Enhancement of Remembering by Application of the Principle of Transfer-Appropriate Processing

by

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A Thesis submitted to the Faculty of Graduate Studies of

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Abstract

According to the principle of transfer-appropriate processing (Morris, Bransford, & Franks, 1977), a match in the cognitive processing employed during an initial encounter with a stimulus and a subsequent attempt to remember that stimulus will facilitate successful remembering. Research suggests that a mismatch between featural and holistic processing reduces recognition accuracy, and that there may be a bias to use holistic processing when making recognition judgments (Doan & Leboe, 2006). The main objective of this thesis was to examine whether participants would use the principle of transfer-appropriate processing as a strategy to promote successful remembering. Participants in two experiments were shown abstract shapes featurally or holistically during a study phase, and performed *old/new* recognition judgments during a subsequent recognition test. Results suggest that participants will use the principle of transfer-appropriate processing as a strategy to enhance recognition under some conditions, but they do not do so easily.

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CHAPTER 1

INTRODUCTION

The ability to recognize people and things in our environment is an important part of our daily lives. The simplest tasks require the ability to recognize objects or faces, such as identifying a toothbrush among the other products on the pharmacy shelf. Recognition can also be more broadly applied to refer to the way one recognizes a stimulus as *old*, meaning that one has previously encountered the stimulus, or *new*, meaning that one has not previously encountered it. For example, imagine that an individual steps into line at the grocery store. The recollection of specific details regarding the individual's identity may come to mind, or one may experience a sense of familiarity without recalling any information pertaining to the individual. In either case, one recognizes the individual as someone that has been encountered before. These experiences represent explicit recognition memory, and it is this use of the term recognition that is the focus of the current study.

To set the current study within a theoretical and empirical context, a review of the relevant research literature will begin with a description of the dual-process theory of recognition (e.g., Jacoby & Dallas, 1981; Jacoby, 1991; Mandler, 1980), followed by a review of research literature pertaining to the role of match between study and test conditions in enhancing or impairing recognition accuracy. Finally, research examining the verbal overshadowing effect will be presented.

The verbal overshadowing effect is a phenomenon in which verbally describing a stimulus encountered previously impairs one's ability to recognize that stimulus during a subsequent encounter (Schooler & Engstler-Schooler, 1990). Research suggests that recognition accuracy is enhanced by holistic processing (Doan & Leboe, 2006; Tanaka & Farah, 1993), and some researchers propose that the disadvantage for recognition accuracy occurs when there is a mismatch in processing between the first encounter and a subsequent encounter with a stimulus along the dimensions of featural vs. holistic processing (Macrae & Lewis, 2002; Schooler, 2002). The purpose of the current study was to investigate whether participants would use the principle of transfer-appropriate processing as a strategy to assist them in making their recognition judgments. Thus, this thesis examined factors that might encourage participants to switch to featural processing when making recognition judgments. Participants in two experiments initially viewed abstract shapes under conditions designed to induce holistic or featural processing, followed by a test phase in which they were presented with an equal number of *old* and *new* shapes and made recognition judgments for each shape. To foreshadow my results, Experiment 1 revealed a holistic processing bias when making recognition judgments, despite conditions that highlighted featural processing as a strategy to aid recognition. However, Experiment 2 suggests that participants will switch to a featural processing strategy at test if the study phase requires featural processing on all trials. This finding suggests that, even if people are not aware of the principle of transfer-appropriate processing, they are flexible in using this principle as a strategy to aid recognition. However, Experiment 1 suggests that there are other factors that must be taken into account, as the holistic processing bias in making recognition judgments is not easily overcome.

Recognition

Perhaps one of the most striking illustrations of the importance of being able to recognize a stimulus as *old* or *new* is found in eyewitness identification, where a witness to a crime may be asked to identify the perpetrator of that crime from a series of photographs or a line-up of possible suspects. The witness may have caught only a brief glimpse of the perpetrator and, thus, the task of identifying that person from a number of other people that are similar in appearance may be quite difficult; the witness may have little more to rely on in making his or her recognition judgment than a feeling of familiarity for one of the individuals in the line-up. However, this feeling of familiarity could result in an error if the witness misattributes the feeling of familiarity to mean that the individual in the line-up was the perpetrator when, in fact, the witness had previously encountered this person in a different context, such as the doctor's office (Whittlesea, 1993). This example underscores the value of understanding the cognitive processes involved in explicit recognition memory. Dual-process theory offers a framework that can serve as a basis for scientific investigations regarding recognition memory processes.

