The Role of Verbal Processing in Face Recognition Memory

Kazuyo Nakabayashi

Department of Psychology, University of Glasgow

Submitted for the Degree of Ph.D. to the Higher Degree Committee of the Faculty of Information and Mathematical Sciences, University of Glasgow.

August 2005

Abstract

This dissertation attempts to provide a comprehensive view of the role of verbal processing in face recognition memory by examining some of the neglected issues in two streams of cognitive research, face recognition and verbal overshadowing. Traditionally, research in face recognition focuses on visual and semantic aspects of familiar and unfamiliar face processing, with little acknowledgement of any verbal aspect. By contrast, the verbal overshadowing literature examines the effect of verbal retrieval of unfamiliar face memory on subsequent recognition, with little attention to <u>actual</u> mechanisms underlying processing of these faces. Although both are concerned with our ability to recognise faces, they have proceeded independently as their research focus is diverse. It therefore remains uncertain whether or not face encoding entails verbal processing, and whether or not verbal processing is always detrimental to face recognition. To address these issues, some experimental techniques used in face recognition research were combined with methods from verbal overshadowing research. The first strand of experiments examined configural-visual and featural-verbal processing associations in change recognition tasks. The second strand systematically examined the role of verbal processing in recognition memory by manipulating the degree of verbal involvement during and after encoding. The third strand examined the 'perceptual expertise' account of verbal overshadowing in picture recognition memory tasks, involving pictures of familiar and unfamiliar people. The fourth strand directly tested a tentative hypothesis 'verbal code interference' to explain verbal overshadowing by manipulating the frequency and time of face verbalisation in line-up identification tasks. The concluding experiment looked at the relation between intentional learning and verbal

overshadowing in a recognition memory task using more naturalistic stimuli. The main findings indicate first, that mechanisms underlying face processing appear to be complex, and simple processing associations (configural-visual and featural-verbal processing) cannot be made. Second, face encoding seems to involve some sort of verbal processing which may actually be necessary for successful recognition. Third, post-encoding verbalisation *per se* does not seem to be the key determiner for recognition impairment. Rather, the interference between verbal representations formed under different contexts seems to harm recognition. Fourth, verbal overshadowing was found only for unfamiliar face picture recognition, but not for familiar face picture recognition, casting a doubt on 'perceptual expertise account'. Finally, although no clear evidence linking intentional learning and verbal overshadowing was found, intentional learning and verbalisation in combination affected a response pattern. These results were discussed in relation to ongoing debate over causes of the verbal overshadowing effect, which raises an important ecological question as to whether the phenomenon might reflect natural human memory interference. This has practical implications for eyewitness testimony investigations where describing a previously seen perpetrator' face is a part of the investigation processes.

Acknowledgements

I would like to express my gratitude to Professor Mike Burton for his patience and constructive guidance throughout the course of this project. This research was supported by a doctoral studentship from the EPSRC.

Declaration

I declare that this thesis is my own work carried out under the normal terms of supervision.

中林一代....................

Kazuyo Nakabayashi

Publications

Chapter 3

Nakabayashi, K. & Burton, A.M. (submitted). The role of verbal processing in face recognition memory. *Memory & Cognition.*

Chapter 4

Nakabayashi, K. & Burton, A.M. (in preparation). The verbal independence of familiar and unfamiliar picture recognition memory.

Chapter 5

Nakabayashi, K. & Burton, A.M. (in preparation). Verbal code interference and verbal overshadowing.

Table of contents

Chapter 1

General Introduction

1.1 Introduction

This thesis examines the role of verbal processing in face recognition memory by exploring some overlooked issues in the face recognition and verbal overshadowing research. Although both are concerned with human face processing, they have proceeded independently as their research focus is diverse. This has left some unanswered questions. It is still uncertain whether or not face learning entails verbal processing as well as visual processing, and whether or not describing faces aloud (verbalisation) is always detrimental to face recognition. Moreover, much work in memory research involves the use of non-face stimuli (e.g. words or objects) so that mechanisms involved in face memory processing remain unclear. More specifically, it is uncertain whether or not the verbal component also plays a part in face memory processing. The goal of this thesis is to address these issues by combining some of the experimental methods used in face recognition research with those used in the verbal overshadowing research.

1.2 Memory process

1.2.1 LEVELS -OF -PROCESSING THEORY

The levels-of-processing approach was developed in research on verbal learning (Craik & Lockhart, 1972; Craik & Tulving, 1975). This framework states that memory for information would depend on the depth at which information is processed; information processed at a shallow level (i.e. on the basis of physical characteristics) will be remembered less well than information processed deeply (meaningfully or semantically). This approach, therefore, is concerned with how the nature of encoding would influence later memory. It is clear that if we are to understand how information is represented in memory, it would be useful to know how the information was initially encoded. In Craik and Tulving's experiment (1975) participants answer questions regarding each visually presented word. In each trial a question is asked, concerning with either the physical aspect of the word (e.g. is the word in capital letters?), the sound of the word (e.g. does the word rhyme with WEIGHT?), its meaning (e.g. is the word a type of fish?), or " Would the word fit the sentence: He met a_____ in the street?" Then the word in the question appears, and participants provide an answer. This procedure was repeated for the remaining target words. Participants answer one question for each word, and each question demands different levels of information about the word. In other words, each question is designed to induce different levels of encoding processing. This is followed by an unexpected recognition test where participants identify the target words they saw previously from the same number of similar distractor words. The findings were that recognition performance was best for words processed with a question asking meaning, worse for words processed with a question asking sound, and worst for words processed with a question asking physical appearance. Presumably, judgements of physical characteristics only require shallow processing, whereas judgements of meaning induce deep processing. In short, deeper the levels of processing the better the memory.

1.2.2 THE LEVELS-OF-PROCESSING APPROACH TO MEMORY FOR FACES

The levels-of-processing framework had an enormous impact, and the theoretical notions were also applied to understand face processing. The pioneering work of levels-of-processing on face memory comes from Bower and Karlin (1974). In the study, participants were shown pictures of faces, one at a time, for 5 seconds, and answered one question for each face, either asking sex (encouraging shallow processing), likableness, or honesty (encouraging deep processing) of the person shown. In a subsequent surprise recognition test, participants were shown the same pictures of targets (duplicates) and the same number of distractor pictures (different images of the targets), and indicated whether each face was old or new. The results showed that faces encoded on the basis of likableness or honesty were recognised better than faces that were judged on sex. From the results the authors concluded that face memory representations can be varied by provoking different levels of processing at encoding. However, the task required the recognition of previously seen face pictures (duplicates were presented at test) from the same number of distractor pictures. Therefore, it could be argued that the results merely reflect levels-of-processing underlying picture recognition rather than face recognition which normally entails the presentation of different face pictures between learning and test (i.e. each face picture is used only once during an experiment). Subsequently, Sporer (1991) suggested that performance decline resulting from shallow level processing may reflect participants' reduced involvement in the task, rather than the depth of processing. Judgments about physical characteristics of a face are a trivial task which might lead to boredom. Others also question the notion of levels-of-processing as to whether it is the quantity or quality of encoding that facilitates performance (Winograd, 1978, 1981). Winograd (1978) stresses the quantity view of face memory in that trait judgments facilitate memory because they lead to broader feature sampling (i.e. more features encoded). Moreover, elaborative encoding is effective as it increases the chance of distinctive features begin encoded (Winograd, 1981).

1.2.3 ENCODING SPECIFICITY

While levels-of-processing is concerned primarily with the nature of encoding processing, encoding specificity incorporates the effect of context into its framework. Tulving and Thomson (1973) suggest that memory represents both the information about to-be-remembered items and contextual information in which these items are presented. Thereby, success in memory performance would be most likely when encoding context matches that at retrieval. This framework often entails two different encoding conditions and two retrieval conditions. For example, Thomson and Tulving (1970) presented their participants pairs of words in which the first word was a cue word for the second word in a pair which participants were required to learn. The cue words were either weakly associated with target words (e.g. "train-black") or strongly associated (e.g. "white-black"). At test participants were tested either with weakly associated cue words or strongly associated cue words. The results showed that recall performance was best when cue words presented at retrieval were the same as those presented at encoding. Any change in pairing (e.g. weak cues at learning, but strong cues at test) lowered performance. The result is taken as supporting evidence demonstrating the context effect on memory performance. A similar finding was also reported for the physical context in that word recall was best when they were learned and tested underwater or on land than when they were learned underwater and tested on land or vice versa (Godden & Baddeley, 1975).

1.2.4 ENCODING SPECIFICITY AND MEMORY FOR FACES

Wells and Hryciw (1984) argue that the trait judgement advantage for face recognition memory may be better explained by encoding specificity framework, rather than the notion of levels-of-processing. They suggest that trait judgments lead to better recognition performance as they induce holistic processing of faces, which matches with recognition processing that is also holistic. In short, recognition success depends on the overlap between encoding and retrieval cognitive operations. Wells and Hryciw refer to holistic processing as processing of between feature comparisons "interfeature topographical cues" such as distance between eyes and symmetry across lips. In the study, participants studied a target face for 30 seconds during which time they rated either physical characteristics (e.g. narrow-wide eyes and long-short nose) or traits (e.g. honesty and intelligence) of the person shown. Subsequently, those in a recognition condition engaged in a target present line-up recognition task where they were shown 6 Identi-kit faces, and identified the target. Those in a reconstruction condition were asked to reconstruct the target face by selecting features from Identi-kit. The results showed that trait judgments were significantly better than feature judgments for recognition, whereas feature judgments were significantly better than trait judgments for reconstruction. In other words, the trait judgment advantage disappeared when the task at retrieval favoured more featural based processing (face construction using Identi-kit). The results also challenge the quantity assumption of the trait judgment advantage in that trait judgements lead to better memory because they induce greater feature sampling (Winograd, 1978). Wells and Hryciw argue that if the quantity assumption were true, trait judgments should have resulted in better reconstruction performance than feature judgments, yet the result indicated the opposite pattern. All these results were taken as supporting evidence for processing match interpretation of face memory in that processing underlying trait judgment (holistic processing) and that involved in face recognition (holistic processing) are similar, and this leads to better recognition performance.

It is clear that attempts have been made to understand face (face picture) memory processing by applying some of the findings from non-face memory studies. However, much work in this area has been conducted on non-face stimuli, therefore, process underlying face memory still remains poorly understood.

1.3 Some findings from face recognition studies

Research in face recognition takes a rather different approach from the face memory studies described above to understand mechanism involved in face processing. Traditionally, studies on face recognition focus on understanding the contributions of visual and semantic information of a face or person to the recognition of age, sex, or identity, with little or no attention to the contribution of verbal processing to these. The paradigm often entails encoding manipulations by adding changes to various aspects of facial information. It is now well known that the recognition of faces uses more than information of facial features and their spatial layout. Face recognition can be affected by any variations in colour, shading, brightness (Bruce & Langton, 1994; Kemp, Pike, White, & Musselman, 1996), or viewpoint and orientation (Hill, Schyns, & Akamatsu, 1997; O'Toole, Edelman, & Bulthoff, 1998) of faces. For example, we find it very hard to recognise faces in photographic negatives as this inverts the pattern of brightness across an image (Bruce & Langton, 1994). It is also well documented that our face recognition is affected by semantic knowledge of a person. For example, interpreting faces on the basis of occupation can enhance the recognition of the seen faces (Klatzky, Martin, & Kane, 1982). Making semantic judgments about faces during learning (e.g. personality traits) lead to better recognition than making physical judgments (e.g. the face with big eyes) (Patterson & Baddeley, 1977). It is also well documented that our ability to recognise faces can vary, depending on a face type. We are better at recognising familiar faces (e.g. faces of friends, colleagues, or celebrities) than unfamiliar faces (i.e. faces of people who are unknown to us) (Ellis, Shepherd, & Davis, 1979; Hancock, Bruce, & Burton, 2002; Klatzky & Forrest, 1984; Yarmey, 1971). Similar findings have been also reported for matching performance. We are bad at matching unfamiliar faces (Bruce et al., 1999), but we are good at matching familiar faces (faces of colleagues) (Bruce, Henderson, Newman, & Burton, 2001). Recognising faces of people from other races is harder than those from own race (Brigham & Malpass, 1985; Chiroro & Valentine, 1995; Doty, 1998; O'Toole, Deffenbacher, Valentin, Abdi, 1994).

One way to assess a wide range of face recognition abilities is to use <u>a face recognition memory task</u>, involving a multiple presentation of faces where participants learn a set of target faces, after which they attempt to identity them from a larger set containing additional unfamiliar faces (e.g. Bothwell, Brigham, & Malpass, 1989; Deffenbacher, Carr, & Leu, 1981; Diamond & Carey, 1986; Patterson & Baddeley, 1977). In such a face recognition memory task, participants are often required to identify, for example, whether each face is old (i.e. having seen the face before) or new (i.e. not having seen the face before). Typically, this approach attempts to examine our ability to recognise previously encountered faces, and to identify possible factors that might influence this ability. Another way to examine face recognition abilities is to use a matching task. For example, participants are shown two images simultaneously, and identify whether the images were of the same person or different people (Hill & Bruce, 1996). Participants might also be asked to engage in a line-up matching task where the target and its corresponding face array (either target present or absent) are shown simultaneously, and the task is to identify which face in the array is the target face (e.g. Bruce et al., 1999). An advantage of this approach is that it can eliminate memory load as participants do a matching task while both a target and distractor face(s) are in view.

1.3.1 CONFIGURAL VERSUS FEATURAL PROCESSING OF FACES

One of the most researched topics in face recognition is configural versus featural processing of faces. The term 'configural processing' has been defined in various ways, and has been used inconsistently in the literature. Configural processing refers to the process based on the spatial relationship among individual facial features, that gives rise to the recognition of a particular face (Diamond & Carey, 1986). Others use, the term 'holistic processing' rather than the term 'configural processing' to refer to processing of faces as a whole like a template. Holistic representations of faces contain information about constituent parts (i.e. facial features, such as eyes and nose) and their spatial layout, but such information is not explicitly represented (e.g. Tanaka & Farah, 1993). Some researchers use the term 'configual' and 'holistic' processing interchangeably to refer to the same process while some treat the two differently. On the other hand, there seems to be a general agreement on the definition of featural processing as to the process of independent facial features (Schwarzer & Massaro, 2001) in a piecemeal fashion, in contrast to configural processing. The key role of configural processing in face recognition has been repeatedly demonstrated by various findings, such as composite effect and inversion effect.

1.3.2 COMPOSITE EFFECT

The composite effect is one of the classical examples highlighting the role of configural processing in face recognition. The phenomenon was first demonstrated by Young, Hellawell, & Hay (1987) who showed participants faces composed of two parts taken from two famous people. The upper part of the face (from the middle of the nose to the hair) was taken from one face and the lower part (the rest of the face) was taken from another face. The task was to identify the upper part of the face. The findings showed that the identification of the upper part in the composite face was difficult. Presumably, the two parts produced new configuration, making it difficult to process the two independently. However, the task was easier when such configuration was disrupted by presenting the upper face alone, by inverting the composite face, and by misaligning the two parts. From these results, it was suggested that configural information is important for face recognition and that configural information is properly processed only in upright faces.

1.3.3 INVERSION EFEFCT

The inversion effect refers to the phenomenon that turning faces upside down impedes face recognition. A classical study showed that the when photographs of faces and other non-face stimuli (e.g. houses or aeroplanes) were learned and tested upright, the recognition of faces was better than other stimuli. However, when all the stimuli were learned and tested inverted, then the recognition of faces became most difficult (Yin, 1969). This was initially interpreted such that faces entail processes that are not engaged by other non-face stimuli. More recently, other researchers suggest that inversion disrupts configural processing of faces, with a little effect on featural processing (e.g. Bartlett & Searcy, 1993; Leder & Bruce, 2000; Rhodes, Brake, & Atkinson, 1993). For example, Leder & Bruce (2000) attempted to clarify the mechanisms underlying the face inversion effect. More specifically, the role of featural and configural information in the inversion effect. In the study, 6 configural changes (changes to the spatial distance between facial features) and 6 local featural changes (changes to colour changes to facial features) were added to each face, which constructed 12 different identities. Each image was given a name (e.g. this is Bob), and participants learned the identities of all the images (i.e. being able to name each face). At test, the participants were shown these images both in upright and upside down orientations, and were asked to name each face. The results showed identification impairment only for inverted configural changed images, but inversion had no effect on the identification of featural changed images. This suggests that what is disrupted by inversion is processing of configural information (the spatial relationship between facial features), rather than processing of local featural information. This was taken as evidence highlighting the importance of configural information for face recognition. However, some researchers argue that inversion disrupts 'holistic processing', and that the effect of inversion is more pronounced for faces than for words and houses since face processing involves lesser degree of part decomposition (i.e. face are processed as a whole) than the other stimuli (Farah, Tanaka, & Drain, 1995; Farah, Wilson, Tanaka, & Drain, 1998; Tanaka & Farah, 1993). In sum, these previous studies demonstrate that our face processing can profoundly be affected by changes in visual and semantic information of a face. More importantly, configural (or holistic) processing of a face appears to play an important part in face recognition.

Nevertheless, research in face recognition has paid little attention to the role of verbal processing in face recognition, and how this might mediate recognition overall. This is surprising because many studies in other domains have endeavoured to understand the relationship between visual and verbal processing underlying various cognitive operations.

1.4 Visual and verbal process

1.4.1. DUAL CODING THOERY

Dual coding theory is one of the domains that attempt to understand human memory organisation by converging evidence from both visual and verbal perspectives. Paivio (1971, 1986, 1991) postulates the modality specific model of memory in that there are verbal and nonverbal processes that organise and transform information differently. Verbal information is represented in logogens, which are processed in parallel, whereas nonverbal information is represented in imagens, which are processed serially.

Nevertheless, the two systems are interconnected with each other, functioning in an additive manner. Therefore, a presentation of a picture (e.g. a picture of an elephant) can trigger off the word associated with that picture (e.g. the word 'elephant' or 'trunk'). When a stimulus is stored in both memory systems, it is dually encoded, which increases the probability of memory retrieval. For example, a response can be retrieved from either code; one code could be forgotten during retrieval but a stored item can be recovered from the other code. Accordingly, recall and recognition of pictures and concrete words (e.g. dog or cat) are, in general, better than abstract words (e.g. bravery or passion) since both codes can coexist for pictures and concrete words, whereas abstract words have only a verbal code (Bower, 1970; Paivio, 1971). Dual coding theory is in sharp contrast to an amodal approach of memory, claiming that all information is stored together (Anderson & Bower, 1973; Pylyshyn, 1973). Supporting evidence for dual coding theory comes from studies manipulating encoding processing for various stimuli, including words, sounds, or pictures. Participants are often required to encode the stimuli verbally by writing or pronouncing words, visually by drawing or imagining pictures, or both by presenting pictures and words together (Paivio & Csapo, 1973; Thompson & Paivio, 1994). Similarly, some studies (Paivio & Csapo, 1969) manipulated the availability of visual and verbal codes. For example, the visual availability was controlled by using abstract words (visual code least available), concrete words, or easily labelled pictures (visual code most available), while verbal code availability was controlled by limiting stimulus presentation duration, aimed at the prevention of verbal processing from occurring. Thus, the general method entailed the manipulation of encoding process, which has provided evidence for the existence of the dual code systems in memory.

However, the applicability of the dual coding framework to face memory processing appears to remain unclear, as there appears to be little work of this kind on faces.

1.4.2 VISUAL AND VERBAL PROCESS AT ENCODING

1.4.2.1 Effect of verbal process on recognition memory

Some earlier studies examined the effects of verbal elaboration or labelling on subsequent memory performance. McKelvie (1976) examined the effect of labelling at encoding on subsequent recognition of schematic faces. The motivation for the study was based on previous findings that labelling facilitates recognition memory for non-meaningful objects, such as shapes (e.g. Daniel & Ellis, 1972; Santa & Rankin, 1972), but not for meaningful common objects, such as a toothbrush, a spoon, or a ruler (e.g. Kurtz & Hovland, 1953). In the study participants were allocated into two encoding conditions. In a labelling condition participants learnt a set of schematic faces until they were able to label each face correctly. Meaningfulness of the labels was varied at three levels (easy-to-label, medium, or hard-to-label) by changing expression of schematic faces. For example, the label 'innocent' was attached to a face with neutral expression. Presumably, there is little meaning relating the word "innocent" to the neutral face, which makes it hard to label that face. The label "smile" would be meaningful if it is attached to a smiling schematic face, hence falling into the category of easy-to-label. In an observation condition, participants learned a set of schematic faces without labels. Correct recognition accuracy deriving from these conditions was compared as a measure of the experimental manipulations. McKelvie also examined the effect of labels at a recognition stage either by encouraging the use of labels, by informing which label was relevant to each recognition trial, or by requiring participants to infer which label to use. The main findings were that both easy-to-label and hard-to-label faces were, in general, recognised better after labelling than observing. Recognition improvement was particularly marked when participants were aware which label was relevant to recognition and used it at recognition. These results were interpreted such that labels direct attention to the whole face which facilitates recognition of that face, and that labels serve as dual codes for memory for pictures.

1.4.2.2 Effect of visual process on memory recall

Some evidence has demonstrated a facilitatory effect of face picture presentation during encoding on recall performance. Kargopoulos, Bablekou, Gondia, & Kiosseoglou (2003) examined whether recall of verbal information about the person may be facilitated when accompanied by face pictures than when accompanied by names. The idea was based on findings that face recognition is better when accompanied by verbal information (e.g. Kerr & Winograd, 1982), and that names are difficult to remember in comparison to occupations (McWeeney, Young, Hay, and Ellis, 1987). In their study, each of 6 faces and 6 names (Greek first names) was given a set of 7 sentences containing personal information. The task was to learn verbal information associated with each name and each face, and to recall as much verbal information as possible for every item. In a face condition, participants were shown 42 facts and their corresponding 6 faces (7 facts for each face), but in a name condition they were presented with facts and their corresponding names. At test the participants were, again, presented with faces or names, and were asked to write down as much information as possible for each item. Recall accuracy was measured in both immediate and delayed (a week after learning) conditions. The findings showed that face presentation led to significantly better recall than name presentation. This was interpreted such that " faces serve as much more effective reference index than names", aiding retrieval. A similar advantage for recall performance was also reported by Glenberg & Grimes (1995) in that recall of political candidates' verbal statements and their political positions was significantly better when accompanied by their photos than without the photos. The authors suggest that people use photographs to organise all incoming information about the person in a unitary manner, and then build a schema that aids memory processing.

These studies have shown that visual and verbal processing can facilitate performance of one another. This might indicate that the use of visual and verbal codes during encoding may be beneficial also to face memory performance.

1.4.3 RECALL AND RECOGNITION

How recall and recognition is related is one of the longstanding issues in memory research (see Baddeley, 1990). In general, recognition is thought to be superior to recall. An influential theory accounting for recognition superiority is "two-process theory" (see Watkins & Gardiner, 1979 for a review). In a simplest term, the theory states that recognition is superior to recall as it involves a single stage process (making a decision or the recognition of retrieved information) whereas recall entails two stage process where the search for stored information needs to be taken place prior to recognition process. Recall and recognition independence has been suggested in studies using words (e.g.

Flexser & Tulving, 1978). Likewise, studies on faces often failed to find the relationship between recall and recognition performance (e.g. Ellis 1986; Pigott & Brigham, 1985). A general finding seems to be that face recall is difficult (e.g. Ellis, 1986; Phillips, 1978), and that recognition of faces is better than recall of faces. One of the difficulties with face recall may be that face recall requires decomposition of a holistic image into elements, which may interfere with the ability to retain that image while attempting to recall it (Ellis, 1986; Ellis, Shepherd, & Davis, 1975).

For example, Pigott and Brigham (1985) attempted to examine the relationship between accuracy of description and accuracy of identification by incorporating levels-of-processing approach. In the study, participants viewed a live person for 15 seconds either in a shallow processing condition (making judgments about physical characteristics) or in a deep processing condition (making judgments about honesty of the person). Then, all of them completed the description checklist before engaging in a face line-up test, composed of 6 faces (either target present or absent). The authors found that overall identification accuracy of 70.83%, but no effect of the depth of processing or the relationship between description accuracy and recognition accuracy. Participants who accurately described the target were not necessarily better at recognising the target than those who described the target less accurately. From the results, it was suggested that the depth of processing manipulation may be effective only for pictorial materials, but not for live people. This could have been due to the fact that the task (rating a live person) was so interesting that the difference in the encoding instructions became irrelevant. The findings of the study, therefore, offer an alternative account for earlier findings of levels-of-processing.

1.4.4 WHEN RECALL AFFECTS RECOGNITION / VERBAL OVERSHADOWING EFFECT

However, work by Schooler and Engstler-Schooler (1990) showed that recall process can affect recognition process. The authors found that describing a previously seen face from memory impairs the recognition of that face (the verbal overshadowing effect). This paradigm demonstrates the detrimental effect that face recall (describing a previously seen face) has on subsequent face recognition. In the original study, participants watched a 30 second video, depicting a bank robbery, and then did a 20 minute filler activity (e.g. reading several passages and answering questions). Immediately after these, half the participants engaged in a further 5 minute filler task while the other half wrote down a detailed description of the robber's face for 5 minutes. In a subsequent test, all participants were shown the robber's face together with other 7 similar looking distractor faces, and were asked to identify which face they had seen earlier. The results showed that verbalisation of the previously seen face significantly reduced recognition accuracy, only 38% of the verbalisers, in contrast to 64% of the non-verbalisers, made a correct identification. However, the proportions of false alarms and misses did not differ between the two groups, indicating that verbalisation did not simply affect willingness to select the target. These findings were also replicated when there was 2 day delay between learning and test, when colour was used as stimuli, and when immediate recognition performance was measured. The fact that the verbal overshadowing effect disappeared under a limited response time condition (5 sec) indicates that verbalisation did not eradicate the original visual memory, but it made the visual memory inaccessible. From these findings, the authors suggested that verbalisation creates a verbal representation that interferes with the access to the original memory at test, resulting in recognition impairment (the recoding hypothesis). This hypothesis, therefore, is consistent with dual coding theory suggesting the coexistence of visual and verbal codes in memory (Paivio, 1986), with the critical difference that the multiple codes, however, interfere with each other, hampering retrieval process.

Over the years, it has become apparent that the negative effect of verbalisation is much broader than originally assumed. The effect extends also to visual forms (Brandimonte, Schooler, & Gabbino, 1997), maps (Finger, 2002; Fiore & Schooler, 2002), voice (Perfect, Hunt, & Farris, 2002), taste (Melcher & Schooler, 1996), and affective decision making (jam preference) (Wilson & Schooler, 1991). However, many researchers have failed to replicate the verbal overshadowing effect or found a facilitating effect of verbalisation (Itoh, 2005; Kitagami, Sato, & Yoshikawa, 2002; Meissner, Brighgam, & Kelly, 2001). The standard method in this paradigm entails the manipulation of post-encoding activities to understand the mechanisms involved in memory interference.

1.4.4.1 Three assumptions of verbal overshadowing

From multiple sources of evidence three main accounts have been offered to explain the verbal overshadowing effect (Schooler, Fiore, & Brandimonte, 1997). The first assumption is 'the recoding hypothesis' as suggested originally. Recall that this hypothesis states that verbalisation forms a verbal representation that is accessed at retrieval, instead of the original visual representation of a face. Thus, in principle, if the negative effect of verbalisation is due to the reliance on the verbal representation, then there should be a relationship between the contents of the description and recognition accuracy. However, the disruptive effect of verbalisation was demonstrated when there was no relationship between the two. For example, verbalisation of a single face can also impair the recognition of other non-described faces (Brown & Lloyd-Jones, 2002, 2003).

The second assumption is 'availability assumption' which postulates that verbalisation does not eradicate the original visual memory, but the original memory becomes inaccessible. Therefore, the effect of verbalisation should be reversible. This release from verbal overshadowing was demonstrated by Schooler, Ryan, & Reder (1996) by re-presenting a target face at test. In their study, participants learnt a face, and then either did a filler task or wrote down a description of the target. Immediately after these, half the control and description participants were assigned to a face-representation condition where they were, once more, shown the target face. At test, all participants identified the target from an array of 5 other distractor faces. The findings showed a verbal overshadowing effect in the non-representation condition, but this effect was reversed in the face representation condition; verbalisation significantly improved identification compared to the control condition. This was taken as supporting evidence for the availability assumption in that the original memory remained intact, thereby, representation of the face provided a retrieval clue, leading to significant gain.

The third assumption 'the modality mismatch assumption' or 'perceptual expertise explanation' is based on the idea that memory involves two types of knowledge, verbal and nonverbal knowledge (Paivio, 1986), but they are, somehow, in competition. Thus, the disruptive effect of verbalisation is due to the mismatch between the two. Technically, the effect of verbalisation should vary depending on the degree of imbalance between the two (verbal knowledge exceeds nonverbal knowledge or vice versa) and whether stimuli rely on verbal or nonverbal processing. In short, the more stimuli rely on visual processing the greater the disruption caused by verbalisation as demonstrated in the original study that verbalisation had no effect on statement recognition (Schooler & Engstler-Schooler, 1990).

1.4.4.2 Content or process?

In essence, the three premises suggest two types of explanations for the verbal overshadowing effect, namely 'content' and 'processing' accounts. The content account states that self-generated verbal information interferes with the access to the original visual information that is critical to face recognition. Some researchers still continue to support this view (Finger & Pezdek, 1999; Meissner, Brigham, & Kelly, 2001; Meissner, 2002). Meissner, Brigham, & Kelly (2001) reported that the verbal overshadowing effect was found only when participants were forced to keep describing a face, but not when they were just asked to provide a description of a face or when they were instructed to report only what they could remember about the face. Forced recall participants produced significantly less accurate information than the other participant. Therefore, the author suggested that the accuracy of the description affects retrieval process. The process account, on the other hand, suggests that verbalisation may change retrieval '*process*'. More specifically, verbalisation causes retrieval inhibition in that it dampens the activity of critical nonverbal processing while emphasising sub-optimal verbal processing (the transfer inappropriate retrieval account). However, the role of retrieval inhibition has become less clear as recognition impairment similar to that of the verbal overshadowing effect has been demonstrated by simply manipulating post-encoding activities, without post-encoding verbalisation (Macrae & Lewis, 2002). Similarly, it is uncertain why engaging in a completely unrelated task at post-encoding (e.g. listening to music, Finger, 2002) can reverse the effect of verbalisation. These findings indicate that the verbal overshadowing effect can be induced or reversed by simply manipulating cognitive operations even before the retrieval process commences. Thus, it appears that retrieval operations per se are unlikely be responsible for the verbal overshadowing effect.

1.4.4.3 The role of configural vs featural processing in verbal overshadowing

More recently, Schooler and his colleagues (Dodson, Johnson, & Schooler, 1997; Fallshore & Schooler, 1995; Schooler, Fiore, & Brandimonte, 1997; Schooler, 2002) have suggested that the verbal overshadowing effect may be due to a general processing shift between learning and test, rather than retrieval inhibition per se. The fundamental idea is that faces are encoded visually, but that subsequent verbalisation affects the way in which these faces are processed. Therefore, *how* a face is described is not so relevant, but the *act of verbalisation* per se produces a switch in processing between learning (configural processing) and test (featural processing), causing recognition impairment 'the transfer inappropriate processing shift hypothesis'. The key concept behind the hypothesis is that verbalisation activates featural processing while deactivating configural processing since featural information of a face (e.g. the size or shape of the nose) is readily described while configural information (the spatial layout among facial features or an global impression of the face) is not. Thus, verbalisation should specifically disrupt the use of 'difficult-to-verbalise' configural information, so stimuli that are particularly associated with this processing should be vulnerable to verbal overshadowing. This prediction was supported by the finding that verbalisation impaired the recognition of own race and upright faces, but not that of other race and inverted faces (Fallshore & Schooler, 1995). This revised account stresses more general interference in processing per se (the processing shift which occurred prior to test carries over to retrieval), rather than retrieval operations as suggested previously.

1.4.4.4 Vulnerability of verbal overshadowing

In the report on a meta-analysis of 29 verbal overshadowing studies Meissner & Brigham (2001) found that the effect is significant, but is fragile, accounting for only 1.4% of the variability across the studies. This might explain why some studies failed to replicate the effect (e.g. Memon & Bartlett, 2002). It appears that the manipulations at any stages of memory processing (encoding, post-encoding, or test) can affect the replication of the effect. For example, face verbalisation can facilitate, rather than impair, recognition when faces are learned under an incidental learning condition (Itoh, 2005). Preventing verbal learning during encoding eliminates the verbal overshadowing effect (Wickham & Swift, in review). As mentioned earlier, the effect can be profoundly affected by the post-encoding verbalisation method (forced recall is more likely to provoke the effect than standard recall)(Meissner & Brigham, 2001). Likewise, those who provide accurate featural information of a face are more vulnerable to verbal overshadowing than those who describe the face in terms of its resemblance to other people (more subjective judgements)(MacLin, 2002). Test conditions also affect the replication of the effect. If similarity among test faces in a line-up is relatively high it is more likely to induce the effect than when similarity is low (Kitagami, Sato, & Yoshikawa, 2002). Limiting response times can eradicate the effect (Schooler & Engstler-Schooler, 1990, though Brown & Lloyd-Jones, 2003 replicated the effect in a speeded-response test). Furthermore, a study design can affect study outcome. For example, a within-subjects design (repeated trials) can attenuate the verbal overshadowing effect (Fallshore & Schooler, 1995).

In sum, although several factors affecting the verbal overshadowing effect have been identified, the mechanisms underlying the disruptive effect of verbalisation still remain unclear. What is surprising is that there appears to be no systematic investigation in this paradigm to examine how faces are actually encoded. Recall that the most fundamental idea behind the verbal overshadowing effect is that describing visual (or perceptual) memory impairs recognition as words do not capture such memory adequately. Faces may be one class of stimuli that might be difficult to describe. However, this does not necessarily eradicate the possibility that face learning might involve some verbal processing. As demonstrated by dual coding research pictures can be encoded and stored both visually and verbally, and this raises the possibility that the same could be said to face memory. Indeed, as reviewed before the verbal overshadowing literature acknowledges the possibility of the dual code memory organisation, yet this possibility has not been fully examined. If verbal processing is already involved in face learning, then post-encoding verbalisation per se is unlikely to cause a change in processing styles from nonverbal to verbal. This will have direct theoretical implications for the processing shift account of verbal overshadowing. Until the role of verbal processing in face recognition becomes clear, it seems immature to make any assumptions about the mechanisms underlying face processing and its relation to verbal overshadowing.

1.5 Overview of previous studies

Studies in memory research, such as dual coding theory, point out the multiple components of memory structure. Studies on face memory also demonstrated the interaction between visual and verbal processing. As reviewed, the ability to recognise faces can be affected by verbal processing occurring during encoding. Conversely, the ability to recall verbal information about the person can be affected by visual process during learning. These findings hint at the possibility that face memory performance involves more than visual processing of faces. Yet, studies in face recognition have focused on visual and semantic aspects of face processing, with little emphasis on verbal processing. Although the emergence of the verbal overshadowing effect, once again, highlighted the impact of verbal processing on face memory, the role of verbal processing in face recognition seems far from clear. As the focus of these studies is diverse, they often used very different methodologies (e.g. some studies provided labels or semantic information of faces at encoding while others forced participants' self-generation of face descriptions at post-encoding). This makes it very difficult to make generalisation of findings across these studies. Consequently, it is hard to obtain a comprehensive view towards the role of verbal processing in face recognition (memory) from previous findings alone.

