of the research is to provide a more comprehensive view of the effects of verbal processing on recognition memory.

In the following section we first provide an overview of the findings on facilitative versus interfering effects of verbalization on recognition. Next, we outline the rationale for investigating these effects in a picture recognition task. We then discuss the main focus of the present study which is a comparison of the effects of verbalization on processing faces as compared with objects, in particular *buildings.* Finally, we describe what we consider to be three important factors in determining whether facilitation or interference is observed: (a) the stage in processing during which verbalization takes place - either during encoding of each stimulus, *stimulus-encoding*, or after the learning phase in which all the stimuli have been encoded, *post stimulus-encoding*; (b) the use of sub-vocal verbalization (whereby one goes through the motions of speaking or perhaps forms a detailed motor plan for speech movements but without making any sound) versus overt verbalization; and (c) stimulus familiarity.

Facilitation and Interference from Verbalization on Visual Recognition

A number of studies have demonstrated that describing one's memory of an individual face can benefit subsequent recognition (for an overview, see Brown & Lloyd-Jones, 2005). For instance, Brown and Lloyd-Jones (2005, 2006) asked participants to view and, once the image was removed, write down a description of each of a number of briefly presented faces. This learning phase was followed immediately by a recognition test in which participants discriminated the original faces from the same number of distractors in making an old-new recognition judgment. The main finding was that producing a description of each face facilitated recognition memory in comparison to a control group with no description. This phenomenon appears robust as it has been replicated under a number of conditions including using global descriptions (i.e., descriptions of personality, weight, and face shape) and local feature descriptions (i.e., descriptions of isolated facial features) and describing either similarities or differences between pairs of faces. Verbalization in this paradigm appears to increase visual (Nakabayashi, Lloyd-Jones, Butcher, & Liu, in press) and semantic (Brown, Gehrke, & Lloyd-Jones, 2010) distinctiveness in memory.

In contrast, verbal interference on recognition has been reported in relatively more studies (e.g., Dodson, Johnston, & Schooler, 1997; Fallshore & Schooler, 1995; Schooler & Engstler-Schooler, 1990). Typically, these studies have demonstrated that describing a face from memory can impair recognition and this finding, termed *verbal overshadowing*, extends to a variety of memory-types including visual (Brandimonte & Collina, 2008), event (Huff & Schwan, 2008), voice (Perfect, Hunt, & Harris, 2002), and taste memory (Melcher & Schooler, 1996). In the original study by Schooler and Engstler-Schooler (1990) participants watched a video of a staged crime and subsequently either wrote down a description of the suspect or engaged in a filler activity. The participants were then asked to identify the suspect from a line-up. The results were clear-cut, with those in the description condition performing more poorly than the control group. In investigating verbal overshadowing, the majority of researchers have used the Schooler and Engstler-Schooler paradigm in which a single face is described and then tested for recognition. Nevertheless, Brown and Lloyd-Jones (2002, 2003) have observed similar interference using a paradigm in which participants first viewed a series of to-be-learnt faces and then described (or not, in a control condition) an additional face from memory (i.e., after it had been removed from view). In this case, a single description of the memory of a face was sufficient to verbally overshadow the set of learned faces and so verbalization produced poorer recognition for a relatively large number of non-described faces.

Several explanations have been offered for verbal overshadowing since its discovery in 1990. Most recently, Chin and Schooler (2008) classified these different explanations as *content*, *criterion shift* and *processing shift* accounts. First, the content account proposes that the generation of a verbal description re-writes the original visual memory into a less optimal verbal form which then interferes with access to the original memory which is crucial for successful recognition. However, this account falls short when trying to understand how describing a single face from memory can lead to a decrement in recognition for other non-described faces (e.g., Brown & Lloyd-Jones, 2002, 2003; see also Dodson, Johnson, & Schooler, 1997; Westerman & Larsen, 1997). Moreover, if description content was responsible for reduced recognition then one would expect that those who generate a more accurate and detailed description would be more likely to recognize the described face. However, a number of studies have failed to show a correlation between description quality and recognition accuracy (e.g., Brown & Lloyd-Jones, 2002, 2003; Kitagami, Sato, & Yoshikawa, 2002; although see Brandimonte & Collina, 2008; Meissner, Sporer, & Susa, 2008).

Second, Clare and Lewandowsky (2004) have proposed a criterion shift account whereby verbalization produces a shift in recognition criterion towards more conservative responding (see also Meissner, 2002; Sauerland, Holub, & Sporer, 2008). As a consequence, participants can be less likely to choose a target from a line-up after generating a description of a face. One problem with the criterion shift account is that a number of studies have failed to observe a change in response criterion (e.g., Brown & Lloyd-Jones, 2002, 2003).

Finally, the processing account proposes that the generation of a verbal description of a face produces a shift in processing modes between learning and test from visually-based, global processing to more verbally-based, featural processing (see Schooler, 2002). The argument here is that verbalization provokes a shift towards verbally-based featural processing, as featural information in the face is more easily described in words, at the expense of global visually-based processing which is assumed to be essential to successful face recognition. Importantly however, although this account has been supported by a number of studies (e.g., Fallshore & Schooler, 1995; Macrae & Lewis, 2002; Melcher & Schooler, 2004) it is based on the premise that faces are visual stimuli that cannot be adequately described in words and this neglects the potential involvement of verbal processes in normal face processing as well as the possibility of verbal processes having a positive effect on performance. Indeed, consistent with this idea two studies have demonstrated that articulatory suppression (e.g., continually repeating the sound *la*) which is presumed to block the articulatory verbal rehearsal process in working memory (e.g., Baddeley & Hitch, 1974) interferes with face learning. This suggests that sub-vocal verbal processing may be beneficial for face recognition (Nakabayashi & Burton, 2008; Wickham & Swift, 2006).

In sum, there is relatively little work on verbal facilitation and it is also apparent that verbal overshadowing can arise from multiple sources which as yet are unclear. No single explanation is sufficient to accommodate all the findings that have been reported. Here, we provide an important test of accounts of verbal facilitation and verbal overshadowing in a picture recognition task.

Picture Recognition

The dominant procedure in studies of face recognition has been to present a series of photographs of faces in a full frontal view for study and then test recognition of those same faces but now in a three-quarter view and mixed with faces of different individuals which were not in the study set, also in a three-quarter view. The general idea is that recognition of facial identity across image transformations is important and ecologically valid (e.g., Baddeley & Woodhead, 1983; Sporer, 1991). However, the role played by *pictorial information*, whereby participants rely on specific surface features of the face or photograph (such as luminosity, texture or color values) has often been overlooked. Nevertheless, it is becoming increasingly clear that such information is important for both face and object recognition (e.g., Bruce, 1982; Hayward, 2003; Liu & Ward, 2006). In particular, Longmore, Liu and Young (2008) found that recognition accuracy for unfamiliar faces was always highest for the image that was studied initially, with performance falling across luminosity and viewpoint transformations between study and test. Moreover, this remained the case even after the studied picture had become highly familiar during the course of the experiment. Thus, even after multiple exposures invariant information about the face had not been extracted, instead recognition depended on image-specific information. This suggests that understanding pictorial processing may be the key to understanding the fundamental mechanisms supporting the accomplishment of face and object recognition. We were interested to know therefore whether verbalization would influence picture recognition in a task that focused on pictorial information which distinguishes between two different pictures with the same identity. Hence, we used identical pictures for learning and recognition with distractors which were different instances of the same item (for instance, a photograph of the same person but taken at a different time and with a different camera).

On a related note, a major difference between previous studies of verbal facilitation and verbal overshadowing is that many studies of verbal facilitation have used identical images from study to test (e.g., Kerr & Winograd, 1982; Klatzky, Martin, & Kane, 1982; Wiseman, MacLeod, & Lootsteen, 1985) whereas almost all studies of verbal overshadowing have used different views of the same face from study to test. Thus, there is often a confound between the positive and negative influences of verbalization and the nature of the images presented during study and test. Furthermore, studies on verbalization have used primarily unfamiliar faces which may exaggerate this problem as they are represented by visual descriptions which are susceptible to image variations (e.g., Hancock, Bruce, & Burton, 2001; Liu & Ward, 2006).