Dual-Process Theory

According to dual-process theory, recognition occurs in either of two ways: through feelings of familiarity or through recollection (Atkinson & Juola, 1973, 1974; Jacoby & Dallas, 1981; Juola, Fischler, Wood, & Atkinson, 1971; Mandler, 1980). According to Mandler and colleagues (Mandler, 1980; Mandler, Hamson, & Dorfman, 1990), initial exposure to a stimulus results in a memory representation of that stimulus in which the stimulus features are integrated with one another, which they referred to as intra-item integration. Intra-item integration occurs more efficiently during subsequent exposure to the same stimulus, and the fluency with which the stimulus features are integrated upon the exposure is experienced as a feeling of familiarity. Feelings of familiarity may cause one to judge a stimulus as *old* despite the absence of specific details regarding the initial stimulus encounter. For example, imagine being in a crowd of people, such as at a movie theatre or walking in the mall, and feeling a strong sense of familiarity for a person in the crowd. This feeling of familiarity may provide a strong cue that one has encountered that individual at some time in the past, even when one is unable to recall specific details regarding the individual's name or the context in which one has encountered that person. Alternatively, Mandler and colleagues proposed that more elaborate processing of a stimulus within the context in which it was encountered, which they referred to as extra-item integration, produces a representation of that specific stimulus exposure in memory. Subsequent stimulus exposure may result in recollection of the contextual details of the initial stimulus exposure, allowing one to recognize that stimulus based on the information that is recalled. For example, recollection of specific details may allow one to recognize the person in the aforementioned crowd as the loans manager from the bank.

Dual-process theory contends that recognition judgments may be based on familiarity, recollection, or a combination of these two processes (Jacoby & Dallas, 1981; Mandler, 1980; Mandler et al., 1990), as when feelings of familiarity cause one to engage in a memory search in an effort to retrieve contextual details. "That woman is familiar. Who is she and where have I seen her before? Is she from my daughter's school? No, I think I met her at the bank. Yes, she is the loans manager that helped me with my mortgage." Thus, Mandler's (1980) conceptualization of the dual-process theory of recognition presents familiarity and recollection as distinct processes that can operate separately or in concert with one another to permit recognition of a stimulus as having been encountered before.

Attribution and familiarity. Mandler (1980) proposed that feelings of familiarity are a result of direct access to a memory representation, but Jacoby and colleagues (Jacoby & Dallas, 1981; Jacoby, Kelley, & Dywan, 1989a; Jacoby, Woloshyn, & Kelley, 1989b), argued that feelings of familiarity are not simply the outcome of a memory for a prior processing event with a stimulus. Rather, they suggested that familiarity is a result of attributing enhanced perceptual fluency to a previous encounter with a stimulus. According to Jacoby and colleagues, fluency is a heuristic used in memory tasks and, as such, is susceptible to error. For example, one may experience a feeling of familiarity for an individual at the library and may attribute that feeling of familiarity to mean that one has encountered that person previously. However, the feeling of familiarity may have occurred because the person at the library resembles one's high school math teacher and, thus, one experienced an increased degree of perceptual fluency upon encountering the individual at the library. In this case, fluency was used as a heuristic to make a recognition judgment, but this heuristic led to an error in that one misattributed the fluency as an indication of a previous encounter with that individual. Thus, although using fluency as a heuristic often leads to successful remembering, this heuristic can also lead to misattribution errors (Whittlesea, 1993).

In an influential paper investigating the dual-process theory of recognition, Jacoby and Dallas (1981) proposed that perceptual identification, meaning the conscious or unconscious perception of a stimulus, is influenced by some of the same factors as explicit recognition memory. Over the course of six experiments, Jacoby and Dallas presented participants with lists of words during an initial study phase, followed by another word list presentation during a test phase. The test phase word list was comprised of a combination of old words that had been presented during the study phase and new words that had not been presented during the study phase, and participants were asked to perform either a standard recognition memory test or a perceptual identification test. Participants who were given the standard recognition memory test were asked to identify whether words presented at test had been presented during the study phase; participants who were given the perceptual identification test were exposed to a brief presentation of each word and were asked to report each word after it was presented.

In the first experiment, Jacoby and Dallas (1981) assessed the effect of different levels of processing on recognition memory and perceptual identification by using the levels of processing framework developed by Craik and Lockhart (1972). Craik and Lockhart suggested that cognitive processing occurs along a continuum that ranges from shallow processing, such as processing the physical characteristics of a stimulus, to deeper semantic processing. They contended that deeper processing at the time of encoding results in better memory performance on recall and recognition tasks. Based on this framework, Jacoby and Dallas asked participants questions about each word during the study phase. These questions pertained to the physical structure of the word (e.g., did the word have the letter "D"), whether the word rhymed with another word, or the meaning of the word. According to the levels of processing framework, these questions represented shallow, intermediate, and deep levels of processing respectively. In the second experiment, task difficulty was manipulated by asking participants to read the word or to solve an anagram. Jacoby and Dallas found that semantic processing and task difficulty influenced recognition memory in that deeper levels of processing and increased task difficulty enhanced recognition memory, whereas perceptual identification was unaffected by these factors. However, both recognition memory and perceptual identification were influenced by the physical structure of the words (i.e., graphemic information), in that perceptual identification success was correlated with the likelihood of claiming a test item as *old* on a standard recognition test.