1.6 General aim of the thesis

The general aim of the thesis was to address some overlooked issues in the face recognition research and verbal overshadowing research by combining some of the methods used in these research areas. As reviewed above, both face recognition literature and verbal overshadowing literature recognise the critical role that configural processing plays in face processing, which has been examined from rather different perspectives. In the face recognition literature, configural versus featural processing has been examined by manipulating visual information in the face. By contrast, the verbal overshadowing literature examines the issue of configural and featural processing from the perspective of verbal processing. However, both research paradigms have one thing in common, which is that they have overlooked the role of verbal processing during encoding to see whether or not face learning involves verbal processing and its effect on recognition. This is surprising as earlier studies already demonstrated the effects of verbal processing at encoding on subsequent face recognition. Therefore, systematic investigations into the role of verbal processing in face recognition memory will provide better insights into mechanisms involved in face memory process. Addressing this will help bring a new perspective towards the current understanding of face recognition and verbal overshadowing. If face memory processing entails verbal processing, then it is likely that some levels of verbal processing is also involved in face recognition. This might encourage a new line of face recognition research. This will, in turn, have significant theoretical implications for the verbal overshadowing literature which emphasises verbalizability of perceptual stimulus for provoking the effect. Furthermore, all these will help clarify the applicability of dual coding theory to face memory organisation.

Chapter 2

The Role of Verbal Encoding in the Recognition of Configural and Featural Changes Made to Faces

INTRODUCTION

Five experiments in this chapter made a novel attempt to investigate the role of verbal encoding in the recognition of configural and featural changes made to faces. As reviewed in Chapter 1, research in face recognition focuses visual or semantic aspects of face processing, with little impact on verbal processing. Therefore, it seems unclear whether or not verbal processing is involved in performing various face recognition tasks and how it might affect face processing.

There are a growing number of studies reporting that verbal processing of visual materials interferes with subsequent memory or imagery performance (e.g. Bahrick & Boucher, 1986; Brandimonte & Gerbino, 1993; Brandimonte, Hitch, & Bishop, 1992, Pezdek et al., 1988; Walker, Hitch, Dewhurst, Whiteley, & Brandimonte, 1997). For example, Brandimonte, Hitch, and Bishop (1992) reported spontaneous verbal encoding in visual image processing. The prevention of verbal encoding affected performance on easy to name images (e.g. pictures of a skipping lope, a pipe, or a mushroom), but not on difficult to name images (e.g. pictures of geometric shapes). When images were easy to name participants tended spontaneously to verbally rehearse these items. Therefore, the prevention of spontaneous verbal encoding affected (suppression can facilitate) subsequent performance on easy to name images, but had no effect on difficult to name images. These results have led the authors to conclude that participants tend to engage in spontaneous verbal encoding when this is possible. However, to date, there appears to be very little work of this kind on faces to understand whether or not spontaneous verbal encoding might also be involved in face learning.

One of the most influential studies reporting the interference of verbal processing for face memory performance comes from the study by Schooler and Engstler-Schooler (1990). The authors demonstrated that verbally describing previously seen faces and colours impaired the recognition of these stimuli (the verbal overshadowing effect). This phenomenon was first attributed to the fact that verbally describing visual memory leads to the formation of a new verbally (featurally) biased memory representation which interferes with the access to the original visual memory at test, causing recognition memory impairment 'the Recoding Interference Hypothesis'. This is based on the idea that faces are visual stimuli that are difficult to describe in words. However, over the years it has become apparent that the hypothesis does not accommodate many of the subsequent verbal overshadowing findings.

First, according to the recoding interference hypothesis, there should be a relationship between the quality of a description and recognition performance. Recognition impairment, in principle, should occur when the quality of a face description is poor, as this would not help in correctly identifying the target face. However, for example, the verbal overshadowing effect was found even when the described face was a parent's face or a novel face (Dodson, Johnson, & Schooler, 1997). Therefore, it seems that the recoding interference hypothesis cannot account for such findings when there is no relationship between a described face and a face that was tested for recognition. Several other studies replicating a standard verbal overshadowing effect also failed to find the relationship between the quality of a description and recognition performance (e.g.

Brown & Lloyd-Jones, 2002, 2003; Fallshore & Schooler, 1995; Kitagami, Sato, & Yoshikawa, 2002).

Second, face recognition impairment resembling the verbal overshadowing effect was observed when no verbalisation task was involved. For example, in the study by Macrae and Lewis (2002) participants were shown the bank robbery video used in the original verbal overshadowing study. After the video, control participants engaged in a 10 minute filler task. The rest of the participants engaged in a letter identification task for 10 minutes where half of them were asked to identify global letters (e.g. a big T composed of small Ss) while the other half were asked to identify local letters (i.e. small Ss). Subsequently, all of the participants engaged in a recognition memory task where they identified the robber from 7 similar distractor faces. The finding was that those who identified local letters performed worse than the control participants. Conversely, those who identified global letters performed better than the control participants. Recognition impairment similar to the verbal overshadowing effect was demonstrated by simply manipulating post-encoding processing orientations (i.e. global or local processing), without involving a face description task.

Third, engaging in non-verbal tasks before a recognition test can eradicate the verbal overshadowing effect (Finger, 2002). In the study, participants saw a target for 30 sec, followed by a 5 minute filler task. After the filler task, the participants were allocated into one of the four conditions. In the control/maze task condition, participants did a further 5 minute filler task, and then completed a maze task. Likewise, in the control/verbal task condition, participants did a further filler task first and a verbal task second (e.g. listing names of flowers). In the face description/maze task condition, participants wrote down a description of the target for 5 minutes, and then completed the maze task. Similarly, in the face description/verbal task condition, participants did the face description task first and the verbal task second. At test, all participants were shown a slide containing the target and 5 other similar distractor faces, and were asked to identify the target they had seen earlier. The findings showed that identification accuracy in the control/verbal condition was significantly higher than that in the face description/verbal condition, a replication of a standard verbal overshadowing effect. Moreover, identification performance was significantly better in the face description/maze condition than in the face description/verbal task condition, a demonstration of release from verbal overshadowing. These findings were replicated when the maze task was replaced with a music task where the participants listened to instrumental music. These findings were taken as evidence illustrating that the verbal overshadowing effect is due to a shift in processing between encoding and post-encoding, caused by describing non-verbal memory. Therefore, the effect can be eradicated by engaging in a visual (maze) or auditory (listening to music) task, which reinstates the original perceptual processing. Release from verbal overshadowing has also been demonstrated in imagery tasks by reinstating cues that were present during encoding (Brandimonte, Schooler, & Gabbino 1997; Pelizzon, Brandimonte, & Luccio, 2002).

From these multiple sources of evidence Schooler (2002) proposed a revised account, 'the Transfer Inappropriate Processing Shift Hypothesis'. The basic idea behind this hypothesis is the same as that of the earlier hypothesis (the recoding interference hypothesis) in that faces (and other perceptual stimuli) are encoded visually (configurally), and describing non-verbal memory is detrimental to recognition. In the verbal overshadowing literature configural processing is tied with nonverbal (visual) processing of a face, referring to as processing of the face based on global percept (processing of the face in terms of spatial layout among facial features or its honesty or likableness). This is contrasted with featural processing (verbally based processing) referring to as processing of the face in terms of its constituent parts such as beautiful eyes or a small nose. The processing shift hypothesis states that verbally describing visual memory causes a shift in processing from visual (configural) processing to verbally based (featural) processing. This is detrimental to recognition performance since visual (configural) processing is critical for face recognition while verbally based (featural) processing is suboptimal. If verbally based (featural) processing is carried over to test, this will dampen visual (configural) processing necessary for successful recognition.

However, the problem with the assumption behind the processing shift hypothesis is the assertion that faces are encoded visually (configurally), and that engaging in sub-optimal verbal (featural) processing is detrimental to face recognition. It might be true that configural processing is important for successful face recognition. Indeed, the findings from the face recognition literature report the significance of configural processing in face recognition (e.g. Freire, Lee, & Symons, 2000; Leder & Bruce, 2000; Rhodes, Brake, & Atkinson, 1993; Young, Hellawell, & Hay, 1987). However, what is unconvincing with the hypothesis is that it assumes that faces are encoded visually when there appears to be no studies in the verbal overshadowing literature directly examining actual face encoding processing. Note that in the verbal overshadowing literature, manipulations are always introduced at post-encoding, and the research focus is to understand their effects on recognition memory, but not to understand actual encoding processes. As mentioned earlier, the role of verbal processing in face recognition remains unclear as much work on face recognition overlooked the contribution of verbal processing to various face recognition tasks. Despite the lack of understanding and research into this line of investigation, the verbal overshadowing literature seems to emphasis nonverbalisability of faces. Thus, making simple processing associations (visual-configural and verbal-featural processing) may not be plausible until the role of verbal processing in face recognition becomes clearer.

The five experiments reported in this chapter attempted to address these unattended issues. The method used in this chapter was designed to understand whether or nor verbal encoding is involved in change recognition performance, and to explore its relations to subsequent change recognition performance. For this purpose a configural / featural change recognition task, rather than a face recognition task (e.g. the recognition of the targets from a larger pool of distractor faces) was chosen. In addition, all manipulations were introduced at encoding. Therefore, the method used in the five experiments differs from that of in the verbal overshadowing literature, which often entails the manipulation of verbal processing at post-encoding and the examination into the effect of such a manipulation on subsequent face recognition.

Experiment 1

The aim of this experiment was to examine the effects of verbal encoding manipulations on change recognition performance by using the articulatory suppression technique and by asking participants to verbally describe faces during encoding. Articulatory suppression is a well-established technique which is used to reduce the extent of spontaneous verbal rehearsal in short term memory (Murray, 1967). Participants normally rehearse visually presented material within a phonologically based short-term store (Baddeley, 1986). It is possible to disrupt the use of this subvocal rehearsal by requiring participants to utter some repeated sounds (e.g. da, da, da) which prevents verbal rehearsal of to be learnt materials (Baddeley, 1992). This forces the reliance on the visual resource to process the stimuli. Therefore, if verbal encoding is involved in change recognition performance, then articulatory suppression should impair performance compared to controls. In contrast, if verbal encoding is not involved in change recognition performance, then forced verbalisation should affect performance. When considered in the perspective of the visual-configural and verbal-featural processing relationship, verbalisation of faces during encoding is likely to influence, or possibly enhance, the recognition featural changes, but not that of configural changes as (only) featural information of a face would be verbalised.

METHOD

Participants

38 Undergraduate students from the University of Glasgow took part in this experiment. There were 7 males and 31 females, all of whom had normal or corrected-to-normal vision by self-report. They received a small payment for their participation.

Stimuli / apparatus

An Apple Macintosh computer was used to present stimuli and record responses, using Superlab 1.75. Stimulus preparation was done by Photoshop 5.5. Stimuli consisted of greyscale head and shoulder pictures of 30 young Caucasian men, taken from the UK Home Office PITO database. Example stimuli are illustrated in Figure A, B, & C. There were no female faces due to the limited stimulus availability. These men were clean-shaven, had short hair, and wore no accessories or spectacles. These images varied in expression, lighting conditions, and viewing angles. Clothing and background of all pictures were removed. The picture size was approximately 3.5 cm x 4.5 cm.

Two different types of changes were made to each face: one configural and one featural. Configural changes refer to changes in the spatial layout of the facial features. These were created by moving hair, a nose, and a mouth slightly up or down and by spacing eyes closer together or further apart from each other. Only one of these changes was made to each original face. Featural changes refer to changes in facial features, which were created by replacing the eyes of one person with those of another person or by changing the size or shape of the eyes. Such changes were also made to other facial features, including eyebrows, a nose, a mouth, and chin. Each original face had only one of these featural changes. However, the number of changes made to each facial feature varied among features. For example, eyes were used to create changes more often than hair. The reason for this was that some facial features (e.g. eyes or nose) were easier to change than other features (e.g. hair or chin), without making faces look unnatural. This varied depending on individual faces. For example, a configural or featural hair change can be made to Face A, but not to Face B. Thus, which facial feature can be changed and which type of change can be added to which feature of a face were often determined by individual faces. Care was taken not to make changed faces look grotesque. For this reason all changes were subtle, rather than obvious. If faces had noticeable changes, they would have looked odd, possibly, causing a ceiling effect. A total of 90 images, consisting of 30 original images, 30 configural images, and 30 featural images, were used in the experiment, resulting in 3 stimulus sets. Each set was used only once in one of the conditions. The stimulus set – condition combination was systematically varied across participants.

Figure A

Figure B

Figure C

Figure A, B, and C: Examples of stimuli used in the study. Figure A is the original intact face. Figure B is a featural mouth changed image. Figure C is an eye configural changed image.

Design / procedure

A 3 (Group – Control / Suppression / Verbalisation) x 3 (Test – Same / Configural / Featural) mixed design was used to examine the effect of articulatory suppression and that of verbalisation during encoding on the recognition of changes made to a face, with Group as a between-subjects factor and Test as a within-subjects factor. Measurements were taken on accuracy (i.e. correctly identifying whether a test image was the same as or different from the original image presented before) and time between stimulus presentation and a response (RT).

There were 10 same, 10 configural, and 10 featural trials per condition. Each trial proceeded in the following order; learning, 2 sec blank, and test. At learning participants learned targets, one at a time, for 7 sec. In the same trials, the original intact image was presented again at test. In the configural trials, the original image with a configural change was presented at test. In the featural trials, the original image with a featural change was presented at test. The target presentation order was randomised across participants, and also the trial order was randomised within and across participants. A few practice trials were given to the participants prior to the real trials. At the beginning of the session, participants were given the standardised instructions:

" First, I will show you a picture of a face, a first picture, that I would like you to study. Then, after a brief blank screen you will be shown a different picture of the same person, a second picture. The second picture may be exactly the same as, or different from, the first picture you had just seen. Your task is to identify whether the second picture is the same as or different from the first picture. The second picture can differ from the first picture in two ways. First, the two pictures may differ in terms of their facial features. For example, the eyes of the second picture may be completely different from those of the first picture. Second, the two pictures may differ in terms of their spatial distance between facial features. For example, the distance between the nose and mouth in the second picture may be larger than that in the first picture. These types of changes are also added to all other facial parts, including, chin, nose, and eyebrows, and facial feature distance, including the distance between eyes and eyebrows. If you detect any change in second picture, please indicate 'different'. Otherwise, indicate 'same'. Please guess if you are unsure"

The nature of changes was informed prior participation as pilot work showed that when no information about the nature of changes was given, people struggled with the task so that their performance tended to be low.

The participants were randomly allocated into one of the three learning conditions: control, suppression, and verbalisation. Control participants learned targets without a secondary task. Suppression participants uttered irrelevant sounds, *la, la, la, la,* during learning. They remained silent while a cross was displayed on the computer screen. The rate of articulatory suppression (at a rate of three or four *la*'s per second) was similar to that of other studies (e.g. Brandimonte, Hitch, & Bishop, 1992) that used this technique to suppress verbal encoding of stimuli, without creating additional demands on attention (cf. Baddeley, 1986). During articulatory suppression the experimenter tapped a table at the stated rate, and the participants articulated in accordance with the tapping rate. A stopwatch was used to monitor the rate of table tapping. Verbalisation participants described each face aloud in as much detail as possible. They were encouraged to keep describing the face while it was on the screen for 7 sec. The participants were instructed to describe a face on the basis of facial features (e.g. the face with big eyes, large, nose, bush eyebrows, and so on), but not in any other ways, such as describing the faces on the basis of its impression. However, the verbal description was not recorded for further analysis as the main purpose of the description task was to provoke verbal encoding of faces (enforcing the use of verbal resource during learning), and to examine its effect on change recognition performance.

The condition – stimulus set combination was systematically varied in such a way that each set was used equally frequently in each condition. At test, the participants were shown a test image and made a speeded key response to indicate whether the test image was the same or different from the original image they had just seen. The image disappeared from the screen once a response had been made. The participants were tested on the same trials (i.e. presenting the intact original image), configural trials (i.e. the original image with a configural change), and featural trials (i.e. the original image with a featural change). To summarise, learning was followed by brief blank and test. The participants repeated this procedure for the remaining 29 trials.

RESULTS

Results on 'same' trials were analysed separately from results on configural and featural trials as the detection of sameness and that of changes are likely to involve different processes. The data from 2 participants were excluded from a further analysis due to their accuracy being 2 standard deviations away from the mean. The following analyses were based on the data from 36 participants.

Accuracy for 'same' trials: Percentage of correct responses for 'same', configural, and featural trials is shown in Figure 1 (83% of correct responses for the control condition, 80% for the suppression condition, and 77% for the verbalisation condition). A between-subjects (Condition – Control / Suppression / Verbalisation) analysis of variance (ANOVA) was conducted on correct responses. The results of the analysis did not reveal the effect of condition [$F(2,33) < 1$].

Accuracy for configural and featural trials: 63% of correct responses for configural changes and 67% of correct responses for featural changes were found in the control condition. In the suppression condition, 61% of correct responses for configural changes and 80% of correct responses for featural changes were found. In the verbalisation condition, 61% of correct responses for configural changes and 63% of correct responses for featural changes were found. A 3 (Condition – Control / Suppression / Verbalisation) x 2 (Test – Configural / Featural) mixed ANOVA was conducted on correct responses, with Condition as a between-subjects factor and Test as a within-subjects factor. This did not reveal any effects of Condition [$F(2,33) < 1$], Test [$F(1,33) = 2.98$, $p > 0.05$], or the interaction [$F(2,33) = 1.06$, $p > 0.05$].

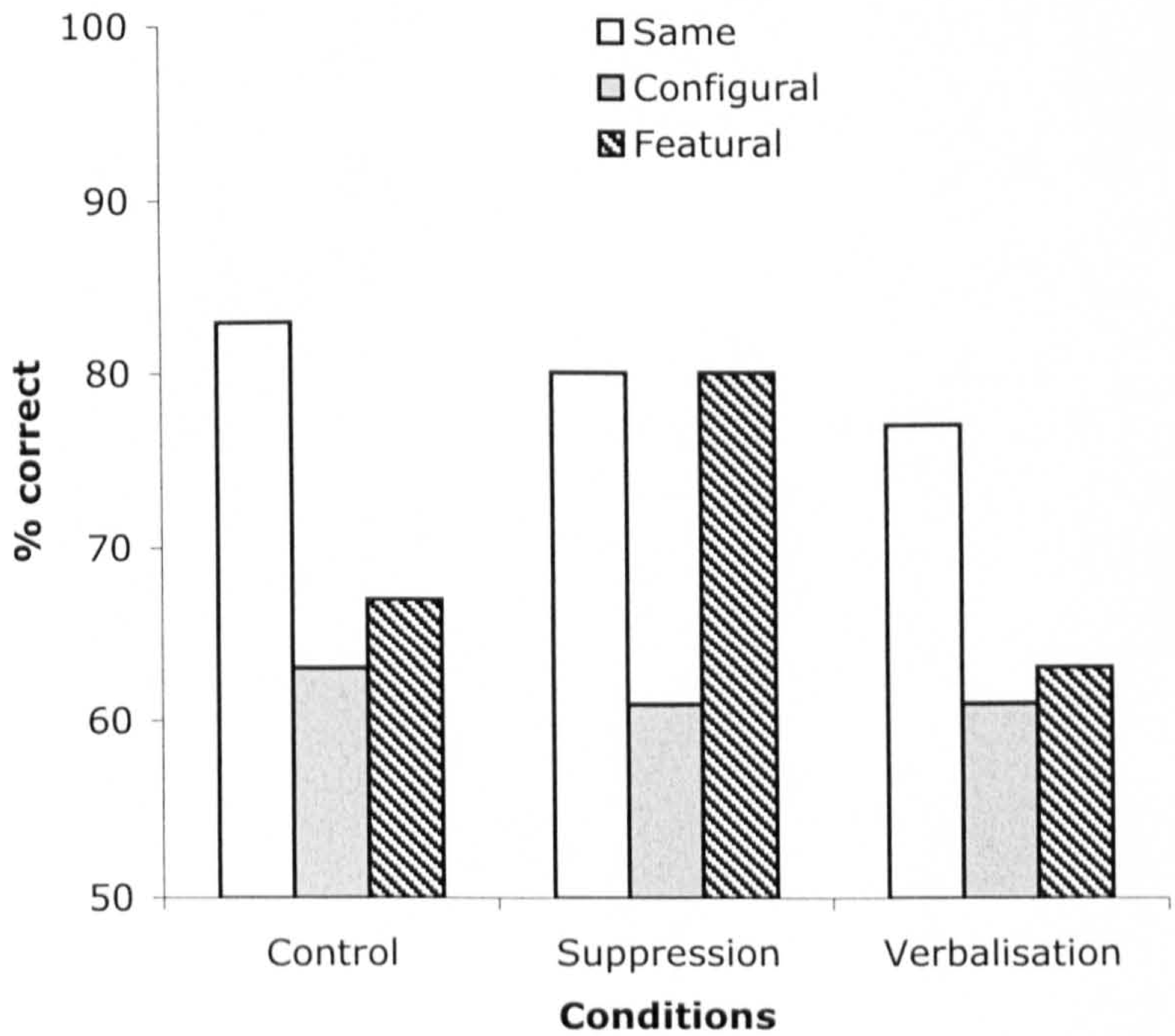


Figure 1 Percentage of correct responses for change recognition performance. Recognition performance is shown as a function of experimental condition and test stimulus (same, configural and featural).

RT for 'same' trials: Means of median response times for correct responses for 'same', configural, and featural trials are shown in table 1. A between-subjects (Condition – Control / Suppression / Verbalisation) ANOVA was conducted on correct responses. The results of the analysis did not reveal the effect of condition [$F(2,33) = 1.15$, $p > 0.05$].

RT for configural and featural trials: A 3 (Condition – Control / Suppression / Verbalisation) x 2 (Test – Configural / Featural) mixed ANOVA was conducted on correct responses. This did not reveal any effects of Condition [$F(2,33) < 1$], Test [$F(1,33) = 2.04$, $p > 0.05$], and the interaction [$F(2,33) < 1$].

	Test stimulus		
Condition	Same	Configural	Featural
Control	1669.7 (172.7)	1605.8 (206.1)	1565.3 (177.4)
Suppression	1411.7 (135.5)	1611.8 (259.8)	1406.6 (123.7)
Verbalisation	1729.7 (161.4)	1919.5 (257.3)	1765.2 (184.8)

Table 1 Means of median RTs (in msec) for correct responses. RTs are shown as a function of experimental condition and test stimulus (same, configural and featural). Standard errors of the means in parenthesis.

DISCUSSION

The results demonstrated that neither articulatory suppression nor verbalisation affected accuracy. There was no difference between the recognition of configural and featural changes made to a face. Moreover, no difference in RTs across conditions was found.

These results may indicate that the participants were equally sensitive to both types of changes since no difference in recognition accuracy between the two was found. This seems counterintuitive in that the importance of and our sensitivity to configural information of a face have been repeatedly reported in the face recognition literature (e.g. Young, Hellawell, & Hay, 1987). Although the task used in this study tapped into change recognition performance which differs from those used in the face recognition literature, some difference between configural and featural performance was expected to be seen.

One possible reason for failing to observe any difference between configual and featural performance could be due to the participants' awareness of the nature of changes. They were informed of the two types of changes, and were given a practice session for the coming task. This could have influenced the participants' task strategies. It may be that the participants engaged in a serial search strategy. For example, they might have first attempted to find a configural change in a face. When no configural change was detected, the participants, then, moved onto the search for a featural change, or vice versa. This could have affected the study outcome.

Alternatively, the inclusion of the 'same trials' (i.e. presenting intact target images, again, at test) might have affected performance on configural and featural stimuli. It could be that the 'same trials' might have encouraged the participants to make a comparison among test images (i.e. same, configural, and featural images), rather than a comparison between the target image they had just seen and a test image. If response judgments were made on the basis of test image comparison, then configural and featural images would be always different from 'same images', regardless of the type of change. Hence, the participants simply indicated 'Different' whenever they were shown changed images, simply because they were different from the intact test images. If this were the case, the removal of the 'same trials' would help in discouraging such test item comparisons.

Understanding underlying mechanisms for the null effects of articulatory suppression and verbalisation on performance is not straightforward. If verbal encoding were involved in change recognition performance, then the effect of articulatory suppression, rather than that of verbalisation, could have been observed. By preventing verbal encoding, the participants were left primarily with visual encoding, and this might have affected subsequent recognition. On the other hand, if verbal encoding were not involved in change recognition performance, then the effect of verbalisation, rather than that of articulatory suppression, was likely to be seen. The verbalisation participants were forced to encode faces verbally that is not normally involved in learning. This could have influenced encoding processing, affecting performance. Therefore, either the effect of articualtory suppression or that of verbalisation was predicted. Yet, the current results suggested that this was not the case. One possible explanation for the null effects is that there were marked individual variations in performance so the design used in this experiment was not optimal for detecting an effect. However, if a within-subjects design had been employed in this experiment, the participants would have faced 3 conditions, which would have made the task laborious, especially when coupled with the demanding task. In the next experiment, an attempt was made to overcome with this difficulty by reducing the number of trials per condition.

Experiment 2

The results from Experiment 1 found no difference in the recognition accuracy between configural and featural changes. Moreover, the manipulations of verbal encoding had no effect on performance. This could have been due to the design used in the previous experiment or due to the fact that the inclusion of 'same trials' (i.e. presenting intact target images, again, at test) led to a comparison among test item (i.e. a comparison among same, configural, and featural test items), rather than a comparison between the target and a test item. Therefore, the current experiment employed a within-subjects design with the exclusion of 'same' trials.

METHOD

Participants

32 new volunteers participated in this experiment from the same source as Experiment 1. There were 11 males and 21 females, all of whom had normal or corrected-to-normal vision by self-report.

Stimuli / apparatus

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

Design / procedure

In this experiment a within-subjects design was employed so participants did the change recognition task in all of the three conditions (i.e. control, suppression, and verbalisation conditions). Thus, the participants acted as their own control. The order of condition was systematically varied in such a way that the verbalisation condition was never followed by the control condition in order to avoid possible carry over effects deriving from having described faces in the preceding condition. If this was not controlled, encoding processing in the control condition could have been affected. This resulted in 4 combinations of condition order; Control-Suppression-Verbalisation, Control-Verbalisation-Suppression, Suppression-Control-Verbalisation, Verbalisation-Suppression-Control, which were counterbalanced across participants. Although this might not have completely eliminated the risk of carry-over effects, care was taken to reduce the risk. The procedure was identical to that of in Experiment 1, except that in this experiment, 'same trials' were removed in order to reduce the number of trials per participants, but also to avoid the possibility of the 'same trials' influencing performance. Thus, this experiment involved 10 configural and 10 featural trials per condition, totalling in 60 trials per participant. At test they engaged in speeded key response to indicate whether the test image was the same as or different from the target image they had just seen. Participants were unaware that there were no 'same trials'.

RESULTS

Accuracy: Percentage of correct responses is shown in Figure 2. A 3 (Condition – Control / Suppression / Verbalisation) x 2 (Test – Configural / Featural) within-subjects ANOVA was conducted on correct responses. This revealed no effects of Condition [$F(2,31) = 3.76$, $p > 0.05$], Test [$F(1,31) = 1.06$, $p > 0.05$], or the interaction [$F(2,62) = 1.99$, $p > 0.05$].

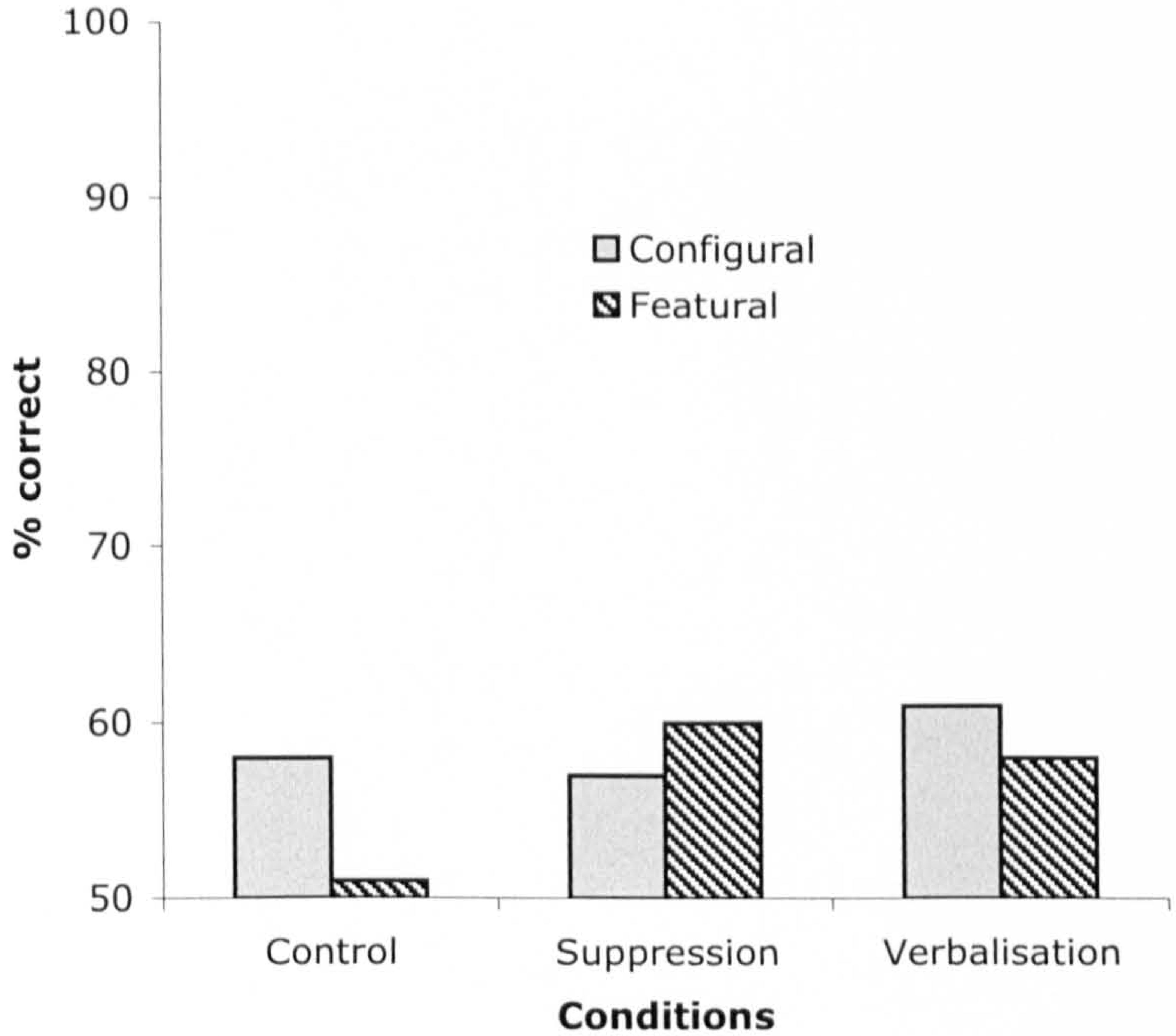


Figure 2 Percentage of "Different" responses for change recognition performance. Recognition performance is shown as a function of experimental condition and test stimulus (configural and featural).

RT: Means of median response times for " Different " responses are shown in table 2. A 3 (Condition – Control / Suppression / Verbalisation) x 2 (Test – Configural / Featural) within-subjects ANOVA showed an effect of Condition [$F(2,31) = 5.66$, $p < 0.01$]. However, neither the effect of Test [$F(1,31) < 1$] nor the interaction was significant [$F(2,62) < 1$]. A Tukey HSD ($p < 0.01$) test was conducted to explore the effect of Condition further, which revealed that RTs in the suppression condition were significantly faster than those in the control condition.

	Test stimulus			
Condition	Configural		Featural	
Control	2153.2	(204.7)	2130.5	(231.0)
Suppression	1549.8	(108.9)	1551.0	(112.8)
Verbalisation	1891.7	(109.1)	2017.5	(123.5)

Table 2 Means of median RTs (in msec) for "Different" responses. RTs are shown as a function of experimental condition and test stimulus (configural and featural). Standard errors of the means in parenthesis.

DISCUSSION

The results have shown that accuracy was not affected by any of the factors, but RTs were shortened significantly by articulatory suppression. Taken together with the results from Experiment 1, the manipulation of verbal encoding did not affect subsequent change recognition performance, and this seems to be the same regardless of the study design. Performance in this experiment appears to be low, and this was likely to be due to the exclusion of the 'same trials', possibly making the task even harder to do. However, due to the design used in this experiment it was difficult to retain the 'same trials'.

When considered together with the findings from Experiment 1, failing to observe any difference between configural and featural performance does not seem to derive simply from the removal of the 'same trials' or the study design. This might, in turn, suggest that the removal of the 'same trials' did not affect response patterns. It was possible that the exclusion of these could have increased the number of 'Different' responses (i.e. correct responses) as the participants might have become aware of the fact that there were no 'same trials'. It is unlikely that this affected study outcome significantly.

However, it is important to note that performance in this experiment was, in general, very low. In particular, performance on the recognition of featural changes in the control condition was close to the chance level of 50 %. This may have contributed to the null effects of experimental conditions.

Although Experiment 1 and the current experiment failed to see the effects of the verbal encoding manipulations, they highlighted a few experimental issues, providing a direction for the next experiment. In Experiment 3 an attempt was made to alleviate the task difficulty while maintaining a within-subjects design to see whether this would help in addressing the role of verbal encoding in change recognition performance.

Experiment 3

The results from Experiment 1 and Experiment 2 failed to reveal any effects of the verbal encoding manipulations on change recognition performance, regardless of the study design. The use of a within-subjects design in Experiment 2 led to the exclusion of the 'same trials', which could have led to low performance. In this experiment an attempt was made to ease the task difficulty by simultaneously presenting the target image, again, together with a test image at test.

METHOD

Participants

20 new volunteers participated in this experiment from the same source as the previous experiments. There were 8 males and 12 females, all of whom had normal or corrected-to-normal vision by self-report.

Stimuli / apparatus

The stimuli and apparatus were the same as in Experiment 2, except that at test the target image was, once more, presented together with a test image (i.e. the target image having either a configural or featural change) as illustrated in figure D and E. The two images were displayed side by side in the centre of the computer screen, with approximately 1.3 cm of distance between them. The picture size of each image was approximately 3.5 cm x 4.5 cm.

Figure D

Figure E

Figure D and E: Examples of test stimuli used in the study. In Figure D, the original image is shown on the left and a test image (the original face with a featural mouth change) is shown on the right. In Figure E, the original image is shown on the right and a test image (the original face with an eye configural change) is shown on the left.

Design / procedure

The design and procedure were identical to those of in Experiment 2, except that the original image (i.e. the intact image) was, once more, shown at test together with a test image (i.e. the face with either a configural or featural change) for 1.5 sec. Thus, participants were first shown a face, followed by a blank screen of 2 sec, and test where two images (the learnt image and a test image either having a featural or configural change) were shown simultaneously for 1.5 sec. Participants responded after the two images had disappeared from the screen. This was an attempt to lessen the task difficulty and to aid performance. At test the two images were displayed in the centre of the computer screen side by side. The display position for these images was counterbalanced so that each image appeared on each side of the visual field equally frequently across trials. At test the participants made a speeded key response once the two images had disappeared from the screen. They indicated whether the two images were the same or different from each other. The participants were unaware that the two images were always different from each other. There were 10 configural and 10 featural trials, presented at random, per condition.

RESULTS

Accuracy: Mean percentage of correct responses is shown in Figure 3. A 3 (Condition – Control / Suppression / Verbalisation) x 2 (Test – Configural / Featural) within-subjects ANOVA was conducted on correct responses. This showed no effect of Condition [$F(2,19) < 1$] but revealed a main effect of Test [$F(1,19) = 4.94$, $p < 0.05$]. These were, however, modulated by the effect of the two-way interaction [$F(2,38) = 8.81$, $p < 0.01$]. Results from Simple Main Effects analyses showed an effect of Condition for both Configural [$F(2,38) = 3.53$, $p < 0.05$] and Featural [$F(2,38) = 5.32$, $p < 0.01$] recognition. A Tukey HSD test ($p < 0.05$) was conducted to explore this further (see also figure 3), which found that the recognition of configural changes was better when faces were described (the verbalisation condition) than when they were not described (control). However, the reverse pattern was found for featural performance. The recognition of featural changes was better without verbalisation (the control condition) than with verbalisation. In addition, the recognition of featural changes was better with suppression than with verbalisation. The analyses also revealed an effect of Test for the control [$F(1,19) = 8.48$, $p < 0.01$] and suppression conditions [$F(1,19) = 5.52$, $p < 0.05$], but not for the verbalisation condition [$F(1,19) = 1.99$, $p > 0.05$]. These results indicate that in the control and suppression conditions, the recognition of featural changes was better than that of configural changes. However, there was no difference between configural and featural recognition in the verbalisation condition.