Factors Influencing The Effects of Verbalization on Picture Recognition

The main focus of the present study is a comparison of the effects of verbalization on processing faces as compared with objects, in particular *buildings*. There is continuing debate as to whether faces and objects recruit distinct perceptual systems (e.g., Germine, Cashdollar, Duzel, & Duchaine, 2011; McGugin & Gauthier, 2010; Williams, Willenbockel, & Gauthier, 2009). On the one hand, neuroimaging, neuropsychological, and behavioural studies support a distinction between face and object recognition (e.g., Gauthier et al., 2000; Riddoch, Johnston, Bracewell, Boutsen, & Humphreys, 2008; Spiridon & Kanwisher, 2002). For instance, there are cortical regions that respond preferentially to faces (e.g., Kanwisher, McDermott, & Chun, 1997; Moeller, Friewald, & Tsao, 2008) and face processing can be selectively disrupted by transcranial magnetic stimulation (Pitcher, Charles, Devlin, Walsh, & Duchaine, 2009). Moreover, face recognition appears to depend more on holistic or configural processing (e.g., Avidan, Tanzer, & Behrmann, 2011; Robbins & McKone, 2007; but see Gauthier & Bukach, 2007) whereas object recognition may depend more on feature-based information (e.g., Biederman, 1987). On the other hand, effects of perceptual expertise have been used to argue against functional specialization for faces (e.g., Diamond & Carey, 1986; Gauthier & Tarr, 2002; Rossion, Kung, & Tarr, 2004). The general idea is that the processes and neural substrates of face recognition are not unique to faces but instead reflect perceptual expertise in recognizing stimuli at the subordinate level of individual people: if expertise is acquired for stimuli other than faces then similar processes and neural regions may be recruited. A review by McKone, Kanwisher, and Duchaine (2007) has challenged the expertise hypothesis on the basis that the effects are inconclusive and holistic or configural processing of faces is not a result of expertise. Nevertheless, a number of recent studies have since reinforced the original position (e.g., Curby, Glazek, & Gauthier, 2009; McGugin & Gauthier, 2010; Wong, Palmieri, & Gauthier, 2009).

Here, we propose that face recognition can be particularly challenging because faces constitute a highly visually homogenous category (e.g., Damasio, Damasio, & Van Hoesen, 1982; Gauthier, Behrmann, & Tarr, 1999; although see Busigny, Graf, Mayer, & Rossion, 2010). Faces are comprised of very similar features in the same general configuration whereas for most other categories of object this is not generally the case. This may be why face recognition is particularly sensitive to processing subtle differences in the spatial relationships between features

(Maurer, Le Grand, & Mondloch, 2002; Tanaka & Farah, 1993; Tanaka & Sengco, 1997). Moreover, faces are also the only category where we usually need to individuate members quickly and accurately in order to enable social interaction. For other visually homogenous categories (such as *car* or *cat*) basic-level categorization is usually sufficient (Rosch, 1975). Nevertheless, it is also possible that when the recognition of objects makes similar demands to face recognition involving discrimination within a set of items sharing the same overall shape and as observers increase their perceptual experience in differentiating between members of a particular category, the representational processes involved may become more similar for the two categories (Bruce & Humphreys, 1994).

For these reasons, we suggest that verbalization may influence face and object recognition in a flexible manner, either positively or negatively and in similar or different ways, depending on particular stimulus and task constraints. To date, no study has compared the effects of verbal facilitation on faces and objects. Concerning verbal overshadowing, two studies have compared face and car recognition however their findings are inconsistent. Using the standard verbal overshadowing paradigm of Schooler and Engstler-Schooler (1990) and Westerman and Larsen (1997) found that describing both faces and cars, in a video showing a man breaking into the car, interfered with recognition of the perpetrator's face but failed to influence recognition of the car. In contrast, using a paradigm in which a large number of faces were tested for recognition, Brown and Lloyd-Jones (2003) found that describing one's memory of a single face after the learning phase interfered with the subsequent recognition of both faces and cars. In the Westerman and Larson study, the lack of verbal interference on car recognition was likely due to the ease with which a single image of a car could be recognized on the basis of distinctive features. In contrast, the Brown and Lloyd-Jones paradigm encouraged a relatively large number of faces and cars to be processed similarly: in both cases a number of stimuli had to be differentiated within a set of items which shared the same overall shape and a number of features. In addition, over the course of the experiment participants increased their perceptual experience in differentiating between cars. These two aspects of the paradigm meant that the recognition of cars made similar demands to face recognition and so the visual processes involved were similar and as a consequence verbalization had similar effects on face and car recognition.

In the present study, we examined whether verbalization could have contrasting positive and negative influences on the processing of faces and buildings in an adapted picture recognition paradigm. We expected to observe a dissociation between these two stimulus classes which was influenced by: (a) the stage in processing during which verbalization took place, either during stimulus-encoding or post stimulus-encoding; (b) the use of sub-vocal versus overt verbalization; and (c) stimulus familiarity (i.e., familiar vs. unfamiliar faces and buildings). Let us first outline our hypotheses concerning faces and buildings in the stimulus-encoding task.

Verbalization During Stimulus-encoding

Nakabayashi and Burton (2008) studied the effects of verbal processing during stimulus-encoding in an unfamiliar face recognition task which examined recognition across changes in viewpoint. They presented three conditions: articulatory suppression (i.e., continually repeating the sound *la*), a description task (i.e., describing the face aloud) and a control task (i.e., desk tapping). Articulatory suppression reduced recognition accuracy as compared with description and control conditions. This suggests that sub-vocal verbal processing is normally engaged during face encoding (see also Pelizzon, Brandimonte, & Favetto, 1999; Wickham & Swift, 2006). Is sub-vocal verbal processing also engaged during the visual encoding of buildings? It is possible. Nevertheless, we suggest that because buildings are likely to be less difficult to discriminate visually than faces they may also be less likely to recruit sub-vocal verbalization processes during encoding. If this is correct, we would expect to observe weaker effects of articulatory suppression on recognition for buildings as compared with faces. Importantly however, for overt verbalization during stimulus-encoding the situation is likely to be different. In the case of faces, overt verbalization may not help face encoding because sub-vocal verbal processing is normally invoked and so an overt description either provides no additional benefit or the process of self-generating an overt description actively interferes with sub-vocal processing. In contrast, if buildings do not normally invoke sub-vocal processing to the same extent as faces there is less likely to be conflict between sub-vocal and overt verbalization and so overt verbalization may be optimised to benefit task performance.

Turning to the notion of familiarity, it is clear that the processing of familiar (i.e., faces of people we know, including famous people, friends, and family) and unfamiliar faces (i.e., faces of strangers) is qualitatively different (Bruce & Young, 1986; Burton & Bruce, 1993) and this is likely to be the case for buildings as well. Familiar faces have pre-existing representations which comprise visual and semantic information acquired through repeated exposure to different instances of the face. In contrast, the representation of unfamiliar faces appears to be limited to visual descriptions (e.g., Hancock, Bruce, & Burton, 2001; Liu & Ward, 2006). For instance, the recognition or matching of unfamiliar faces is particularly error prone even when the pictures are of high quality (e.g., Henderson, Bruce, & Burton, 2001). How might the effects of verbalization during stimulus-encoding differ according to one's familiarity with faces and buildings? Using a paradigm in which the overt verbalization of face memories was assessed, that is participants wrote a description of each face after it had been removed from the display, Brown et al (2010) found that verbal facilitation was stronger for unfamiliar than familiar faces. On this basis, they argued that verbalization benefited recognition through the association of visually-derived semantic information which enhanced facial distinctiveness in memory: this information was particularly useful for unfamiliar faces whereas similar information was already available for familiar faces. If this is the case here, we might expect greater verbal facilitation for unfamiliar faces and buildings as compared with familiar exemplars of these categories. Moreover, if it is the case that faces are more difficult to discriminate visually, the benefit of verbalization for unfamiliar stimuli may be greater in the case of faces as compared with buildings.

These proposals are reasonable. However, our study examines verbalization during a stage of processing when the stimulus is still present in the display rather than participants describing their memory of the stimulus as in Brown et al (2010). This is an important difference between the two studies. In our case, it is possible that verbalization and familiarity exert independent influences on recognition because their effects are localized in different stages of processing. Verbalization may influence visual processing (e.g., Nakabayashi, Lloyd-Jones, Butcher, & Liu, in press; Winograd, 1981; Wells & Hryciw, 1984) whilst the benefit of familiarity arises from accessing stored semantic information (e.g., Burton & Bruce, 1993). If this is correct, we would expect to observe independent effects of verbalization and familiarity on recognition performance.

Verbalization Post Stimulus-encoding

For verbalization which takes place after all the stimuli have been learned we expect to observe a different pattern of findings, namely similar effects of verbal overshadowing on the recognition of both faces and buildings. In a recognition paradigm where many stimuli are processed, as here, over the course of the experiment participants will gain experience in differentiating between buildings and so the recognition of objects may begin to make similar demands to face recognition. The consequence will be that, as with faces, participants become sensitive to processing subtle differences in the spatial relationships between features. Verbal overshadowing then arises in this task because an overt description of a memory of a face or building shifts an individual's orientation towards a less optimal visual or semantic processing strategy (Brown & Lloyd-Jones, 2002, 2003).