The remaining four experiments involved manipulations of variables such as repetition, word frequency, and modality switches between study and test phases. Results revealed that these variables had similar affects on both recognition memory and perceptual identification. Specifically, repetition of a word and increased spacing between the initial word presentation and the word repetition benefited perceptual identification in that participants exhibited a higher accuracy rate when reporting repeated words compared to novel words and when the repetitions did not immediately follow the initial word presentation; recognition memory was also more accurate in these conditions. Presenting words that occur frequently in the English language (i.e., high-frequency words) had opposite effects on perceptual recognition and recognition memory, increasing perceptual identification accuracy but impairing recognition memory. However, Jacoby and Dallas (1981) argued that their results also demonstrated that word frequency has a similar effect on perceptual identification and recognition memory in terms of the influence of study phase exposure to a word on subsequent test performance, as they found that low-frequency words presented during the study phase enhanced perceptual identification and recognition memory performance during the test phase. Finally, switching modalities between study and test phases impaired both perceptual identification and recognition memory, and also eliminated the advantage of low-frequency words in both perceptual identification and recognition memory tests.

Jacoby and Dallas (1981) argued that the differential effects of semantic processing level and task difficulty on perceptual identification and recognition memory suggest that they utilize different information. Specifically, deeper processing of a word during the study phase benefits recognition memory performance only, suggesting that perceptual identification does not rely on this information. However, Jacoby and Dallas contended that the similar effects on perceptual identification and recognition memory that were obtained for repetition, word-frequency, and modality switches indicates that recognition memory is also influenced by some of the same factors that influence perceptual identification. Perceptual identification and recognition memory were similarly affected under conditions in which the physical characteristics of the words were important. According to Jacoby and Dallas, the presentation of a word during the study phase increased perceptual fluency upon a subsequent encounter with that word during the test phase, leading to increased accuracy in perceptual identification tasks and an increased likelihood of judging a stimulus as *old* during a recognition memory task. Thus, Jacoby and Dallas interpreted their findings as support for the dual-process theory of recognition. Specifically, they demonstrated that perceptual identification success was correlated with the likelihood of claiming a test item as *old*, reflecting the influence of fluency on both tasks and the subsequent use of feelings of familiarity as a basis for recognition memory judgments. In contrast, the variables that influenced only recognition memory (i.e., deeper stimulus encoding) reflected the use of recollection in recognition memory judgments (Jacoby & Dallas, 1981).

As a result of these findings, Jacoby and Dallas (1981) suggested that participants use "relative perceptual fluency" (p.333) as a heuristic when making recognition judgments. Relative perceptual fluency refers to an assessment of fluency that is based on how fluent an item is processed compared to how fluent an item is *expected* to be processed. For example, if an individual would expect to perceive a particular stimulus fluently (e.g., a common word, such as *mother*), the individual may not attribute enhanced perceptual fluency to prior experience with the stimulus and, thus, may not judge the item as *old* during a recognition test. Conversely, if an individual would not expect to perceive a stimulus fluently (e.g., an uncommon word, such as *hyena*), the individual may attribute enhanced perceptual fluency to a prior experience with the stimulus and judge the stimulus as *old* during a recognition test (Whittlesea & Leboe, 2003).

Whittlesea (1993) provided support for a fluency heuristic in recognition judgments through a series of experiments in which participants were presented with a list of words during the study phase, followed by a test phase in which they were asked to judge those words as *old* or *new* when they were presented at the end of a "high-constraint" or "low-constraint" sentence. A high-constraint sentence was a sentence stem which, if the last word of the sentence was left blank, could be completed by a somewhat predictable word. For example, Whittlesea presented participants with the sentence "She tied the parcel together with ________" . This sentence could predictably be completed with the word "string", but it could also be completed with the words twine, rope, or cord. A low-constraint sentence was a sentence stem which, if the last word of a sentence was left blank, could be completed with a number of words (i.e., the last word was not easily predicted). For example, "She had saved up miles of red __________" could be completed with any of the aforementioned words in the previous example, but it could also be completed with many other words (e.g., yarn, cloth, wallpaper, etc.). Whittlesea found that participants were more likely to judge words presented at the end of high-constraint sentences as *old* compared to words presented at the end of low-constraint sentences. He interpreted these results as evidence that participants attributed the enhanced fluency caused by the predictable target word to a prior experience with that target word in the study phase, even when the target word was *new*. Thus, the enhanced fluency generated feelings of familiarity that benefited recognition accuracy for *old* words, but that also increased recognition errors for *new* words. These results suggest that feelings of familiarity are not simply a result of direct access to a memory representation, as suggested by Mandler (1980; Mandler et al., 1990), but can result from other sources of enhanced fluency. Feelings of familiarity that derive from a prior experience with a stimulus, such as in the case of correctly recognizing a word as *old* during a recognition test, increase recognition accuracy if the participant correctly attributes those feelings of familiarity to the previous encounter with the stimulus. However, Whittlesea demonstrated that other factors that enhance perceptual fluency, such as the high-constraint sentence stems, could also produce feelings of familiarity. In that case, however, the experience of familiarity would be illusory, leading to incorrect recognition judgments.