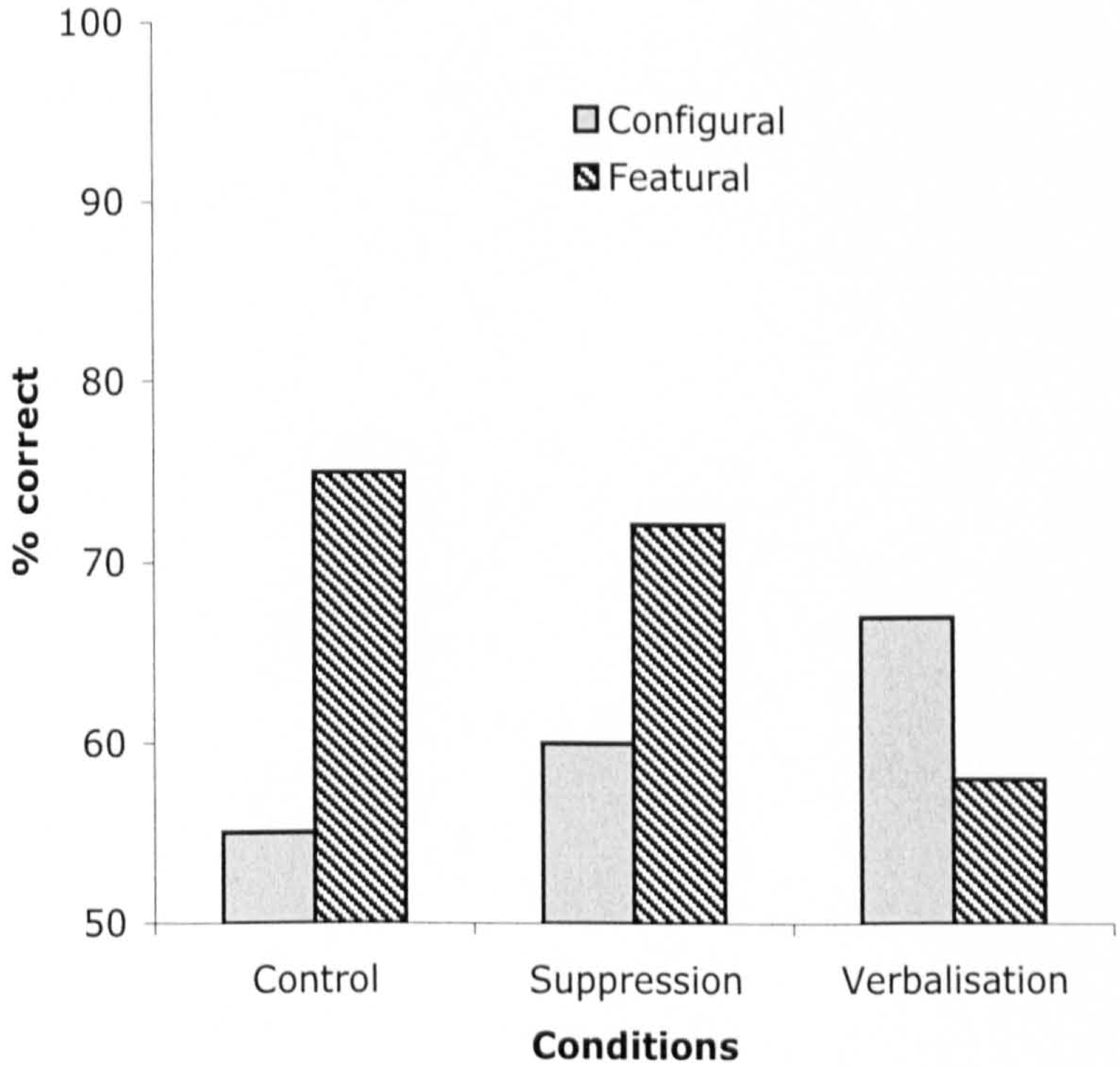


Figure 3 Mean percentage of " Different" responses for the recognition of configural and featural changes made to faces. Recognition performance is shown as a function of experimental condition and test stimuli.

RT: Means of median response times (RT) for " Different " responses are shown in table 3. The results from a 3 (Condition – Control / Suppression / Verbalisation) x 2 (Test – Configural / Featural) within-subjects ANOVA did not reveal any effects of Condition [$F(2,19) = 1.72$, $p > 0.05$], Test [$F(1,19) < 1$], and the two-way interaction [$F(1,19) < 1$].

Condition	Test stimulus	
	Configural	Featural
Control	981.6 (81.0)	1000.3 (72.6)
Suppression	868.3 (70.9)	817.5 (88.6)
Verbalisation	912.9 (126.6)	886.0 (125.5)

Table 3 Means of median RTs (in msec) for " Different" responses. RTs are shown as a function of experimental condition and test stimulus. Standard errors of the means in parenthesis.

DISCUSSION

The results have shown that verbalisation, but not articulatory suppression, affected recognition accuracy. Describing faces during learning impaired the recognition of featural changes while it enhanced the recognition of configural changes, in comparison to not describing faces. In addition, a response pattern following verbalisation tended to differ from that of the control and suppression conditions. In the control and suppression conditions, the recognition of featural changes was significantly better than that of configural changes. However, this was not the case for the verbalisation condition where mean performance on configural stimuli (the mean of 6.7) was slightly higher than that of on featural stimuli (the mean of 5.9), though the difference was non-significant. There were no differences in RTs across conditions.

The null effect of articulatory suppression on performance might suggest that verbal encoding is unlikely to be involved in change recognition performance, thereby, the suppression of verbal encoding did not influence performance. This might, in turn, explain why verbalisation affected performance. In the verbalisation condition, the participants were forced to engage in verbal encoding which might not normally be involved in performing the task. From these results, it could be speculated that change recognition processing is predominately based on visual processing. However, the current results alone do no substantiate this speculation, thus future work is required to explore this further.

The findings that verbalisation improved the recognition of configural changes, while hampering the recognition of featural changes are counterintuitive. It seems more likely to predict the reverse pattern of finding as verbalisation might encourage more featural processing than configural processing. Consequently, some improvement in featural recognition, but not in configural recognition, was predicted following verbalisation. Indeed, the assumption underlying the verbal overshadowing effect is based on the idea that the act of verbalisation encourages featural processing since featural information of the face can easily be verbally described, whereas configural information of the face is difficult to describe in words (Schooler & Engstler-Schooler, 1990). Although these assumptions may be correct to some extent, these could be due to various factors, including words available to describe particular information or our tendency to describe a certain stimulus in a certain way. For example, we might be more inclined to describe a face on the basis of its facial features, rather than describing it on the basis of a global impression as describing a face to others often underlies some sort of identification purposes.

Furthermore, one of the major problems with the proposed processing associations is that verbalisability of information (i.e. what can or cannot be verbally described) is likely to depend on many factors, including the characteristics of individual faces and experimental settings (e.g. instructions given for the description task). Indeed, in the original verbal overshadowing study (Schooler & Engstler-Schooler, 1990), participants were encouraged to provide a detailed description of each facial feature of a target face. Such a facial feature description has been tied with the concept of verbal processing being primarily featural. This, however, does not necessarily reflect how we actually describe a face in natural settings (natural verbal processing). Therefore, a given description might not necessarily reveal a whole picture of verbalisability of facial information. It would not be feasible to assume that information contained in the description was verbalisable, but information that was not included was non-verbalisable. In this series of experiments participants were also encouraged to describe faces in a featural manner (describing a face on the basis of each facial feature, such as a large nose or big eyes). However, unlike standard verbal overshadowing studies, the current experiment directly examined processing associations (configural-nonverbal processing and featural-verbal processing) that may underlie face processing by using a change recognition task (the recognition of configural and featural changes made to faces). Thus, the present experiment directly examined the relationship between the effects of verbal processing manipulations on configural and featural processing of faces. This is very different from standard verbal overshadowing studies that use a face recognition task where participants identify a previous seen face from memory. Such a task reveals, however, only the accuracy of recognition (overall recognition performance), but it does not reveal anything about how verbalisation affects retrieval of configural and featural information of the face. Here, I presented direct evidence showing that mechanisms underlying face processing are much more complex than assumed by using a change recognition task.

Evidently, the proposed processing associations are, just, inadequate for understanding the effects of verbalisation observed in this experiment. Although the precise mechanisms underlying the results are uncertain at this stage, it seems to be the case that the effects of verbalisation on change recognition are complex; verbalisation can affect featural processing as well as configural processing. Clearly, there are differences between the current experiment and standard verbal overshadowing experiments in terms of the purpose and methodology. Still, the current findings raise a question about the ideas underlying the processing shift hypothesis, and point out the possibility that the effects of verbalisation on recognition memory may also be complex.

From the results of current experiment, it could be suggested that encouraging featural encoding of faces (i.e. the verbalisation condition encouraged participants to describe each face on the basis of its features) may actually facilitate the retrieval of holistic information of the face. This may be because verbalisation (featural encoding) may guide attention to the whole facial features as participants are required to pay attention to and to describe facial features of the face. As more features are encoded, this makes it easier to retrieve the whole face. By contrast, articulatory suppression, (the prevention of verbal encoding by occupying the verbal resource) does not allow such encoding so that attention may not be directed to the whole face, possibly, leading to fewer feature sampling. Therefore, recognition performance in the suppression condition was no better or worse than that in the control condition. Although the current results alone are insufficient to draw any conclusions about mechanisms underlying these results, it is clear that verbalisation (featural encoding) can actually aid retrieval of configural information in the face. Accordingly, it is not feasible to make any simple processing associations as to configuiral processing as being non-verbal while featural processing as being verbal.

However, several points need to be addressed here. Firstly, the faces used in the experiment were all male faces that could be characterised as visually similar to each other as all of them were young, clean-shaven, and had short hair. This could have affected verbalisation of these faces. If faces are visually similar, then it is likely that the verbal descriptions of these faces will be also similar. This might have affected the study outcome.

Secondly, a major difficulty in exploring configural versus featural processing of a face is that it is unlikely that the two can be teased apart. Although much research is conducted to examine configural and featural processing of a face by attempting to separate the two, the feasibility of achieving this should be questioned. Each facial feature contributes both to featural and configural information of the face. It is likely that making a change to one eye (e.g. making one eye smaller) also changes the spatial distance between the eyes (i.e. making one eye smaller would lengthen the distance between the eyes) or it might change the spatial distance between the eye and the eyebrow above it. This practical difficulty was, indeed, observed in the current experiment. Although care was taken during stimulus preparation, in some cases adding a change to one caused a change in another. Therefore, the difference between the two types of changes was not clear-cut, but the difference lay in the degree of the manifestation of a change. Configural changes manifested more changes in the spatial layout of facial features than changes in facial features themselves, and vice versa. All these make it more difficult to envision that face processing modes can shift from one to another simply by the act of verbalisation as the processing shift hypothesis claims (e.g. Schooler, 2002).

Thirdly, another problem with this line of investigation is that it might not be feasible to equate the magnitude (or perceived magnitude) of changes between configural and featural changes. One type of change might always be (or perceived to be) larger than the other, especially given the importance of and our sensitivity to configural information of a face (e.g. Leder & Bruce, 2000; Rhodes, Brake, & Atkinson, 1993; Young, Hellawell, & Hay, 1987), and this is likely to affect study outcome.

These issues, however, do not completely undermine the findings of this experiment as the stimuli were used equally frequently across conditions. As demonstrated there appeared to be some clear differences across conditions that were designed to encourage particular type of processing during encoding. This experiment, for the first time, demonstrated the complex effects of verbal encoding on change recognition performance in spite of the potential obstacles embedded in this line of investigation.

Experiment 4

The results from Experiment 3 have shown that verbally describing unfamiliar faces (faces of unknown people) during encoding affected change recognition performance. Moreover, a response pattern following verbalisation tended to differ from that in the other two conditions. In this experiment, familiar faces (celebrities' faces) were used to see whether the same findings could also be found when the degree of familiarity of the face (whether faces were of unknown people or celebrities) increases.

Processing differences between familiar and unfamiliar faces have been repeatedly documented in the face recognition literature (Bruce, et al., 1999; Ellis, Shepherd, & Davies, 1979; Young, Hay, McWeeney, Flude, & Ellis, 1985). For example, Ellis, Shepherd, and Davis (1979) reported the difference in the way familiar and unfamiliar faces was recognised. For the recognition of familiar faces, internal features of a face (the eyebrows, eyes, nose, and mouth) were more useful than external features of the face (the hairline, hair, and ears). However, for the recognition of unfamiliar faces, internal and external features were both equally informative. The internal advantage for the recognition of familiar faces was also shown in response times for a matching task (Young et al., 1985). In the matching task people were asked to match a whole face with either internal or external features of the face by using familiar and unfamiliar faces. The results showed that whole face-internal feature matching for familiar faces was faster than that for unfamiliar faces. However, response times for whole face-external feature matching did not differ between familiar and unfamiliar faces. These were taken as evidence illustrating the processing difference between familiar and unfamiliar faces.

Although the current series of experiments used a change recognition task, which is different from tasks (e.g. recognition of previously seen faces or a face matching task) often used in the face recognition literature, it would be of theoretical interest to examine the effect of familiarity on change recognition performance. To date, no work of this kind has been conducted to explore the difference in the role of verbal encoding in change recognition between familiar and unfamiliar faces. As mentioned before, the importance of internal features of a face for the recognition of familiar faces has been reported repeatedly (Ellis, Shepherd, & Davis, 1979, Young, et al., 1985). This may be because internal features may be a better diagnostic tool for recognising familiar faces than external features (such as hair) that change over time. It is therefore possible that any changes made to familiar faces may be more readily be detected than those made to unfamiliar faces, regardless of the nature of the changes. Thus, participants in this experiment are likely to perform equally well on both featural and configural changes made to familiar (celebrities') faces. However, performance is likely to be affected by whether or not verbal encoding is encouraged during learning. From the finding of the previous experiment, if verbalisation (describing faces aloud) encourages retrieval of configural information (the recognition of configural changes is better in the verbalisation condition than in the control condition), then a similar finding should be also found for familiar face performance. Thus, it is possible that the recognition of configural changes to be facilitated following verbalisation.

In this experiment, participants learned familiar faces in control, suppression, and verbalisation conditions, and were tested on the recognition of configural and featural changes made to each familiar (celebrity's) face.

METHOD

Participants

20 new volunteers participated in this experiment from the same source as the previous experiments. There were 9 males and 11 females, all of whom had normal or corrected-to-normal vision by self-report.

Stimuli / apparatus

In this experiment, familiar faces were used as stimuli, consisting of greyscale head and shoulder pictures of 18 male and 12 female celebrities, taken from the internet and magazines (see appendix 1 for a list of celebrities' faces used in this study). Due to the stimulus availability, all faces used in Experiment 3 were male faces. However, there was no such limitation for familiar faces, therefore, the faces varied in gender, age, hair, expression, lighting conditions, and viewing angles, for the reason that using a variety of faces would create a more natural setting as faces that we encounter in daily settings vary in their background. As in the previous experiments one configural and one featural change was made to each original face. A total of 90 images, consisting of 30 original images, 30 configural images, and 30 featural images were used as stimuli. The apparatus was the same as for the previous experiments.

Design / procedure

The design and procedure were identical to those in Experiment 3. There were 10 configural and 10 featural trials in each of three conditions (i.e. control, suppression, and verbalisation conditions).

RESULTS

Accuracy: Mean percentage of correct responses is shown in Figure 4. A 3 (Condition – Control / Suppression / Verbalisation) x 2 (Test – Configural / Featural) within-subjects ANOVA was conducted on " Different " responses. This revealed a main effect of Test [$F(1,18) = 6.59$, $p < 0.05$]. Performance on featural stimuli was significantly better than that of on configural stimuli, regardless of the experimental condition. Neither the effect of Condition [$F(2,36) < 1$] nor the effect of the interaction were significant [$F(2,36) = 2.21$, $p > 0.05$].

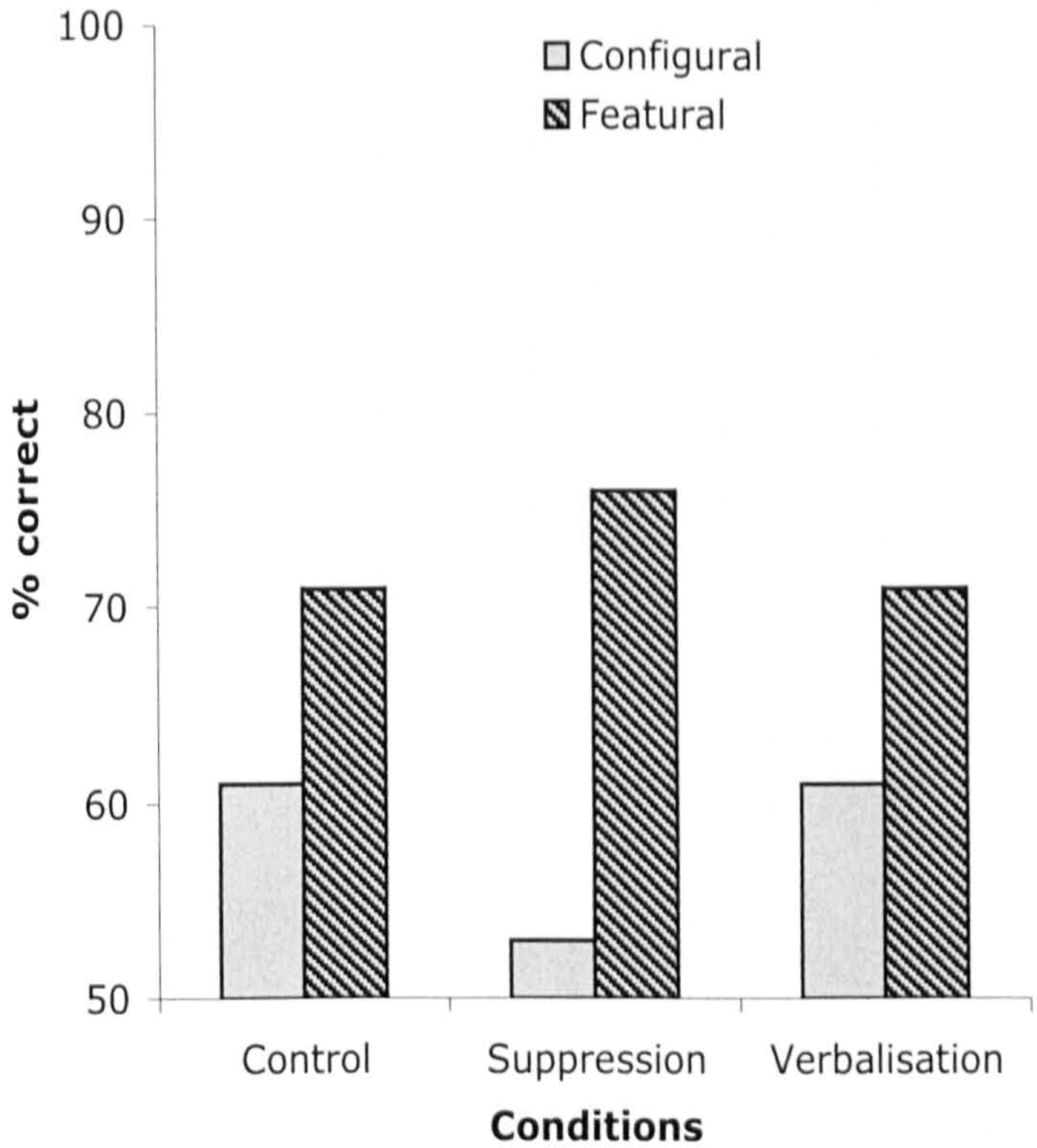


Figure 4 Mean percentage of " Different" responses for the recognition of configural and featural changes made to familiar faces. Recognition performance is shown as a function of experimental condition and test stimulus.

RT: Means of median response times for " Different " responses are shown in table 4. Results from a 3 (Condition – Control / Suppression / Verbalisation) x 2 (Test – Configural / Featural) within-subjects ANOVA revealed a main effect of Test [$F(1,18) = 5.26$, $p < 0.05$]. The recognition of featural changes was significantly faster than that of configural changes. Neither the effect of Condition [$F(2,36) < 1$] nor the effect of the interaction were significant [$F(2,36) = 1.18$, $p > 0.05$].

Condition	Test stimulus	
	Configural	Featural
Control	887.1 (111.0)	745.0 (86.4)
Suppression	827.9 (93.2)	760.7 (94.3)
Verbalisation	845.3 (64.9)	808.9 (78.4)

Table 4 Means of median RTs (in msec) for " Different" responses. RTs are shown as a function of experimental condition and test stimulus. Standard errors of the means in parenthesis.

DISCUSSION

The recognition of featural changes was always better than that of configural changes, and this was also reflected in the RT data. RTs for featural stimuli were significantly faster than those for configural stimuli. However, neither verbalisation nor articulatory suppression affected recognition performance when faces were familiar. Taken together with the results from Experiment 3, it seems apparent that verbalisation led to different responding patterns between familiar and unfamiliar faces. Under verbalisation condition, the recognition of configural changes was better than that of featural changes when faces were unfamiliar (see figure 3). The reverse pattern of responding was found for familiar faces (figure 4), and the interpretation of these results is not straightforward. Recall that all participants were encouraged to describe faces on the basis of their facial features, regardless of whether faces are familiar or unfamiliar. Yet, verbalisation affected responding patterns differently between these faces. Thus, it appears that verbal processing of the face (what one describes aloud) does not necessarily predict visual processing of these faces (i.e. featural descriptions do not necessarily enhance the recognition of these described features). This is clear evidence highlighting further that the effects of verbalisation on recognition performance are complex, which can vary, depending on face familiarity.

However, it is important to note that the findings from Experiment 3 and the current experiment might have been affected, in some ways, by the stimuli used in these studies. The fact that only unfamiliar faces were used in Experiment 3 and only familiar faces were used in this experiment could have encouraged participants to process faces in a fixed way. It is possible that all unfamiliar faces were processed similarly, and the same could be said to familiar faces. Thus, the results from the two experiments might have been affected by such a processing set, and this could have led to the difference in the effects of verbalisation between familiar and unfamiliar faces. In other words, the differential effects of verbalisation observed for unfamiliar and familiar faces could merely be the reflections of the differences in processing sets between the two. This issue was examined in the next experiment.

Experiment 5

In this experiment, both familiar and unfamiliar faces were used to see whether the results from Experiment 3 and Experiment 4 were more likely to be due to a processing set or whether they reflect the difference in underlying processing between familiar and unfamiliar faces. Thus, in this experiment, familiar and unfamiliar face trials were randomly presented in an attempt to break down any possible processing habits.

METHOD

Participants

20 new volunteers participated in this experiment from the same source as the previous experiments. There were 8 males and 12 females, all of whom had normal or corrected-to-normal vision by self-report.

Stimuli / apparatus

Stimuli were the same as those in Experiment 3 and Experiment 4. There were 30 original familiar faces and 30 original unfamiliar faces, with each face having one configural change and one featural change. The apparatus was the same as for the previous experiments.

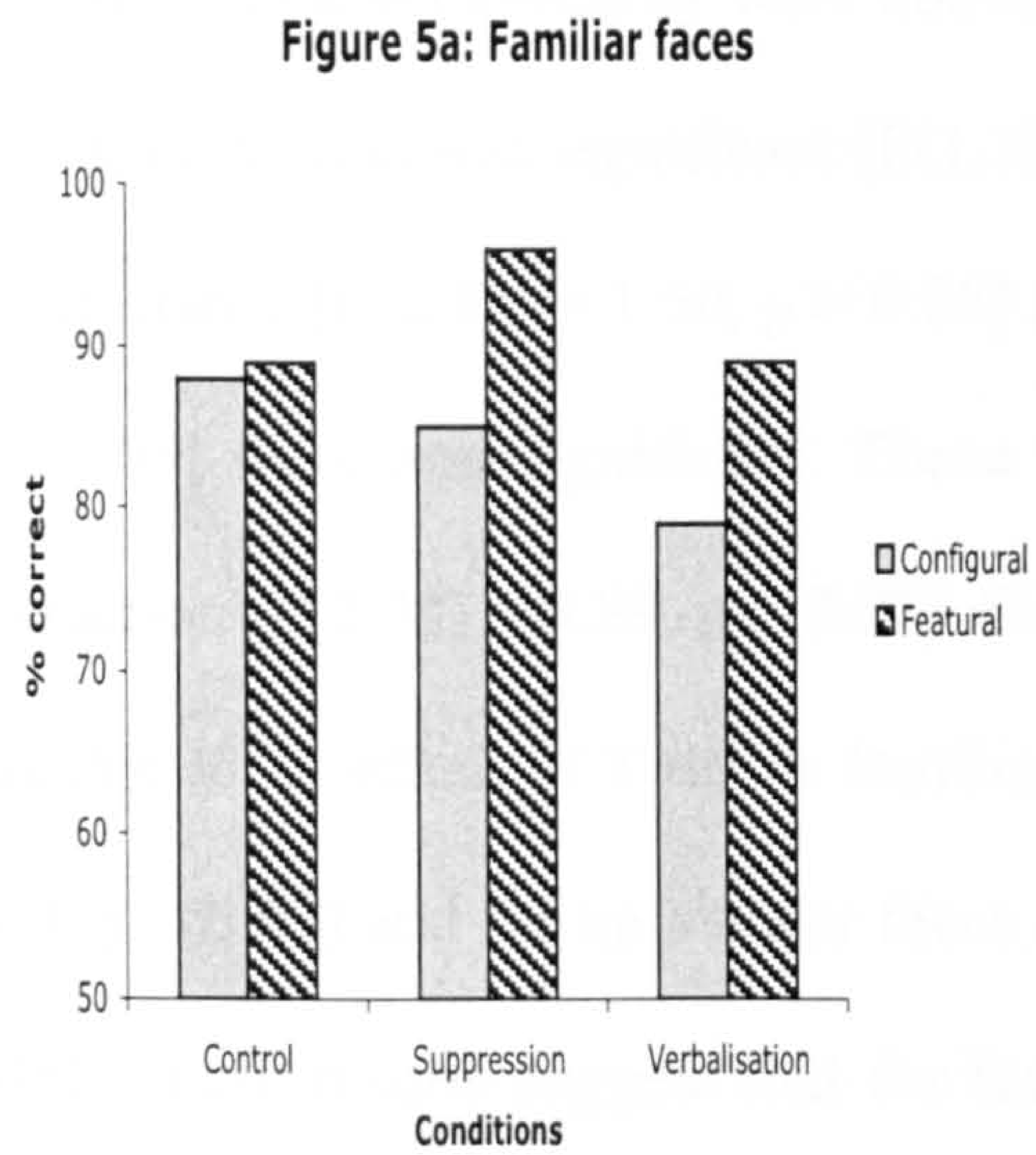
Design / procedure

The design and procedure were identical to those in the previous experiments, except that participants learned 10 familiar and 10 unfamiliar faces, and were tested on these faces. There were 20 configural and 20 featural trials per condition. Although the number of trials per participant was doubled in this experiment, half the faces were familiar so that the task was considered feasible.

RESULTS

Accuracy: Mean percentage of correct responses is shown in Figure 5a and 5b. A 3 (Condition – Control / Suppression / Verbalisation) x 2 (Familiarity – Familiar / Unfamiliar) x 2 (Test – Configural / Featural) within-subjects ANOVA was conducted on

" Different " responses. This revealed a main effect of Familiarity [$F(1,19) = 99.16$, $p < 0.01$], but not the effect of Condition [$F(2,38) = 1.99$, $p > 0.05$]. The effect of Test was approaching significance [$F(1,19) = 4.23$, $p < 0.06$]. The effect of Condition x Test interaction also failed to reach significance [$F(2,38) = 1.76$, $p > 0.05$]. These were modulated by Condition x Familiarity interaction [$F(2,38) = 3.98$, $p < 0.05$], by Familiarity x Test interaction [$F(1,19) = 7.0$, $p < 0.05$], and further by a three-way interaction [$F(2,38) = 3.28$, $p < 0.05$]. Simple Main Effects analyses were conducted to explore the three-way interaction, which revealed an effect of Familiarity for all recognition performance, except for configural change recognition in the verbalisation condition [$F(1,19) < 1$]. The effect of Familiarity was identified for configural change recognition [$F(1,19) = 29.02$, $p < 0.01$] and featural change recognition [$F(1,19) = 29.02$, $p < 0.01$] in the control condition, for configural change recognition [$F(1,19) = 9.88$, $p < 0.01$] and featural change recognition [$F(1,19) = 29.02$, $p < 0.01$] in the suppression condition, and for featural change recognition [$F(1,19) = 27.43$, $p < 0.01$] in the verbalisation condition. These results indicate that recognition performance on familiar faces was always better than that on unfamiliar faces, except for configural change recognition in the verbalisation condition. The familiarity advantage disappeared for the recognition of configural changes following verbalisation. The analyses also revealed an effect of Test for familiar faces in the suppression [$F(1,19) = 10.28$, $p < 0.01$] and verbalisation conditions [$F(1,19) = 8.41$, $p < 0.01$], and for unfamiliar faces in the verbalisation condition [$F(1,19) = 6.74$, $p < 0.05$]. These results suggest that for familiar faces, featural change recognition was significantly better than configural change recognition, but this was only true for the suppression and verbalisation conditions. In the control condition there was no difference in the recognition between the two. For unfamiliar faces, there was significant difference between configural and featural change recognition in the verbalisation condition. Following verbalisation the recognition of configural changes was significantly better than that of featural changes when faces were unfamiliar.



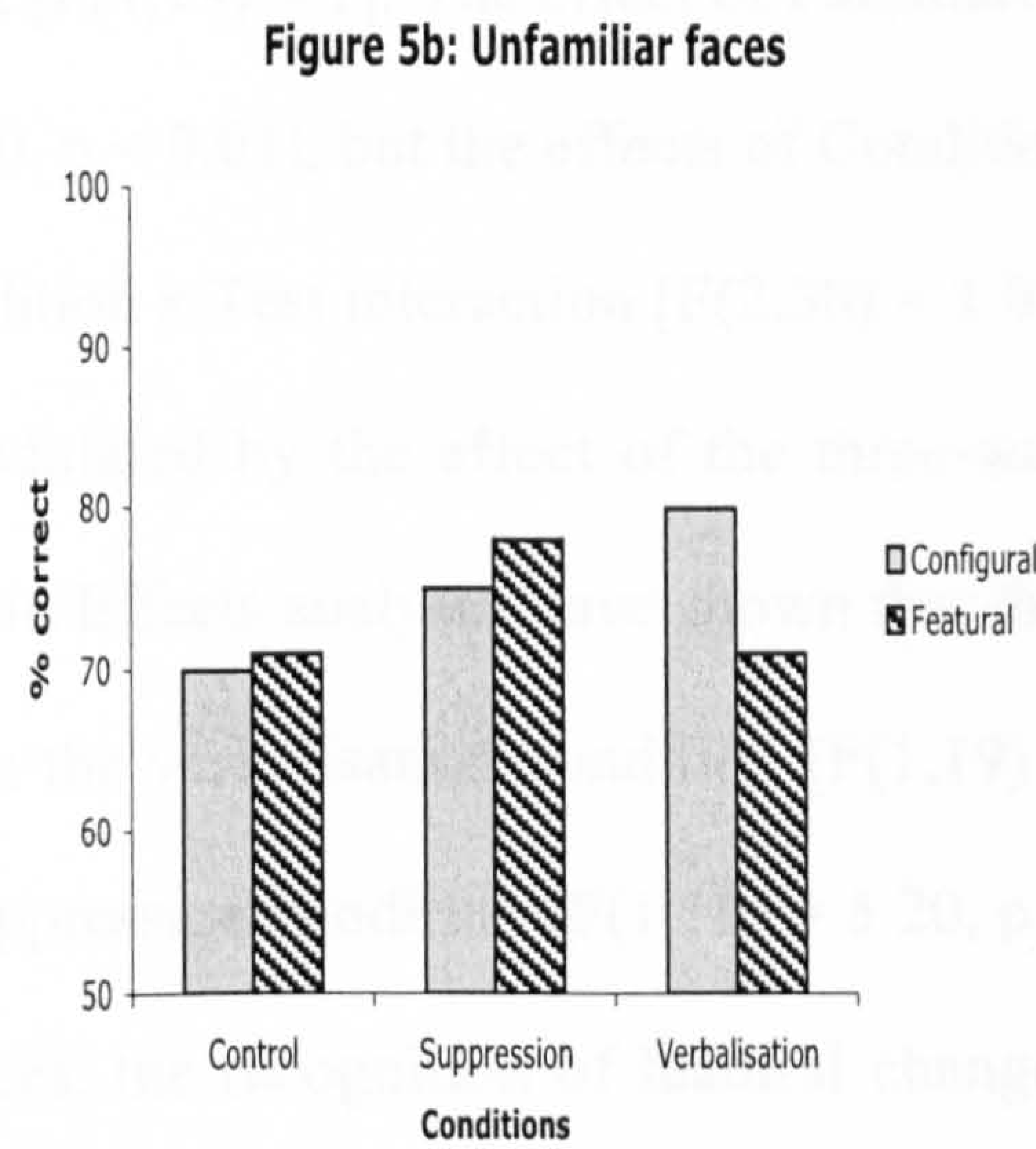


Figure 5a and 5b Mean percentage of " Different" responses for the recognition of configural and featural changes made to familiar faces (5a) and unfamiliar faces (5b). Recognition performance is shown as a function of experimental condition and test stimulus.

RT: Large variations in RTs were found (RTs tended to vary depending on test items). Therefore, means of median response times for ' Different 'responses are shown in table 5a and 5b. Taken together with the results of accuracy data, it appears that RTs and follow similar patterns in that for familiar faces the recognition of featural changes was better and faster than that of configural changes. For unfamiliar faces, the recognition of configural changes in the verbalisation conditions was better and faster than that of featural changes.

Results from a 3 (Condition – Control / Suppression / Verbalisation) x 2 (Familiarity – Familiar / Unfamiliar) x 2 (Test – Configural / Featural) within-subjects ANOVA revealed a main effect of Test [$F(1,19) = 10.98$, $p < 0.01$]. Main effects of Condition [$F(2,38) < 1$] and familiarity were non-significant [$F(1,19) < 1$]. The effect of Familiarity x Test interaction was significant [$F(1,19) = 10.30$, $p < 0.01$], but the effects of Condition x Familiarity [$F(2,38) = 1.50$, $p > 0.05$] and Condition x Test interaction [$F(2,38) = 1.07$, $p > 0.05$] were non-significant. These were modulated by the effect of the three-way interaction [$F(2,38) = 3.89$, $p < 0.05$]. Simple Main Effects analyses have shown that this was due to an effect of Test for familiar faces in the verbalisation condition [$F(1,19) = 8.60$, $p < 0.01$] and for unfamiliar faces in the suppression condition [$F(1,19) = 5.20$, $p < 0.05$]. These results suggest that for familiar faces, the recognition of featural changes was significantly faster than that of configural changes in the verbalisation. CHANGE STARTS This is also reflected in the accuracy data in that the recognition of featural changes was better than that of configural changes. For unfamiliar faces, the recognition of featural changes was significantly faster than that of configural changes in the suppression condition. This suggests that there might have been speed-accuracy trade for performance on unfamiliar faces in that the recognition of featural changes was worse than that of configural changes.

Table 5a: Familiar faces.