Concerning stimulus familiarity, it is not immediately apparent from any of the major accounts of verbal overshadowing, namely the content, criterion shift, and processing shift accounts, how familiarity might influence performance in the post stimulus-encoding task. We will consider these accounts in detail following Experiment 4. Nevertheless, we have stressed the importance of flexibility and experience in determining the influence of verbalization on picture recognition and the notion of expertise in particular can be developed to hypothesize how familiarity may influence performance. Schooler and colleagues have proposed that a number of findings on verbal overshadowing reflect a conflict between verbal and nonverbal processes: verbal overshadowing can arise when participants draw on verbal knowledge at the expense of nonverbal knowledge (Fallshore & Schooler, 1995; Melcher & Schooler, 1996, 2004). From this general account it follows that, when an individual's perceptual expertise is more highly developed than their semantic expertise, under certain conditions verbalization may shift processing from a perceptual to a less optimal semantic processing strategy resulting in verbal overshadowing. In contrast, when the two kinds of expertise are more in balance the influence of verbalization will not be as harmful. On this basis, we expect that unfamiliar faces and objects will be more vulnerable to verbal overshadowing than familiar faces and buildings because, as we have described, the evidence suggests that the representation of unfamiliar faces and buildings is limited to visual descriptions whereas the representation of familiar faces and buildings also comprises associated semantic and verbal information. If this proposal is correct, we will have specified more precisely the nature of the processes which can give rise to verbal overshadowing for faces and other kinds of object.

In sum, across 4 experiments we expect to observe a dissociation in the effects of verbalization on recognizing pictures of faces and buildings. In doing so, the research will place important parameters on the mechanisms which govern effects of verbalization on picture recognition across the different domains and reconcile the different theoretical explanations of verbal facilitation and verbal overshadowing. Experiments 1 and 2 examine the influence of verbalization on faces and objects during stimulus-encoding and Experiments 3 and 4 examine the influence of verbalization on faces and objects post-stimulus encoding (we discuss the findings from Experiments 1 and 2 following Experiment 2 and the findings from Experiments 3 and 4 following Experiment 4).

Experiment 1

Experiment 1 examined the influence of verbalization during *stimulus-encoding* on the recognition of pictures of faces. To ensure the task required remembering particular pictorial details rather than remembering the face per se, we presented identical target images during learning and recognition and we also selected the distractors presented at recognition to be different images of each target face. We assessed the effects of sub-vocal and overt verbalization on the recognition of familiar and unfamiliar faces. Following the rationale outlined earlier, there were three encoding conditions: control (desk tapping), articulatory suppression (AS) and overt verbalization. Our proposal was that faces are particularly difficult to differentiate from one another and so (a) sub-vocal verbal processing is normally recruited during encoding in order to aid visual differentiation; and (b) as a consequence an overt description of the face during encoding provides little additional benefit. Thus, we expected a negative effect of articulatory suppression and a null effect of overt verbalization relative to the control condition on face recognition performance. We also expected that familiar faces would show better recognition than unfamiliar faces. Finally, we examined the extent to which familiarity would modulate the influence of verbalization on face encoding. As described previously, it is possible that we will see stronger effects of verbalization on unfamiliar as compared with familiar faces. Nevertheless, it is more likely that in this task sub-vocal verbalization influences visual processing whilst the benefit of familiarity arises from accessing stored semantic information about the face. If this is correct, we would expect to observe independent effects of these variables on performance.

Method

Participants

Thirty undergraduate students (21 females) from the University of Glasgow took part in this experiment for a small payment. All had normal or corrected-to-normal vision. On completion of the experiment participants were tested on their familiarity with the famous faces used. They were shown a picture of each famous face sequentially and were asked to name the face or if unsuccessful to recall some semantic information associated with the face (e.g., in which movie or TV program the person acted). All the participants were able to provide at least semantic information.

Materials and apparatus

An Apple Macintosh computer was used with Superlab version 1.75 software to present the stimuli and record responses. The stimuli comprised 60 Caucasian male faces with half familiar (rated as highly familiar by an independent group of 18 raters, see Appendix for a list) and half unfamiliar (i.e., faces of unknown Caucasian males; see Figure 1 for examples). The pictures did not show facial expressions and were greyscale frontal or side views of head and shoulders with clothing and background edited out using Adobe Photoshop version 5.5. The pictures of familiar males were selected via an internet search using the Google search engine whilst the pictures of unfamiliar males were taken from the same source as described in Nakabayashi and Burton (2008). Two different images of each person were used with one as the target and the other as a distractor in the recognition test. Target and distractor images were taken at different times by different cameras and so there were small changes in hair style, pose, lighting conditions and viewing angle (see Figure 1). Efforts were made to ensure that the similarity of the targets and distractors did not differ with the familiarity condition. The targets and distractors were counterbalanced so that they were seen equally often as targets and distractors across participants. The size of the images was approximately 5.5 cm x 6.5, with a resolution of 72ppi. Computer screen luminance was the same for all conditions.

Design and procedure

Participants learned an equal number of familiar and unfamiliar faces under the three different encoding conditions: (a) *control* - desk tapping; (b) *articulatory suppression* – AS; and (c) *describe* – overtly describing the face. This was followed by a filler task and then the recognition test. The learning conditions were manipulated within-participants and blocked. During the learning phase of the experiment participants were shown 20 pictures (10 familiar and 10 unfamiliar faces) one at a time in a random order. Each picture was shown for 7 seconds preceded by a 250 ms fixation cross. Participants were instructed that the task was to remember all the pictures for subsequent testing. Face learning was followed by a 5-minute filler task which involved writing down lists of countries, hobbies, or school subjects, with a different task for each condition. A recognition phase followed immediately after the filler task and participants were shown the same pictures as were presented during learning (i.e., targets) along with new pictures of the same stimuli that had not been seen before (i.e., distractors). The task was to indicate whether each picture was 'old' (an identical image) or 'new' (a distractor) with a speeded key-press response using the M or Z key, respectively. For half of the participants this key assignment was reversed.

During the learning phase of the control condition, participants were asked to remember a set of faces for subsequent testing whilst tapping the desk at a rate of 3 or 4 taps per second (Nakabayashi & Burton, 2008). Tapping has often been used as a control condition in studies examining the effect of articulatory suppression (e.g., Baddeley, 1986; Emerson & Miyake, 2003; Wickham & Swift, 2006) as it has very low or no attentional demands (Brandimonte et al., 1992a). Participants began tapping when the picture appeared on the screen and stopped when it disappeared from view. During the learning phase of the AS condition, participants articulated the sounds *la, la, la, la,* repeatedly at the same rate as the desk tapping task whilst learning each face. Finally, during the learning phase of the describe condition, participants described each face aloud: the participants started describing the face when it appeared on the screen and stopped when it disappeared from view. For all three encoding conditions no instruction was given on how to remember or describe the faces. The experimenter was present throughout the three tasks in order to monitor compliance. The order of conditions was counterbalanced with the constraint that the describe condition was never followed by the control condition in order to avoid carry over effects (i.e., describing faces in the preceding condition may have induced sub-vocal encoding of faces in the control condition). Thus, there were three condition orders (a) control/describe/AS; (b) AS/control/describe; and (c) describe/AS/control. (Note, a visual inspection of the data obtained here and in Experiment 2 also revealed no effect of condition order.) Stimuli were fully counterbalanced across the experiment and no picture appeared in more than one condition for any given participant.

Results

Means of *A'*, hits, false alarms (FAs), and bias (*B''D*; Donaldson, 1992; 1993) are given in Figure 2. For clarity and efficiency, in both this and subsequent experiments (and across-experiment comparisons) we report solely *A'* as analyses of hits, FAs and bias were either consistent with the findings for *A'* or not significant (see also footnotes 1 and 2). Discrimination was analysed with a 3 (stimulus-encoding condition; control, AS, describe) x 2 (familiarity; familiar vs. unfamiliar) repeated measures analysis of variance (ANOVA).

For *A'*, a main effect of stimulus-encoding condition, $F(2,58) = 37.13$, $p < .001$, $MSE = .01$, was found. Pairwise comparisons with Bonferroni correction ($p < .01$) showed better performance in the control (mean = .85) than AS condition (mean = .74) and better performance in the describe (mean = .86) than AS condition. No difference was found between the control and describe conditions. A main effect of familiarity was also found, $F(1,29) = 58.41$, $p < .001$, $MSE = .01$, with better performance for familiar faces (mean = .88) than unfamiliar faces (mean = .76). The two-way interaction was not significant, $F(2,58) = 1.67$, $p > .05$, $MSE = .01$.

In sum, the main finding was that engaging in articulatory suppression during encoding interfered with discrimination. There was also better performance for familiar than unfamiliar faces. In addition, effects of verbalization and familiarity were independent[1].