Other research findings have also demonstrated that using familiarity as a basis for recognition can result in memory errors. For example, Whittlesea and Williams (1998) presented participants with a list containing words, non-words, and pseudohomophones (i.e., non-words that sound like a word, such as *phraug*), and the test task was a standard recognition task. Participants judged pseudohomophones as *old* more often than either words or non-words, suggesting that participants attributed the surprising fluency of access to the meaning of those items (e.g., "phraug" sounds like "frog") to prior experience with the pseuedohomophone, causing them to be more likely to make more errors in terms of false recognition than they made with either words or non-words. Memory illusions have also been created using prior experience with a stimulus to enhance perceptual fluency in judgments of truth (Begg & Armour, 1991) and fame (Jacoby et al., 1989b). In these experiments, prior exposure to a stimulus influenced participants' judgments in that they were more likely to judge a statement as true or a name as famous if they had been presented with the statement or name in the study phase, resulting in increased errors for false statements and non-famous names. Participants would have correctly judged the statement or name as *old* in a standard recognition test if they had attributed the enhanced perceptual fluency to prior stimulus exposure. However, when asked to make a different judgment, such as truth or fame, participants' *misattributions* regarding the source of the enhanced perceptual fluency experienced during the subsequent presentation of the stimulus resulted in memory *illusions* in that participants were incorrect when reporting specific stimulus information. Thus, fluency attributions can facilitate recognition memory, but they can also lead to false recognition (e.g., Whittlesea & Williams, 1998) and false claims about the nature of the current stimulus (e.g., Begg & Armour, 1991; Jacoby et al., 1989b).

Attribution and recollection. Leboe and Whittlesea (2002) found evidence that recollection is also influenced by fluency attributions and can result in memory errors. Specifically, the ease with which information is generated, or retrieval fluency, can be used as a heuristic in recognition judgments that involve recollection processes. Leboe and Whittlesea suggested that familiarity and recollection are not separate processes per se, as suggested by dual-process theory, but instead use different information sources while sharing a common underlying process involving inference and attribution. To illustrate, they presented participants with words that were typically associated with either a question or an exclamation, such as "HUNGRY?" and "DANGER!", as well as with neutral words that were not typically associated with either punctuation. An initial experiment used a combination of questioning, exclamatory, and neutral words to confirm that participants generally agreed with the punctuation associated with each word. Once this was established, Leboe and Whittlesea conducted another experiment in which they presented participants with words from each of the aforementioned categories in the study phase. Half of the words were presented followed by three question marks and half of the words were presented followed by three exclamation marks. In addition, half of the questioning and exclamatory words were presented with typical punctuation and half were presented with atypical punctuation (e.g., "HUNGRY???" versus "HUNGRY!!!"). Participants read each word aloud with the correct inflection according to the punctuation. During a subsequent test phase, participants were presented with all the words from the study phase, but without punctuation, and were asked to read the words aloud and report the punctuation that had accompanied the word in the prior training phase. In addition, participants were asked to provide confidence ratings regarding their recollection accuracy for each punctuation judgment.

Participants were more accurate in reporting punctuation during the test phase when it was consistent with the word it was paired with during the study phase than when it was not consistent. Further, recollection for punctuation that was inconsistent with the word it was presented with (e.g., DANGER???) was less accurate than recollection for punctuation presented with neutral words. Participants' confidence ratings indicated the lowest confidence for neutral words; however, participants were equally confident in their recollection of punctuation paired with both consistent and inconsistent words, regardless of below-chance accuracy in reporting punctuation paired with inconsistent words. Leboe and Whittlesea (2002) concluded that the accuracy data indicated that participants were able to successfully recall some contextual information, but the confidence data revealed that the ease with which consistent punctuation was generated influenced participants' confidence in the accuracy of their recollections. In other words, participants that incorrectly reported punctuation in the inconsistent context condition, meaning that they reported the punctuation normally associated with the word rather than the punctuation presented in the study phase, were equally confident that their recollection was accurate as when they reported the correct punctuation. According to Leboe and Whittlesea, this suggested that participants were using attributions as to the fluency of retrieval as a heuristic to guide their recollection judgments. Thus, recollection appears to be vulnerable to memory errors as a result of retrieval fluency attributions, similar to the manner in which familiarity is vulnerable to memory errors as a result of perceptual fluency attributions, suggesting a common underlying inference and attribution process (Leboe & Whittlesea, 2002).