Condition	Test stimulus Configural	Featural
Control	2898.7 (313.1)	2285.1 (183.6)
Suppression	2224.1 (242.9)	1568.4 (98.4)
Verbalisation	3094.5 (327.8)	1940.3 (167.7)

Table 5b: Unfamiliar faces

Condition	Test stimulus Configural	Featural
Control	2561.0 (293.3)	2422.8 (290.4)
Suppression	2976.4 (883.2)	2078.5 (393.2)
Verbalisation	2337.6 (323.3)	2601.9 (303.3)

Table 5a and 5b Means of median RTs (in msec) for " Different" responses. RTs are shown as a function of experimental condition and test stimulus. Standard errors of the means in parenthesis.

DISCUSSION

The results showed a familiarity advantage for recognition accuracy, except for performance on configural stimuli in the verbalisation condition where no difference between familiar and unfamiliar faces was found. For familiar faces, the recognition of featural changes was better than that of configural changes in the suppression and verbalisation conditions, but not in the control condition. The results from the RT data also found faster RTs for featural stimuli than configural stimuli in the verbalisation condition. Conversely, for unfamiliar faces, the recognition of configural changes was better than that of featural changes in the verbalisation condition. However, no difference in RTs between configural and featural recognition was found for the verbalisation condition. In the control and suppression conditions, there was no difference in recognition accuracy between configural and featural stimuli.

Taken together with the results from Experiment 3 (an unfamiliar face experiment) and Experiment 4 (a familiar face experiment), it seems that verbalisation affected response patterns differently depending on the familiarity of the face. The results from these experiments found that following verbalisation the recognition of featural changes was better than that of configural changes when faces were familiar. The opposite was true when faces were unfamiliar in the current experiment. This pattern of responding, though it was not significant, was also found in Experiment 3. Therefore, it is unlikely that the findings from Experiment 3 and Experiment 4 were due to a processing set caused by using only one category of faces as similar findings were observed in the current experiment, involving both familiar and unfamiliar faces. These differences between familiar and unfamiliar faces further highlight processing differences between these faces. It is possible that verbalisation directs attention to the whole face, thereby, facilitating the recognition of configural changes when faces are unfamiliar. This may be particularly useful for encoding unfamiliar faces as we do not have any pre-existing visual representation of these faces so that attending features facilitates retrieval of configural information. This may be because not only does each facial feature convey information of that feature, but it also contributes to configural information (how facial features are placed in the face), facilitating retrieval of the face. However, when faces are familiar, attending to the whole face by virtue of verbalisation may not necessarily benefit retrieval of configural information. This may be because we have some levels of pre-existing visual representations of familiar faces through repeated exposure to them. In other words, learning processing involved in familiar and unfamiliar faces are unlikely to differ, and this difference that leads to differential effects of verbalisation on change recognition performance. Thus, it is possible that familiar face processing may be relatively resistant to any manipulations introduced during learning. So, the results on familiar faces (verbalisation facilitated the recognition of featural changes) may simply reflect the benefit of verbal rehearsal (describing facial features facilitate the recognition of these simply because they are rehearsed verbally), rather than verbalisation affecting any other underlying face processing.

In sum, these results highlight that the effects of featural and configural changes on familiar and unfamiliar face processing are different, and that simple configural-nonverbal and featural-verbal processing associations cannot be made as suggested in the verbal overshadowing literature (e.g. Schooler & Engstler-Schooler, 1990). Although the importance of configural information of the face in face recognition has been well documented in the face recognition literature (e.g. Bartlett & Searcy, 1993; Diamond & Carey, 1986; Young, Hellawell, & Hay, 1987), this has been examined from a visual processing perspective, but not from a verbal processing perspective. Verbal overshadowing literature, on the other hand, conducted this line of research from a verbal perspective, with no examination into <u>actual</u> visual processing. However, by bringing these different perspectives together, it was possible to demonstrate the interplay between verbal and visual processing, affecting overall change recognition performance.

GENERAL DISCUSSION

The purpose of this chapter was to examine the role of verbal encoding in the recognition of configural and featural changes made to familiar and unfamiliar faces by using articulatory suppression and by asking participants to describe faces during learning. The methods were modified throughout the series of experiments. In Experiment 1 (an unfamiliar face experiment) recognition accuracy for 'same', configural, and featural changes was measured with a between-subjects design. The results showed no effect of the verbal manipulations. However, this could have been due to marked individual differences in performance. Thus, subsequent experiments employed a within-subjects design, resulting in the exclusion of the 'same trials' (i.e. presenting the intact target image, again, at test). The results from Experiment 2 (an unfamiliar face experiment) also failed to reveal any effects of the verbal encoding manipulations, which could have been due to low performance. In Experiment 3 (an unfamiliar face experiment), participants were shown two images (i.e. the target face and the target having either a configural and featural change) simultaneously at test to aid performance. The results showed that following verbalisation the recognition of configural changes was improved while that of featural changes was impaired. Moreover, a response pattern in the verbalisation condition tended to differ from that in the control and suppression conditions. The findings from Experiment 4 (a familiar face experiment) showed that the recognition of featural changes was always better than that of configural changes. However, no effect of the verbal encoding manipulations was found. In Experiment 5, recognition performance on both familiar and unfamiliar faces was examined. For familiar faces the recognition of featural changes was better than that of configural changes in the suppression and verbalisation conditions. For unfamiliar faces, the recognition of configural changes was better than that of featural changes in the verbalisation condition. Response patterns following verbalisation differed between familiar and unfamiliar faces.

An overview of these results shows a consistent pattern of finding such that verbalisation seems to affect the way of responding differently depending on the familiarity of the face. For familiar faces verbalisation leads to better recognition of featural changes than configural changes. However, the reverse was found for unfamiliar faces. Evidently, the role of verbal encoding in change recognition performance is complex, depending on face familiarity. This is the first piece of evidence illustrating the processing difference between familiar and unfamiliar faces on change recognition in the context of verbal processing. Moreover, this series of experiments highlighted the complexity and difficulty in conducting this line of research, especially the practical difficulties with stimulus preparation and methodological and theoretical issues for separating processing modes apart. In particular, it is difficult to equate the magnitude (or perceived magnitude) of changes between configural and featural stimuli. One type of changes might be always larger than the other, especially given the importance of and our sensitivity to configural information of faces. Therefore, one might always encounter the difficulty with the interpretation of data as to whether the findings reflect the effects of experimental manipulations or whether they are due to the difference in the magnitude (or perceived magnitude) of changes between the two. This brings a question of the study validity. Nevertheless, the experiments yielded an intriguing finding that cannot completely be discounted by the issues addressed in this chapter.

Chapter 3

The Role of Verbal Processing in Face Recognition Memory

Introduction

The experiments in the preceding chapter examined the role of verbal encoding in the recognition of configural and featural changes made to familiar and unfamiliar faces. The results revealed that describing faces during learning induced different patterns of responding between familiar and unfamiliar faces. Following verbalisation the recognition of featural changes was better than that of configural changes when faces were familiar. However, the reverse was found for unfamiliar faces. These are the first evidence, illustrating a complex verbal role in change recognition performance, and of theoretical importance for the concept behind the processing shift hypothesis (e.g. Schooler, 2002).

However, the four experiments reported in this chapter examine the effects of verbal manipulations on face recognition performance, rather than on change recognition performance for following reasons. First, in the preceding chapter, the verbal processing manipulations were introduced during encoding and measurements were taken on immediate change recognition performance (i.e. measuring performance shortly after learning). If, however, this thesis is to have direct relevance to the verbal overshadowing literature it is necessary to look at the effect of verbalisation at post-encoding (describing a previous seen face after learning had occurred) on delayed recognition performance (i.e. measuring performance sometime after learning).

Second, although the change recognition experiments in the preceding chapter yielded intriguing findings, understanding the role of verbal processing in face recognition memory would have greater practical and theoretical importance. For example, revealing the verbal mechanisms involved in face recognition memory would have practical relevance, especially to eyewitness investigations, which often entails asking an eyewitness to produce a description of a perpetrator's appearance sometime after the incident. Moreover, if verbal processing were involved in face recognition memory, then there are more reasons to assume that face recognition tasks typically used in the face recognition research may also entail similar verbal processes. This might provide the impetus for conducting a new line of face recognition research.

Third, as discussed in the preceding chapter, change recognition experiments remain open to potential criticisms that derive from the nature of stimuli used and the feasibility of this line of enquiry. It is uncertain whether or not configural and featural processing of a face can (should) be separated from each other and whether or not these different processing modes can reliably be measured in isolation. In addition, it is very hard to measure and equate the magnitude (or perceived magnitude) of changes between configural and featural changes, especially given the significance of configural information for face recognition (e.g. Freire, Lee, & Symons, 2002; Leder & Bruce, 2000; Rhodes, Brake, & Atkinson, 1993; Young, Hellawell, & Hay, 1987). Therefore, one might always face with the difficulty in interpreting findings as to whether they were due to experimental manipulations or whether they are due to the difference in the magnitude of changes between the two.

The four experiments in this chapter, therefore, employed a face recognition memory task designed to tap delayed recognition performance. In addition, verbal processing was manipulated at post-encoding (describing a previous seen face after the face had learned) as well as at encoding. This allowed a systematic investigation into whether or not verbal processing is involved in face learning and whether or not the effect of verbal processing on face recognition memory differs depending on the time of verbalisation. These will be of theoretical importance for the theory of dual coding (Paivio, 1971) and the theory of verbal overshadowing (Schooler, 2002; Schooler & Engstler-Schooler, 1990; Schooler, Fiore, & Brandimonte, 1997).

The main purpose of this series of experiments is to establish whether face learning entails verbal processing as well as visual processing. The manipulation of verbal processing during learning would allow establishing whether dual coding can be also applied to face recognition memory. Performance deriving from various learning conditions (single visual encoding and dual coding) would be compared to understand whether face memory processing would be benefitted by dual coding or single coding. If verbal processing plays an important part in face recognition, then the suppression of this during learning would dampen recognition while verbalisation having little or no effect. In pursuit of this methods used in dual coding studies and those used in other memory studies (use of the articulatory suppression) were brought together.

As reviewed in Chapter 1, the dual-coding approach distinguishes between nonverbal imagery processing and verbal symbolic processing (Paivio, 1971). These systems are independent of each other, but are partially interconnected for encoding, storage, organisation, and retrieval of information. In addition, the two systems are said to function in an additive manner so that dual coding of information leads to better memory performance than single coding. In other words, the existence of dual codes facilitates memory retrieval due to the multiple sources of recollection. For example, dual codes (i.e. visual and verbal codes) can co-exist for both pictures and concrete words (e.g. scissors, desks, or chairs), whereas only a single verbal code can exist for abstract words (e.g. confidence, ambition, or bravery). Therefore, recall of both pictures and concrete words would be easier and generally better than recall of abstract words (e.g. Pavio & Csapo, 1969, 1973; Pellegrino, Siegel, & Dhawan, 1976). The focus of this approach is to understand encoding processing and its impact on subsequent memory retrieval. Thus, manipulations are made during stimulus learning, and performance deriving from different learning conditions is compared. However, to date, there has been little work of this kind addressing the applicability of dual coding theory to face memory processing.

More recent research in the memory literature, however, has demonstrated that dual coding of visual materials does not necessarily facilitate subsequent memory performance (Brandimonte, Hitch, & Bishop, 1992a,b; Hitch, Brandimonte, & Walker, 1992; Pelizzon, Brandimonte, & Favretto, 1999). Different stimuli give rise to inherently different emphases on visual and verbal codes during learning (see, e.g. Bahrick & Boucher, 1968; Schooler & Engstler-Schooler, 1990). So, for example, in studies by Brandimonte and colleagues (op. cit.) articulatory suppression was used to examine the role of *spontaneous* verbal encoding in image transformation tasks. The technique is said to prevent phonological encoding of a stimulus without attentional costs (cf. Baddeley, 1986). In one study Brandimonte, Hitch, and Bishop (1992a) examined the effects of articulatory suppression on subsequent mental imagery performance. Participants were first asked to remember a set of composite pictures (either easy-to-name or difficult-to-name pictures) with or without articulatory suppression. In a subsequent mental imagery task, the participants were shown one part of a picture and asked to identify the other part of the picture using mental imagery. The authors found that imagery performance for the easy-to-name stimuli was significantly improved when verbal encoding was prevented, indicating that the verbal representation of those pictures have little value in performing the imagery task. However, articulatory suppression had no effect on imagery performance when stimuli were difficult to name. These findings were attributed to the fact that people tend spontaneously to name and describe stimuli, when this is possible, whether this is relevant to the task at hand or not. However, to date, there appears to be very little work of this kind conducted on faces to understand whether or not spontaneous verbal encoding might also occur during face learning.

Indeed, studies on verbal overshadowing repeatedly demonstrate the verbal interference of perceptual memory in that describing a previously seen stimulus, such as a face or colour, can significantly damage recognition performance (Schooler & Engstler-Schooler, 1990). In this paradigm, manipulations are introduced after learning, but not during learning as for the case of dual coding research. As reviewed previously, in the verbal overshadowing literature, perceptual stimuli are assumed to be encoded visually (configurally). Therefore, memory for perceptual stimuli is better not to be verbally recalled since this can dampen the activity of critical configural (visual) processing at test, leading to recognition impairment (the inappropriate transfer processing shift hypothesis, Schooler, 2002). Although this account might appear to be plausible, there seems to be no direct evidence in this paradigm illustrating the precise mechanisms involved in face encoding. Thus, neither the involvement of verbal processing in face encoding or its effect on subsequent recognition remains clear.

A recent study (Wickham & Swift, in review) directly challenge the key assumption of processing shift hypothesis by demonstrating the involvement of verbal processing during face learning. The authors suggest that verbal encoding plays an important part in face recognition memory performance. In the experiment, participants were allocated into one of the learning conditions (tapping control or articulatory suppression) and one of the post-encoding task conditions (a crossword puzzle or write down a description of a previously seen face). At learning, the tapping control group was asked to tap a table continuously and the articulatory suppression group was asked to say, ***the, the, the,*** continuously. Immediately after learning, half of the tapping control group and half of the articulatory suppression group did a crossword puzzle for 1 minute. The remaining participants (i.e. the other half of each group) were asked to write down a description of the face they had seen for 1 minute. After 1 minute all participants were shown an array of 10 faces, including the target, and were asked to identify the target. This procedure was repeated for the remaining 12 trials. The authors found that performance of the articulatory suppression group was worse than that of the tapping control group. The verbal overshadowing effect was seen only for the tapping control group who described the targets, but not for the articulatory suppression group who described the targets. In short, when verbal processing at learning was prevented, no verbal overshadowing effect was observed. From these results the authors concluded that face encoding entails spontaneous verbal processing, and that the verbal overshadowing effect may be due to interference in verbal codes formed during and after learning. However, this possibility deserves further investigation as this is the only evidence reporting spontaneous verbal encoding of faces.

As reviewed above, although both dual coding theory and verbal overshadowing theory are concerned with human memory processing, their focus is diverse, and the two research traditions have proceeded separately. The focus of dual coding theory is to understand encoding processes and their influence on subsequent memory performance. In contrast, the focus of verbal overshadowing theory is to understand the effect of verbalisation of perceptual (visual) memory on recognition memory. However, if the two paradigms are brought closer together, then it will provide better insights into the mechanisms underlying face memory processing. In an attempt to achieve this, the experiments in this chapter adopted methods from both research fields. This helps in addressing whether or not the dual coding approach can be applied to face memory. This would also have important theoretical relevance to the processing shift account of the verbal overshadowing effect.

The four experiments reported in this chapter examined delayed recognition performance by inserting filler tasks between learning and test, such as listing hobbies or sports for a period of time. This is a standard procedure employed in the verbal overshadowing paradigm. These tasks can be considered as verbal tasks requiring some level of verbal processing. In typical verbal overshadowing studies, participants learn a face, then engage in a verbally related filler task. Immediately after the filler task those in a control condition do a further filler task while those in a face description condition write down a description of the target face they had seen before. Subsequently, all participants are tested on the recognition of the target. The only difference between the control and description conditions is following the initial filler task whether one does a further filler task or the face description task. In the context of the verbal overshadowing literature the verbal processing that is responsible for provoking a processing shift is held to be the verbal processing caused by making a description of a previously seen target face or a completely unrelated face (e.g. Dodson, Johnson, & Schooler, 1997), but not by any other verbal processing. The importance of *making a description* of a previously seen face for the verbal overshadowing effect to occur has also been reported (Kitagami, Sato, & Yoshikawa, 2002).

Experiment 6

The purpose of this experiment was to examine whether or not verbal encoding is involved in face memory performance. To examine this, as in Chapter 2 articulatory suppression was used to prevent spontaneous verbal encoding of a face during learning, thereby, creating a single visual encoding condition. Recognition memory performance deriving from this condition was compared with that of the control condition where participants learned a set of faces without articulatory suppression. If verbal encoding plays a part in face memory recognition, then performance with articulatory suppression would be worse than that of controls.

METHOD

Participants

20 Undergraduate students from the University of Glasgow took part in this experiment for a course credit. There were 6 males and 14 females, all of whom had normal or corrected-to-normal vision by self-report.

Stimuli / apparatus

An Apple Macintosh computer was used to present stimuli and record responses, using Superlab 1.75. Stimuli consisted of greyscale head and shoulder pictures of 60 young Caucasian men, taken from the UK Home Office PITO database. These men were clean-shaven, had short hair, and wore no accessories or spectacles. These images varied in expression, lighting conditions, and viewing angles. For a half of these men (those to be used as targets), there were two images differing in pose and expression. For the other half, a single image was used as a distractor face at test. Clothing and background of all pictures were removed by using Photoshop 5.5. The picture size was approximately 3.5 cm x 4.5 cm.

Design / procedure

A 2 (Condition – Control / Suppression) x 2 (Test – Old / New) within-subjects design was used to examine the effect of articulatory suppression on recognition performance. Measurements were taken on accuracy (i.e. correctly identifying a seen face as old and correctly identifying an unseen face as new) and time taken to make a response (RT). There were 30 trials in each condition. A few practice trials were given to the participants prior to the real trials. The experiment proceeded in the following order; learning, 2 x 5 minute filler tasks, and test. This procedure was repeated for the remaining condition, with a 5 minute break between conditions.

At learning participants were shown 15 target faces, one at a time at random. Each target was displayed in the centre of the computer screen for 7 sec, followed by a cross for 2,5 sec. The target presentation order was randomised across participants. In the control condition, participants learned a set of 15 targets without a secondary task. In the suppression condition, participants learned a new set of 15 targets while uttering irrelevant sounds, *la, la, la, la.* They remained silent while a cross was displayed on the computer screen. During articulatory suppression the experimenter tapped a table at a rate of 3 or 4 tapping per second, and the participants uttered the sounds in accordance with the table tapping rhythm. A stopwatch was used to monitor the table tapping rate. The order of condition was counterbalanced across participants. In addition, the stimulus – condition combination was counterbalanced such that each stimulus set was used equally frequently in each condition.

Immediately after learning, participants engaged in 2 consecutive pen and paper filler tasks, such as writing lists of clothing items, countries, school subjects, and hobbies, each for 5 minutes before test. At test, participants were shown 30 faces with a 2 sec ISI between faces. Half of these faces were new images of people they had seen earlier, and the other half were new distractor faces. The images shown during learning (i.e. targets) were never presented at test, but instead new images of the targets were shown to ensure that the task tapped into person recognition, but not image recognition. The participants made speeded key-press responses as to whether each face was old or new. Each face disappeared from the display once a response had been made. Time between stimulus presentation and a response was measured as RT.

RESULTS

Accuracy: Percentage of correct responses is shown in Figure 6. A 2 (Condition – Control / Suppression) x 2 (Test – Old / New) within-subjects analysis of variance (ANOVA) was conducted on correct responses. This showed a main effect of Condition [$F(1,19) = 6.80$, $p < 0.05$], reflecting that recognition accuracy was significantly worse with articulatory suppression than without articulatory suppression. Neither the effect of Test [$F(1,19) = 2.32$, $p > 0.05$] nor the interaction [$F(1,19) < 1$] was significant.

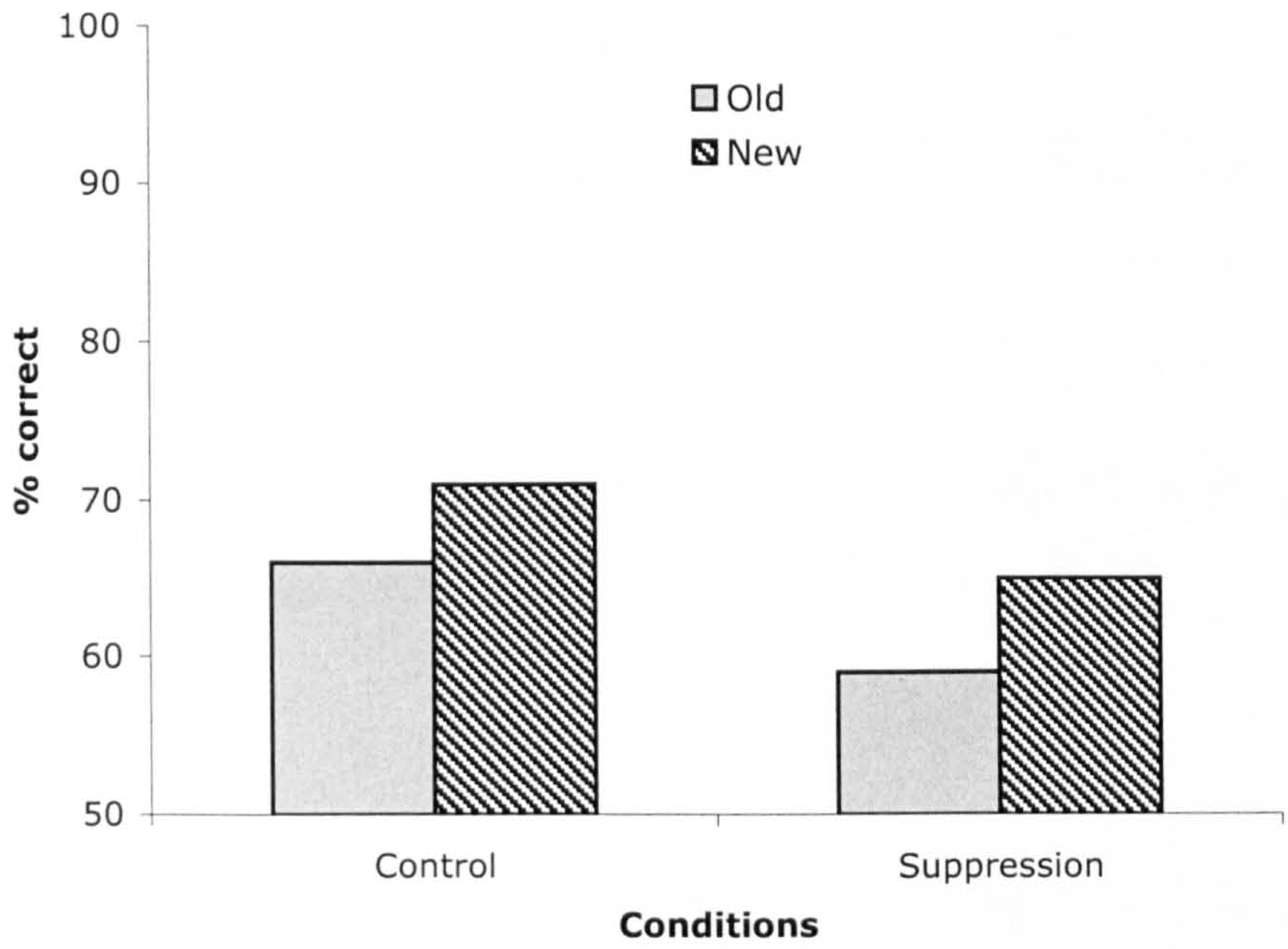


Figure 6 Percentage of correct responses for the recognition of seen and unseen faces from memory. Recognition performance is shown as a function of encoding condition and test item.

RT: Means of median response times for correct responses are shown in table 6. A 2 (Condition – Control / Suppression) x 2 (Test – Old / New) within-subjects ANOVA failed to reveal any effects of Condition [$F(1,19) < 1$], Test [$F(1,19) = 2.36$, $p > 0.05$] and the interaction [$F(1,19) = 1.18$, $p > 0.05$].

Condition	Test item Old		Test item New	
Control	950.9	(56.8)	1056.8	(63.1)
Suppression	971.7	(63.4)	977.8	(72.7)

Table 6 Means of median RTs (in msec) for correct responses. RTs are shown as a function of encoding condition and test item. Standard errors of the means in parenthesis.

DISCUSSION

The results have shown that articulatory suppression during encoding significantly impaired recognition accuracy. No difference in RTs between conditions was found. However, participants engaged in speeded responses, and this could have affected the results. In the present multiple trial experiment, it is difficult to allow unlimited response time. Moreover, the main purpose of measuring RTs was to ensure that there would be no tendency of speed-accuracy trade off in the results. From these results and given the function of articulatory suppression (i.e. the disruption of subvocal rehearsal, Baddeley, 1986; Murray, 1976), it could be suggested that some degree of spontaneous verbal encoding was likely to be occurring in the control condition, which could be important for successful face recognition. Therefore, articulatory suppression significantly impaired performance. Given the function of articulatory suppression (it prevents spontaneous verbal encoding of stimuli by occupying the verbal resource), it can be suggested that face learning entails some degree of spontaneous verbal encoding, which appears to be actually beneficial to subsequent face recognition performance.

These results might, in turn, suggest that faces can spontaneously be verbalised, and that verbal processing of faces may not necessarily be detrimental to face recognition as assumed (Schooler, 2002; Schooler & Engstler-Schooler, 1990; Schooler, Fiore, & Brandimonte, 1997). The detrimental effect of verbalisation at post-encoding has been clearly demonstrated in various verbal overshadowing studies (e.g. Brown & Lloyd-Jones, 2002; Dodson, Johnson, & Schooler, 1997; Fallshore & Schooler, 1995; Ryan & Schooler, 1998; Schooler & Engstler-Schooler, 1990; Westerman & Larsen, 1997). However, such demonstrations do not reveal anything about the role of verbal processing that could be involved in encoding, and how this might affect subsequent face recognition.

Although there are differences in the purpose and methodology between the current experiment and typical verbal overshadowing studies, the present findings raise some questions about the assumptions underlying the verbal overshadowing effect. For example, if verbal processing were, indeed, harmful to face recognition, then the prevention of verbal processing during encoding should not have significantly impaired performance, in comparison to controls where harmful verbal processing were likely to be involved during learning. Likewise, if faces were visual stimuli that were encoded primarily visually (configurally) (Schooler & Engstler-Schooler, 1990; Schooler, 2002), then articulatory suppression should not have had any effects on performance. In fact, it seems more likely that articulatory suppression would have enhanced performance as it could have maximised the use of visual (configural) processing of faces by suppressing verbal processing during learning. Evidently, it is difficult to reconcile the current findings with the concept behind the verbal overshadowing effect.

Note, however, that the current result demonstrated only that recognition performance with articulatory suppression was worse than that without articulatory suppression. There is no direct evidence to substantiate that the result was due to spontaneous verbal encoding in the control condition. As learning processing was not controlled in the control condition, it is uncertain what kind of encoding processing actually took place in this condition. Alternatively, it is possible that articulatory suppression simply disrupted the primary task of face learning, resulting in recognition impairment. Although articulatory suppression is thought not to demand attention (cf. Baddeley, 1986), this possibility cannot be eliminated completely. These issues were explored in the next experiment by controlling learning processing in each condition.

Experiment 7

The result from Experiment 6 demonstrated the negative effect of articulatory suppression on recognition memory. However, it is uncertain whether the results were due to spontaneous verbal encoding in the control condition or due to the learning disruption caused by articulatory suppression as learning processing in the control condition was not manipulated. In other words, it is uncertain how faces were actually learned in the control condition. It is possible that participants engaged in some sort of mnemonics (possibly verbal rehearsal) during learning in the control condition.

In order to clarify this, a control condition was replaced with a verbalisation condition where participants were asked to describe each face aloud during learning. Thus, face learning in both suppression and verbalisation conditions was accompanied by a secondary task (i.e. articulatory suppression and describing faces aloud respectively). This means that face encoding processing in each condition was controlled such that the suppression condition encouraged single visual encoding while the verbalisation condition forced dual encoding of faces so that direct comparison between performance deriving from a single encoding condition (the suppression condition) and that deriving from a dual coding condition (verbalisation condition) can be made. As the main purpose of this experiment is to examine the difference in performance between single and dual coding of faces, a control condition was excluded from the experiment.

This also allowed the examination into whether or not the theory of dual coding could be applied to face memory. As mentioned earlier, much work on dual coding has been conducted on non-face stimuli, therefore, it remains uncertain whether or not face memory processing might also be explained by this framework. If performance is worse with articulatory suppression than with verbalisation, then it would highlights further the importance of verbal encoding for face recognition. This might, in turn, suggest that the negative effect of articulatory suppression observed in Experiment 1 might have not stemmed solely from the costs of engaging in a secondary task.

METHOD

Participants

20 new volunteers participated in this experiment from the same source as Experiment 6. There were 5 males and 15 females, all of whom had normal or corrected-to-normal vision by self-report.

Stimuli / apparatus

Stimuli and apparatus were the same as for Experiment 6.

Design / procedure

The design and procedure were identical to those in Experiment 6, except that the control condition was replaced with the verbalisation condition in which participants described each face aloud during learning. They were encouraged to keep describing a face in as much details as possible while the face was on the computer screen for 7 sec. They remained silent when a cross was on the screen for 2.5 sec. Learning was followed by 2 x 5 minute filler tasks, and test.

RESULTS

Accuracy: Percentage of correct responses is shown in Figure 7. Taken together from the results from the previous experiment, both figure 6 and figure 7 shows a consistent pattern in that articulatory suppression seems to impair recognition, in comparison to both the control and verbalisation conditions. This suggests that whether or not participants received explicit instructions to describe each face aloud did not make any different to performance. What affected performance was whether verbal encoding was prevented or not.

A 2 (Condition – Suppression / Verbalisation) x 2 (Test – Old / New) within-subjects ANOVA was conducted on correct responses. This showed a main effect of Condition [$F(1,19) = 9.96$, $p < 0.01$], reflecting that recognition accuracy was significantly worse with articulatory suppression than with verbalisation. Neither the effect of Test nor the interaction was significant [$F(1,19) < 1$] .

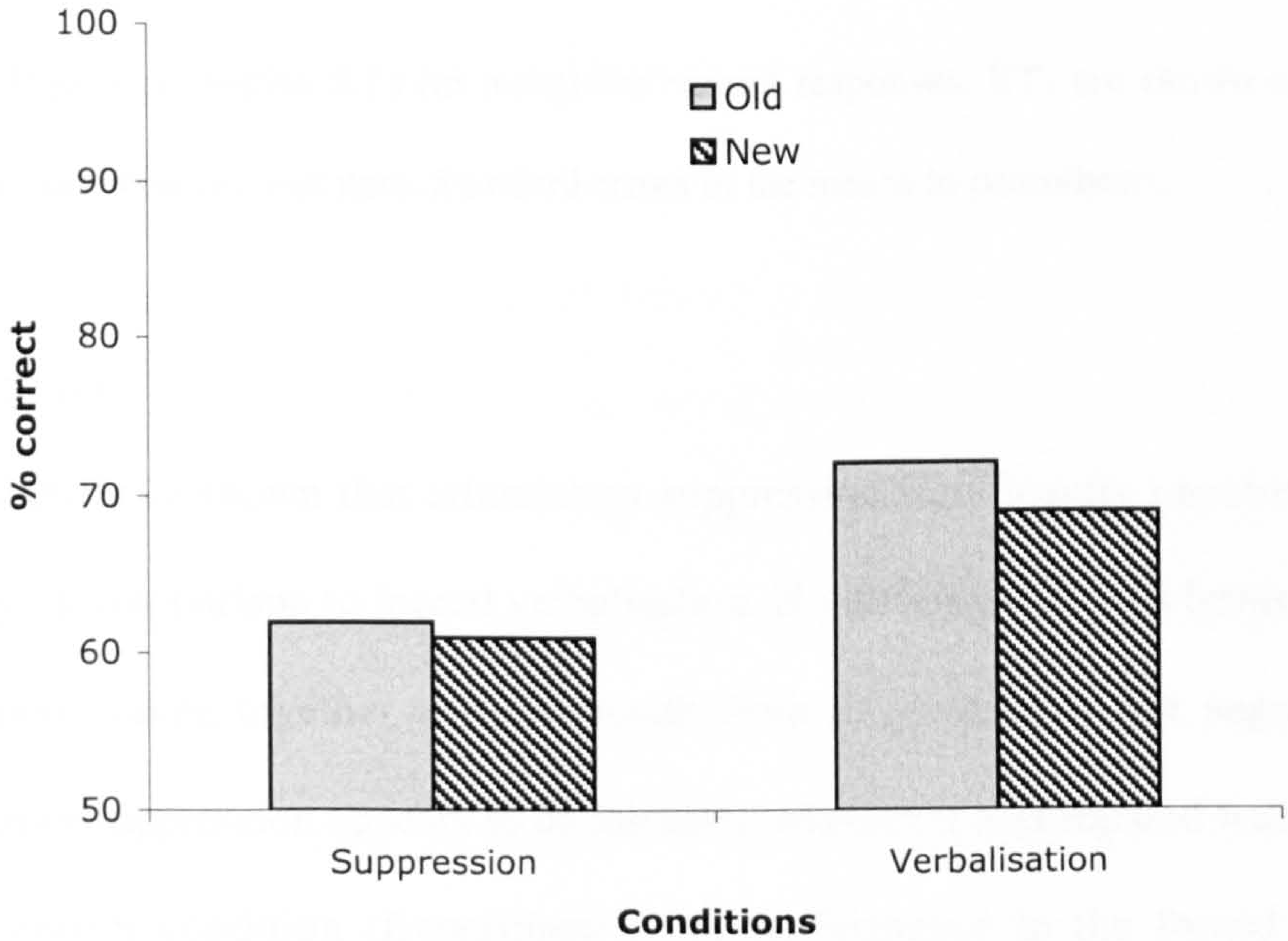


Figure 7 Percentage of correct responses for the recognition of seen and unseen faces from memory. Recognition performance is shown as a function of encoding condition and test item.

RT: Means of median response times (RT) for correct responses are shown in table 7. Results from a 2 (Condition – Suppression / Verbalisation) x 2 (Test – Old / New) within-subjects ANOVA revealed no effects of Condition [$F(1,19) = 1.20$, $p > 0.05$], Test [$F(1,19) < 1$], and the interaction [$F(1,19) < 1$].

	Test item			
Condition	Old		New	
Suppression	1023.8	(103.3)	1051.2	(86.5)
Verbalisation	1085.1	(92.4)	1099.4	(74.6)

Table 7 Means of median RTs (in msec) for correct responses. RTs are shown as a function of encoding condition and test item. Standard errors of the means in parenthesis.

DISCUSSION

The results have shown that articulatory suppression significantly impaired recognition memory, in comparison to forced verbalisation. No difference in RTs between conditions was found. Taken together with the result from Experiment 6, the negative effect of articulatory suppression appears to be the same whether it is compared with performance in the control condition (Experiment 6) or performance in the forced verbalisation condition (this experiment). This might be because spontaneous verbal encoding plays a role in face recognition memory, thereby, the prevention of this impaired subsequent recognition. As a result, whether or not participants were asked to verbally describe faces during learning made no difference to the outcome.

These results, again, cast a doubt on the processing shift account of the verbal overshadowing effect (e.g. Schooler, 2002). This account stresses that engaging in suboptimal verbally based (featural) processing is detrimental to face recognition because it dampens critical visual (configural) processing. Even if this were true it is difficult to comprehend the fact that performance with articulatory suppression was worse than that with verbalisation. The verbalisation condition already induced sub-optimal verbal processing at learning by forcing participants to describe each face. Consequently, this should have jeopardised the optimal use of visual (configural) processing, and performance should have been affected accordingly. Conversely, articulaotry suppression prevented verbally based (featural) processing from occurring, and this could have optimised the activation of visual (configural) processing during learning. Nevertheless, the current results indicate that verbalisation is more useful for face recognition than articulatory suppression, which does not seem to fit well with the concept of the processing shift hypothesis. Instead, the results are better explained by the framework of dual coding theory such that dual coding (visual and verbal processing) of a face leads to superior memory performance than mono coding (visual processing). In other words, neither visual processing nor verbal processing alone might be sufficient for successful recognition memory. Therefore, when verbal encoding was prevented, subsequent recognition suffered severely.