Experiment 2

Experiment 1 examined the role of verbal processing during stimulus-encoding on recognition memory for pictures of familiar and unfamiliar faces. The main finding was that engaging in articulatory suppression interfered with subsequent recognition. Experiment 2 extended the investigation to the recognition of pictures of familiar and unfamiliar objects, in particular buildings. The aim was to assess whether the previous findings were specific to faces or a similar pattern of findings to that observed for faces would also emerge for the recognition of buildings. The main interest concerned the influence of verbal processing on recognition. First, during stimulus-encoding buildings are likely to be less difficult to visually differentiate than faces and so sub-vocal verbalization is less likely to be recruited routinely in order to aid visual processing. As a result, we expected a lesser or null effect of AS on recognition for buildings. Importantly however, as a consequence there was now scope for an overt description of each building to encourage the visual processing of additional information which is beneficial for subsequent recognition. Second, we expected independent and beneficial effects of familiarity on discrimination as we had observed for faces in Experiment 1. The influence of verbalization in this task is likely tied to early visual encoding processes whereas the influence of familiarity arises in the access and retrieval of associated semantic information.

Method

Participants

Thirty undergraduate students (21 females) from the University of Teesside took part in this experiment for a small payment. All had normal or corrected-to-normal vision. Participants' familiarity with buildings was ensured in the same way as in Experiment 1.

Materials and apparatus

The apparatus and materials were the same as Experiment 1, with the exception of the stimuli. In this experiment, stimuli comprised 60 pictures of objects (i.e., buildings and monuments) with half familiar and half unfamiliar. Familiarity ratings gathered by 16 independent raters were closely matched to those of faces used in Experiment 1 (see Appendix). All the pictures were greyscale and the background was removed using Adobe Photoshop 5.5. As in Experiment 1, there were two views of the same building: one to be used as a target presented both at study and test and the other as a distractor presented at test. In addition, efforts were made to ensure that the similarity of the targets and distractors was matched across the familiarity conditions (see Figure 3). The targets and distractors were counterbalanced so that they were seen equally often across participants. The picture size was approximately 5.5 cm x 11 cm for tall buildings and 11 cm x 5.5 for wide buildings and resolution was 72ppi.

Design and procedure

The design and procedure were the same as Experiment 1.

Results

Means of *A'*, hit proportions, false alarm proportions (FAs) and bias (*B''D*) are shown in Figure 4. Discrimination was analysed with a 3 (stimulus-encoding condition; control, AS, describe) x 2 (familiarity; familiar vs. unfamiliar) repeated measures ANOVA.

For *A'*, main effects of stimulus-encoding condition, $F(2,58) = 9.36$, $p < .001$, $MSE = .01$, and familiarity, $F(1,29) = 25.51$, $p < .001$, $MSE = .004$, were found. Pairwise comparisons with Bonferroni correction ($p < .01$) revealed better performance in the describe (mean = .93) than control condition (mean = .87) and better performance in the describe than AS condition (mean = .85) with no difference between control and AS conditions. Independently, familiarity benefited performance (familiar mean = .90 vs. unfamiliar mean = .86). The two-way interaction was not significant, $F(2,58) = 2.39$, $p > .05$, $MSE = .004$.

These results demonstrate that overt verbalization during stimulus-encoding benefited the subsequent discrimination of buildings. In contrast, there was no evidence for a benefit from sub-vocal verbalization. Finally, there was an independent benefit of familiarity on performance.

Discussion of Experiments 1 and 2

Experiments 1 and 2 examined the effects of verbal processing during stimulus-encoding on picture recognition. Importantly, we observed a double dissociation in the effects of verbalization for faces and buildings. For faces, articulatory suppression whilst learning faces had a detrimental effect on their subsequent recognition. This is evidence for sub-vocal verbal processing during face encoding. Note, this finding cannot be attributed to the attentional demands of the secondary tasks used during encoding as: (a) articulatory suppression was unlikely to be sufficiently attention-demanding (Brandimonte et al., 1992a); and (b) one could argue reasonably that, if anything, verbally describing the face was likely to be more attention-demanding than articulatory suppression and yet there was no influence of an overt description on recognition. In contrast, overt verbalization during learning had no effect on subsequent face recognition. In previous studies by Brown and colleagues, providing an overt description of each face has been shown to benefit performance (Brown et al., 2010; Brown & Lloyd-Jones, 2005, 2006). Importantly however, the paradigm of Brown and colleagues focused on verbalization during the retrieval and rehearsal of faces in memory whereas here verbalization engaged primarily with early visual encoding processes.

For buildings, there was a different pattern of findings: overt verbalization benefited recognition and there was no effect of sub-vocal verbalization on performance. Here, we suggest that sub-vocal verbalization is not normally recruited during object encoding as object categories are generally less visually homogenous than faces. As a consequence there is an opportunity for overt verbalization to benefit performance. Finally, consistent with the influence of verbalization on visual processing in particular, for both faces and objects the influence of verbalization was independent from the effect of familiarity which is localized in the access and retrieval of semantic knowledge (e.g., Burton & Bruce, 1993; Hancock, Bruce, & Burton, 2001).

Experiment 3

In Experiment 3, we examined the influence of verbalization during *post stimulus-encoding* on face processing in the picture recognition task. We adopted the paradigm used by Brown and Lloyd-Jones (2002, 2003) and Nakabayashi and Burton (2008) whereby a large number of faces were tested for recognition. Participants viewed a series of to-be-learnt faces and then described (or not, in a control condition) their memory of a single face from those that were studied.

Extending previous findings, we examined whether verbal overshadowing could arise for picture recognition and whether familiarity would modulate the negative influence of verbalization post stimulus-encoding. We compared description and control conditions and expected to observe verbal overshadowing for pictures of faces. We also expected that unfamiliar faces would be more vulnerable to verbal overshadowing than familiar faces. Following the rationale outlined in the Introduction, we proposed that verbalization in this context would induce a shift towards more semantically-driven processing during the subsequent recognition task and this would occur at the expense of perceptually-based processing which is critical for successful recognition. Moreover, verbalization is likely to be detrimental to the recognition of pictures of unfamiliar faces in particular because perceptual expertise for these faces exceeds semantic expertise. In contrast, for familiar faces the relationship between semantic and perceptual expertise is more in balance because their representation comprises associated semantic information already acquired through experience.

Method

Participants

In total, forty-four new participants (35 females) were recruited from the same source as in Experiment 1. Half the participants were tested on familiar faces and half on unfamiliar faces. Participant familiarity with the faces was confirmed as in Experiment 1. All participants had normal or corrected-to-normal vision.

Materials and apparatus

The stimuli and apparatus were the same as in Experiment 1.

Design and procedure

The design was similar to Experiment 1 with the exception that the experimental manipulation comparing describe and control conditions was introduced post stimulus-encoding as a within-participants factor and was blocked. Face familiarity (i.e., familiar versus unfamiliar faces) was a between-participants factor in order to maintain a manageable number of trials per participant. There were describe and control conditions in a post stimulus-encoding task carried out between the learning and test phases. During the learning phase participants studied 15 pictures of either familiar or unfamiliar faces for subsequent testing without any secondary task or specific instructions on how to remember the faces. Each face was shown for 7 seconds preceded by a 250 second fixation cross. The learning phase was followed by a 5-minute filler task in the control condition and a 5-minute description task in the describe condition (a duration used in similar studies, e.g., Brown & Lloyd-Jones, 2002, 2003). The filler task in the control condition was the same as in Experiment 1, namely writing down lists of countries, hobbies, or school subjects. The describe condition required participants to write down a detailed description of a single face they could remember best of all the faces they had just seen. During the recognition phase, which was the same as Experiment 1, participants were shown the targets (i.e., identical images to those presented at study) as well as new pictures of the targets (i.e., distractors) and engaged in a speeded key-press response task to indicate whether each picture was ‘old’ (encountered at study) or ‘new’ (a distractor). The order of conditions was counterbalanced across participants. Stimuli were fully counterbalanced across the experiment and no picture appeared in more than one condition for any given participant. In sum, the only difference between the control and describe conditions was the nature of the task which was either to describe a single face from memory or to engage in a filler activity.

Results

Means of *A'*, hits, false alarms (FAs), and bias (*B''D*; Donaldson, 1992; 1993) are shown in Figure 5. Discrimination was analysed with a 2 (post stimulus-encoding condition; control vs. describe) x 2 (familiarity; familiar vs. unfamiliar) mixed ANOVA with post stimulus-encoding condition as the within-participants factor and familiarity as the between-participants factor.

For *A'*, main effects of post stimulus-encoding condition, $F(1,42) = 33.24$, $p < .001$, $MSE = .003$, and familiarity, $F(1,42) = 19.69$, $p < .001$, $MSE = .01$, were found. Discrimination was better in the control (mean = .88) than describe condition (mean = .82) and familiarity also benefited performance (familiar mean = .90 vs. unfamiliar mean = .80). The two-way interaction was also significant, $F(1,42) = 20.09$, $p < .001$, $MSE = .003$. Pairwise comparisons revealed that the interaction was due to unfamiliar faces, with better performance in the control (mean = .86) than describe condition (mean = .74), $t\ (21) = 9.23$, $p < .001$. In sum, these results demonstrated verbal overshadowing for picture recognition and in particular for pictures of unfamiliar but not familiar faces.