The Role of Match in Memory Performance

The ability to recognize a stimulus as *old* or *new* can be influenced by many factors, and research has demonstrated that perceptual fluency is a particularly useful heuristic for performing recognition judgments (e.g., Leboe & Whittlesea, 2002; Whittlesea, 1993; Whittlesea & Williams, 1998). One obvious source of enhanced perceptual fluency is previous experience with a stimulus (Jacoby & Dallas, 1981), as in the earlier example of feeling a sense of familiarity for someone in a crowd of people. Research has also demonstrated that the degree of similarity, or match, between the conditions within which one previously encountered a stimulus and the conditions within which one attempts to retrieve stimulus information influences memory success or failure, with increased similarity between encoding and retrieval conditions enhancing memory performance (e.g., Bower, 1981; Morris, Bransford, & Franks, 1977; Tulving & Thomson, 1973). The theories of encoding specificity (Tulving & Thomson, 1973) and transfer-appropriate processing (Morris et al., 1977) figure prominently in this literature.

Encoding Specificity

As mentioned earlier, the levels of processing framework (Craik & Lockhart, 1972) proposes that cognitive processing occurs along a continuum that ranges from shallow processing of physical stimulus information to deep semantic processing. According to this framework, deeper processing promotes successful memory performance. For example, the levels of processing framework predicts that processing a word in terms of its meaning results in better memory performance on a recognition test compared to processing a word in terms of how many vowels it contains (Craik & Lockhart, 1972). However, levels of processing is an information encoding framework that does not address the issue of information retrieval (Craik & Lockhart, 1972; Morris et al., 1977; Tulving & Thomson, 1973). In an effort to address the role of retrieval in memory performance, Tulving and Thomson (1973) proposed the *encoding specificity principle*, which suggests that a higher degree of similarity between encoding and retrieval conditions provides additional memory cues that may facilitate successful memory performance, relative to the amount of cues available when retrieval conditions are dissimilar to prior encoding conditions.

Tulving & Thomson (1973) tested the encoding specificity principle by presenting participants with two types of word pairs: strong associates (*table* - *chair*), and weak associates (*ground* - *cold*). Participants were presented with either a strong or a weak cue and asked to recall the target word. For example, if participants were given the word *table* they were required to recall the word *chair* (strong cue), and if they were give the word *ground* they were required to recall the word *cold* (weak cue). In addition, on some trials the cue would be the same as the word presented in the study phase (i.e., *ground*), and on other trials it would be different (i.e., given the word *hot*, participants would be required to recall the word *cold* even though *hot* had not been the paired associate in the study phase). Participants exhibited better recall for words that were presented with the same weak (*ground-cold*) cue than for words that were presented with a different strong cue (*hot-cold*). Tulving and Thomson proposed that these results indicated that a match between encoding and retrieval conditions enhances memory performance because the match in the information that is present during both conditions promotes successful recollection of the information as having been present during the initial encounter with the stimulus or event.

The encoding specificity principle is generally accepted among researchers today, and research has shown that memory performance can be affected by a match between encoding and retrieval conditions with factors such as mood (Bower, 1981) and physical surroundings (Godden & Baddeley, 1975). For example, Godden and Baddeley (1975) conducted an experiment in which participants read words on land or under water during study and test phases. They found that participants were more successful in recalling those words when the test context (i.e., on land or under water) matched the study context.

Transfer-Appropriate Processing

Morris et al., (1977) were the first to use the term *transfer-appropriate processing* (TAP) which, like encoding specificity, addresses the issues of encoding *and* retrieval of stimulus information. The premise of TAP is that previous cognitive processing of a stimulus or event influences subsequent encounters with the same (or a similar) stimulus or event. This premise has important implications for the concept of depth of processing, and in terms of the levels of processing framework (Craik & Lockhart, 1972), Morris et al. (1977) stated that, "Task meaningfulness must be defined relative to particular learning goals" (p. 519). In other words, it is not the depth of processing that matters per se; rather, it is the degree of match between the processing demands during the encoding and retrieval of information that influences memory performance. For example, if a test situation requires semantic recall (e.g., name a bird that cannot fly), recall performance will be enhanced by encoding the information with the intent to extract meaning in the study situation. Conversely, if a test situation requires the recollection of the physical properties of a stimulus, recall performance will be enhanced by encoding the physical properties of that stimulus in the study situation. Effective encoding is, therefore, dependent on the conditions that exist at the time of testing (Morris et al., 1977).