However, it is possible to argue that the findings observed in the experiment could have been due to the fact that describing faces during encoding facilitated learning by making the participants concentrate on learning. The participants might have paid more attention to what they were learning since they had to keep describing faces for the whole learning time. On the other hand, articulatory suppression is unrelated to the primary task of face learning, and this could have hampered face learning. As a consequence, performance under articulatory suppression was worse than that of under verbalisation. Moreover, so far no direct comparison between control and verbalisation conditions has been made, therefore, the effect of forced verbalisation on performance, in comparison to the baseline performance, remains uncertain. The next experiment attempted to overcome these issues by introducing a secondary task to all three conditions, in one condition participants describe faces, but in the other conditions they engaged in secondary tasks that are unrelated to the primary task of face learning.

Experiment 8

In this experiment participants did the recognition memory task in control, suppression, and verbalisation conditions. This allowed further examination into the possibility of spontaneous verbal encoding of a face in memory processing. In this experiment a tapping task was introduced into the control condition to ensure that in all conditions participants engaged in a concurrent task. Tapping (e.g. foot tapping, Emerson & Miyake, 2003; and desk tapping, Wickham & Swift, in review) is sometimes used as control by studies examining the effect of articulatory suppression on subsequent performance. If verbal processing is indeed involved in face encoding, then there should be little or no difference in performance between control and verbalisation conditions. The only difference between these conditions is whether verbal processing is articulated (in the case for the verbalisation condition) or subvocal (in the case for the control condition). If this prediction were correct, then performance in the suppression condition would be worse than that in the control and verbalisation conditions.

METHOD

Participants

The recruitment for the 24 Undergraduate students was the same for the previous experiments. None of them had taken part in the previous experiments. There were 6 males and 18 females, all of whom had normal or corrected-to-normal vision by self-report.

Stimuli / apparatus

Stimuli and apparatus were the same as those in the previous experiments.

Design / procedure

The design and procedure were identical to those in the previous experiments, except that there were three learning conditions; control, suppression, and verbalisation conditions, with 5 minute break between conditions. Therefore, the number of trials per condition was reduced from 30 trials to 20 trials.

RESULTS

Accuracy: Percentage of correct responses is shown in Figure 8. A 3 (Condition – Control / Suppression / Verbalisation) x 2 (Test – Old / New) within-subjects ANOVA was conducted on correct responses. This revealed a main effect of Condition [$F(2,46) = 7.73$,

$p > 0.01$]. Neither the effect of Test [$F(1,23) < 1$] nor the two-way interaction [$F(2,46) < 1$] was significant. A Tukey HSD test was conducted to explore the effect of Condition further, which revealed that recognition accuracy in the suppression condition was significantly worse than that in the control and verbalisation conditions ($p < 0.05$). This analysis showed no difference in recognition accuracy between control and verbalisation conditions ($p > 0.01$).

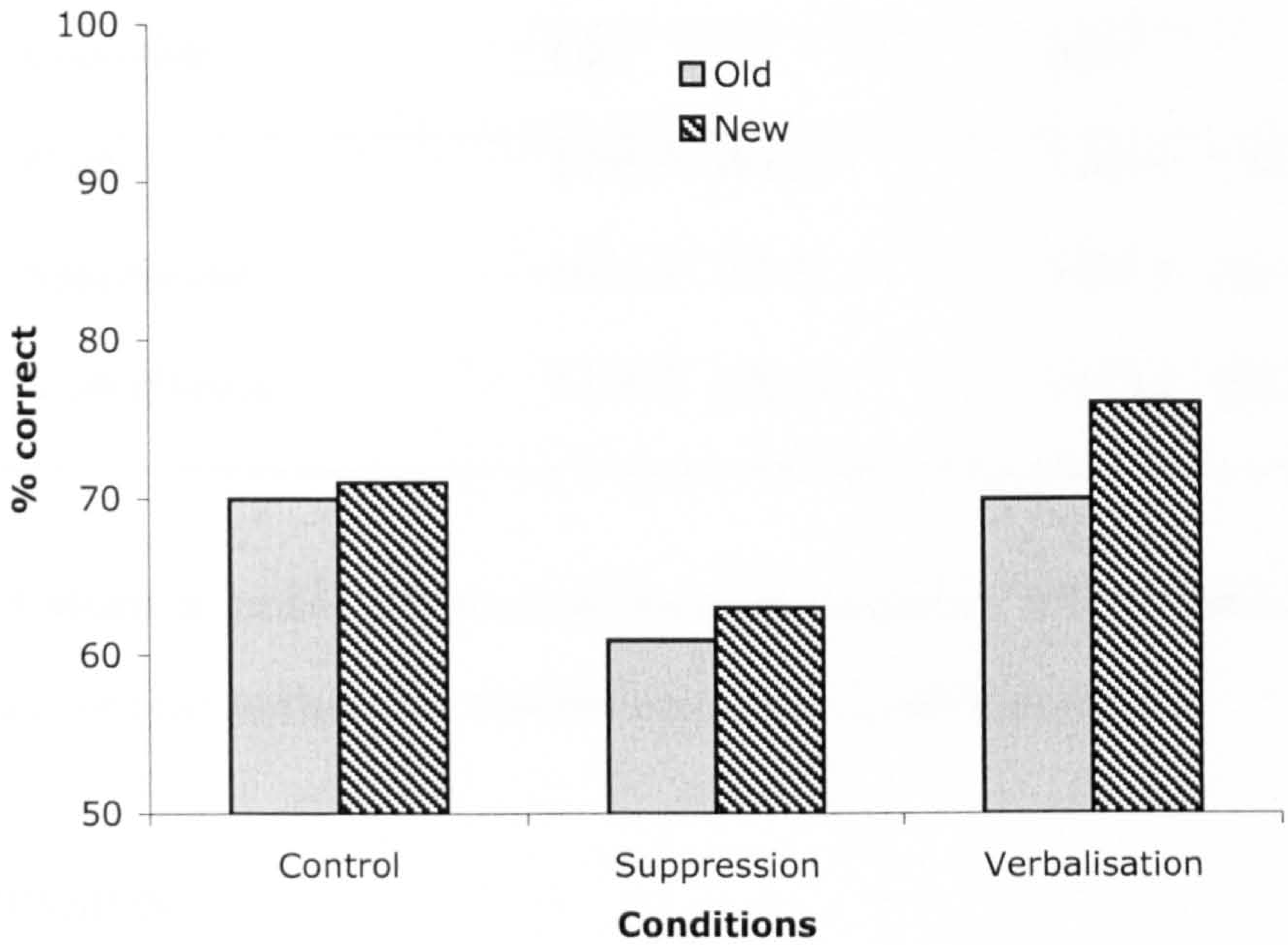


Figure 8 Percentage of correct responses for the recognition of seen and unseen faces from memory. Recognition performance is shown as a function of encoding condition and test item.

RT: Means of median response times for correct responses are shown in table 8. Results from a 3 (Condition – Control / Suppression / Verbalisation) x 2 (Test – Old / New) within-subjects ANOVA did not reveal any effects of Condition [$F(2,46) < 1$], Test [$F(1,23) < 1$] and the interaction [$F(2,46) = 1.08$, $P > 0.05$].

Condition	Test item: Old		Test item: New	
Control	1093.3	(84.2)	1101.0	(70.4)
Suppression	1051.3	(57.7)	1105.5	(69.3)
Verbalisation	1136.2	(56.4)	1096.8	(50.4)

Table 8 Means of median RTs (in msec) for correct responses. RTs are shown as a function of encoding condition and test item. Standard errors of the means in parenthesis.

DISCUSSION

The negative effect of articulatory suppression on recognition performance was, once more, observed in this experiment. In contrast, describing faces during encoding had no effect on performance. No difference in RTs across conditions was found. These results further suggest that face encoding involves some degree of verbal processing, and that verbal encoding has important value in successful face recognition memory. This is why verbalisation during learning did not affect performance, whereas the suppression of verbal encoding did. It seems unlikely that the findings of the previous chapter could have been affected by the attention factor in that articulatory suppression diverted attention from learning while verbalisation did the opposite. The negative effect of articulatory suppression was observed when compared with control performance.

Once more, all these results might suggest that engaging in suboptimal verbal (featural) processing of a face might not necessarily be harmful to face memory processing. As Schooler and Engstler-Scholler (1990) and Schooler (2002) claim verbal (featural) processing of a face may not be optimal to face recognition, it is, nevertheless, necessarily for aiding recognition performance. As demonstrated in verbal overshadowing studies (e.g. Dodson, Johnson, & Schooler, 1997; Fiore & Schooler, 2002; Schooler & Engstler-Schooler, 1990; Westerman & Larsen, 1997), verbalisation at post-encoding can have a negative effect on face recognition, but the current result showed that verbalisation at encoding does not significantly affect performance. Therefore, it could tentatively be suggested that the effect of verbalisation on memory performance varies depending on the time of verbalisation. The following experiment directly tested this possibility by introducing a verbalisation task at post-encoding.

Experiment 9

The previous experiments examined the role of verbal encoding in face recognition memory by manipulating learning process. However, this does not have direct relevance to the verbal overshadowing literature as the verbal overshadowing effect refers to recognition impairment caused by verbalisation at post-encoding. Therefore, the final experiment of this chapter examined the effect of verbal processing occurring at post-encoding with the same recognition memory task. This allowed clarifying whether the effect of verbalisation on performance depends on the time of verbalisation.

METHOD

Participants

The recruitment for the 20 Undergraduate students was the same for the previous experiment. None of them had taken part in the previous experiments. There were 6 males and 14 females, all of whom had normal or corrected-to-normal visual acuity by self-report.

Stimuli / apparatus

Stimuli and apparatus were the same as those in the previous experiments.

Design / procedure

The design and procedure were identical to those in the previous experiments, except that the verbal manipulation was introduced at post-encoding. There were two conditions; control and verbalisation conditions, with 30 trials per condition. In a control condition, participants learned 15 targets without any secondary task, and then engaged in 2 x 5 minute pen and paper filler tasks consecutively, prior to the recognition test. At test the participants were shown 30 faces, a half of which were new pictures of the targets and the other half were new distractor faces to ensure that the task tapped into person recognition. The procedure was identical for the verbalisation condition, except that after learning the participants engaged in only one 5 minute filler task, and then wrote down a detailed description of a single face they had previously seen for 5 minutes, and the test followed. An earlier study demonstrated that providing a description of a single face from memory was sufficient for provoking the verbal overshadowing effect (Brown & Lloyd-Jones, 2003). Therefore, this procedure was used. Moreover, it was not feasible to ask the participants to provide descriptions of all the faces they had seen. The order of condition was counterbalanced across participants.

RESULTS

Accuracy: Percentage of correct responses is shown in Figure 9. A 2 (Condition – Control / Verbalisation) x 2 (Test – Old / New) within-subjects ANOVA was conducted on correct responses. This revealed a main effect of Condition [$F(1,19) = 4.49$, $p < 0.05$], indicating that describing a previously seen face from memory impaired recognition performance, a replication of the verbal overshadowing effect. Neither the effect of Test nor the interaction was significant [$F(1,19) < 1$].

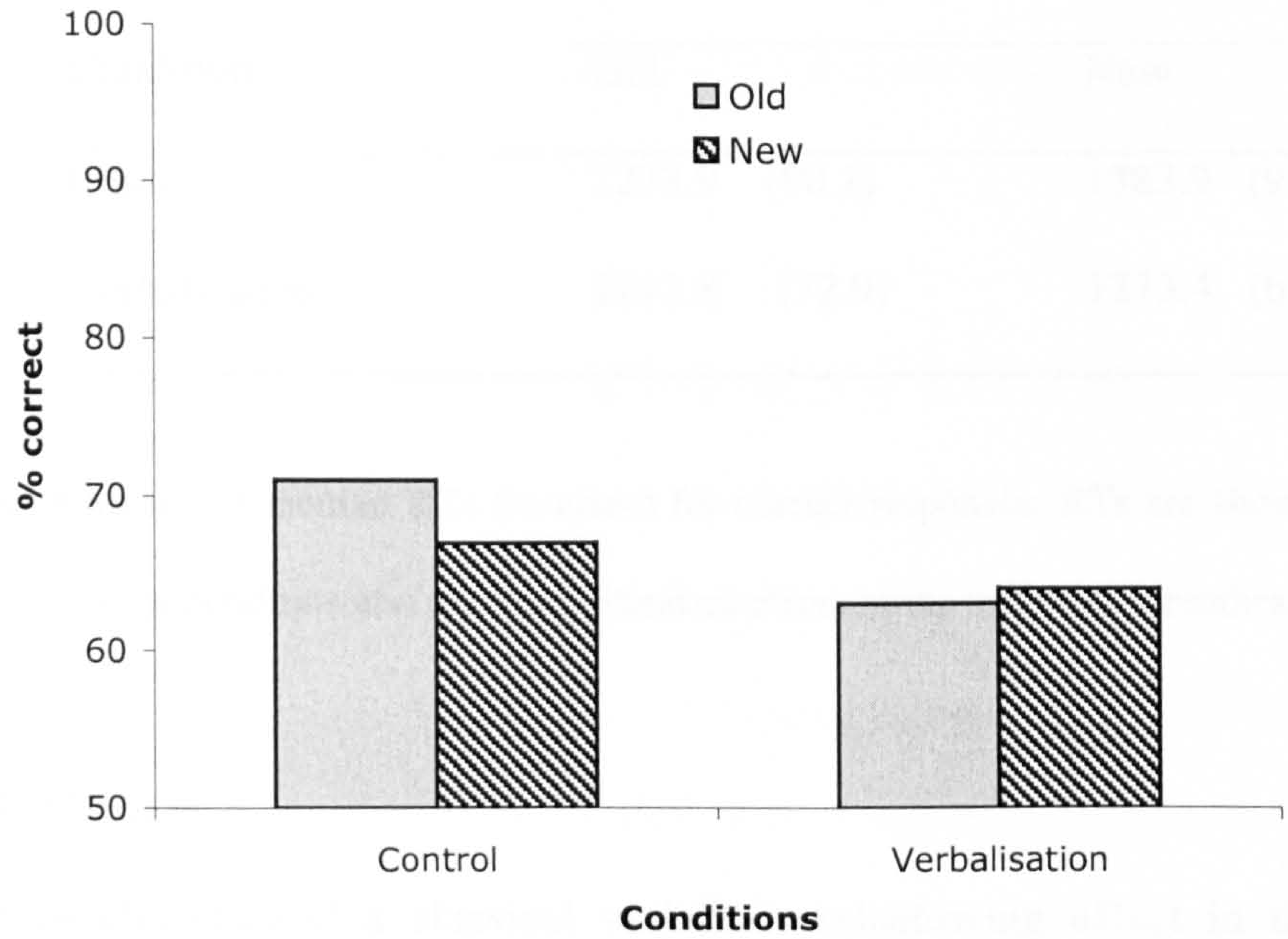


Figure 9 Percentage of correct responses for the recognition of seen and unseen faces from memory. Recognition performance is shown as a function of post-encoding condition and test item.

RT: Means of median response times for correct responses are shown in table 9. Results from a 2 (Condition – Control / Verbalisation) x 2 (Test – Old / New) within-subjects ANOVA failed to reveal any effects of Condition [$F(1,19) = 2.40$, $p > 0.05$], Test [$F(1,19) = 2.50$, $p > 0.05$], and the interaction [$F(1,19) < 1$].

Condition	Test item	
	Old	New
Control	1273.9 (90.1)	1383.9 (91.0)
Verbalisation	1211.8 (72.9)	1273.4 (67.6)

Table 9 Means of median RTs (in msec) for correct responses. RTs are shown as a function of post-encoding condition and test item. Standard errors of the means in parenthesis.

DISCUSSION

The results showed a classical verbal overshadowing effect in that describing a previously seen face from memory impaired recognition performance, in comparison to not describing a face. No difference in RTs between conditions was found. The verbal overshadowing effect can be replicated in a within-subjects multiple trial experiment that differs from a typical verbal overshadowing experiment often using a between-subjects single trial method. Taken together with the result from Experiment 3, the effects of verbalisation on performance differ depending on the time of verbalisation. Verbalisation can affect recognition when it occurs at post-encoding, but not when it occurs at encoding. Although learning processing was not controlled in this experiment, participants were likely to have engaged in some degree of verbal encoding as illustrated in the previous experiments. Once again, it is very difficult to explain the current result in the framework of the processing shift hypothesis for the reason that a standard verbal overshadowing effect was replicated in the same experimental context, which repeatedly highlighted the possibility of the verbal involvement in face encoding. Therefore, it is difficult to reason that the recognition impairment observed in the current experiment was due to a processing shift deriving from the act of verbalisation at post-encoding when verbal processing could have already been in operation at encoding.

GENERAL DISCUSSION

The four experiments demonstrated systematically the role of verbal processing in face recognition memory performance by manipulating verbal processing at encoding and post-encoding. The result from Experiment 6 indicated that the suppression of verbal encoding was detrimental to subsequent memory performance. This result was replicated in Experiment 7 and Experiment 8. Performance in the suppression condition was worse than that in the control and verbalisation conditions, which themselves did not differ. However, verbalisation at post-encoding impaired recognition, a replication of the verbal overshadowing effect (Experiment 9). From these results it was suggested that face encoding involves some level of spontaneous verbal processing, and this is important for successful face recognition. Thus, dual coding theory could also be applied to face memory processing. These results are taken as evidence arguing against the inappropriate transfer processing shift hypothesis. It is unlikely that the verbal overshadowing effect derives primarily from a processing shift between learning and test since sub-optimal verbal processing may already be involved in encoding. Even if verbalisation induces a change in processing modes, this change is expected to be more gradual, rather than abrupt.

From the findings of this series of experiments it could be speculated that the verbal overshadowing effect might be more to do with interference in verbal representations of a face formed during and after learning, rather than interference in processing shift per se. It might be that spontaneous verbal encoding forms a verbal representation of a face, but describing a face at post-encoding forms another verbal representation of the same face. These two (different) verbal representations interfere with each other at test, hampering recognition performance. This may be because describing a face while seeing the face (describing the face while its in view) is different from describing the face from memory (describing memory), and this may, in some way, interfere recognition process at test, leading to recognition impairment. Indeed, when spontaneous verbal encoding was prevented via articulatory suppression, no verbal overshadowing was observed (Wickham & Swift, in review), demonstrating that the phenomenon might be due to verbal code interference. Thus, the verbal code interference hypothesis argues against the claim that verbal overshadowing is due to the interference between visual and verbal representations However, the experiments in this chapter have not provided direct evidence to verify the verbal code interference account of the verbal overshadowing effect. This will be explored in Chapter 5.

It is important to note that as reviewed in Chapter 1 the verbal overshadowing effect is said to be fragile, accounting only for 1.4 % of a total variance across studies (Meissner & Brigham, 2001). As reported in the meta analysis of verbal overshadowing studies, the replication of the effect can be influenced by various factors, including the length of the interval between verbalisation and test, the elaborateness of the description, and individual differences (Ryan & Schooler, 1998). Such large variation among studies explains why some studies (Davis & Thasen, 2000; Memon & Bartlett, 2002; Yu &

Geiselman, 1993) failed to replicate the effect. This is another reason to suspect that the verbal overshadowing effect observed in this chapter may have been due to interference in verbal representations formed at different memory processing stages. Thus, it is possible that the verbal overshadowing effect found across studies derive from various factors, including a processing shift. It might also be possible to speculate that more than one factors co-exist in a single study. Therefore, the strong emphasis on the processing shift hypothesis while overlooking other potential explanations could hinder our understanding of the mechanisms underlying the phenomenon.

To sum up, the current results, for the first time, revealed the complex role of verbal processing in face recognition memory. The effect of verbalisation on memory performance tends to vary depending on the time of verbalisation. Moreover, the verbal overshadowing effect can be successfully replicated in an experimental setting involving a multiple trial task, which differs from a typical verbal overshadowing study. Furthermore, the results have led to an alternative explanation, the verbal code interference hypothesis, for the phenomenon. However, it should be stressed that there might be more than one factors contributing to the phenomenon, and that the underlying causes for the effect are still under debate.

Chapter 4

The Role of Verbal Processing in Picture Recognition Memory

INTRODUCTION

The experiments in the preceding chapter examined the role of verbal processing in face recognition memory by using unfamiliar faces. The results have shown that the suppression of verbal encoding during learning impaired subsequent recognition accuracy, whereas describing each face aloud during learning had no effect. However, describing a face after learning impaired recognition; a replication of a standard verbal overshadowing effect. These results were taken as evidence suggesting the possibility of spontaneous verbal encoding in face recognition memory. In addition, the effects of verbal processing on recognition memory are complex, which appear to vary depending on the time of verbalisation, whether it occurs during or after learning. More importantly, the results have led to a tentative hypothesis that the verbal overshadowing effect may derive from interference between verbal representations of a face, rather than a change in processing modes between learning (visual / configural processing) and test (verbal / featural processing) as Schooler (2002), Schooler et al (Dodson, Johnson, & Schooler, 1997; Fallshore & Schooler, 1995; Schooler, Fiore, & Brandimonte, 1997; Schooler, Ryan, & Reder, 1996), and Westerman & Larsen (1997) suggest.

The three experiments in this chapter employed a picture recognition memory task. The focus of this chapter was two fold. First was to examine the effects of verbal processing on face picture recognition, which would consolidate the findings from Chapter 3. The previous findings showed no effect of verbal encoding on face recognition memory. This was interpreted as supporting evidence for the involvement of subvocal verbal processing in face learning. Yet, there is a chance that the null effect of verbalisation could have been also due to the fact that a verbal description formed during learning was not the precise description of a test face (i.e. pictures between learning and test were different). For example, a description of smiling Face A created during learning would be different from describing Face A with neutral expression shown at test. Describing a front facing Face B would be different from describing a three-quarter view of Face B. A picture recognition task would provide a useful tool for clarifying this as the same pictures can be presented, again, at test.

Moreover, although the negative effect of post-encoding verbalisation on face recognition was demonstrated in Chapter 3, the converse finding has been reported for picture recognition memory (Wiseman, MacLeod, & Lootsteen, 1985), including face pictures (Read, 1979). For example, Wiseman, MacLeod, & Lootsteen (1985) asked participants to learn photographs of, for example, people, animals, and plants, sequentially. Each presentation was followed by ISI of either 5 sec blank or 5 sec display of additional verbal information of each picture. The relatedness of verbal information (i.e. how related the verbal description is to each photograph) and the amount of the information (i.e. low, medium, and high) were also varied. One week later the participants engaged in a yes-no recognition test where they identified whether each picture was old (having seen it before) or new (not having seen it before).

The findings showed that recognition accuracy was significantly better for photographs with post-encoding verbal information than for photographs without post-encoding verbal information. Although both related and unrelated verbal information aided recognition, related information was significantly more helpful. However, the amount of related information had no effect. These results were interpreted such that post-encoding verbal information induced participants to rehearse the previously seen picture. The verbal information acted as a cue to elaborate the representation of the picture, improving memory for this picture. What was elaborated was not the verbal information, but the representation of the picture. Therefore, increasing the amount of verbal information did not affect outcome. Other researchers have also reported the benefit of post-encoding processing for picture memory in that pictures can continue to be processed after exposure, which facilitates both recognition and recall (e.g. Graefe & Watkins, 1980; Tversky & Sherman, 1975).

It seems that the role of verbal processing in recognition performance could well vary depending on task, whether it involves the recognition of identity or the recognition of pictorial information. Understanding this would provide a comprehensive view towards the role of verbal processing in face memory; faces as identity and faces as complex pictures.

The second focus was to examine an under-researched aspect of verbal overshadowing, 'the perceptual expertise account' (Fallshore & Schooler, 1995; Melcher & Schooler, 1996, 2004; Ryan & Schooler, 1998; Schooler, Fiore, & Brandimonte, 1997). The perceptual expertise account falls under one of the three premises of verbal overshadowing, the modality mismatch assumption (Schooler, Fiore, & Brandimonte, 1997). The modality mismatch assumption postulates that the verbal overshadowing effect is due to a mismatch between verbal (conceptual) and nonverbal (perceptual) knowledge of a stimulus. Thus, the effect of verbalisation depends on the degree to which recognition memory relies on nonverbal perceptual knowledge. For example, Schooler & Engstler-Schooler (1990) showed that recognition accuracy for the target face was severely impaired by verbally describing the face at post-encoding. However, this was not the case for the recognition of spoken statements. These results are interpreted as supporting evidence that face recognition relies on nonverbal (perceptual) knowledge while statement recognition relies on verbal (conceptual) knowledge. Thus, verbalisation affected face recognition only, but not statement recognition.

The key concept underlying 'the perceptual expertise' account is that when a nonverbal (perceptual) aspect of memory for a stimulus is more highly developed than a verbal (conceptual) aspect of that memory, then this induces a condition for verbal overshadowing (Melcher & Schooler, 2004). Considered in the context of face memory, the ability to recognise faces (a nonverbal/perceptual aspect of memory) is much more developed than the ability to describe faces from memory (a verbal/conceptual aspect of the memory)(Schooler, Fiore, & Brandimonte, 1997). Verbalising a face from memory makes participants draw on verbally oriented knowledge at the expense of nonverbal knowledge, leading to recognition impairment (Schooler & Engstler-Schooler, 1990). In principle, relative differences in verbal and nonverbal expertise for a given stimulus should mediate its vulnerability to verbal overshadowing. Therefore, the verbal overshadowing effect should occur in a situation where nonverbal (perceptual) expertise profoundly exceeds verbal (conceptual) expertise. Conversely, the effect is unlikely to arise when the two are in balance or when verbal expertise exceeds nonverbal expertise as in the case for the recognition of spoken statements. These predictions have been supported by studies of individual differences (Ryan & Schooler, 1998), wine memory (Melcher & Schooler, 1996), and perceptual and conceptual training on mushroom memory (Melcher & Schooler, 2004).

In the study of face memory, Fallshore & Schooler (1995) used own versus other race faces to examine the effect of perceptual expertise on the verbal overshadowing effect (see Meissner, Brigham, & Butz, 2005 for an alternative account for the other-race effect in that individuals qualitatively encode more information about own-race faces, creating a more diagnostic representation for subsequent identification). In addition, the presentation orientation at test (i.e. presenting distractors either upright or upside-down) was changed. A main rationale for these was that these faces represent different levels of perceptual expertise in that we are better at recognising own race and upright faces (expert domain) than we are at recognising their counterparts (novice domain). Nonetheless, we are in general poor at describing faces. Thus, there should be a greater perceptual/verbal expertise disparity for own race and upright faces than for other race and upside-down faces.

Moreover, the difference in perceptual expertise is linked to that in a processing style. Own race and upright face processing relies more on configural information (i.e. attention to the spatial layout of facial features) while other race and upside-down face processing relies more on processing of featural information (i.e. attention to individual features). It was suggested that verbalisation may de-emphasis configural information that is normally used for face recognition while over-emphasising featural information, and this might affect recognition. Thus, it was hypothesised that the verbal overshadowing effect would be likely to be seen for own race and upright faces than for other race and upside-down faces.

The stimuli in Fallshore & Schooler' s study were photographs of an African American man, an African American woman, a White man, and a White woman. All participants were White so that the African American faces served as other race faces while White faces served as own race faces. At learning the participants were shown one of these faces for 5 sec, and then did a crossword puzzle for 5 minutes. Immediately after, those in a verbalisation condition wrote down a description of the target while those in a control condition did a filler task for 5 minutes, before test. At test the participants identified the target from 5 other similar distractor faces. This procedure was repeated for the remaining targets. The results showed that verbalisation impaired the recognition of own race faces, but had no effect on the recognition of other race faces. The effect was eliminated when test faces were inverted. These results were taken as supporting evidence for the role of perceptual expertise in verbal overshadowing of face memory.

However, there is a possibility that the faces used in Fallshore & Schooler's study may not be most reliable representations of different levels of perceptual expertise for the following reasons. First, a strand of evidence has shown that we are poor at recognising unfamiliar faces (Bruce, et al., 1999; Burton, Wilson, Cowan, & Bruce, 1999; Henderson, Bruce, & Burton, 2001; Kemp, Towell, & Pike, 1997). For example, people did poorly on a matching task where they were asked to match a video image of the target with a photograph of that target in an array of photographs of similar looking people. A substantial number of errors were made even when there were no changes in the angle and expression between video image and photograph (Bruce, et al., 1990). These results seem to suggest that we may be actually bad at recognising faces from CCTV.

Second, much research has been conducted on the processing differences between upright and upside-down faces. The general understanding seems to be that we are better at recognising upright faces than upside-down faces (the inversion effect, e.g. Rhodes, Brake, & Atkinson, 1993; Yin, 1969). This is due to the fact that face inversion disrupts configural processing that is assumed to be critical to face recognition (e.g. Bartlett & Searcy, 1993; Friere, Lee, Symons, 2000). So, processes underlying upright and upside-down faces are different from each other in this respect. However, more recent studies (Megreya & Burton, in press; Sekular, Gaspar, Gold, & Bennett, 2004) suggest that this may not be the case. The difference in processing of upright and upside-down faces may be quantitative (i.e. the recognition of upright faces is better than that of upside-down faces) rather than qualitative (i.e. processes between the two are different).

For example, in a series of experiments Megreya & Burton (op. cit.) used a matching task, requiring participants to match a video image of a target with a photograph of that target from an array of 10 other faces, with target present and absent trials. The participants did the task on both upright and inverted faces (sometimes only targets were inverted, but other times both targets and distractor faces were inverted). The results showed a strong correlation between upright and inverted unfamiliar face matching performance, with an advantage for upright face matching. In other words, matching performance on upright faces for a given individual can be predicted from the same task using upside-down faces. From the findings, it was suggested that processes involved in matching upright and upside-down unfamiliar faces could be actually similar.

When all these findings are taken into consideration, one is tempted to question whether the faces used in Fallshore & Schooler' s study represented the opposite pole of the perceptual scale as they assumed. The key point of using these faces was to categorise them into an expert domain and a novice domain with regard to the ability to recognise them, which was used to represent the degree of the perceptual/verbal disparity among the faces. However, it appears that we are <u>not</u> experts at recognising unfamiliar faces even when these are own race, and the right way up. There may be a better way to examine perceptual expertise than Fallshore & Schooler's study.

To overcome this, the current chapter took a radical approach to examine perceptual expertise by using face pictures rather than using different kinds of faces. There is abundant evidence showing that picture memory is strikingly good. Our capacity for remembering complex and meaningful pictorial stimuli is said to be great (Haber, 1970; Nickerson, 1965; Standing, Conezio, & Haber, 1970), and recognition accuracy for complex pictures exceeds 90% (Shepard; 1967; Nickerson, 1968). In particular, the ability to recognise photographs of faces seem to be significantly better than that of photographs of objects (Dobson & Rust, 1993) or patterns (Goldstein & Chance, 1970). Dobson & Rust' study has shown that a " learning disabled " group did as well as a non-retarded group on a face picture recognition memory task. Moreover, neither of the groups showed significant loss of memory for face pictures over time (e.g. 1 week, 1 month, and 2 months after learning).

From an overview of previous studies it could be suggested that a picture recognition task would provide a better tool for investigating the perceptual expertise account than the task used in Fallshore & Schooler's study. It seems that we are skilled at recognising face pictures, but we are poor at recognising the identity of, even, own race faces. However, our difficulty in describing faces should not be affected whether a task is picture verbalisation or face verbalisation. Therefore, it might be plausible to assume that a perceptual/verbal disparity would be more signified in a picture recognition task than in the face recognition task, involving classes of faces.

Experiment 10

The main purpose of this experiment was to examine further the role of verbal processing at encoding in recognition memory. The findings from Chapter 3 found no effect of verbal encoding on recognition. This could have been partly due to the nature of the task in which pictures between learning and test were always different from each other. This means that verbal descriptions formed during learning were not the precise descriptions of test faces. Thus, describing faces aloud during learning had no effect. If this were the case, then presenting the same pictures, again, at test might change study outcome. As

Experiment 8 in Chapter 3, this experiment entailed articulatory suppression and verbalisation during learning. Recognition memory performance deriving from these learning conditions was compared with that of a control condition. In addition, pictures of famous people, including actors, actresses, and politicians were also included to see how the familiarity of the face might mediate the effects of the verbal manipulations. If some degree of subvocal verbal processing were also involved in picture recognition memory, then verbalisation during learning is unlikely to affect recognition. Instead, articulatory suppression should impair recognition performance. Whether these would differ between pictures of famous people and those of non-famous people remains to be seen.

METHOD

Participants

24 Undergraduate students from the University of Glasgow took part in this experiment for course credit. There were 5 males and 19 females, all of whom had normal or corrected-to-normal vision by self-report. All of them were familiar with the faces of the famous people used in the study.

Stimuli / apparatus

An Apple Macintosh computer was used to present stimuli and record responses, using Superlab 1.75. Unfamiliar face pictures (i.e. pictures of unfamiliar people) consisted of greyscale head and shoulder pictures of 30 young Caucasian men, taken from the UK Home Office PITO database. 2 images of each person, differing in pose and expression, were used in the experiment (one as a target and another as a test image). These men were clean-shaven, had short hair, and wore no accessories or spectacles. These images varied in expression, lighting conditions, and viewing angles. Familiar face pictures (i.e. pictures of famous people) consisted of grey scale head and shoulder pictures of 30 famous males (e.g. see appendix 2 for the list of faces used in this experiment). 2 images of each person were taken from magazines and websites, varying in age, hair length, hairstyle, a direction of eye gaze, expressions, lighting conditions, and viewing angles. Clothing and background of all pictures were removed by using Photoshop 5.5. The picture size was approximately 3.5 cm x 4.5 cm.

Design / procedure

A 3 (Learning condition – Control / Suppression / Verbalisation) x 2 (Familiarity – Familiar / Unfamiliar) x 2 (Test – Old / New) within-subjects design was used to examine the effect of articulatory suppression and that of verbalisation on picture recognition memory. Measurements were taken on accuracy (i.e. correctly identifying a seen picture as old and correctly identifying an unseen picture as new) and time taken to make a response (RT).

Prior to participation all participants were given the list of celebrities faces used in the study, and were asked whether they would be able to recognise these faces when they were shown photos of these people. Those who are unsure of recognising any of these faces were excluded from the study. Only those who were confident with identifying all the faces participated in the study. Participants did a task in each of the three conditions, tapping control, suppression, and verbalisation conditions. There were 40 trials in each condition. A few practice trials were given to the participants prior to the real trials. The experiment proceeded in the following order; learning, 2 x 5 minute filler tasks, and test. This procedure was repeated for the other conditions, with a 5 minute break between conditions. At learning participants were shown 10 familiar and 10 unfamiliar face pictures, one at a time at random, who were asked to learn them for a subsequent test. Each target was displayed in the centre of the computer screen for 7 sec, followed by a cross for 2,5 sec. The target presentation order was randomised across participants.

In the control condition, participants tapped a table at a rate of 3 or 4 tapping per second while learning each picture. A stopwatch was used to monitor the rate of tapping. The participants started tapping the table when each picture appeared, and stopped when it disappeared from the screen for 2.5 sec. In the suppression condition, the participants learned a different set of target pictures while uttering irrelevant sounds, *la, la, la, la* at the same rate as that of tapping. During articulatory suppression the experimenter tapped a table, and the participants articulated the sounds in accordance with the tapping rhythm. Care was taken to maintain the rate of tapping. The participants articulated the sounds when a picture appeared on the screen, and stopped when it disappeared from the screen. They remained silent while a cross was displayed on the computer screen for 2.5 sec. In the verbalisation condition, the participants described each picture during learning. They were required to describe the picture in as much detail as possible, starting when the picture appeared, and stopping when it disappeared 7 sec later.