Experiment 4

Experiment 4 investigated the influence of overt verbalization during post stimulus-encoding on the recognition of pictures of buildings. Here, we expected to observe a similar pattern of findings to that observed with faces in Experiment 3, namely verbal overshadowing for pictures of unfamiliar but not familiar faces. The reason for this is that when the recognition of objects makes similar demands to face recognition and when observers gain some experience with a particular category through repeated encounters in the same context, the representational processes involved likely become more similar for objects and faces. Post stimulus-encoding, participants will have encountered a large number of to-be-remembered buildings and we suggest that as a result they will have become more sensitive to subtle differences in the spatial relationships between features. Furthermore, as proposed previously, overt verbalization of one's memory of a building is likely to induce more semantically-driven processing during the subsequent recognition task and this will occur at the expense of perceptually-based processing which is important for successful recognition. As a result, verbalization will be detrimental to the recognition of unfamiliar buildings, but not familiar buildings.

Method

Participants

Forty-four new participants (32 females) took part in this experiment from the same source as in Experiment 2. All had normal or corrected-to-normal vision and were familiar with the appropriate buildings.

Materials and apparatus

The stimuli were the same as those used in Experiment 2.

Design and procedure

The design and procedure was the same as Experiment 3.

Results

Means of *A'*, hit proportions, false alarm proportions (FAs), and bias (*B''D*) are shown in Figure 6. Recognition accuracy was analyzed with a 2 (post stimulus-encoding condition;

control vs. describe) x 2 (familiarity; familiar vs. unfamiliar) mixed ANOVA, with post stimulus-encoding condition as a within-participants factor and familiarity as a between-participants factor.

For *A'*, main effects of post stimulus-encoding condition, $F(1,42) = 17.77$, $p < .001$, $MSE = .004$, and familiarity, $F(1,42) = 5.95$, $p < .05$, $MSE = .01$, were found. Discrimination was better in the control (mean = .93) than describe condition (mean = .87) and familiarity of the building also benefited performance (familiar mean = .93 vs. unfamiliar mean = .87). The two-way interaction was also significant, $F(1,42) = 5.60$, $p < .05$, $MSE = .004$. Pairwise comparisons revealed that the interaction was due to unfamiliar buildings, with better performance in the control (mean = .91) than describe condition (mean = .82), $t(21) = 4.11$, $p < .001$.

In sum, these results demonstrated verbal overshadowing for picture recognition and in particular for unfamiliar but not familiar buildings.

Discussion of Experiments 3 and 4

Experiments 3 and 4 extended our examination of face and object encoding in Experiments 1 and 2 to a post-stimulus encoding task. The main findings were clear-cut. Overt verbalization overshadowed picture recognition but was modulated by familiarity: verbal overshadowing arose for unfamiliar but not familiar faces and buildings. Importantly, this finding cannot be accommodated easily by the main accounts of verbal overshadowing (i.e., the content, criterion shift, and processing shift accounts). We will examine these accounts in detail in the General Discussion and also develop a novel account based upon the notion of perceptual expertise (cf., Fallshore & Schooler, 1995; Melcher & Schooler, 1996, 2004). Prior to the General Discussion we present statistical analyses directly comparing faces and buildings during (a) stimulus encoding (Experiments 1 and 2); and (b) post stimulus-encoding (Experiments 3 and 4). We analyse the data in this way because different cognitive processes underlie these different stages of picture recognition. For the sake of clarity and efficiency we only report significant results.

Across-experiment comparisons

Stimulus-Encoding (*Experiment 1 with faces and Experiment 2 with buildings).* Separate 3 (stimulus-encoding condition; control, AS, describe) x 2 (familiarity; familiar vs. unfamiliar) x 2 (stimulus; face vs. building) mixed ANOVAs, with stimulus-encoding condition and familiarity as within-participants factors and stimulus as the between-participants factor, were conducted for *A'*. Power for these and subsequent analyses is greater than .97.

For *A'*, main effects of stimulus-encoding condition (control mean = .86; AS mean = .79; describe mean = .90), $F(2,116) = 34.02$, $p < .001$, $MSE = .01$, familiarity (familiar mean = .89; unfamiliar mean = .81), $F(1,58) = 83.71$, $p < .001$, $MSE = .007$, and stimulus (face mean = .82; building mean = .88), $F(1,58) = 16.84$, $p < .001$, $MSE = .02$, were significant. These results indicate that (a) performance was poorer in the AS than either the control or describe condition; (b) familiarity benefited performance; and (c) overall recognition was better for buildings than faces. However, these effects were qualified by a stimulus-encoding condition x stimulus interaction, $F(2,116) = 7.16$, $p < .01$, $MSE = .01$, and a familiarity x stimulus interaction, $F(1,58) = 16.12$, $p < .001$, $MSE = .007$. To explore these interactions separate pairwise comparisons were conducted. For the stimulus-encoding condition x stimulus interaction for faces, results showed better performance in the control (mean = .85) than AS condition (mean = .74), $t(29) = 7.55$, $p < .001$, and better performance in the describe (mean = .86) than AS condition, $t(29) = 7.43$, $p < .001$. For buildings, better performance was found in the describe (mean = .93) than control condition (mean = .86), $t(29) = 5.44$, $p < .001$, and AS condition (mean = .85), $t(29) = 3.55$, $p < .01$. These results are consistent with the original analyses which showed negative effects of AS for faces and positive effects of an overt description for buildings. Results for the familiarity x stimulus interaction for faces showed better performance for familiar (mean = .88) than unfamiliar faces (mean = .76), $t(29) = 7.64$, $p < .001$. The same pattern of results was found for buildings with familiarity benefiting recognition performance (familiar mean = .90 vs. unfamiliar mean = .86), $t(29) = 5.05$, $p < .001$.

In sum, these analyses are in agreement with the key findings of the original analyses of each experiment demonstrating (a) a negative effect of AS on the recognition of pictures of faces which contrasts with a positive effect of overt verbalization on the recognition of buildings; and (b) independent and beneficial effects of familiarity on discrimination. The analyses also confirmed that, overall, recognition of faces was poorer than the recognition of buildings which is consistent with our premise that face recognition is particularly challenging as compared with object recognition.

Post stimulus-encoding (Experiment 3 with faces and Experiment 4 with buildings). Separate 3 (post stimulus-encoding condition; control vs. describe) x 2 (familiarity; familiar vs. unfamiliar) x 2 (stimulus; face vs. building) mixed ANOVAs, with post stimulus-encoding condition as the within-participants factor and familiarity and stimulus as between-participants factors, were conducted for *A’*. For additional clarity of interpretation, we provide a visual summary of the findings in Figure 7.

For *A’*, main effects of post stimulus-encoding condition (control mean = .91; describe mean = .84), $F(1,84) = 47.95$, $p < .001$, $MSE = .004$, stimulus (face mean = .85; building mean = .90), $F(1,84) = 7.15$, $p < .01$, $MSE = .01$), and familiarity (familiar mean = .92; unfamiliar mean = .83), *F*(1,84) = 22.42, *p* < .001, *MSE* = .01) were found. These results indicate that post stimulus-encoding (a) verbalization led to poorer performance than the control condition; (b) familiarity benefited performance; and (c) performance was better for buildings than faces. However, these results were qualified by a post stimulus-encoding condition x familiarity interaction, *F*(1,84) = 21.96, *p* < .001, *MSE* = .01. Pairwise comparisons revealed that the interaction was due to unfamiliar items, *t*(43) = 8.15, *p* < .001, with better performance in the control (mean = .88) than describe condition (mean = .78). Finally, recognition was better for buildings (mean = .90) than faces (mean = .85).

In sum, these analyses are also in agreement with the key findings of the original analyses of each experiment in demonstrating verbal overshadowing on the recognition of pictures of unfamiliar but not familiar faces and buildings. The analyses also confirmed that overall recognition was poorer for faces than buildings, which is consistent with our premise that face recognition is particularly challenging as compared with object recognition.