Morris et al. (1977) tested the TAP model by manipulating study and test task demands over the course of three experiments. Their basic experimental paradigm involved the presentation of a semantic or phonetic task to participants in the study phase, and a subsequent recognition task in the test phase. In the study phase, participants were required to make two different types of judgments. The semantic task required participants to judge whether words were appropriate to the context of a sentence (i.e., deep semantic processing), and the phonetic task required participants to judge if a target word rhymed with another word (i.e., intermediate phonemic processing). For example, Morris et al. presented participants with the sentence "The _____ had a silver engine". This sentence was followed by a pause and then a target word. If the target word fit the sentence (e.g., train), the participant would respond "yes", and if it did not fit the sentence (e.g., peach), the participant would respond "no". This would constitute a semantic task. A phonetic task would involve the presentation of a sentence such as "________ rhymes with legal", followed by a pause and then a target word. The participant would respond "yes" if the target word rhymed, and "no" if it did not. In the test phase, half of the participants were given a recognition test with the original words and an equal number of distractors, and the other half were given a recognition test with rhymes of the original words and an equal number of distractors.

As predicted by the levels of processing framework, performance was better on a standard recognition test for words encoded semantically than for words encoded phonemically. However, when the recognition test involved a judgment as to whether the probe word rhymed with a word seen during the study task, recognition performance was best for words that had been encoded phonemically. These results remained constant over a 24-hour delay, and Morris et al. (1977) concluded that:

> The concept of transfer-appropriate processing suggests that it is no longer beneficial to simply assume that the traces of certain items are less durable or adequate than others because those items were processed at a shallower level. The evidence that appears to support this latter assumption involves test situations that are not optimal for assessing what was actually learned. (p. 528).

Morris et al.'s findings support the premise that success or failure in memory tasks is determined by the degree of match in processing between study and test phase task demands. Therefore, effective encoding is defined by retrieval task demands rather than by the type of processing engaged in at the time of encoding (Morris et al., 1977).

A match between encoding and retrieval conditions may produce enhanced perceptual fluency which, as previously noted, results in the feelings of familiarity that are an important basis for performing recognition judgments (e.g., Jacoby & Dallas, 1981). Although circumstances that facilitate feelings of familiarity through enhanced perceptual fluency may cause an individual to judge a stimulus as *old* when it was not (e.g., Whittlesea, 1993), circumstances that block feelings of familiarity, such as a mismatch in processing between encoding and retrieval conditions, may impair recognition performance and cause an individual to judge a stimulus as *new* when it is actually *old*.

The verbal overshadowing effect is a phenomenon in which verbal descriptions of a stimulus impair subsequent recognition of that stimulus (Schooler & Engstler-Schooler, 1990). Principles, such as encoding specificity and TAP, have been combined with the dual-process theory of recognition memory to explain such failures of recognition. Some researchers have suggested the source of this phenomenon is a mismatch between encoding and retrieval conditions that block feelings of familiarity (Schooler, 2002; Schooler, Fiore, & Brandimonte 1997). It is also possible that a mismatch between encoding and retrieval conditions could prevent people from correctly recognizing an item as *old* by blocking recollection of the prior experience with that stimulus (e.g., Tulving & Thomson, 1973).

Verbal Overshadowing

Imagine a scenario in which an individual stops at the local corner store to pick up some milk, only to find that there is a robbery in progress. The individual gets a brief look at the thief's face and is asked to provide a verbal description of the thief to police, followed at a later date by a request to identify the thief from a police line-up. This may appear to be a simple task, but research has demonstrated that there may be some problems with the reliability of eyewitness identification that is done in the manner just described. Schooler and Engstler-Schooler (1990) presented participants with a 30 second video tape of a mock robbery, followed by a 20 minute distractor task. Participants were then assigned to one of two conditions in which one half of the participants provided a verbal description of the thief, while the other half performed an unrelated task. Both groups were asked to identify the thief from a line-up of photographs during the test phase. Surprisingly, participants in the group that provided the verbal description exhibited lower recognition accuracy than participants who performed the unrelated task. Schooler & Engstler-Schooler labeled this phenomenon the *verbal overshadowing effect*, and although many researchers have demonstrated this effect using various stimuli, such as colour (Brandimonte, Schooler, & Gabbino, 1997) and wine (Melcher & Schooler, 1996), other researchers have had difficulty replicating the effect (see Meissner & Brigham, 2001; Schooler, 2002). These findings have prompted theoretical and empirical investigations to find a cognitive mechanism that could account for the simultaneous generality and fragility of the verbal overshadowing effect.