The order of condition was systematically varied in such a way that the verbalisation condition was never followed by the tapping control condition in order to avoid possible carry over effects deriving from having described pictures in the preceding condition. If this was not controlled, encoding processes in the tapping control condition could have been affected. This resulted in 4 combinations of condition order; Control-Suppression-Verbalisation, Control-Verbalisation-Suppression, Suppression-Control-Verbalisation, Verbalisation-Suppression-Control, which were counterbalanced across participants. Although this might not have completely eliminated the risk of carry over effects, an attempt was made to reduce the risk. In addition, the stimulus – condition combination was counterbalanced such that each stimulus set was used equally frequently in each condition.

Immediately after learning the participants engaged in 2 consecutive pen-paper filler tasks, such as writing lists of clothing items, countries, school subjects, and hobbies, each for 5 minutes before test. At test, participants were shown 60 pictures with a 2 sec ISI between presentations. Half of the pictures were old pictures they had seen earlier (duplicates), and the other half were new pictures of the targets. The participants made speeded key-press responses as to whether each picture was old or new. In a multiple trial experiment it is not feasible to allow unlimited response time, therefore, a speeded response procedure was used. Each picture disappeared from the display once a response had been made. Time between stimulus presentation and a response was measured as RTs. They were taken in order to identify any tendency of speed-accuracy trade off in data.

RESULTS

Accuracy: Percentage of correct responses is shown in Figure 10a and 10b. From the visual inspection of figure 10a and 10b, it appears that verbalisation did not affect recognition performance for both familiar and unfamiliar faces. There appears to be no significant difference in recognition performance between control and verbalisation conditions. However, there is a hint in the data that articulatory suppression affected performance. A 3 (Condition – Control / Suppression / Verbalisation) x 2 (Familiarity – Familiar / Unfamiliar) x 2 (Test – Old / New) within-subjects analysis of variance (ANOVA) was conducted on correct responses. This showed a main effect of Condition [$F(2,46) = 25.17$, $p < 0.01$] and a main effect of Familiarity [$F(1,23) = 86.37$, $p < 0.01$]. A main effect of Test was close to significance [$F(1,23) = 3.40$, $p > 0.05$]. Neither the effect of Condition x Familiarity interaction nor Condition x Test interaction was significant [$F(2,46) < 1$]. These were modulated by the effect of Familiarity x Test interaction [$F(1,23) = 16.91$, $p < 0.01$], and further by the effect of three-way interaction [$F(2,46) = 7.79$, $p < 0.01$]. Simple Main Effect Analyses were conducted to explore the three-way interaction, which found an effect of Condition for new familiar face pictures [$F(2,46) = 13.74$, $p < 0.01$] and for old unfamiliar face pictures [$F(2,46) = 17.69$, $p < 0.01$]. For familiar face pictures, articulatory suppression impaired the recognition of new pictures in comparison to that in the tapping control and verbalisation conditions. In contract, for unfamiliar face pictures, articulatory suppression impaired the recognition of old pictures in comparison to that in the tapping control and verbalisation conditions. The analyses also identified an effect of Familiarity for all recognition performance, except for the recognition of new pictures in the suppression condition [$F(1,23) < 1$]. The effect of

Familiarity for old [$F(1,23) = 26.77, p < 0.01$] and new pictures [$F(1,23) = 7.96, p < 0.01$] in the tapping control condition was significant. The effect of Familiarity for old pictures [$F(1,23) = 58.06, p < 0.01$] in the suppression condition was significant. The effect of Familiarity for old [$F(1,23) = 15.61, p < 0.01$] and new pictures [$F(1,23) = 9.06, p < 0.01$] in the verbalisation condition was significant. These results indicate that the recognition accuracy for familiar face pictures was always better than that for unfamiliar face pictures, except when recognising new pictures in the suppression condition where no difference between familiar and unfamiliar face pictures was found. Furthermore, the analysis revealed an effect of Test for performance on unfamiliar face pictures in the suppression condition [$F(1,23) = 9.91, p < 0.01$]. Following articulatory suppression, the recognition accuracy for old unfamiliar face pictures was significantly worse than that for new unfamiliar face pictures.

Figure 10a: Familiar face pictures

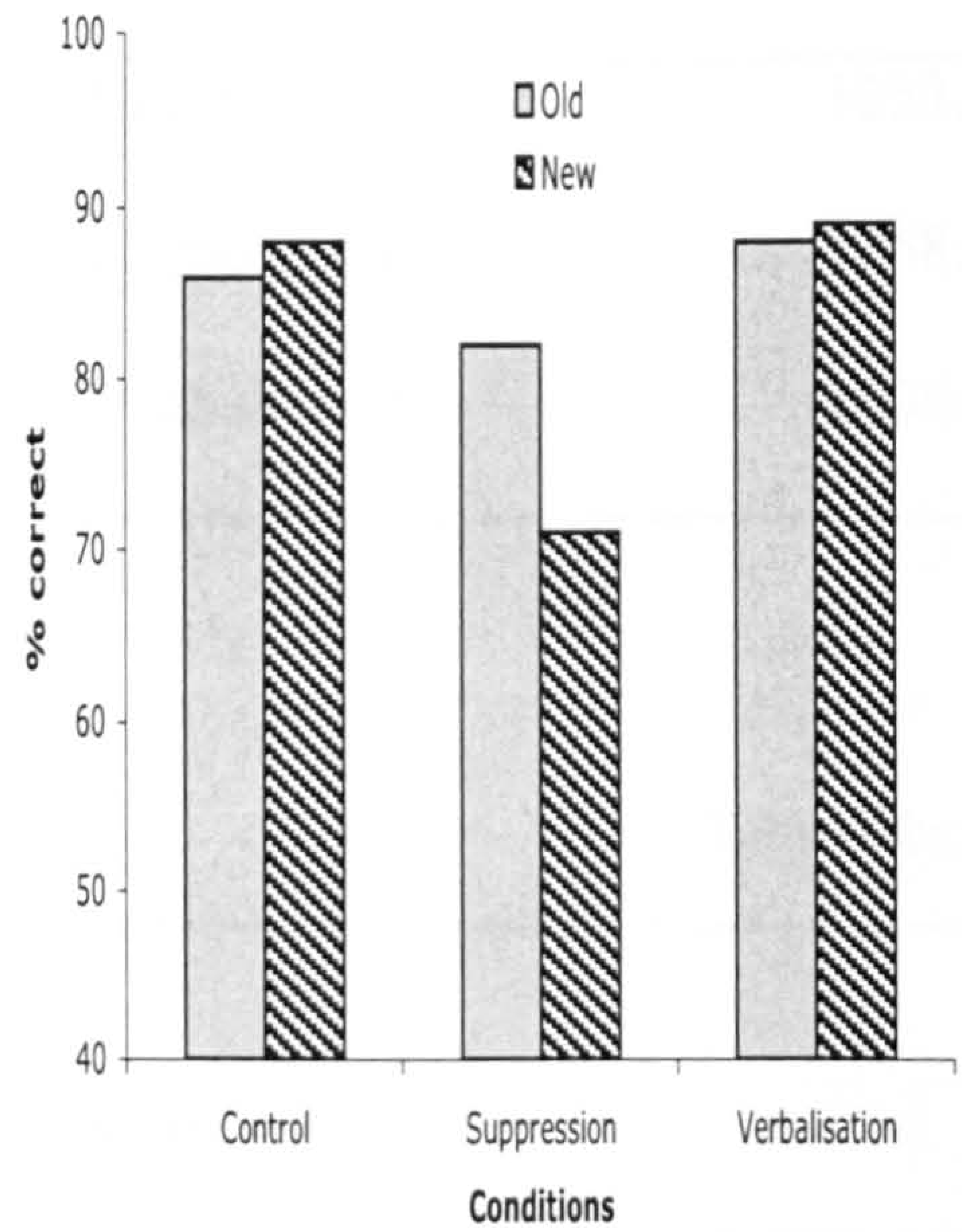


Figure 10b: Unfamiliar face pictures

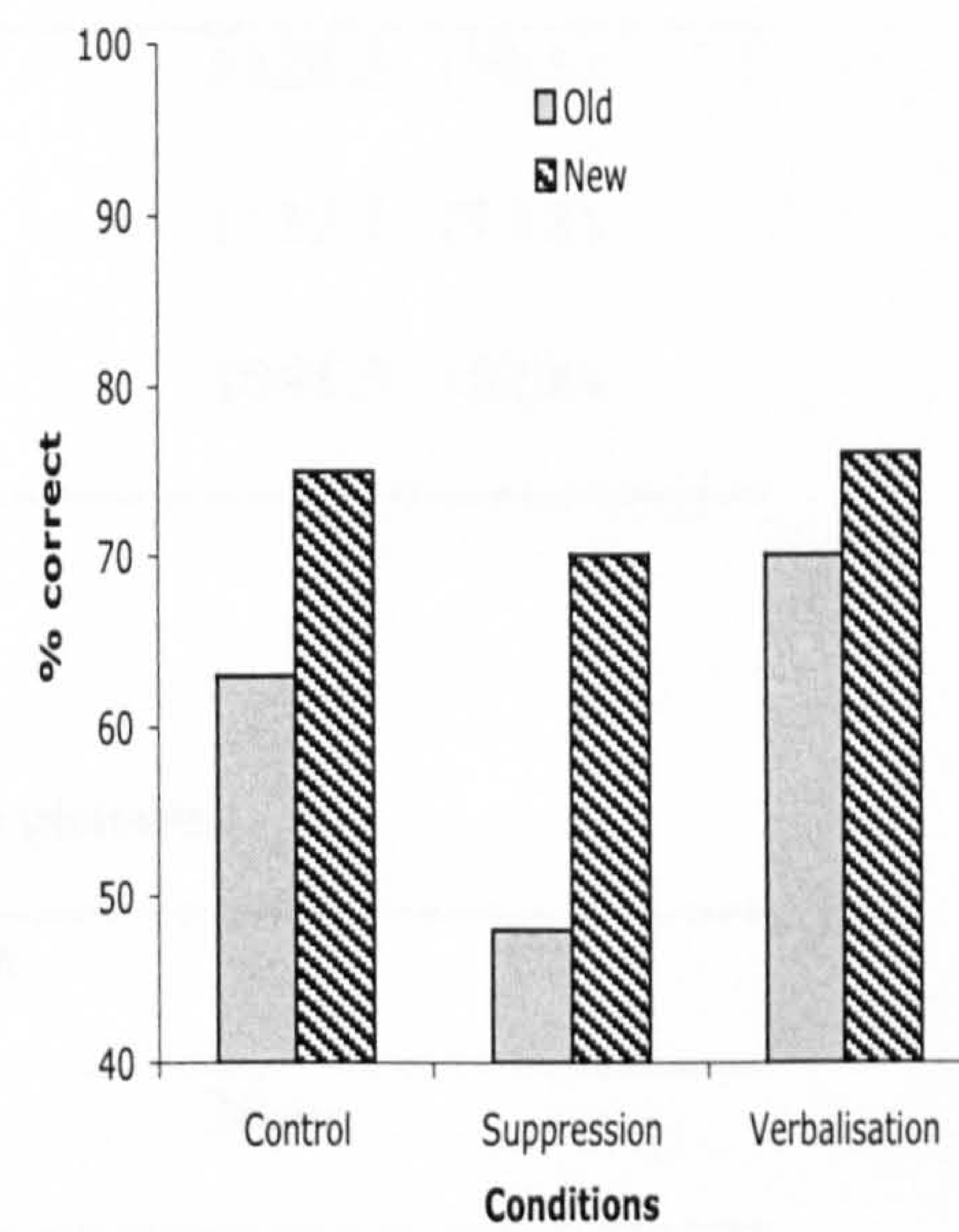


Figure 10a and 10b Percentage of correct responses for the recognition of seen and unseen pictures from memory. Recognition performance is shown as a function of encoding condition, picture familiarity, and test item.

RT: Means of median response times for correct responses are shown in table 10a and 10b. The results from a 3 (Condition – Control / Suppression / Verbalisation) x 2 (Familiarity – Familiar / Unfamiliar) x 2 (Test – Old / New) within-subjects ANOVA failed to reveal any effects of Condition [$F(2,46) = 1.46$, $p > 0.05$], Familiarity [$F(1,23) < 1$], and Test, near significance [$F(1,23) = 3.56$, $p > 0.05$], Condition x Familiarity interaction [$F(2,46) = 1.01$, $p > 0.05$], Condition x Test interaction [$F(2,46) = 2.13$, $p > 0.05$], Familiarity x Test interaction approaching significance [$F(1,23) = 4.09$, $p > 0.05$] and the three-way interaction approaching significance [$F(2,46) = 3.15$, $p > 0.05$].

Table 10a: Familiar face pictures

Condition	Test item: Old		Test item: New	
Control	1253.5	(101.2)	1128.3	(59.1)
Suppression	1068.2	(55.7)	1132.1	(73.8)
Verbalisation	1096.8	(75.6)	1045.3	(52.8)

Table 10b: Unfamiliar face pictures

Condition	Test item: Old		Test item: New	
Control	1203.0	(72.4)	1177.7	(66.0)
Suppression	1153.2	(84.6)	1072.8	(55.4)
Verbalisation	1279.5	(108.5)	1020.5	(57.3)

Table 10a and 10b Means of median RTs (in msec) for correct responses. RTs are shown as a function of encoding condition, picture familiarity, and test item. Standard errors of the means in parenthesis.

DISCUSSION

The results have shown that recognition accuracy for familiar face pictures was generally better than that for unfamiliar face pictures, except when recognising new images in the suppression condition where no familiarity advantage was found. More importantly, articulatory suppression had different effects on recognition performance, depending on the familiarity of the face. When pictures were of famous people articulatory suppression impaired the recognition of unseen pictures, in comparison to that in the tapping control and verbalisation conditions. The converse was found for unfamiliar face pictures; articulatory suppression impaired the recognition of seen pictures, in comparison to that in the tapping control and verbalisation conditions. In agreement with the results from Chapter 3, verbalisation during learning did not affect recognition performance. Moreover, the RTs did not differ across all conditions. These results are the first piece of evidence demonstrating the effect of familiarity of the face on picture recognition memory in the context of verbal processing.

Taken together with the results from Chapter 3, the null effect of verbalisation during learning on recognition memory seems to remain the same, regardless of the task. Verbalisation had no effect on identity recognition where pictures between learning and test were different. This was also found for picture recognition where half the pictures between learning and test were the same and the other half were different. These eliminate the possibility that the null effect of verbalisation in Chapter 3 could have been due to the fact that verbal descriptions created during learning were not transferable to test stimuli.

In Chapter 3 articulatory suppression impaired the recognition of both seen and unseen people. However, in this experiment the effects of articulatory suppression differed, depending on the familiarity of the face. Articulatory suppression impaired the recognition of old familiar face pictures (faces presented during learning) while impairing the recognition of new unfamiliar face pictures (faces not presented furing learning). This means that articulatory suppression impaired memory (the recognition of seen faces) only for unfamiliar faces, but not for familiar faces. Moreover, in the suppression condition there was no difference in the recognition of new pictures between familiar and unfamiliar face pictures. These results, therefore, suggest that following articulatory suppression, the participants were much more conservative to accept seen pictures as old when pictures were of unfamiliar people. This was not, however, the case for familiar face pictures. In other words, articulatory suppression impaired only the recognition of seen unfamiliar face pictures, but not that of seen familiar face pictures.

One possible explanation for this may be that processes involved in learning familiar and unfamiliar face pictures were different. All participants were familiar with famous faces used in this experiment, so they have already had some visual representations of these faces. However, the participants did not have any prior exposure to unfamiliar faces used in the experiment. Although the task required the recognition of pictorial information, but not the recognition of identity, the difference in pre-exposure could have affected the learning process, leading to different outcome. The fact that recognition accuracy, except the recognition of new pictures in the suppression condition, was generally better for familiar face pictures than for unfamiliar face pictures would suggest that pre-exposure to the famous faces aided recognition. For this reason, verbal encoding might have been important for learning unfamiliar face pictures. Thus, the prevention of this significantly damaged the recognition of seen unfamiliar face pictures. Though this was not the case for familiar face pictures, verbal encoding seems to be useful for identifying unseen face pictures as new. Hence, following articulatory suppression the recognition of unseen familiar face pictures was significantly worse than that in other conditions.

These findings provide more reasons to argue that some degree of verbal encoding was involved in picture learning, and this might be important for subsequent recognition. As a consequence, forcing participants to describe pictures during learning had no effect while articulatory suppression showed differential negative effects, depending on the picture type (familiar or unfamiliar).

Experiment 11

The previous experiment examined the role of verbal encoding in picture recognition by manipulating verbal processing during learning. The findings demonstrated that verbalisation during learning had no effect on recognition memory, whereas articulatory suppression had some effects. From these results it was suggested that some level of verbal encoding is likely to be involved in picture memory performance. However, these findings do not reveal the effect of verbal processing occurring at post-encoding on recognition performance. As demonstrated in Chapter 3, the effects of verbalisation on face recognition memory differed, depending on the time of verbalisation. Verbalisation during learning did not affect face recognition memory, but verbalisation after learning impaired recognition. Therefore, it is worth examining whether similar findings could be found for picture recognition memory. Thus, in this experiment participants described a picture after seeing it (i.e. verbalisation at post-encoding).

More importantly, the current experiment explored one of under-researched aspects of verbal overshadowing, the perceptual expertise account (Fallshore & Schooler, 1995; Melcher & Schooler, 1996, 2004; Ryan & Schooler, 1998; Schooler, Fiore, & Brandimonte, 1997) by using pictures, rather than faces, as stimuli. The main rational for this was that our picture recognition appears to be strikingly good, in particular recognising face pictures (e.g. Dobson & Rust, 1993; Goldstein & Chance, 1970). Yet, our difficulty in describing faces should not be affected whether a task is picture verbalisation or face verbalisation. Therefore, the disparity between the ability to recognise pictures (expertise domain) and the ability to describe pictures (novice domain) is more likely to be signified than that between own versus other races faces and between upright versus upside-down faces. In effect, a picture recognition memory would provide a more valid tool for investigating perceptual expertise than the task used in Fallshore & Schooler's study. If perceptual expertise were one of the key factors contributing to the verbal overshadowing effect, then post-encoding verbalisation would significantly impair picture recognition. To make a direct comparison between the present experiment and Fallshore & Schooler's experiment, only unfamiliar face pictures was used.

METHOD

Participants

20 new volunteers participated in this experiment from the same source as Experiment 10. There were 2 males and 18 females, all of whom had normal or corrected-to-normal vision by self-report.

Stimuli / apparatus

The stimuli were similar to those in the previous experiment, except that only unfamiliar face pictures were used. The apparatus was the same as for the previous experiment.

Design / procedure

A 2 (Post-encoding condition – Control / Verbalisation) x 2 (Test – Old / New) within-subjects design was used to examine the effect of verbalisation at post-encoding on picture recognition. As in the previous experiment, measurements were taken on accuracy (i.e. correctly identifying a seen picture as old and correctly identifying an unseen picture as new) and time taken to make a response (RT). The procedure was similar to that in the previous experiment, except that in this experiment a verbalisation task was given at post-encoding.

Participants did the task in 2 conditions; control and verbalisation conditions, with a 5 minute break between them. There were 30 trials per condition. In the control condition, the participants learned 15 unfamiliar face pictures, one at a time for 7 sec., without any secondary task. Learning was followed by 2 consecutive filler tasks and test. This procedure was repeated for the verbalisation, with the exception that after the initial filler task, participants, this time, wrote down a description of one of the pictures they had seen. Description of a single face is said to be sufficient to induce the verbal overshadowing effect (e.g. Brown & Lloyd-Jones, 2002), therefore, this procedure was used. Moreover, it was not feasible for the participants to describe all the pictures they had seen from memory. After this description task the test followed. At test 15 old pictures they had seen earlier and 15 new distractor pictures (i.e. different pictures of the targets) were shown one at a time. Participants engaged in a speeded key-response as to whether each picture was old or new.

RESULTS

Accuracy: Percentage of correct responses is shown in Figure 11. A 2 (Post-encoding condition – Control / Verbalisation) x 2 (Test – Old / New) within-subjects ANOVA was conducted on correct responses. This revealed a main effect of Condition [$F(1,19) = 11.56$, $p < 0.01$], but the effect of Test just failed to reach significance [$F(1,19) = 3.66$, $p > 0.05$]. The two-way interaction [$F(1,19) < 1$] was also non-significant. Describing a previously seen picture impaired subsequent recognition accuracy.

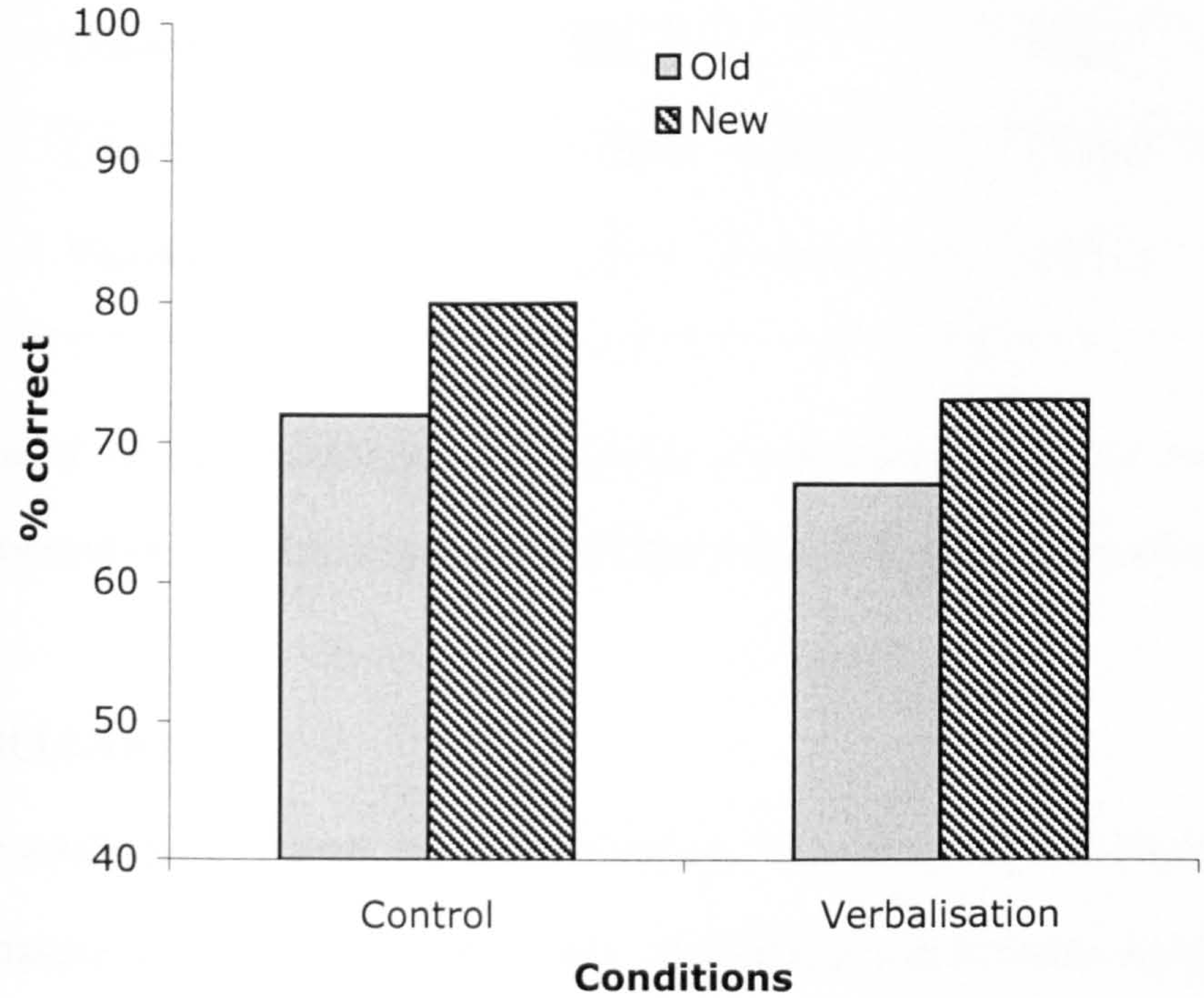


Figure 11 Percentage of correct responses for the recognition of seen and unseen pictures from memory. Recognition performance is shown as a function of post-encoding condition and test item.

RT: Means of median response times are shown in table 11. Results from a 2 (Post-encoding condition – Control / Verbalisation) x 2 (Test – Old / New) within-subjects ANOVA failed to reveal any effects of Condition [$F(1,19) = 1.20$, $p > 0.05$]. Test [$F(1,19) < 1$], and the two-way interaction [$F(1,19) < 1$].

	Test item	
Condition	Old	New
Control	1550.0 (109.9)	1576.9 (139.8)
Verbalisation	1471.1 (126.0)	1423.5 (97.5)

Table 11 Means of median RTs (in msec) for correct responses. RTs are shown as a function of post-encoding condition and test item. Standard errors of the means in parenthesis.

DISCUSSION

The result demonstrated, for the first time, a classical verbal overshadowing effect on the recognition of pictorial information. Describing a previously seen picture impaired recognition performance, in comparison to not describing a picture. Evidently, the verbal overshadowing effect can arise even when a task does not require identity recognition. It is possible that the effect observed in the experiment could have been due to a perceptual / verbal disparity in that the ability to recognise pictures profoundly exceeded the ability to describe a picture.

Taken together with the result from Experiment 10, it is clear that the effects of verbalisation on picture recognition differ depending on the time of verbalisation. Verbalisation can affect recognition memory when it occurs at post-encoding, but not when it occurs at encoding. The same pattern of findings was also reported in Chapter 3. It appears that the effects of verbal processing on recognition memory seem to be the same, regardless of the task. Moreover, the verbal overshadowing effect was, once more, seen in the same experimental context where the possibility of spontaneous verbal encoding has been demonstrated (Experiment 10).

Although the current results demonstrated verbal overshadowing of picture memory, which could have derived from the perceptual/verbal expertise disparity, it is important to examine this further as this is the first evidence demonstrating the possibility. Therefore, the next experiment examined further the perceptual expertise account of verbal overshadowing effect by using, this time, familiar face pictures only.

Experiment 12

This experiment examined whether or not the verbal overshadowing effect could be also seen when pictures of famous faces were used. Although the current task is picture recognition, but not face recognition, the findings from the previous experiment identified some familiarity advantage for recognition accuracy. This suggests that having some experience with the famous faces (e.g. through the media) helped memory processing even though the task was to identify pictorial information. Indeed, Goldstein & Chance (1970) reported that subjective familiarity plays a significant role in picture recognition. The fact that people are significantly better at recognising face pictures than ink blots and snow crystals reflects the difference in the levels of familiarity with these pictures. Considered in the context of the perceptual expertise account, verbalisation of familiar face pictures could lead to greater recognition memory impairment than the effect found in the previous experiment that used the pictures of unfamiliar people to which the participants had no prior exposure. Therefore, post-encoding verbalisation would significantly impair familiar face picture recognition.

METHOD

Participants

20 new volunteers participated in this experiment from the same source as Experiment 10. There were 2 males and 18 females, all of whom had normal or corrected-to-normal vision by self-report. All of them were familiar with the famous faces used in the study.

Stimuli / apparatus

The stimuli were similar to those in Experiment 10, except that only familiar face pictures were used. The apparatus was the same as for the previous experiment.

Design / procedure

The design and procedure were identical to those in Experiment 11, except that participants learned 15 familiar face pictures. As in the previous experiment the participants were tested on the recognition of 15 old pictures they had seen earlier and 15 new pictures they did not see before.

RESULTS

Accuracy: Percentage of correct responses is shown in Figure 12. A 2 (Post-encoding condition – Control / Verbalisation) x 2 (Test – Old / New) within-subjects ANOVA was conducted on correct responses. This revealed no effects of Condition, Test, and the two-way interaction [$F(1,19) < 1$]. Describing a previously seen familiar face picture did not affect recognition performance.

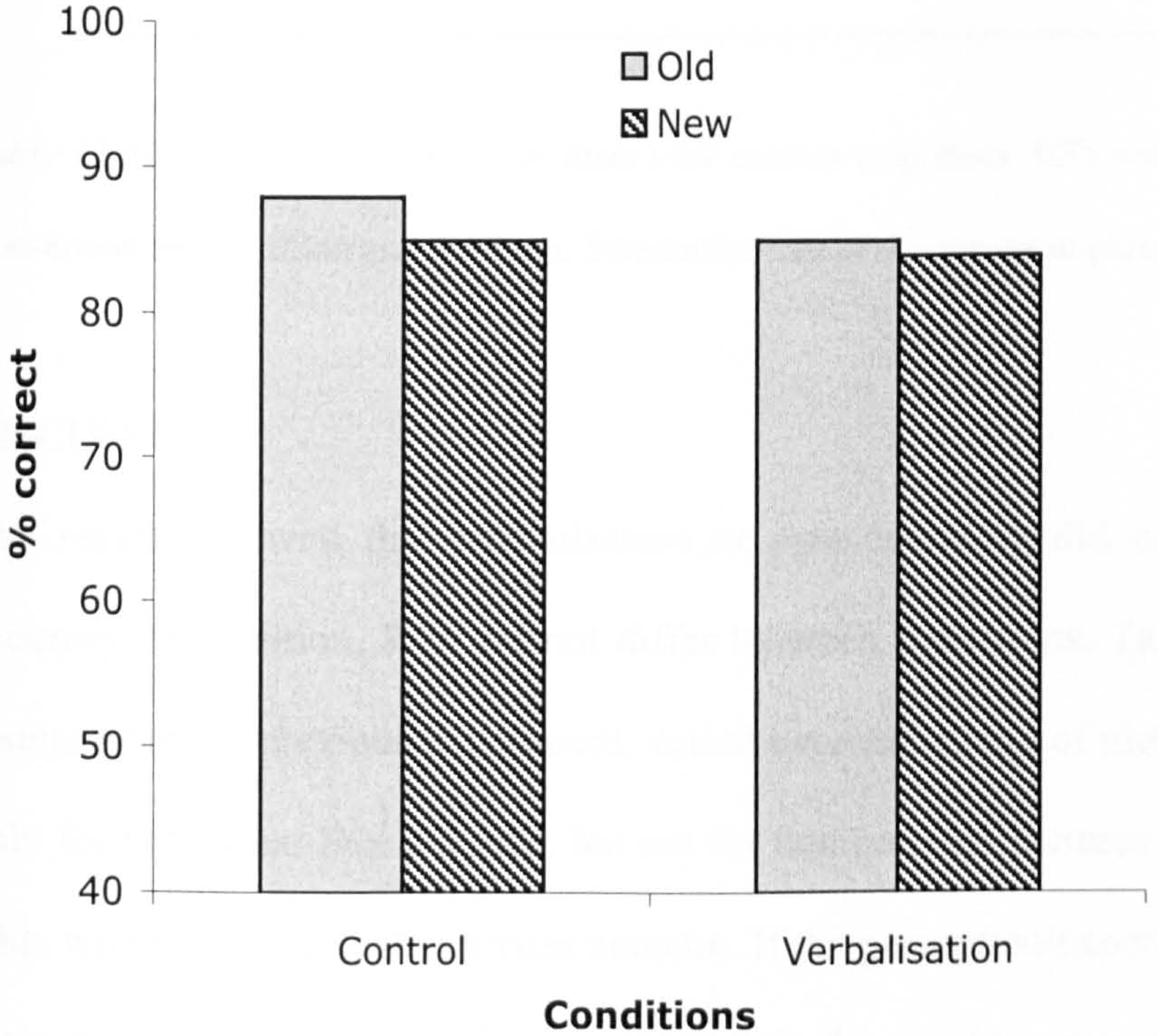


Figure 12 Percentage of correct responses for the recognition of seen and unseen pictures from memory. Recognition performance is shown as a function of post-encoding condition and test item.

RT: Means of median response times are shown in table 12. Results from a 2 (Condition – Control / Verbalisation) x 2 (Test – Old / New) within-subjects ANOVA failed to reveal any effects of Condition [$F(1,19) < 1$], Test [$F(1,19) = 1.97$, $p > 0.05$], and the two-way interaction [$F(1,19) < 1$].

	Test item			
Condition	Old		New	
Control	949.3	(42.3)	1002.9	(69.6)
Verbalisation	968.1	(39.5)	989.0	(36.3)

Table 12 Means of median RTs (in msec) for correct responses. RTs are shown as a function of post-encoding condition and test item. Standard errors of the means in parenthesis.

DISCUSSION

The results showed that verbalisation at post-encoding did not affect recognition accuracy. In addition, RTs did not differ between conditions. Taken together with the results from the previous experiment, verbal overshadowing of picture memory occurred only for unfamiliar face pictures, but not for familiar face pictures. These findings are at odds with the perceptual expertise account. If the perceptual/expertise disparity were the main cause for the recognition impairment in the previous experiment, then the same finding should have been observed in this experiment. Especially, there appears to be a familiarity advantage for recognition (Experiment 10). It is difficult reconcile the current finding with the perceptual expertise account.

One reason for the null effect of verbalisation may be that the current participants' perceptual and conceptual (verbal) knowledge were similar so that verbalisation did not affect recognition. As Melcher & Schooler (2004) suggest verbal overshadowing is more likely to occur when perceptual expertise is high and verbal expertise is low, but not when the two are in balance. It could be that the participants possessed both high perceptual and verbal abilities. Nevertheless, the participants in the previous and current experiments found the description task laborious. They reported that they struggled to keep describing a face for the whole duration of 5 minutes. Therefore, it is unlikely that their ability to describe a picture from memory was as good as their ability to recognise pictures. In other words, the null effect of verbalisation was unlikely to be due to the fact that the levels of perceptual/verbal expertise were in balance. However, as no measurements were taken on individuals' perceptual/verbal abilities it is not plausible to speculate the participants' levels of perceptual/verbal expertise.

There is one study (Ryan & Schooler, 1998) that measured individuals' perceptual and verbal abilities. The authors measured perceptual expertise by using a face recognition test and a non-specific task (i.e. embedded figure tests) while measuring verbal expertise on the basis of college/high school grade point average. The authors found that the verbal overshadowing effect was greatest among those with high perceptual expertise and low verbal expertise. However, it is uncertain how well a general verbal measure can reflect the ability to describe faces. Recall that the verbal processing that is held to be responsible for the verbal overshadowing effect is the verbal processing of *making a description*. Verbal overshadowing studies use filler tasks (such as writing down as many US states as possible), which also involve verbal processing. Still, simply engaging in such tasks does not lead to recognition impairment. Therefore, a specific measure must be taken in order to examine the specific verbal processing. More recently, Melcher & Schooler (2004) made another attempt to explore the role of perceptual expertise in verbal overshadowing by providing participants with either conceptual or perceptual training on mushroom recognition. Although their hypothesis was supported (i.e. perceptual training increased the vulnerability to verbal overshadowing), the results do not speak directly to the earlier findings on the effect of perceptual expertise on face recognition. Clearly, more work is required to examine perceptual expertise further.

Another reason for the null effect of verbalisation may be due to the method. Fallshore & Schooler's study on the perceptual expertise required participants to describe all the faces they had seen. This was possible since there were only 4 trials per participant. Participants described or did not describe a previously seen face, then later they were tested on recognition accuracy. This was repeated for the three remaining targets. This means that the recognition test always consisted of the described face, but in a different picture. In contrast, the current participants described only a single picture they had seen. This was due to the fact that it was not feasible to ask the participants to describe all the faces they had seen. Also, the verbal overshadowing effect can be attenuated with repeated trials (Fallshore & Schooler, op. cit.). This means that only a single picture in an entire test set was actually described. Such a difference between the current experiment and Fallshroe & Schooler's study could have led to different outcome. Even so, it is difficult to account the null effect of verbalisation for the method used when the previous experiment (Experiment 11) demonstrated the verbal overshadowing effect. The only difference between previous and current experiments was whether pictures were taken from famous or unfamiliar people. It is clear that the current results alone are insufficient for making any conclusions as to why the verbal overshadowing effect was not found for familiar face picture recognition. However, it is unlikely that perceptual expertise can account for the discrepancy in the findings between current and previous experiments.