General Discussion

Four experiments developed the work of Nakabayashi and Burton (2008) by examining the role of verbalization in a picture recognition task with faces and objects (i.e., buildings) and by assessing the moderating effects of stimulus familiarity on performance. The key findings can be summarized as follows. First, verbalization influenced picture recognition. Second, there were contrasting influences of verbalization on the recognition of pictures of faces and objects which were driven by (a) the stage of processing during which verbalization took place; (b) whether verbalization was sub-vocal or overt; and (c) stimulus familiarity. On the one hand, during stimulus-encoding there was a double dissociation whereby sub-vocal verbalization benefited the recognition of faces (as indexed by reduced recognition following articulatory suppression) but not objects, whilst overt verbalization benefited the recognition of objects but not faces. In addition, stimulus familiarity provided an independent influence on performance. On the other hand, post stimulus-encoding overt verbalization interfered with the recognition of both faces and objects and this interference was apparent for unfamiliar but not familiar stimuli. Together, these findings extend work on verbalization to picture recognition and place important parameters on factors which contribute to contrasting beneficial and detrimental effects of verbalization on recognition memory for faces and objects.

The prevailing position in research on face processing is that recognition of facial identity across image transformations is important and ecologically valid. As a result, the role played by pictorial information (i.e., particular surface features of the picture or photograph) has often been neglected. Indeed, a range of important studies have confounded recognition of facial identity with picture recognition (e.g., Golerai et al., 2007; Gupta & Srinivasen, 2008; Mehl & Buchner, 2008; Tsukiura & Cabeza, 2011). Importantly however, recent work by Longmore et al (2008) has shown that both unfamiliar and familiarized (during the experiment) faces are primarily learned and remembered using pictorial information, over and above any contribution from invariant information extracted across changes in viewpoint or illumination. This suggests that pictorial processing may be a core mechanism mediating visual recognition. Indeed, the formation of a 3D structural model via the extraction of invariant properties, for instance as described by Marr (1982) for object recognition, may not be required and recognition may be accomplished by the use of multiple pictorial representations stored following each encounter with the face or object. An important aspect to the present study was that we extended this research by demonstrating that the verbal mechanisms recruited in face and object recognition operate on pictorial information used to distinguish between similar photographs with the same identity.

Our main focus was a comparison of the effects of verbalization on pictures of faces and objects in order to understand the mechanisms by which verbalization may positively and negatively influence recognition memory. There is much controversy over whether faces are *special*. Studies using a range of behavioral, neuropsychological, and neuroimaging techniques suggest that face processing differs from object processing both in terms of the neural systems that are recruited and the types of representations that mediate recognition (e.g., Gauthier et al., 2000; Kanwisher et al., 1997; Robbins & McKone, 2007). It has been suggested that this specialization is due either to inner constraints or preferential exposure early in life (e.g., Kanwisher, 2000; McKone, et al., 2007). Nevertheless, if expertise is acquired in individuating objects then similar processes and neural regions to those observed for faces may be recruited for objects (e.g., Gauthier et al., 1999; Gauthier et al., 2000; McGugin & Gauthier, 2010). There is a continuing debate over the expertise account (e.g., Robbins & McKone, 2007; McKone et al., 2007). However, a number of phenomena considered to be hallmarks of face perception, such as the detrimental effect of inversion, holistic/configural processing, and sensitivity to spatial frequency information, have been shown to arise at least sometimes from perceptual expertise (e.g., Busey & Vanderkolk, 2005; Curby et al., 2009; Gauthier & Tarr, 1997; McGugin & Gauthier, 2010).

Our premise was that verbalization may influence visual recognition in a flexible manner, depending on particular stimulus and task constraints. We proposed that recognizing faces would be particularly challenging because faces are a highly visually homogenous category and for this reason verbalization may exert effects that are unique to them (cf., Damasio et al., 1982;

Gauthier et al., 1999; although see also Busigny et al., 2010). Nevertheless, with the requirement to differentiate between objects of similar shape and parts in a picture recognition task which required distinguishing between different exemplars of the same object, and as participants gained some perceptual experience with a particular category through repeated encounters during the experiment, we expected that the processing of objects would become more similar to the processing of faces. As a result, we expected that verbalization would then exert similar effects on the recognition of faces and objects. In line with these proposals, we found important similarities and differences in the influence of verbalization on the processing of these different stimulus classes.

Verbalization During Stimulus-encoding

During stimulus-encoding, sub-vocal verbal processing benefited face but not object recognition. In contrast, overt verbalization benefited the recognition of objects but not faces. This double dissociation in the beneficial effects of verbalization on processing faces versus objects suggests independent verbal mechanisms which can be engaged during stimulus learning and are constrained by the nature of the stimulus. For faces, most likely due to the difficulty in differentiating between highly visually similar exemplars, sub-vocal verbal processes are normally recruited to aid efficient visual discrimination. Sub-vocalisation may bias visual processing towards information in each face that is of the greatest use in helping to differentiate that particular face from other faces that have been encountered. As a consequence, an additional overt description either provides no further benefit or the process of self-generating an overt description may actively interfere with sub-vocal processing which is normally more beneficial to performance. For instance, information from the different sources may compete for storage as an *action tag*: additional information which is attached to the visual representation of the face in memory and directs visual processing towards information relevant to the task when the face is re-presented (cf., DeSchepper & Triesman, 1996; Neil & Valdes, 1992). In contrast, objects are less difficult to differentiate visually during learning and so sub-vocal verbalization is not normally recruited to aid identification. In this case, there is scope for an overt description to be used to construct an action tag which can benefit learning and subsequently improve recognition.

As an aside, we note that in other picture processing tasks articulatory suppression can have positive effects on performance (e.g., Brandimonte, Hitch, & Bishop, 1992a; 1992b). For instance, Brandimonte, Hitch, and Bishop (1992a) showed that articulatory suppression improved recognition in a mental subtraction task where subtraction of part of a picture (e.g., of a candy) revealed another picture (e.g., a fish). In this case, articulatory suppression benefited performance for pictures that were easy rather than difficult to name. The authors suggested that naming interfered with generating a visual image and thus performing the task in the most optimal way. In this way, articulatory suppression shifted the emphasis from verbal processing to a greater reliance on visual imagery. As Logie (1995) points out, participants may have a number of strategies available but do not always select the most optimal one: a verbal strategy was not optimal for the mental subtraction task and yet many participants spontaneously used such a strategy.

Finally, independent of the influence of verbalization during stimulus-encoding, familiarity also benefited recognition and it did so equally for faces and objects. The benefit from familiarity most likely arose from the retrieval of stored semantic information gained through experience and which results in a more robust stored representation. In contrast, the representation of unfamiliar faces and objects is normally limited to visual descriptions (e.g., Hancock, Bruce, &

Burton, 2001; Liu & Ward, 2006). The independent influences of verbalization and familiarity here support their locus at different stages of processing: verbalization influences visual processing whereas the benefit from familiarity arises from the retrieval of semantic knowledge. Moreover, as we shall see, the independent influence of familiarity during stimulus-encoding contrasts with its moderating influence on verbalization post stimulus-encoding and this provides further evidence for distinct verbal mechanisms during stimulus-encoding and post stimulus-encoding, respectively.

Verbalization Post Stimulus-encoding

Post stimulus-encoding, overt verbalization interfered with the recognition of unfamiliar but not familiar faces and objects. Importantly, the main accounts of verbal overshadowing cannot easily accommodate these findings. First, according to a content account the generation of a description leads to verbal recoding of the original visual memory of the stimulus which then interferes with access to the original memory (e.g., Schooler & Engstler-Schooler, 1990). In the present paradigm however, participants described their memory of a single face or object and yet this led to interference for many non-described faces and objects. We note here that one could also argue that providing a detailed description required retrieving a visual image and this rather than verbalization per se led to a performance decrement. Nevertheless, once again, on such an account one would have difficulty in explaining why doing so for a single stimulus interfered with subsequent performance for a number of non-described stimuli. Second, a criterion shift account proposes that verbalization shifts the recognition criterion towards more conservative responding (e.g., Clare & Lewandowsky, 2004). However, here there was no evidence of verbal overshadowing influencing response bias for either faces or objects[2]. Finally, according to a processing shift account a verbal description produces a shift from a more visually-based global processing style towards a more verbally-based featural processing style because featural information is more easily verbalized (e.g., Brown & Lloyd-Jones, 2002; 2003; Fallshore & Schooler, 1995; Macrae & Lewis, 2002). It is not clear however, how such an account can explain verbal overshadowing for unfamiliar but not familiar faces and objects: we would not expect a shift in visual processing operations to be affected by familiarity, particularly when familiar and unfamiliar faces are known to be processed visually in a similar fashion (e.g., Collishaw & Hole, 2002; Schwaninger, Lobmaier, & Collishaw, 2002).