Schooler and colleagues (Schooler, 2002; Schooler et al., 1997) proposed that the verbal overshadowing effect may be caused by transfer-*inappropriate* processing. This theory is based on the principle of transfer-appropriate processing which, as mentioned earlier, suggests that success or failure in any memory task is determined by the degree of match between the cognitive processing that occurs during an initial encounter with a stimulus and the processing demands of a subsequent encounter with the same, or a similar, stimulus (Morris et al., 1977). Schooler (2002) suggested that the verbal overshadowing effect may be the result of a processing mismatch between encoding and retrieval of stimulus information between non-verbal versus verbal processing, controlled versus automatic processing, or featural versus holistic processing. Macrae and Lewis (2002) concurred with the transfer-inappropriate processing account of the verbal overshadowing effect and proposed that verbal overshadowing occurs when the featural processing used to provide the verbal description of the stimulus biases participants towards engaging in featural processing during a subsequent recognition test. Since holistic processing is generally used in face perception and recognition (Macrae & Lewis, 2002), there would be a mismatch between memory encoding (holistic) and retrieval (featural) processes. Applying the dual-process model of recognition memory to this premise, a mismatch between the processes employed during memory encoding and retrieval could result in decreased perceptual fluency, blocking feelings of familiarity and impairing recognition performance (Jacoby & Dallas, 1981; Whittlesea & Price, 2001).

An alternative explanation for the verbal overshadowing effect is that the verbal description affects the subsequent recognition judgment by altering the original memory representation or interfering with the retrieval of the original representation (Meissner, Brigham, & Kelley, 2001; Schooler & Engstler-Schooler, 1990). This explanation of the verbal overshadowing effect is consistent with some of the literature regarding the misinformation effect. In a classic example of the misinformation effect, individuals viewed a video tape of a car accident and were then asked misleading questions (Loftus & Palmer, 1974). Although there was no broken glass in the video, individuals that were asked during the initial experimental session to estimate the speed the cars were traveling when they *smashed* into each other were more likely to report seeing broken glass during an experimental session that took place one week later than were individuals that were asked the same question using a word such as *hit* or *bumped*. Loftus & Palmer (1974) suggested that the original memory was altered by the suggestive wording of the test question.

Meissner et al. (2001) provided support for a misinformation/interference account of the verbal overshadowing effect when they demonstrated that instructions requiring participants to provide elaborate descriptions, which included guessing if they were unsure of the details, resulted in a larger verbal overshadowing effect than standard instructions requiring participants to provide only the details of which they were certain. They interpreted this as an indication that the elaborate descriptions produced misinformation that interfered with memory retrieval. This is consistent with other research findings that have indicated an effect for different types of instructions (MacLin, 2002; Meissner, 2002; Meissner & Brigham, 2001). Finger and Pezdek (1999) also found similar effects for elaborate and standard instructions and interpreted it as retroactive interference, asserting that the misinformation generated in the elaborate instruction condition resulted in a second memory representation that interfered with participants' access to the original representation. They demonstrated that the insertion of a time delay between the verbal description and the test phase eliminated the verbal overshadowing effect, and suggested that the time delay served to decrease the interference caused by the second memory representation.

Other researchers have not found any significant correlation between the quality of descriptions provided by participants and the subsequent recognition accuracy of those participants (e.g., Brown & Lloyd-Jones, 2002; Schooler & Engstler-Schooler, 1990). In the original verbal overshadowing experiments, Schooler & Engstler-Schooler (1990) compared the quality of the verbal descriptions provided by the participants and found that description quality did not exert a significant influence on recognition accuracy. This suggests that memory recoding or retrieval interference theories do not fully account for the verbal overshadowing effect.

Featural versus Holistic Processing

A great deal of research effort has been devoted to the area of featural and holistic processing in face recognition (Macrae & Lewis, 2002). Featural processing refers to the processing of the individual details of a particular stimulus, and holistic processing refers to the processing of a stimulus as an integrated whole. As previously noted, researchers have suggested that a mismatch between featural and holistic processing during study and test conditions may account for the verbal overshadowing effect (e.g., Macrae & Lewis, 2002; Schooler, 2002).

Macrae and Lewis (2002) demonstrated that verbalization is not necessary to produce the verbal overshadowing effect. They showed participants the same videotape used by Schooler and Engstler-Schooler (1990), and then divided the participants into three groups. The first group performed an unrelated task, and the other two groups were presented with larger letters that were composed of smaller, mismatching letters, such as an F composed of Ns. One group was asked to identify the larger letter (holistic processing) and the other group was asked to identify the smaller letters (featural processing). All participants were subsequently given a recognition task during the test phase. Macrae and Lewis found that participants who engaged in the featural processing task between the videotape and the recognition task exhibited impaired recognition accuracy similar to that found in the verbal overshadowing paradigm. These results demonstrated that verbalization is not necessary to produce the verbal overshadowing effect and support the contention that the verbal overshadowing effect is the result of a processing mismatch between encoding and retrieval conditions along the dimensions of featural versus holistic processing.