GENERAL DISCUSSION

The three experiments demonstrated systematically the role of verbal processing in picture recognition memory by manipulating verbal processing both at encoding and post-encoding. The results from Experiment 10 showed that verbalisation during learning had no effect, but articulatory suppression during learning had different effects, depending on the picture type. Articulatory suppression impaired the recognition of unseen familiar face pictures, but impaired the recognition of seen unfamiliar face pictures. The results from Experiment 11, for the first time, demonstrated verbal overshadowing of unfamiliar face picture memory. However, the effect was not seen when familiar face pictures were used (Experiment 12). It is unlikely that perceptual expertise can accommodate these inconsistent findings.

All these findings seem to suggest that verbal encoding is involved in picture recognition memory. Thus, verbalisation during encoding had no effect while the diverse effects of articulatory suppression were found. However, the effects of verbalisation appear to be complex, depending on the time of verbalisation and picture type. The complex effects of verbalisation on face recognition memory were also reported in Chapter 3. It appears that verbal processing plays some part in recognition memory, whether faces as identity or pictorial stimuli.

Significant achievements of this series of experiments are that the findings demonstrated the verbal overshadowing effect on the recognition of pictorial information. In addition, the results demonstrated that even when the task requires the recognition of pictorial information, the familiarity of the face can influence performance. Most importantly, the results provided the first piece of evidence questioning the validity of the perceptual expertise account of verbal overshadowing.

Chapter 5

Verbal Code Interference and Verbal Overshadowing

INTRODUCTION

The three experiments in this chapter are follow-up studies of Chapter 3 which hypothesised that the verbal overshadowing effect may derive from interference between verbal representations formed during and after learning, rather than a shift in processing styles between learning and test as Schooler (2002), Schooler et al., (Dodson, Johnson, & Schooler, 1997; Fallshore & Schooler, 1995; Schooler, Fiore, & Brandimonte, 1997; Schooler, Ryan, & Reder, 1996), and Westerman & Larsen (1997) suggest. The current chapter took a direct measure to examine the verbal code interference hypothesis.

The experiments in Chapter 3 employed a face recognition memory task where participants learned a set of faces, and later identified the targets from the same number of distractors. Verbal processing at both encoding and post-encoding was manipulated. Every face was described at encoding, but only a single face was described at post-encoding, due to the practical difficulty with asking participants to describe all the faces they had seen. The findings demonstrated that verbalisation at encoding had no effect. However, articulatory suppression during learning and verbalisation at post-encoding impaired recognition accuracy. From the results it was suggested that some degree of subvocal verbal processing occurs during learning even when this is not required, forming a verbal representation of a face. In short, suboptimal verbal processing may be already in operation during learning. If this were really the case, it is doubtful that post-encoding verbalisation provokes a shift in processing modes between learning (visual or configural processing) and test (verbally based featural processing). Instead, a more plausible account for the verbal overshadowing effect observed in Chapter 3 would be that post-encoding verbalisation formed another verbal representation, which interfered with the original verbal representation of a target created during learning. This damaged recognition. Indeed, the verbal code interference hypothesis has been also suggested by Wickham & Swift (in review). Their study showed that the verbal overshadowing effect disappeared when participants were prevented from verbal encoding of faces during learning (i.e. no verbal representation was formed during learning). The authors concluded that spontaneous verbal encoding is involved in face recognition, and that the verbal overshadowing effect is likely to derive from interference between verbal codes formed during and after learning.

However, a direct comparison between the effect of verbalisation at encoding and that at post-encoding is yet to be made. As mentioned before, in Chapter 3 every face was described at encoding, but only a single face was described at post-encoding. Although a single face description was sufficient to induce the verbal overshadowing effect, it does not directly qualify whether or not the effect of describing a face at encoding on recognition memory actually differs from that at post-encoding. Thus, the first experiment of this chapter attempted to answer this question.

Experiment 13

This experiment made a direct comparison between the effect of verbal processing at encoding and that at post-encoding on identification performance by using a line-up test, allowing every face being described both at encoding and post-encoding. Participants learned one face, and later they did a target present line-up test in two experimental conditions; verbalisation at encoding and verbalisation at post-encoding conditions. The verbalisation at post-encoding condition reflected a typical verbal overshadowing condition where participants were forced to describe a face at post-encoding.

From the findings of Chapter 3 it could be hypothesised that face learning in the verbalisation at post-encoding condition would involve some degree of subvocal verbal processing. In contrast, face learning in the verbalisation at encoding condition forces articulated verbal processing. Thus, both conditions involve verbal processing during learning, forming a verbal representation of a face. However, forcing participants to engage in verbal processing at post-encoding would lead to another verbal representation of a face, and this would cause interference between the two verbal representations. Therefore, identification accuracy in the verbalisation at post-encoding condition would be significantly worse than that in the verbalisation at encoding condition.

METHOD

Participants

30 Undergraduate students from the University of Glasgow took part in this experiment for course credit. There were 3 males and 27 females, all of whom had normal or corrected-to-normal vision by self-report.

Stimuli

20 targets and 20 target-present face arrays were used as illustrated in Figure F. Each face array was composed of 10 faces, including a target. All faces (young Caucasian men)

were taken from the UK Home Office PITO database. Each face was clean-shaven and showed neutral expression. Target faces were taken from a video, and face arrays were high-quality photographs. Faces resembling a target were constructed to form each line-up so that identification judgements could not be based on trivial features, such as age or hairstyle. All these still images were shown in grey scale. The picture size of each image was approximately 7cm x 10cm. These stimuli were presented in a large booklet, one target per page and one array per page.

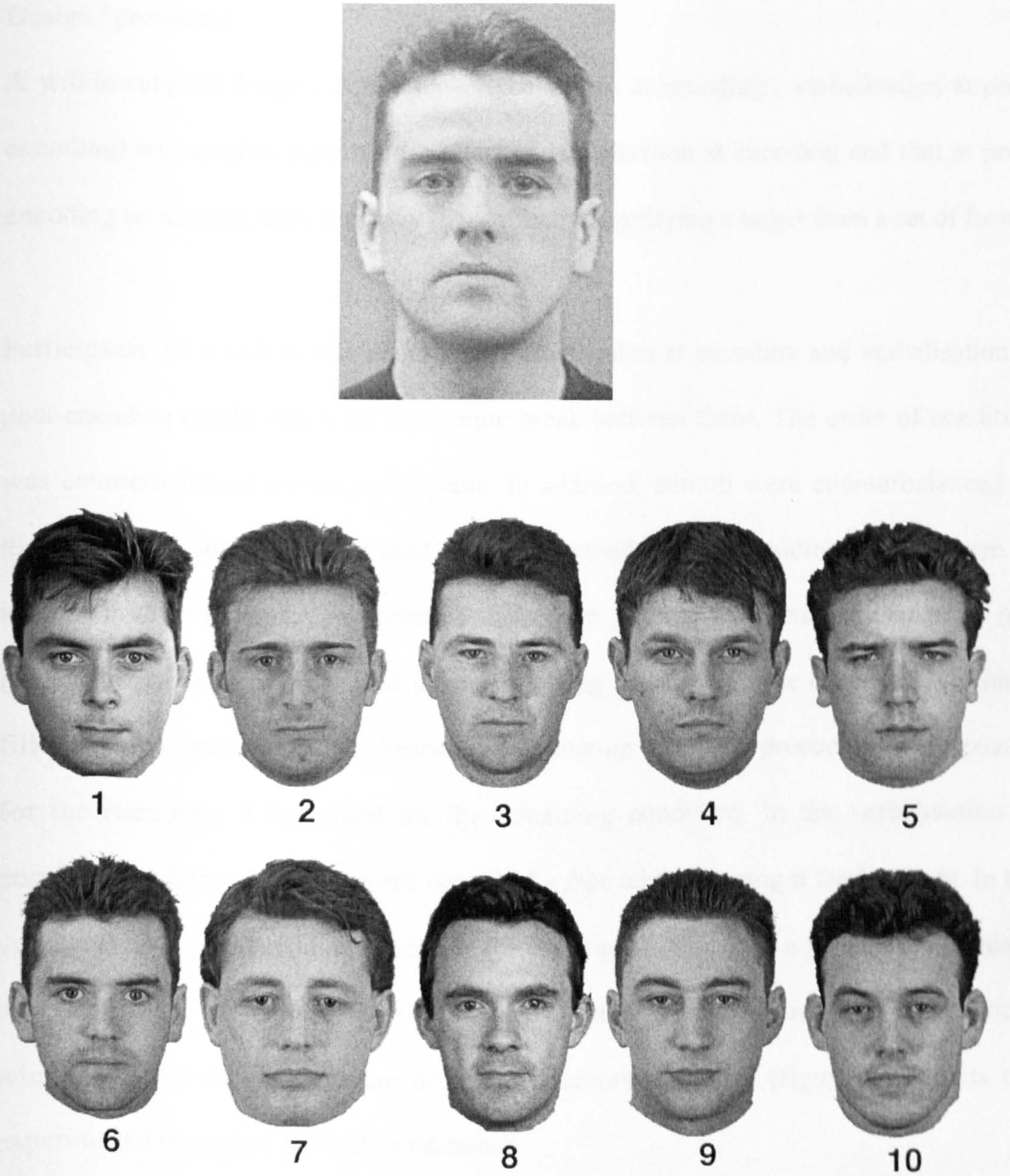


Figure F: Examples of stimuli. The face at the top is a target face shown only during learning. In a subsequent test, participants identify the target from the array of 10 faces.

Design / procedure

A within-subjects design (Condition - verbalisation at encoding / verbalisation at post-encoding) was used to examine the effect of verbalisation at encoding and that at post-encoding on identification accuracy (i.e. correctly identifying a target from a set of faces).

Participants did a task in two conditions; verbalisation at encoding and verbalisation at post-encoding conditions, with a 5 minute break between them. The order of condition was counterbalanced across participants. In addition, stimuli were counterbalanced so that each target-line up set was used equally frequently in each condition. There were 10 trials in each condition. A few practice trials were given to the participants prior to real trials. The experiment proceeded in the following order; 1 minute encoding, 1 minute filler task, 1 minute memory rehearsal, and a line-up test. This procedure was repeated for the remaining 9 faces and for the remaining condition. In the verbalisation at encoding condition, the participants described a face while learning it for 1 minute. In the verbalisation at post-encoding condition, the participants described a face during memory rehearsal. Thus, the only difference between conditions was the time of verbalisation, whether it was during encoding or during memory rehearsal (figure 13 depicts the experimental procedure for both conditions).

Figure 13 The experimental procedure for the verbalisation at encoding condition (above) and for the verbalisation at post-encoding condition (below).

Face **DESCRIBE**		Filler		Rehearsal		Test
	⇒		⇒		⇒	
Face		Filler		Rehearsal **DESCRIBE**		Test
(1 min)		(1 min)		(1 min)		

During 1 minute encoding the participants were asked to study a target for a subsequent test, then engaged in a filler task, such as listing countries, hobbies, or UK cities as many as possible. This was followed by memory rehearsal where they were told to keep the image of the face they had just learnt for a subsequent test. At test the participants identified the target from an array of 10 faces as quickly as possible. Participants were informed that the target would be always present so that they need to choose the person from the line-up, and were given no option not to select the target. It was not feasible to allow unlimited response time as the task entailed multiple trials. The participants were aware that the target was always present in the array. It took approximately 1 hour 30 minutes to complete the experiment.

RESULTS

Only correct identifications were recorded and analysed. As the purpose of the current experiment was to directly test the verbal code interference hypothesis offered in the previous Chapter where only correct identifications were recorded and analysed.

Accuracy: the mean proportions for correct identification for the verbalisation at encoding condition was 88% while that for the verbalisation at post-encoding condition was 80% A one-way within-subjects ANOVA (Condition - verbalisation at encoding / verbalisation at post-encoding) was conducted on correct identifications. This showed an effect of Condition [$F(1,29) = 6.79$ $p < 0.05$], reflecting that identification accuracy was significantly worse in the verbalisation at post-encoding condition than that in the verbalisation at encoding condition.

DISCUSSION

As predicted identification accuracy was significantly worse in the verbalisation at post-encoding condition than in the other condition. This is direct evidence showing that the effects of verbalisation on identification performance differ significantly, depending on the time of verbalisation, whether verbalisation occurs during or after learning. The preceding chapters also highlighted a complex role of verbalisation in face and picture recognition memory.

Although learning process in the verbalisation at post-encoding condition was not controlled, from the findings of Chapter 3, it is likely that some degree of subvocal verbal processing was involved in learning. Thus, in both conditions verbal processing was already in operation during encoding, with the key difference in whether it was articulated or not. However, engaging in verbalisation at post-encoding might have led to another verbal representation which interfered with the original verbal representation of a target, hampering identification at test. Consequently, identification was worse in the verbalisation at post-encoding condition than in the other condition where there was no forced verbalisation at post-encoding.

Nevertheless, it is important to note that there was no control over memory rehearsal process in the verbalisation at encoding condition. Accordingly, it is uncertain what process actually took place during this period. This means that there is no direct evidence that the observed effect was due to post-encoding verbalisation. The next experiment was designed to clarify this issue.

Experiment 14

The results of the previous experiment showed that identification accuracy was significantly worse in the verbalisation at post-encoding condition than in the verbalisation at encoding condition. However, it is unclear whether the results were due to verbalisation at post-encoding. Thus, in this experiment participants engaged in verbalisation at post-encoding in both conditions; matched verbalisation and mismatched verbalisation conditions. The only difference between the two was whether learning was accompanied by forced verbalisation or not.

In the matched verbalisation condition the participants described a face aloud twice, during and after learning. It was assumed that verbalisation in this condition was matched in the sense that verbal processing was articulated at both occasions. In contrast, in the mismatched verbalisation condition, the participants described a face aloud only once, after learning. It was assumed that verbalisation in this condition was mismatched in the sense that verbal processing during learning was subvocal, whereas verbal processing after learning was articulated. This method allowed investigation of whether verbalisation at post-encoding per se is detrimental to subsequent recognition or whether mismatch in the form of verbal processing between learning and test plays a more important part in damaging identification.

The purpose of this experiment was two fold. One was to examine whether or not the effect observed in the previous experiment (i.e. verbalisation at encoding led to better identification than verbalisation at post-encoding) was due to the difference in the post-encoding activity. Another was to examine whether verbalisation at post-encoding per se would dampen identification performance or whether the mismatch in the form of verbal processing between learning and test might be detrimental to identification. If engaging in verbal processing at post-encoding itself creates a condition for the verbal overshadowing effect, then there would be no difference in identification performance between matched and mismatched verbalisation conditions since both involved verbalisation at post-encoding. If, however, interference between verbal representations formed under different circumstances hampers identification, then performance in the mismatched verbalisation condition representing a typical verbal overshadowing condition would be significantly worse than that in the matched verbalisation condition.

METHOD

Participants

20 new volunteers participated in this experiment from the same source as Experiment 13. There were 5 males and 15 females, all of whom had normal or corrected-to-normal vision by self-report.

Stimuli

The stimuli were identical to those in Experiment 13.

Design / procedure

The design and procedure were similar to those in Experiment 13, with the exception that verbalisation at post-encoding was required in both conditions. In the matched verbalisation condition participants described a face aloud twice, during and after learning. In the mismatched verbalisation condition, they described a face aloud only once, during learning. In addition, in this experiment encoding time was reduced from 1 minute (the previous experiment) to 45 sec. This was due to a ceiling effect in the matched verbalisation condition in the pilot work. Thus, the experiment proceeded in the following order; 45 sec encoding, 1 minute filler task, 45 sec memory rehearsal / a line-up test (figure 14 depicts the experimental procedure for both conditions).

Figure 14 The experimental procedure for the matched verbalisation condition (above) and for the mismatched verbalisation condition (below).

Face **DESCRIBE**	Filler	Rehearsal **DESCRIBE**	Test
⇒	⇒	⇒	
Face	Filler	Rehearsal **DESCRIBE**	Test
(45 sec)	(1 min)	(45 sec)	

To stress that the focus of the experiment was to test the verbal code interference hypothesis, but not a replication of the verbal overshadowing effect. Therefore, the current experiment did not contain a control condition where no forced verbalisation occurs at post-encoding. Moreover, the inclusion of the third condition would have made the experiment excessively lengthy.

During encoding the participants were asked to study a target for a subsequent test, and during memory rehearsal they were encouraged to keep the image of the target, but also to describe it in details for 45 sec. At test, they identified the target from an array of 10 faces as quickly as possible. This procedure was repeated for the remaining 9 targets, and for the remaining condition.

RESULTS

Accuracy: the mean proportion of correct identification for the matched verbalisation condition was 80% while that for the mismatched verbalisation condition was 69%. A one-way within-subjects ANOVA (Condition – matched verbalisation / mismatched verbalisation) was conducted on correct identifications. This showed the effect of Condition [$F(1,19) = 8.55$ $p < 0.01$], reflecting that identification accuracy was significantly worse in the mismatched verbalisation condition than that in the matched verbalisation condition.

DISCUSSION

Identification accuracy was significantly worse in the mismatched verbalisation condition than that in the matched verbalisation condition. It seems clear that post-encoding verbalisation per se is not detrimental to identification as it was involved in both conditions. This leaves a possibility that the observed effect could have been due to interference between verbal representations formed under different circumstances. In the matched condition verbal processing was always articulated. On the contrary, in the mismatched condition verbal processing was articulated only once, at post-encoding, with the assumption that some degree of subvocal verbal processing was involved in learning. The difference in the form of verbal processing between learning and test in the mismatched condition might have resulted in the formation of two different verbal codes, damaging identification.

One possible explanation for the finding may be that post-encoding verbalisation in the matched condition was based on what one had described during learning, but not what one had seen. In other words, at post-encoding the participants simply repeated what they had described before. Therefore, there was little or no discrepancy between two verbal representations. Indeed, some participants reported that they remembered more about what they had said before, rather than what they had seen. Some individuals found this helpful when come to do the test, but some reported the opposite. How this might have affected individuals' performance differently remains uncertain. In contrast, in the mismatched verbalisation condition, the participants needed to recall what they had seen from memory, which could have been, in some ways, different from the original verbal representation formed during learning, and this hampered identification. This may be because a verbal representation created while seeing a face and that created from memory are different. Alternatively, articulated verbal processing and subvocal verbal processing leads to different verbal representations. However, the current data alone are unable to identify a direct cause for performance in the mismatched verbalisation condition.

The key finding of this experiment is that post-encoding verbalisation per se does not seem to be harmful to identification. Rather, the similarity between verbal process during and after learning seems to play a more important part in subsequent identification. Accordingly, it is unlikely that the processing shift account can elucidate the current findings.

Experiment 15

Throughout previous chapters, the involvement of subvocal verbal processing in learning has been demonstrated. This is one of the core assumptions behind the verbal code interference of the verbal overshadowing effect observed in this thesis. However, one may be tempted to question whether subvocal verbal processing really occurs during face learning (i.e. natural behaviour) or whether the experimental setting provoked it. This is a very important issue for this thesis and for the verbal overshadowing literature.

It would be fair to say that experimental settings encourage intentional learning, but real life learning is incidental. One does not normally attempt to learn faces that one encounters in a daily setting. Accordingly, it is unlikely that one engages in some verbal rehearsal in order to memorise faces. However, under intentional learning one is likely to do so, just to enhance memory. If subvocal verbal encoding were a product of the experimental setting, then the verbal code interference of face recognition would apply only to a situation that induces intentional learning of faces. Moreover, if the verbal code interference were, indeed, a major cause for the verbal overshadowing effect, then it is possible that the phenomenon might not arise in a natural environment where learning is often incidental. If these speculations were correct, then asking real-life crime witnesses to describe a perpetrator's face from memory should not impair subsequent recognition. Although no effect of deliberate learning on voice recognition memory has been reported (Perfect, Hunt, Harris, 2002), the effect of intentional learning on face recognition memory has rarely been examined.

The final experiment of this thesis was designed to investigate whether or not the verbal overshadowing effect would be related to intentional learning of a face by taking a novel approach. The level of learning intention was manipulated by devising intentional and incidental learning conditions. Within each condition half the participants did filler tasks at post-encoding while the other half described a face from memory. If the verbal overshadowing effect were the product of intentional learning, then recognition impairment would be seen only for intentional learners who describe a face at post-encoding.

METHOD

Participants

60 new volunteers participated in this experiment from the same source as Experiment 10. There were 17 males and 43 females, all of whom had normal or corrected-to-normal vision by self-report. At the time of recruitment none of them were aware that they were participating in a face recognition experiment. Half the participants were allocated to an incidental learning condition while the other half allocated to an intentional learning condition.

Stimuli / apparatus

An Apple Macintosh computer was used to present stimuli and record responses, using Superlab 1.75. Stimuli consisted of 10 twenty-second colour video segments and 40 colour photographs of Soap Opera Stars, taken from Irish Soap Opera ' The Fair City '. These people were unknown to participants in this experiment, therefore, functioned as unfamiliar people, varying in age, gender, facial expression, and hairstyle. The video segments were prepared, using Final Cut Pro 1.2. Each video segment contained 2 main characters talking to each other, which was played during learning. 20 photographs of the targets and 20 photographs of new people (distractors) were prepared, using Photoshop. These photographs were shown at test. The picture size of the photographs was approximately 3.5cm x 4.5cm.

Design / procedure

A 2 (Group – Intentional learning / Incidental learning) x 2 (Post-encoding condition – Control / Verbalisation) between-subjects design was used to examine whether or not there would be a relationship between learning and the verbal overshadowing effect. Measurements were taken on accuracy (i.e. correctly identify targets as old and correctly identify distractors as new) and time taken to make a response (RT). There were 40 trials per person. A few practice trials were given to participants prior to real trials. The experiment proceeded in the following order; learning, post-encoding activities, and test.

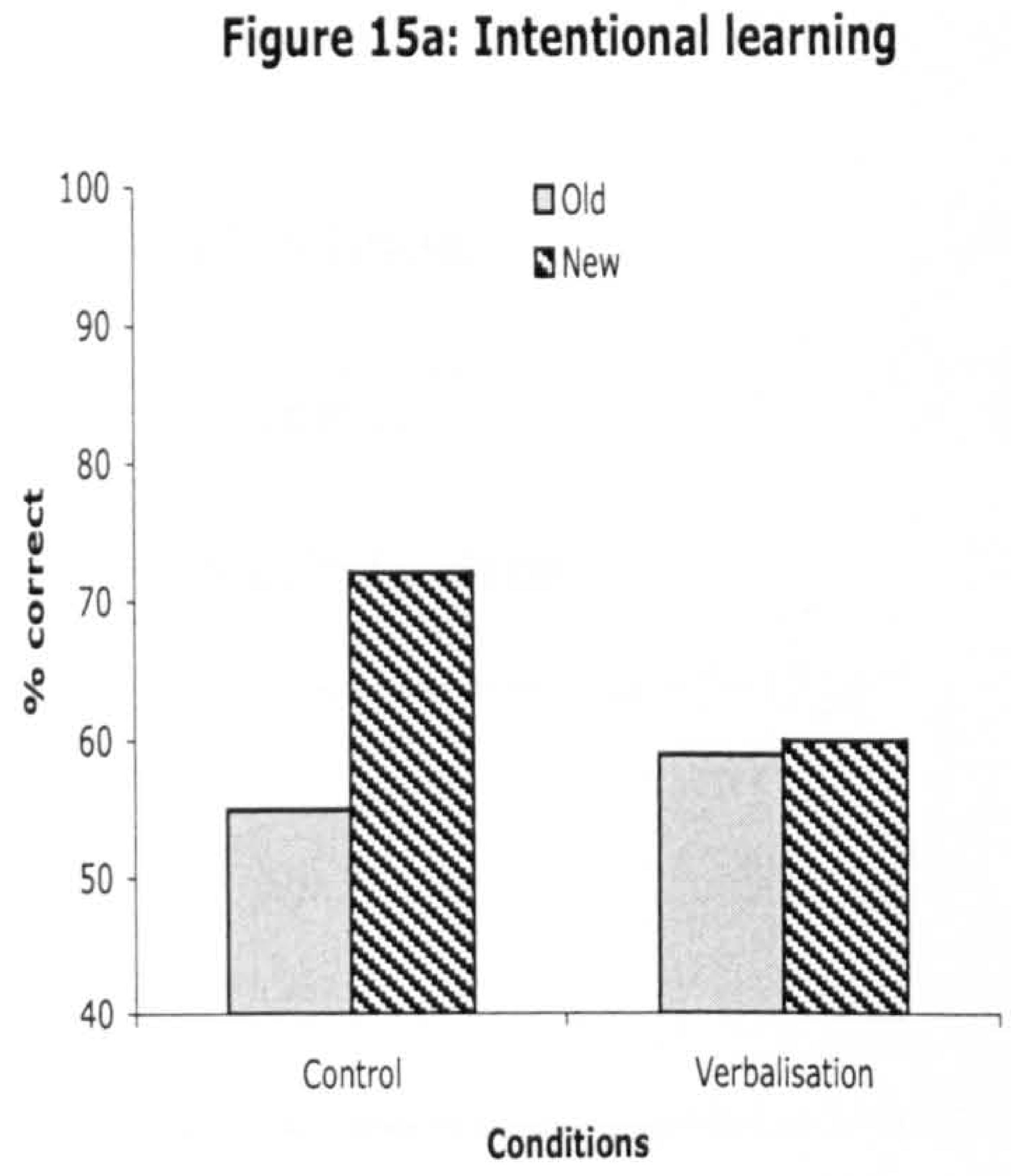
The participants did a recognition task in one of the four conditions, Intentional control, Intentional verbalisation, Incidental control, and Incidental verbalisation conditions. The incidental learning group was informed that they would be participating in a study examining relationships. Thus, they were unaware of the purpose of the experiment. At learning all participants were shown 10 video segments, one at a time, each for 20 sec, with ISI of 5 sec. Each video depicted 2 main characters talking to each other, so the participants also listened to their conversation. The order of the video segments was systematically varied across participants. During learning the intentional learning group was told to study faces for a subsequent test, whereas the incidental learning group was told to guess the relationship of the two people in a video, and wrote down their answer during 5 sec ISI.

After learning, half of the intentional learning group did 2 consecutive filler tasks, such as listing names of flowers, UK cities, or names of musicians as many as possible, each lasting for 3 minutes. The other half did one filler task, and then wrote down a description of one of the faces they had seen. The incidental learning group was also divided into the two post-encoding conditions; control and verbalisation conditions. Immediately after post-encoding activities, all of them did a recognition task where they were shown photographs of the targets and the same number of distracotrs. The task was to indicate whether each face was old (having seen it before) or new (not having seen it before). The participants made speeded key-press response. Each face disappeared from the display once a response had been made. Time between stimulus presentation and a response was measured as RT. The order of photographs was randomised across participants.

RESULTS

Accuracy: Percentage of correct responses is shown in Figure 15a and 15b. From visual inspection of figure 15a and 15b, it seems that the recognition of old faces seems to be better in the intentional learning condition than that in the incidental learning condition. There appears to be no clear indication of verbal overshadowing in the data (describing a face at post-encoding impairs subsequent recognition of both old and new faces). In general, participants tended to respond 'old' more often than to respond 'new', with the exception for the intentional – verbalisation group who responded 'old' and 'new' and equally frequently.

A 2 (Group – Intentional learning / Incidental learning) x 2 (Post-encoding condition –Control / Verbalisation) x 2 (Test – Old / New) mixed ANOVA, with Group and Post-encoding condition as between-subjects factors and Test as a within-subjects factor, was conducted on correct responses. This revealed effects of Group [$F(1,56) = 4.49$, $p < 0.05$] and Test [$F(1,56) = 36,27$, $p < 0.001$], but not the effect of Condition [$F(1,56) = 2.25$, $p > 0.05$]. Neither the effect of Group x Condition interaction nor the three-way interaction was significant [$F(1,56) < 1$]. However, Group x Test interaction [$F(1,56) = 5.47$, $p < 0.05$] and Condition x Test interaction [$F(1,56) = 5.80$, $p < 0.05$] were significant. Simple Main Effects analyses were conducted to explore these further. The results revealed that Group x Test interaction was due to an effect of Group for the recognition of old faces [$F(1,112) = 9.92$, $p < 0.01$] and an effect of Test for the intentional learning group [$F(1,56) = 6.79$, $p < 0.05$] and for the incidental learning group [$F(1,56) = 34.95$, $p < 0.001$]. These results indicate that the intentional learning group recognised targets significantly more than the incidental learning group. In addition, both groups recognised distractors significantly more than targets. The analyses also revealed that Condition x Test interaction was due to an effect of Condition for the recognition of new faces [$F(1,112) = 7.94$, $p < 0.01$] and an effect of Test for the control condition [$F(1,56) = 35.55$, $p < 0.001$] and for the verbalisation condition [$F(1,56) = 6.53$, $p < 0.05$]. These results suggest that the recognition of distractors was significantly worse in the verbalisation condition than in the control condition. In addition, the recognition of targets was worse than that of distractors in both post-encoding conditions.



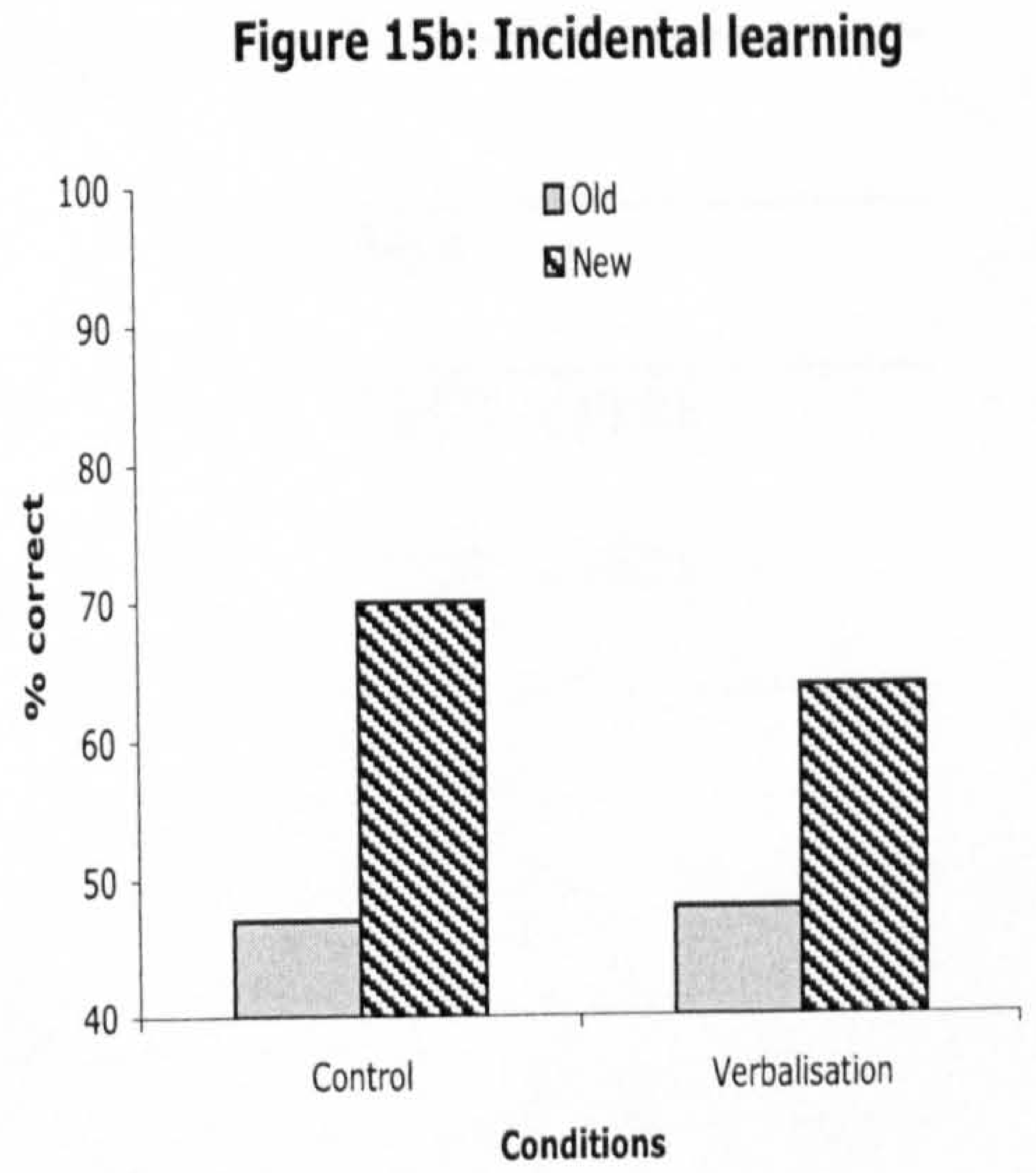


Figure 15a and 15b Percentage of correct responses for the recognition of seen and unseen faces from memory. Recognition performance is shown as a function of post-encoding condition and test item.

RT: Means of median response times for correct responses are shown in table 13a and 13b. A 2 (Group – Intentional learning / Incidental learning) x 2 (Post-encoding condition – Control / Verbalisation) x 2 (Test – Old / New) mixed ANOVA did not reveal any effect of Group [$F(1,56) < 1$], Condition [$F(1,56) < 1$], or Test [$F(1,56) = 1.17$, $p > 0.05$]. None of the two-way interactions were significant, Group x Condition interaction [$F(1,56) = 1.41$, $p > 0.05$], Group x Test interaction [$F(1,56) < 1$], and Condition x Test interaction [$F(1,56) < 1$]. Moreover, the three-way interaction just failed to reach significance [$F(1,56) = 3.62, p > 0.05$].

Table 13a: Intentional learning

	Test item			
Condition	Old		New	
Control	1233	(90)	1357	(118)
Verbalisation	1780	(232)	1524	(161)

Table 13b: Incidental learning

	Test item			
Condition	Old		New	
Control	1579	(259)	1405	(236)
Verbalisation	1393	(183)	1387	(287)

Table 13a and 13b Means of median RTs (in msec) for correct responses. RTs are shown as a function of post-encoding condition and test item. Standard errors of the means in parenthesis.

DISCUSSION

The results have shown that the recognition of targets was significantly better under intentional learning than under incidental learning, but that there was no difference in the recognition of unseen distractors. Not surprisingly, incidental learning seemed to have made the recognition of targets more difficult than intentional learning. However, both learning groups showed similar response patterns, producing more correct responses for distractors than for targets. Such a trend was also observed for both post-encoding conditions; there were more correct responses for distractors than for targets. More importantly, post-encoding verbalisation led to the recognition impairment for unseen distractors, but not for targets. This was true for both learning groups, indicating that there was no effect of learning condition. These findings suggest that there is no clear indication of the verbal overshadowing effect or intentional learning – the verbal overshadowing effect link in the data.

Nevertheless, a closer look of the data hints at the possibility that the results could have been due to a shift in the response pattern among the intentional learners who described a face at post-encoding. There appeared to be a noticeable difference between the recognition of targets and that of distractors for the intentional control, incidental control, and incidental verbalisation groups, expect for the intentional verbalisation group. The number of correct responses for distractors was greater than that for targets among these groups. However, this difference was not marked for the intentional verbalisation group. It appears that this group was more conservative to recognise distractors as 'not having seen them before' than the other groups. The intentional verbalisation group tended to make 'old' and 'new' responses equally often. This change in the responding pattern might have influenced the results.

Taken together with the findings of the previous experiment, it seems that post-encoding verbalisation per se seems to be insufficient to influence recognition performance. What seems to matter more is that the combination of learning process and post-encoding activities, which can influence responding patterns. Although no link between verbal overshadowing and intentional learning of faces was found in the data, the role of learning intention in face memory processing is an intriguing issue, which require much future work.