Nevertheless, the processing shift account can be maintained if we assume that (a) overtly describing a stored memory of a face or object can induce an emphasis on semantic processing during subsequent retrieval; and (b) the balance between perceptual and semantic expertise plays an important role in mediating the effects of verbalization. Schooler and colleagues have proposed that a number of findings on verbal overshadowing reflect a conflict between verbal and nonverbal processes: verbal overshadowing can arise when participants draw on verbal knowledge at the expense of nonverbal knowledge (Fallshore & Schooler, 1995, Melcher & Schooler, 1996; 2004). We propose that verbalization during the retrieval and rehearsal of a face or object from memory encourages greater semantic processing of pictures that are encountered subsequently during the old/new recognition task. For instance, verbalization in this context may encourage participants to attempt to retrieve visually-derived semantic information in making a recognition decision (e.g., concerning the occupation of the person or location of the building). However, this is at the expense of perceptually-based processing which normally is more diagnostic for successful visual recognition. Perceptually-based processing here likely includes the processing of subtle spatial relationships between visual features of faces and buildings (e.g., Nakabayashi et al., in press). Importantly, this shift in processing operations is detrimental to the recognition of pictures of unfamiliar faces and objects in particular because perceptual expertise for these stimuli exceeds their semantic expertise. As described earlier, the representation of unfamiliar faces and objects is limited to visual descriptions (e.g., Hancock et al., 2001; Liu & Ward, 2006). In contrast, the relationship between semantic and perceptual expertise is more in balance for familiar faces and objects because their representation is comprised of both visual descriptions and semantic information acquired through experience (e.g., Bruce & Young, 1986; Burton & Bruce, 1993). The reason that verbal overshadowing arises for both unfamiliar faces and objects is that in this experimental context the recognition of objects makes similar demands to the recognition of faces: participants will have acquired experience in differentiating between similar objects during the course of the experiment and likely become sensitive to subtle differences in the spatial relationships between features.

Conclusions

Our demonstration of contrasting positive and negative effects of verbalization complements the work of Huff and Schwan (2008) on event memory. Huff and Schwan found that when a verbal description preceded an event, namely a video of a ball moving either away from or towards the observer, recognition performance improved whereas when a verbal description followed the event, recognition performance decreased. Their explanation for these findings takes the form of a content account. Concerning the beneficial influence of verbalization, they argue that participants used the verbal description to guide attention during the subsequent viewing of the event and in this way the verbal description shaped the nature of the visual representation derived from the stimulus and hence a better match between the two representations benefited recognition. For verbal interference, they argue that reduced recognition arose from source confusion between the visual and verbal representations of the same event. However, although there is some overlap with our theory the account of Huff and Schwan is not sufficient to explain our findings satisfactorily.

First, a double dissociation in the beneficial effects of verbalization on learning faces and objects as observed here, with sub-vocal processing benefiting face recognition and overt verbalization benefiting object recognition, cannot be explained solely by a prior verbal description shaping subsequent visual processing. Rather, our study provides evidence for two verbal mechanisms which can be engaged to benefit visual recognition and which are constrained by the nature of the stimulus. We suggest that in both cases verbalization guides subsequent visual processing during retrieval. Nevertheless, under some circumstances these different sources of verbal information may compete for use as a label or tag specifying the relevance of the visual information for the task at hand. Second, reduced recognition in our paradigm as a result of verbalization post stimulus-encoding cannot be explained by source confusion between visual and verbal representations of the same stimulus because here a single overt description of a face or object memory reduced subsequent recognition for a relatively large number of non-described faces and objects. Rather, our findings on verbal overshadowing and familiarity are best explained by a novel form of processing shift account which incorporates a shift from visual to semantic processing with the notion of perceptual expertise.

In sum, we have demonstrated that verbalization can influence picture recognition in a complex way which is constrained by the nature of the stimulus and task. More broadly, we have emphasized the importance of perceptual experience in moderating the effects of verbalization on performance. It is clear that verbalization can influence face and object recognition in a flexible manner and we have placed some important parameters on the nature of this flexibility.

Notes

1. There was some evidence in the proportion of hits that the effect of sub-vocal verbalization was more pronounced for unfamiliar faces however the opposite pattern was found for false alarms. Across-experiment comparisons presented after Experiment 4 confirm the independence of effects verbalization and familiarity.

2. For Experiment 3, $Fs < 1.26$, and for Experiment 4, $Fs < 1$. The full data have been seen by the reviewers and are available upon request.

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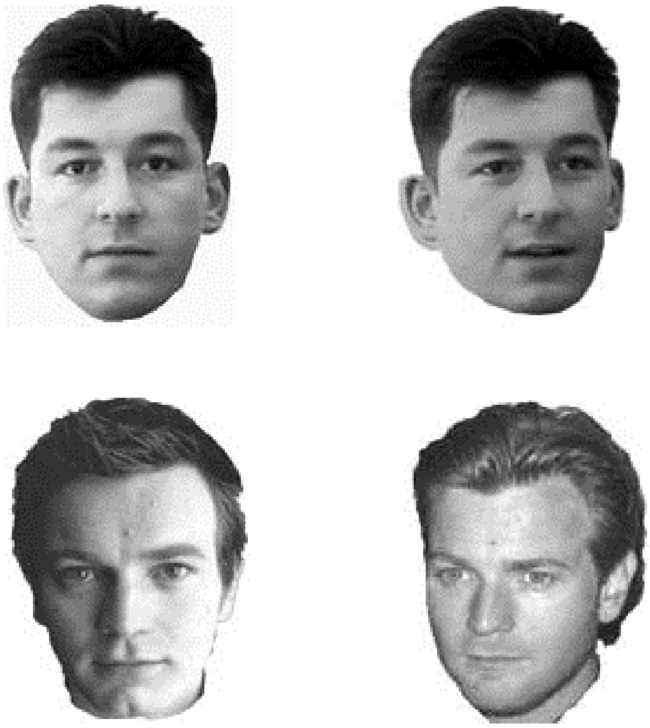

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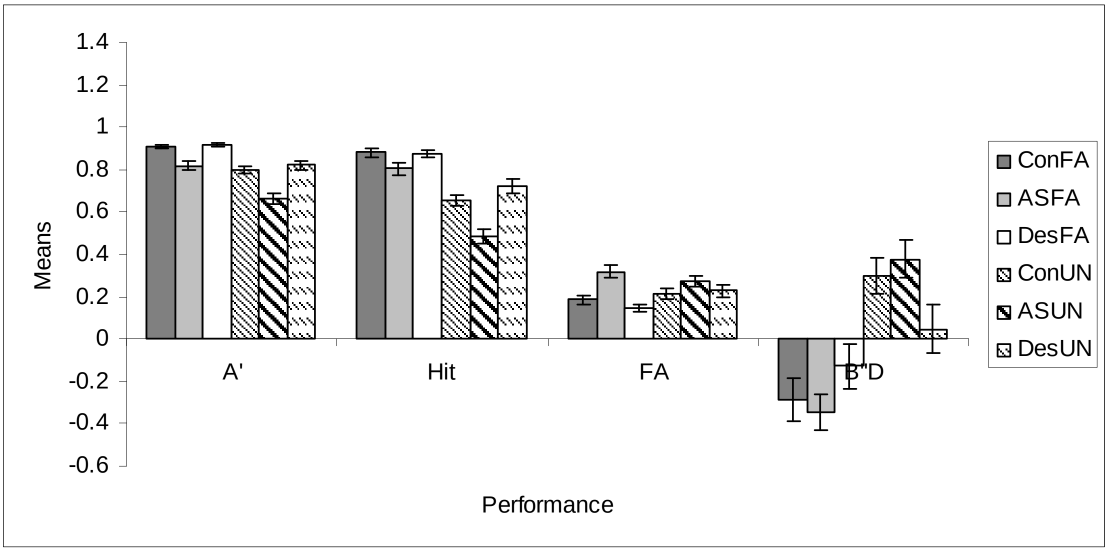
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Figure 2.

(a) Eiffel Tower (a familiar building)

(b) An unfamiliar tower (matched to the Eiffel Tower).

(c) The Sage (a familiar building)

(d) An unfamiliar dome (matched to The Sage).

Figure 3.

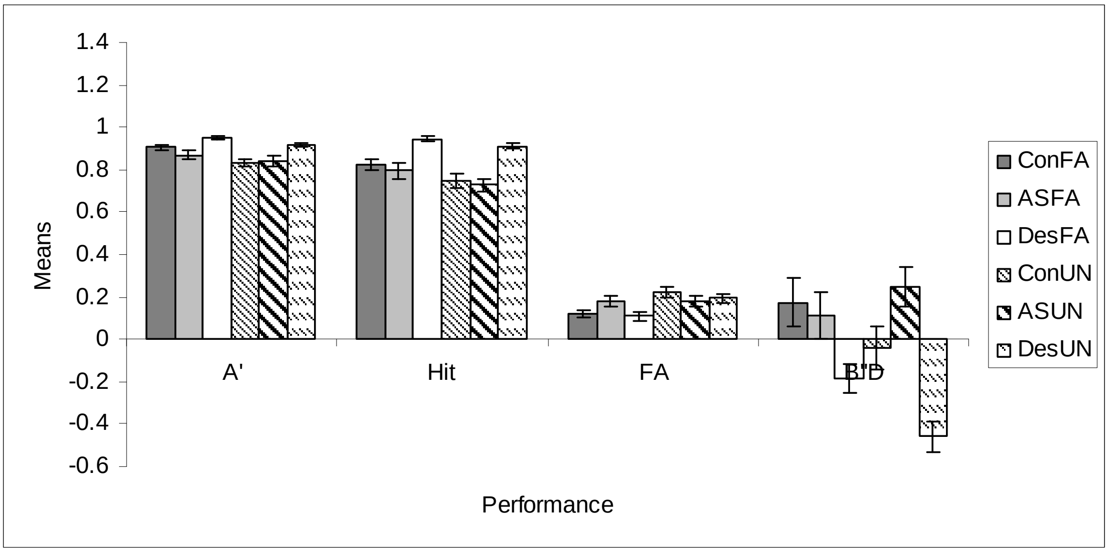

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Figure 4.

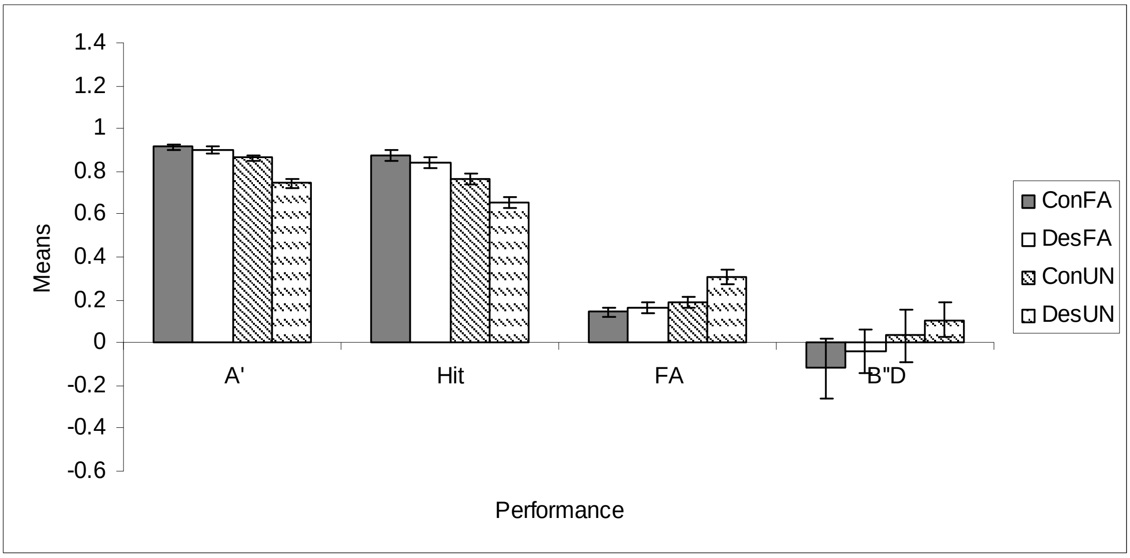
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Figure 5.

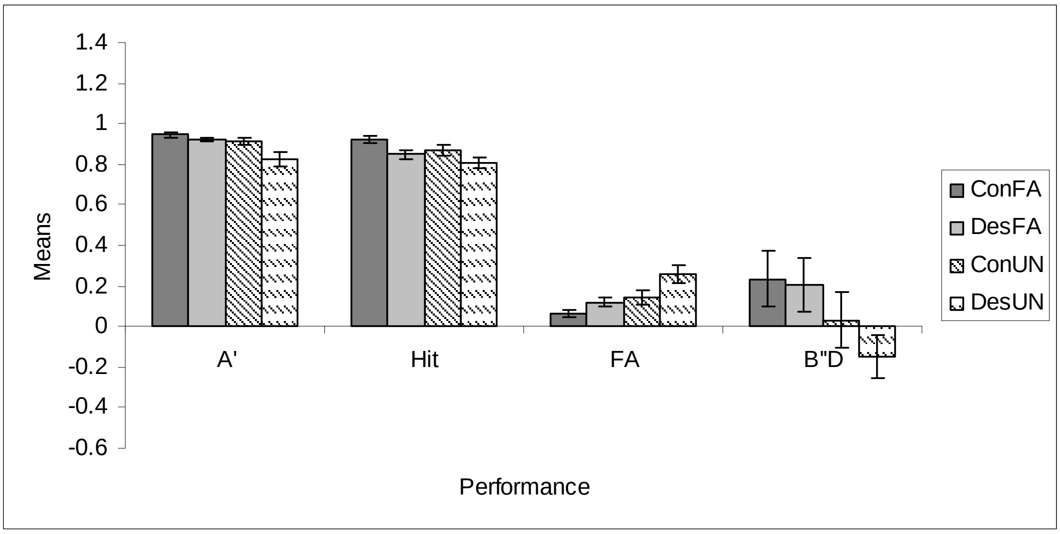
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Figure 6.

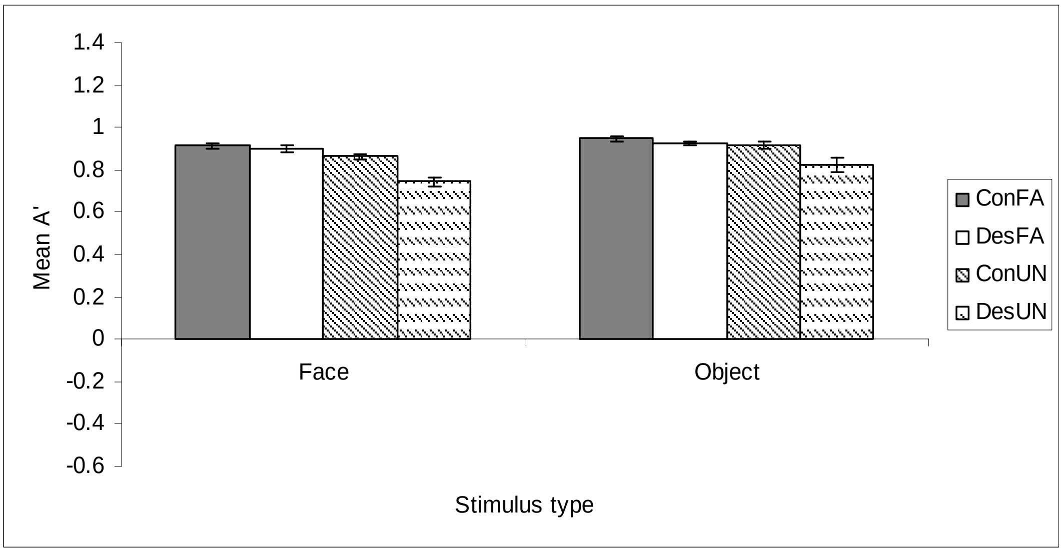
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Figure 7.

Appendix. List of familiar faces and buildings used in the experiments and their familiarity scores on a 7 point scale (1 = not familiar at all, 7 = highly familiar).

Familiar faces	**Mean**	**Familiar buildings**	**Mean**
Anthony Hopkins	4.5	Alcatraz	5.2
Arnold Schwarzenegger	6.4	Arc de Triomph	4.6
Bill Clinton	5.3	Angel	6.1
Brad Pitt	6.5	Big Ben	6.2
Bruce Willis	6.3	Brandenburg	3.8
Chris Tarrant	6.0	Buckingham Palace	5.5
Cliff Richard	5.5	Christ the Redeemer	5.3
Daniel Radcliffe	6.3	Eiffel Tower	6.2
David Beckham	5.1	Empire State Building	4.7
David Bowie	6.3	Forbidden City	3.9
Elton John	5.5	Golden Gate Bridge	5.7
Ewan McGregor	6.0	Great Wall of China	5.1
Gary Lineker	5.8	Harrods	5.3
George Bush	6.2	UK Parliament	6.2
Gordon Brown	6.2	London Bridge	6.1
Jim Carey	6.0	MI6	4.7
Justin Timberlake	6.0	Millennium Dome	6.0
Kevin Spacey	4.5	Mount Rushmore	6.2
Leonard Dicaprio	5.8	Opera House	5.6
Nicolas Cage	5.6	Pyramids	6.1
Paul McCartney	5.8	Roman Colosseum	5.4
Pierce Brosnan	5.3	Sage	5.2
Prince Harry	6.1	Sphinx	6.3
Prince William	6.1	Statue of Liberty	6.2
Robert De Niro	5.3	Stonehenge	6.3
Russell Crowe	5.3	Taj Mahal	6.4
Sean Connery	4.5	Teesside University	6.3
Tom Cruise	6.1	Twin Towers	6.3
Tony Blair	6.2	Tyne Bridge	5.6
Vinnie Jones	5.6	Wembley Stadium	5.0
Overall mean	5.7	Overall mean	5.5