GENERAL DISCUSSION

The three experiments in this final experimental chapter examined possible mechanisms underlying the verbal overshadowing effect by using a line-up identification task and a recognition memory task. The key findings of this chapter indicate that describing a face from memory itself does not appear to be harmful to face recognition, casting doubt on the processing shift hypothesis that emphasises the act of verbalisation at post-encoding. It is more likely that the combination of learning process and post-encoding activities seem to play a key role in influencing memory processing. These novel demonstrations challenge the core concept underlying the verbal overshadowing effect. However, it is important to recognise that future work of this kind is essential to explore these findings further. As reviewed before, the verbal overshadowing effect is fragile, and the replication of the phenomenon can vary considerably from one study to another (Meissner & Brigham, 2001). Thus, hypotheses offered and tested in this chapter could be unique to this experimental setting, and this will become clear only by conducting further research. However, this thesis demonstrated a consistent pattern of findings suggesting that there may be more to verbal overshadowing than currently understood.

Chapter 6

Summary and Conclusions

A series of 15 experiments in this thesis were concerned with the role of verbal processing in recognition tasks (faces as identity and faces as complex pictorial stimuli), with particular relevance to the verbal overshadowing literature. In pursuit of this, verbal processing of a face at encoding was manipulated by using articulatory suppression and by asking participants to describe each face aloud (forced verbalisation). In effect, articulatory suppression encouraged a single visual encoding of faces while forced verbalisation at encoding elicited dual encoding. The forced verbalisation procedure was also used at post-encoding, requiring a single face description. This provoked verbal recall of a previously seen face; a prototypical procedure used in the verbal overshadowing literature. The effects of these manipulations on subsequent recognition were measured by various tasks.

Five experiments in Chapter 2 examined the effects of verbal encoding manipulations on the recognition of configural and featural changes made to faces by measuring immediate recognition performance. Face changes were made to both familiar and unfamiliar faces. The main finding was that verbalisation affected response tendencies differently, depending on the familiarity of the face. Following verbalisation the recognition of featural changes was better than that of configural changes when faces were familiar. The converse was found when faces were unfamiliar. These results highlighted that the role of verbal processing in change recognition is complex so that it cannot be simply associated with either featural or configural processing of a face. This challenges one of the core concepts behind the processing shift hypothesis of verbal overshadowing, emphasising verbal-featural and visual-configural processing association (e.g. Schooler & Engstler-

Schooler, 1990; Schooler, 2002). During the course of the research, it has become clear that a between-subjects design was not suitable for the task, and that people found the task difficult. Thus, the method was modified throughout. However, this line of enquiry always remains open to potential criticisms that derive from the nature of stimuli used and the feasibility of teasing configural and featural processing apart.

Four experiments in Chapter 3 examined the role of verbal processing in face recognition memory by using a similar method to that in Chapter 2, except that in this chapter forced verbalisation was introduced also at post-encoding. Stimuli were composed of unfamiliar faces only. The task was to identify targets from the same number of distractors. Measurements were taken on delayed recognition performance, hence verbal filler tasks were inserted between learning and test. The results repeatedly showed that articulatory suppression impaired subsequent recognition memory, in comparison to both control and verbalisation conditions, which themselves did not differ. However, verbalisation at post-encoding also impaired recognition; a replication of the verbal overshadowing effect. From these results, it was concluded that some degree of verbal processing is likely to be involved in face learning, and this might be actually beneficial to face recognition. Therefore, dual coding theory could be also applied to face memory. Moreover, the results led to a tentative hypothesis that the verbal overshadowing effect may derive from interference in verbal representations formed during and after learning (the verbal code interference hypothesis), rather than a change in processing modes between learning and test as suggested by various researchers (Dodson, Johnson, & Schooler, 1997; Fallshore

& Schooler, 1995; Schooler, 2002; Schooler, Fiore, & Brandimonte, 1997; Schooler, Ryan, & Reder, 1996; Westerman & Larsen, 1997).

Three experiments in Chapter 4 employed a picture recognition memory task using the same method as in Chapter 3. Pictures of familiar and unfamiliar people were used as stimuli. The aim was to examine the mechanisms underlying the null effect of verbalisation at encoding found in the preceding chapter, and also to investigate 'the perceptual expertise account' (Fallshore & Schooler, 1995; Melcher & Schooler, 1996, 2004; Ryan & Schooler, 1998; Schooler, Fiore, & Brandimonte, 1997) of the verbal overshadowing effect. The findings identified a familiarity advantage for recognition performance in that the recognition of familiar face pictures was generally better than that of unfamiliar face pictures, with an exception of the recognition of distractors under articulatory suppression. Moreover, articulatory suppression had different effects on recognition, depending on the familiarity of the face. It impaired the recognition of unseen familiar face pictures while impairing the recognition of seen unfamiliar face pictures. This might reflect the difference in the learning processes between familiar and unfamiliar face pictures in that verbal encoding might be important for aiding learning of unfamiliar face pictures. In contrast, verbalisation during encoding had no effect, suggesting that the null effect of verbalisation found in the preceding chapter was not due to the fact that a verbal representation formed during learning was not transferable to a test image (different images were used between learning and test in the preceding chapter). The same finding was also found in this chapter where the same pictures of the targets (duplicates) were presented at test. More importantly, the verbal overshadowing effect was found only for the recognition of unfamiliar face pictures, but not for that of familiar face pictures, casting a doubt on the perceptual expertise hypothesis. The hypothesis cannot accommodate the fact that the verbal overshadowing effect was seen in one study, but not in another, both of which were conducted in the same experimental context. Taken together with the results from Chapter 3, it was concluded that verbal processing plays a part in recognition memory, whether faces as identity or whether faces as complex pictorial stimuli. In addition, even when the task requires the recognition of specific pictorial information, the familiarity of the face seems affect performance.

Three experiments in Chapter 5 directly examined the tentative hypotheses offered in Chapter 3. Experiment 13 and 14 employed a target present line-up task where participants identified a previous seen target from an array of 10 distractors. Experiment 15 used a face recognition memory task, involving more naturalistic stimuli. Experiment 13 investigated whether the effects of forced verbalisation would really differ depending on the time of verbalisation. The key difference between Chapter 3 and this experiment was that in this experiment every face was described at post-encoding, whereas in Chapter 3 only a single face was described at post-encoding. Identification performance between verbalisation at encoding and verbalisation at post-encoding conditions was compared. The results showed that identification accuracy was significantly worse when verbalisation occurred at post-encoding than when it occurred at encoding. This was attributed to the fact that post-encoding verbalisation formed another verbal representation of a face, which interfered with the original verbal representation created during encoding, the verbal code interference hypothesis. However, post-encoding activities in the verbalisation at encoding was not controlled, thereby, it is uncertain whether the difference was due to the difference in post-encoding activities between the two conditions. Experiment 14 followed this further by using the same method as for Experiment 13, by devising conditions where participants either described each face aloud twice, during and after learning or they did so only once, after learning. The results demonstrated that post-encoding verbalisation per se was not harmful to identification. Rather, it was the mismatch in the form of verbal processing (subvocal or articulated) between learning and test that seemed to reduce identification. Identification accuracy was significantly worse when verbal processing at encoding was subvocal while that at post-encoding was articulated than when both were articulated. The final experiment of the thesis (Experiment 15) examined whether the verbal overshadowing effect would be related to intentional learning of faces. Throughout the thesis, the involvement of verbal processing during face learning has been suggested. However this could have been a product of the experimental setting that encouraged intentional learning of faces, resulting in the formation of a verbal representation of a face at encoding. To investigate this possibility, two learning conditions were devised; intentional and incidental learning conditions. Post-encoding activities were filler tasks (control) or describing a face from memory (verbalisation). Recognition memory among four independent groups (the intentional control, intentional verbalisation, incidental control, and incidental verbalisation groups) was compared. The results showed the verbal overshadowing effect only for the recognition of unseen distractors, but not for targets. This was true for both intentional and incidental learners, illustrating that learning intention had no effect. However, intentional learning and verbalisation in combination affected response patterns. The intentional verbalisation group tended to be more conservative to respond 'a face is new' than the other three groups. This group seemed to respond 'old' and 'new' equally often.

Overall, there is evidence that engaging in verbalisation either at encoding or post-encoding can affect recognition, whether a task involves the recognition of facial changes, identity, or pictorial information. However, the effects of verbalisation appear to vary depending on the task and the familiarity of the face. A key finding is that verbalisation is not necessarily harmful to face recognition. In fact, the prevention of this during learning can significantly impair face recognition memory, implying that verbal processing has some value in performing the task. It seems that encoding faces using both visual and verbal resources is more useful than encoding them using only a visual resource. These are the first strands of evidence demonstrating the complex role of verbal processing in recognition memory, using a variety of tasks. The outcome of the research challenges the core concepts of the verbal overshadowing effect, and offers an alternative explanation. It is possible that verbal overshadowing of face memory derives from the interference between verbal representations, rather than a change in processing modes between learning and test. All these findings might favour a quantity view of memory organisation, as suggested by dual coding theory, in that multiple memory traces increase the probability of retrieval, provided that no post-encoding verbalisation takes place.

The findings presented in the thesis have several important theoretical and practical implications. One main theoretical implication relates to the verbal overshadowing literature. As suggested in the literature featural information of a face may be more readily described than configural information. However, as shown in Chapter 2 the role of verbal processing in face processing is complex so that a simple verbal-featural processing association cannot accommodate the findings. Moreover, another caveat for processing associations is that in typical verbal overshadowing studies, participants are explicitly told <u>how</u> to describe a face (i.e. describe the face feature by feature), but they are not encouraged to describe their spontaneous retrieval process or what they <u>actually</u> remember about the face. In other words, it is possible that the given description might merely reflect what participants are told to provide, rather than their actual retrieval process. Nevertheless, the provided description under such instructions is treated as indicative of internal thoughts, providing a basis for the verbal-featural processing association. Indeed, Ericsson (2002) points out that requiring participants to provide a verbal description might change the sequence of thoughts, compared to those generated while engaging in the same task silently. He found no evidence that 'merely verbally describing one's ongoing thoughts magically transforms one's memory'. Instead, the requirement of participants to produce certain types of detailed descriptions induces the generation of altered thoughts or images. Clearly, this is a very important issue that should not be overlooked when considering the role of verbal retrieval in face memory processing.

A second implication conserns verbal overshadowing and practical importance. The experiments reported here have produced evidence that brings us several steps closer to understand the underlying causes for the verbal overshadowing effect. However, they are open to questions of ecological validity. The verbal code interference hypothesis is a new intriguing proposal, which challenges the longstanding notion of visual and verbal code interference. However, one could question whether the verbal code interference would really mirror natural human memory interference. In daily life, we are unlikely to verbally encode faces that we encounter as we do not have the reason to do so. In an experimental situation, however, we might be inclined to do so, with the intention of enhancing memory performance. We might do so regardless of whether or not it is actually helpful for the task at hand. In other words, if verbal code interference were one of the factors responsible for verbal overshadowing, then there are reasons to question whether the phenomenon really exists in natural environment. This clearly has practical implications for eyewitness identifications where providing a verbal description of a previously seen perpetrator's face is a part of the investigation process.

A third implication is that the findings of this thesis might provide an impetus for a new line of face recognition research. The involvement of verbal processing in recognition memory for face recognition (Chapter 3) and face image recognition (Chapter 4) has been shown repeatedly. This increase the likelihood that the same process might also be involved in various face recognition tasks, such as the recognition of expression or identity, which are often measured in an immediate recognition test condition. Incorporating a verbal factor into such experiments may lead a whole new perspective towards the mechanisms underlying various face recognition processes. Moreover, face picture recognition per se may appear trivial from a forensic perspective as we seldom see identical face images in daily life (hairstyle or expression faces remain hardly the same). However, as shown in Chapter 4, face familiarity seems to have some influence on recognition even when the task required the recognition of pictures. This might hint at the possibility that face recognition and face image recognition share similar process to certain extent. Thus, a picture recognition task can be used to explore more perceptual learning process, which may form a foundation for investigating higher level processing underlying face recognition. The combining the two might provide an ideal condition for unpacking cognitive operations involved in face recognition.

In conclusion, this thesis demonstrates that methods from two research areas can successfully be converged, which helped address some of the unattended issues in these research fields. Indeed, uniting the two appears to be more useful for obtaining more fruitful understanding of the verbal mechanisms involved in face processing and its memory interference. The thesis also provides new directions for future research. Most importantly, it invites the scientific community to review some issues underlying findings based on experimental research and their relation to the ecological validity.

REFERENCES

Anderson, J.R., & Bower, G.H. (1973) *Human associative memory.* Washington, D.C.: V.H. Winston.

Anderson, J.R., & Paulson, R. (1978). Interference in memory for pictorial information. *Cognitive Psychology,* 10, 178-202.

Baddeley, A.D. (1986). *Working memory.* Oxford: Clarendon.

Baddeley, A.D. (1990). *Human memory: theory and practice.* Hove and London: Lawrence Erlmaum Associates, Publishers.

Baddeley, A.D. (1992). Is working memory working? The fifteenth Bartlett Lecture. *The Quarterly Journal of Experimental Psychology,* 44A, 1, 1-31.

Baddeley, A.D. (1996). Exploring the central executive. *Quarterly Journal of Experimental Psychology,* 49A, 5-28.

Bahrick, H.P., & Bahrick, P. (1971). Independence of verbal and visual codes of the same stimuli. *Journal of Experimental Psychology,* 91, 344-346.

Bahrick, H.P., & Boucher, P. (1986). Retention of visual and verbal codes of the same stimuli. *Journal of Experimental Psychology,* 78, 417-422.

Bartlett, J.C., & Searcy, J. (1993). Inversion and configuration of faces. *Cognitive Psychology,* 25, 3, 281-316.

Bothwell, R.K., Brigham, J.C., & Malpass, R.S. (1989). Cross-racial identification. *Personality and Social Psychology Bulletin,* 15, 19-25.

Bower, G.H. (1970). Imagery as a relational organizer in associative learning. *Journal of Verbal Learning and Verbal Behavior,* 11, 431-439.

Bower, G.H., & Karlin, M.B., (1974). Depth of processing pictures of faces and recognition memory, *Journal of Experimental Psychology*, 103, 4, 751-757.

Brandimonte, M.A., & Gerbino, W. (1993). Mental image reversal and verbal recoding: when ducks become rabbits. *Memory & Cognition*, 21, 1, 23-33.

Brandimonte, M.A., Hitch, G.J., & Bishop, D.V.M. (1992). Influence of short-term memory codes on visual image processing: evidence from image transformation tasks. *Journal of Experimental Psychology; Learning, Memory, and Cognition*, 18, 1, 157-165.

Brandimonte, M.A., Schooler, J.W., & Gabbino, P. (1997). Attenuating verbal overshadowing through colour retrieval cues. *Journal of Experimental Psychology*, 23, 4, 915-931.

Brigham, J.C., & Malpass, R.S. (1985). The role of experience and contact in the recognition of faces of own – and other – race persons. *Journal of Social Issues*, 41, 3, 139-155.

Brown, C., & Lloyd-Jones, T.J. (2002). Verbal overshadowing in a multiple face presentation paradigm: effects of description instruction. *Applied Cognitive Psychology*, 16, 873-885.

Brown, C., & Lloyd-Jones, T.J. (2003). Verbal overshadowing of multiple face and car recognition: effects of within versus across category verbal descriptions. *Applied Cognitive Psychology*, 17, 183-201.

Bruce, V., Henderson, Z., Greenwood, K., Hancock, P.J.B., Burton, A.M., & Miller, P. (1999). Verification of face identities from images captured on video. *Journal of Experimental Psychology: Applied*, 5, 339-360.

Bruce, V., Henderson, Z., Newman, C., & Burton, A.M., (2001). Matching identities of familiar and unfamiliar faces caught on CCTV images. *Journal of Experimental Psychology: Applied*, 7, 3, 207-218.

Bruce, V., & Langton, S. (1994). The use of pigmentation and shading information in recognising the sex and identities of faces. *Perception*, 23, 803-822.

Burton, A.M., Wilson, S., Cowan, M., & Bruce, V., (1999). Face recognition in poor-quality video: evidence from security surveillance. *Psychological Science*, 10, 3, 243-248.

Carey, S., & Diamond, R. (1994). Are faces perceived as configurations more by adults than by children? *Visual Cognition*, 1, 253-274.

Chiroro, P., & Valentine, T. (1995). An investigation of the contact hypothesis of own-race bias in face recognition. *The Quarterly Journal of Experimental Psychology*, 48A, 4, 879-894.

Craik, F.I.M., & Lockhart, R.S. (1972). Levels of processing: a framework for memory research. *Journal of Verbal Learning and Verbal Behavior*, 11, 671-684.

Craik, F.I.M., & Tulving, E. (1975). Depth of processing and the retention of words in episodic memory. *Journal of Experimental Psychology: General*, 104, 268-294

Daniel, T.C. (1972). Nature of the effect of verbal labels on recognition memory for form. *Journal of Experimental Psychology*, 96, 152-157.

Daniel, T.C., & Ellis, H.C. (1972). Stimulus codability and long-term recognition memory for visual form. *Journal of Experimental Psychology*, 93, 83-89.

Davis, G., & Thasen, S. (2000). Closed-circuit television; how effective an identification aid? *British Journal of Psychology*, 91, 411-426.

Deffenbacher, K.A., Carr, T.H., & Leu, J.R. (1981). Memory for words, pictures, and faces: retroactive interference, forgetting and reminiscence, *Journal of Experimental Psychology: Human Learning and Memory*, 7, 299-305.

Diamond, R., & Carey, S. (1986). Why faces are and are not special: an effect of expertise. *Journal of Experimental Psychology: General*, 115, 107-117.

Dodson, C.S., Johnson, M.K., & Schooler, J.W. (1997). The verbal overshadowing effect: why descriptions impair face recognition. *Memory & Cognition*, 25, 2, 129-139.

Dobson, E., & Rust, J.O. (1993). Memory for objects and faces by the mentally retarded and nonretarded. *The Journal of Psychology*, 128, 3, 315-322.

Dotty, N.D., (1998). The influence of nationality on the accuracy of face and voice recognition. *American Journal of Psychology*, 111, 2, 191-214.

Ellis, H.D. (1986). Face recall: a psychological perspective. *Human Learning*, 5, 189-196.

Ellis, H.D., Shepherd, J.W., & Davis, G.M. (1975). An investigation of the use of the Photofit technique for recalling faces. *British Journal of Psychology*, 66, 29-37.

Ellis, H.D., Shepherd, J.W., & Davis, G.M. (1979). Identification of familiar and unfamiliar faces from internal and external features: some implications for theories of face recognition. *Perception*, 8, 431-439.

Emerson, M.J., & Miyake, A. (2003). The role of inner speech in task switching: a dual-task investigation. *Journal of Memory and Language*, 48, 148-168.

Ericsson, K.A. (2002). Towards a procedure for eliciting verbal expression of non-verbal experience without reactivity: interpreting the verbal overshadowing effect within the theoretical framework for protocol analysis. *Applied Cognitive Psychology*, 16, 981-987.

Fallshore, M., & Schooler, J.W. (1995). Verbal vulnerability of perceptual expertise. *Journal of Experimental Psychology; Learning, Memory, and Cognition*, 21, 1608-1623.

Farah, J., Tanaka, J.W., & Drain, H.M. (1995). What causes the face inversion effect? *Journal of Experimental Psychology: Human Perception and Performance*, 21, 3, 628-634.

Farah, M.J., Wilson, K.D., Tanaka, J.W., & Drain, M. (1998). What is special about face perception? *Psychological Review*, 105, 3, 482-498.

Finger, K. (2002). Mazes and music: using perceptual processing to release verbal overshadowing. *Applied Cognitive Psychology*, 16, 887-896.

Finger, K., & Pezdek, K. (1999). The effect of cognitive interview on face identification accuracy: Release from verbal overshadowing. *Journal of Applied Psychology*, 84, 340-348.

Fiore, S.M., & Schooler, J.W. (2002). How did you get here from there? Verbal overshadowing of spatial mental models. *Applied Cognitive Psychology*, 16, 897-910.

Flexer, A.J., & Tulving, E. (1978). Retrieval independence in recognition and recall. *Psychological Review*, 85, 153-171.

Freire, A., Lee, K., & Symons, L.A. (2000). The face-inversion effect as a deficit in the encoding of configural information: direct evidence. *Perception*, 29, 159-170.

Glenberg, A., & Grimes, T. (1995). Memory for faces: pictures help you remember who said what. *Personality and Social Psychology Bulletin*, 21, 196-206.

Godden, D.R., & Baddeley, A.D. (1975). Context-dependent memory in two natural environments: on land and underwater. *British Journal of Psychology*, 66, 325-331.

Goldstein, A.G., & Chance, J.E. (1970). Visual recognition memory for complex configurations. *Perception and Psychophysics*, 9, 237-241

Graefe, T.M., & Watkins, M.J. (1980). Picture rehearsal: an effect of selectively attending to pictures no longer in view. *Journal of Experimental Psychology: Human Learning and Memory*, 6, 156-162.

Haber, R.N. (1970). How we see remember what we see. *Scientific American*, 222, 104-112.

Hancock, P.J.B., Bruce, V., Burton, A.M. (2002). Recognition of unfamiliar faces. *Trends in Cognitive Sciences*, 4, 9, 330-337.

Henderson, Z., Bruce, V., Burton, A.M., (2001). Matching the faces of robbers captured on video. *Applied Cognitive Psychology*, 15, 445-464.

Hill, H., & Bruce, V., (1996). Effects of lighting on matching facial surfaces. *Journal of Experimental Psychology: Human Perception and Performance*, 22, 986-1004.

Hill, H., Schyns, P.G., & Akamatsu, S. (1997). Information and viewpoint dependence in face recognition. *Cognition*, 62, 201-222.

Itoh, Y. (2005). The facilitatory effect of verbalization on the recognition memory of incidentally learned faces. *Applied Cognitive Psychology*, 19, 421-433.

Kargopoulos, P., Bablekou, Z., Gonida, E., & Kiosseoglou, G. (2003). Effects of face and name presentation on memory for associated verbal descriptor. *American Journal of Psychology*, 116, 3, 415-430.

Kemp, R., Pike, G., White, P., & Musselman, A. (1996). Perception and recognition of normal and negative cues – the role of shape from shading and pigmentation cues. *Perception*, 25, 37-52.

Kemp, R., Towell, N., & Pike, G., (1997). When seeing should not be believing: photographs, credit cards and fraud. *Applied Cognitive Psychology*, 11, 211-222.

Kerr, N.H., & Winograd, E. (1982). Effects of contextual elaboration on face recognition. *Memory & Cognition*, 10, 603-609.

Kitagami, S., Sato, W., & Yoshikawa, S. (2002). The influence of test-set similarity in verbal overshadowing. *Applied Cognitive Psychology*, 16, 963-972.

Klatzky, R.L., & Forrest, F.H. (1984). Recognising familiar and unfamiliar faces. *Memory & Cognition*, 12, 1, 60-70.

Klatzky, R.L., Martin, G.L., Kane, R.A. (1982). Semantic interpretation effect on memory for faces. *Memory & Cognition*, 10, 3, 195-206.

Kurtz, K.H., & Hovland, C.I. (1953). The effect of verbalization during observations stimulus objects upon accuracy of recognition and recall. *Journal of Experimental Psychology*, 45, 157-164.

Leder, H., & Bruce, V. (2000). When inverted faces are recognised; the role of configural information in face recognition. *The Quarterly Journal of Experimental Psychology*, 53A, 2, 513-536.

Logie, R.H. (1986). Visuo-spatial process in working memory. *Quarterly Journal of Experimental Psychology*, 38A, 229-247.

MacLin, M.K. (2002). The effects of exemplar and prototype descriptors on verbal overshadowing. *Applied Cognitive Psychology*, 16, 929-936.

Macrae, C.N., & Lewis, H.L. (2002). Do I know you? Processing orientation and face recognition. *Psychological Science*, 13, 194-196.

McKelvie, S.J. (1976). The effects of verbal labelling on recognition memory for schematic faces. *Quarterly Journal of Experimental Psychology*, 28, 459-474.

McWeeney, K., Young, A.W., Hay, D., & Ellis, A. (1987). Putting names to faces. *British Journal of Psychology*, 78, 143-151.

Megreya, A.M., & Burton, A.M. (in press). Unfamiliar faces aren't faces: evidence from a matching task. *Memory & Cognition.*

Meissner, C.A. (2002). Applied aspects of the instructional bias effect in verbal overshadowing. *Applied Cognitive Psychology*, 16, 911-928.

Meissner, C. A., & Brigham, J.C. (2001). A meta-analysis of the verbal overshadowing effect in face identification. *Applied Cognitive Psychology*, 15, 603-616.

Meissner, C.A., Brigham, J.C., & Butz, D.A. (2005). *Memory for own-* and other-race faces: a dual-process approach. *Applied Cognitive Psychology*, 19, 545-567.

Meissner, C.A., Brigham, J.C., & Kelley, C.M. (2001). The influence of retrieval processes in verbal overshadowing. *Memory & Cognition*, 29, 1, 176-186.

Melcher, J.M., & Schooler, J.W. (1996). The misremembrance of wines past; verbal and perceptual expertise differentially mediate verbal overshadowing of taste memory. *Journal of Memory and Language*, 35, 231-245.

Melcher, J.M., & Schooler, J.W. (2004). Perceptual and conceptual training mediate the verbal overshadowing effect in an unfamiliar domain. *Memory & Cognition*, 32, 4, 618-631.

Memon, A., & Bartlett, J. (2002). The effects oc verbalisation on face recognition in young and older adults. *Applied Cognitive Psychology*, 16, 635-650.

Murray, D.J. (1967). The role of speech responses in short-term memory. *Canadian Journal of Psychology*, 21, 263-276.

Nelson, D.L., & Brooks, D.H. (1973). Functional independence of pictures and their verbal memory codes. *Journal of Experimental Psychology*, 98, 44-48.

Nickerson, R.S. (1965). Response times for "same"-"different" judgments. *Perception and Motor Skills*, 20, 15-18.

Nickerson, R.S. (1968). A note on long-term recognition memory for pictorial material. *Psychonomic Science*, 11, 58.

O'Toole, A.J., Deffenbacher, K.A., Valentin, D., & Abdi, H. (1994). Structural aspects of face recognition and the other-race effect. *Memory & Cognition*, 22, 2, 208-224.

O'Toole, A.J., Edelman, S., & Bulthoff, H.H. (1998). Stimulus-specific effects in face recognition over changes in viewpoint. *Vision Research*, 38, 2351-2363.

Paivio, A. (1971). *Imagery and verbal processes*. New York: Holt, Rinehart and Winston.

Paivio, A. (1986). *Mental representations: a dual coding approach*. Oxford: Oxford University Press.

Paivio, A. (1991). Dual coding theory: retrospect and current status. *Canadian Journal of Psychology*, 45, 3, 255-28.

Paivio, A., & Csapo, K. (1969). Concrete-image and verbal memory codes. *Journal of Experimental Psychology*, 80, 279-285.

Paivio, A., & Csapo, K. (1973). Picture superiority in free recall; imagery or dual coding? *Cognitive Psychology*, 5, 176-206.

Patterson, K.E., Baddeley, A.D. (1977). When face recognition fails. *Journal of Experimental Psychology: Human Learning and Memory*, 3, 4, 406-417.

Pelizzon, L., Brandimonte, M.A., & Luccio, R. (2002). The role of visual, spatial, and temporal cues in attenuating verbal overshadowing. *Applied Cognitive Psychology*, 16, 947-961.

Pellegrino, J.W., Siegel, A.W., & Dhawan, M. (1976). Differential distraction effects in short-term and long-term of retention of pictures and words. *Journal of Experimental Psychology: Human Learning and Memory*, 2, 541-547.

Perfect, T.J., Hunt, L.J., & Harris, C.M. (2002). Verbal overshadowing in voice recognition. *Applied Cognitive Psychology*, 16, 973-980.

Pezdek, K., Maki, R., Valencia_Laver, D., Whetsone, T., Stoeckert, J., Dougherty, T. (1988). Picture memory: recognizing added and deleted details. *Journal of Experimental Psychology; Learning, memory, and Cognition*, 14, 468-476.

Phillips, R.J. (1978). Recognition, recall, and imagery of faces. In M.M. Gruneberg, P.E., Morris, & R.N. Sykes, (Eds), *Practical aspects of memory* (pp 270-277). London: Academic Press.

Pigott, M., & Brigham, J.C. (1985). Relationship between accuracy of prior description and facial recognition. *Journal of Applied Psychology*, 70, 3, 547-555.

Pylyshyn, Z.W. (1973). What the mind's eye tells the mind' brain: a critique of mental imagery. *Psychological Bulletin*, 80, 1-24.

Read, J.D. (1979). Rehearsal and recognition of faces. *American Journal of Psychology*, 92, 71-85.

Rhodes, G., Brake, S., & Atkinson, P. (1993). What's lost in inverted faces? *Cognition*, 47, 25-57.

Richardson, J.T.E. (2003). Dual coding versus relational processing in memory for concrete and abstract words. *European Journal of Cognitive Psychology*, 15, 4, 481-509.

Ryan, R.S., & Schooler, J.W. (1998). When do words hurt: individual differences in susceptibility to verbal overshadowing. *Applied Cognitive Psychology*, 12, 105-125.

Santa, J.L., & Ranken, H.B. (1972). Effects of verbal coding on recognition memory. *Journal of Experimental Psychology*, 93, 268-278.

Schooler, J.W. (2002). Verbalisation produces a transfer inappropriate processing shift. *Applied Cognitive Psychology*, 16, 989-997.

Schooler, J.W. & Engstler-Schooler, T.Y. (1990). Verbal overshadowing of visual memories: some things are better left unsaid. *Cognitive Psychology*, 22, 36-71.

Schooler, J.W., Fiore, S.M., & Brandimonte, M.A. (1997). At a loss from words: verbal overshadowing of perceptual memories. In *The Psychology of Learning and Motivation*. Medin D.L. (ed.). Academic Press: San Diego, CA; 293-334.

Schooler, J.W., Ryan, R.S., & Reder, L. (1996). The costs and benefits of verbally rehearsing memory for faces. In *Basic and Applied Memory; New Findings*.

Hermann, D., Johnson, M., McEvoy, C., Hertzog, C., & Hertel, P., (Eds.). Erlbaum: Hillsdale, NJ; 51-65.

Schwarzer, G., & Massaro, D.W. (2001). Modelling face identification processing in children and adults. *Journal of Experimental Child Psychology*, 79, 131-161.

Sekuler, A.B., Gaspar, C.M., Gold, J.M., & Bennett, P.J. (2004). Inversion leads to quantitative, not qualitative, changes in face processing. *Current Biology*, 14, 391-396.

Shepard, R.N. (1967). Recognition memory for words, sentences and pictures. *Journal of Verbal Learning and Verbal Behaviour*, 6, 156-163.

Sporer, S.L., (1991). Deep-deeper-deepest? Encoding strategies and the recognition of human faces. *Journal of Experimental Psychology: Learning, Memory, and Cognition*, 17, 2, 323-333.

Standing, L., Conezio, J., & Haber, R.N. (1970). Perception and memory for pictures: single-trail learning of 2500 visual stimuli. *Psychonomic Science*, 19, 73-74

Tanaka, J.W., & Farah, M.J. (1993). Parts and wholes in face recognition. *Quarterly Journal of Experimental psychology Section A: Human Experimental Psychology*, 46, 2, 225-245.

Tanaka, J.W., & Sengco, J.A. (1997). Features and their configuration in face recognition. *Memory & Cognition,* 25, 5, 583-592.

Thompson, V.A., & Paivio, A. (1994). Memory for pictures and sounds: independence of auditory and visual cues. *Canadian Journal of Psychology*, 48, 3, 380-396.

Thomson, D.M., & Tulving, E. (1970). Associative encoding and retrieval: weak and strong cues. *Journal of Experimental Psychology*, 86, 5-262.

Tulving, E., & Thomson, D.M. (1973). Encoding specificity and retrieval processes in episodic memory. *Psychological Review*, 80, 352-373.

Tversky, B., & Sherman, S. (1975). Picture memory improves with longer on time and off time. *Journal of Experimental Psychology: Human Learning and Memory*, 1, 114-118.

Walker, P., Hitch, G.J., Dewhurst, S.A., Whiteley, H.E., & Brandimonte, M.A. (1997). The representation of non-structural information in visual memory: evidence from image combination. *Memory & Cognition*, 25, 4, 484-491.

Watkins, M.J., & Gardiner, J.M. (1979). An appreciation of generate-recognise theory of recall. *Journal of Verbal Learning and Verbal Behavior*, 18, 687-704.

Wells, G., & Hryciw, B. (1984). Memory for faces: encoding and retrieval operations. *Memory & Cognition*, 12, 4, 338-344.

Westerman, D.L., & Larsen, J.D. (1997). Verbal overshadowing effect: evidence for a general shift in processing. *The American Journal of Psychology*, 110, 3, 417-428.

Wickham, L.H.V., & Swift, H. (in review). Articulatory suppression attenuates the verbal overshadowing effect: a role for verbal encoding in face identification. *Applied Cognitive Psychology.*

Wilson, T.D., & Schooler, J.W. (1991). Thinking too much: introspection can reduce the quality of preferences and decisions? *Journal of Personality and Social Psychology*, 60, 181-192.

Winograd, E. (1978). Encoding operations which facilitate memory for faces across the life span. In M.M. Gruneberg, P.E. Morris, & R.N. Sykes (Eds.), *Practical aspects of memory* (pp. 252-262). San Diego, CA: Academic Press.

Winograd, E. (1981). Elaboration and distinctiveness in memory for faces. *Journal of Experimental Psychology: Human Learning and Memory*, 7, 181-190.

Wiseman, S., MacLeod, C.M., Lootsteen, P.J., (1985). Picture recognition improves with subsequent verbal information. *Journal of Experimental Psychology: Learning, Memory, and Cognition*, 11, 3, 588-595.

Yarmey, A.D. (1971). Recognition memory for familiar "public" faces; effects of orientation and delay. *Psychonomic Science*, 24, 286-288.

Yin, R.K. (1969). Looking at upside-down faces. *Journal of Experimental Psychology*, 81, 141-145.

Young, A.W., Hay, D.C., McWeeney, K.H., Flude, B.M., Ellis, A.W. (1985). Matching familiar and unfamiliar faces on internal and external trials. *Perception*, 14, 737-746.

Young, A.W., Hellawell, D., & Hay, D.C. (1987). Configural information in face perception. *Perception*, 16, 747-759.

Young, A.W., McWeeny, K.H., Ellis, A., & Hay, D.C. (1986). Naming and categorising faces and written names. *Quarterly Journal of Experimental Psychology*, 38A, 297-318.

Yu, C.J., & Geiselman, R.E. (1993). Effects of constructing identi-kit composites on photospread identification performance. *Criminal Justice & behaviour*, 20, 280-292.

Appendix A

Celebrities faces used in Chapter 2

Male faces

Anthony Hopkins
Chris Tarrant
Cliff Richard
David Beckham
David Bowie
Ewan McGregor
George Bush
Kevin Spacy
Leonardo Decaprio
Nicholas Cage
Paul Maccartney
Pierce Bronson
Prince William
Robert Deniro
Russell Crow
Sean Connery
Tom Cruise
Vinnie Jones

Female faces

Camilla Parker
Chelie Blair
Cilla Black
Geri Halliwell
Gwyneth Paltrow
Jull Dndo
Liz Hurley
Marilyn Monroe
Meg Ryan
Princess Dianna
Sharon Stone
Victoria Beckham

Appendix B

Celebrities faces used in Chapter 4

Male faces

Anthony Hopkins
Arnold Shawrzenegger
Bill Clinton
Brad Pitt
Bruce Willis
Elton John
Harry Potter
Jim Carey
Justin Timberlake
Prince Harry
Russel Crowe
Saddam Hussein
Sean Connely
Tom Cruise
Tony Blair