Whittlesea and Price (2001) investigated the role of featural versus holistic processing in the mere exposure effect, an effect in which prior exposure to stimuli increases participants' judgments of liking for those stimuli compared to their judgments of liking for novel stimuli. They suggested that cognitive tasks that require one to focus on the individual features induce featural processing, whereas cognitive tasks that require one to focus on the integrated whole induce holistic processing. Whittlesea and Price presented participants with pictures of line drawings of various stimuli (e.g., chairs, trees, geometric drawings, and mountains) and induced featural processing by presenting participants with stimuli that were very similar to each other or by dividing the picture into quadrants and asking participants to concentrate on one particular quadrant of the picture; holistic processing was induced by decreasing the similarity between the stimuli or by instructing participants to ignore the quadrant lines. Participants who engaged in holistic processing during the study phase performed better on a subsequent recognition test than participants who engaged in featural processing during the study phase. Whittlesea and Price argued that featural processing is incompatible with the task of recognition because it prevents feelings of familiarity; thus, it follows that familiarity based recognition judgments would benefit from holistic processing. This being the case, Whittlesea and Price's findings are compatible with the principle of transfer-appropriate processing in that participants recognition performance was better when both study and test phases matched along the dimension of holistic processing.

Whittlesea, Brooks, and Westcott (1994) investigated the factors that influence whether people make use of featural or holistic *knowledge* when performing cognitive tasks, and contended that the match between current processing of a stimulus and prior processing of the same, or a similar, stimulus influences the type of knowledge people implicitly choose to utilize to aid in task performance. To investigate this premise, Whittlesea et al. (1994) presented participants with a training phase and a test phase that involved a series of non-words derived from one of two prototypes, FURIG and NOBAL. For the purpose of the study, exemplars derived from FURIG represented "nouns" and those derived from NOBAL represented "verbs". Exemplars were created by replacing at least one of the letters of these prototypes with one of the letters from the set of T, E, K, Y, and P. In consequence, the letters used to form each exemplar denoted whether the word was a noun or a verb, based on their similarity to one of the two prototypes. In the holistic encoding condition, all exemplars were presented with a suffix, with all nouns ending in "ISM" (e.g., FETIGISM) and all verbs ending in "ING" (e.g., NEKATING).

Participants were exposed to two types of training during the study phase. Featural training consisted of presenting participants with a non-word stem and its category (e.g., NOUN-FUKIG), and asking them to rate how typical each letter in the stem was for the category; this would necessitate processing the individual parts of the stem and would also inform participants as to the rules governing the construction of the non-word stems (Whittlesea et al., 1994). Holistic training involved presentation of a non-word stem with the correct suffix denoting it as a noun (i.e., ISM) or a verb (i.e., ING), and participants were required to pronounce the non-word or copy it onto paper; this would necessitate processing the stimulus as an integrated whole (Whittlesea et al., 1994). There were two groups of words from both the noun and the verb exemplars. One set of noun exemplars and one set of verb exemplars were designated as featural groups, and one set of each noun and verb exemplars were designated as holistic groups. The experimenters used accuracy to determine the type of knowledge utilized during test performance, with a higher degree of accuracy in non-words from the featural non-word group suggesting that participants had used featural knowledge, and vice versa for holistic knowledge groups.

Over the course of five experiments, Whittlesea et al. (1994) presented participants with test tasks that were featural or holistic in nature. In Experiment 1 half of the participants were presented with a non-word (e.g., FETIGISM) and half of the participants were presented with a non-word stem and its category (e.g., NOUN-FETIG). Participants were asked to judge if the non-word was correct (holistic) or if the non-word stem was paired with the correct category (featural). In Experiment 2, half of the participants were presented with two non-words composed of the same stem but paired with each suffix (*ism* and *ing*) and they judged which word was correct (holistic), and half of the participants were presented with two different non-word stems ending with the same suffix and were asked which non-word was correct (featural). Experiment 3 manipulated whether the non-word (holistic) or the category (featural) was presented first, and participants in each condition were asked to judge whether the category was correct. Whittlesea et al. asked participants to perform two parallel tasks during each trial in Experiment 4. Half of the participants were given a non-word stem and were required to generate the suffix and classify the non-word (holistic), and half of the participants were given two non-words composed of the same stem but with a different suffix and were asked to judge which item was correct and to justify their choice (featural). Finally, in Experiment 5, Whittlesea et al. presented participants with two non-words that were composed of different suffixes. There were two conditions, but both tasks were considered holistic. In the first condition the suffixes were the same suffixes that the participants had been exposed to during training and participants were asked to judge if the non-word was correct; in the second condition the participants were given substitutions for these suffixes (i.e., *ous* for nouns and *ly* for verbs, to generate adjectives and adverbs respectively) and were asked to judge an adjective suffix correct with a noun stem and an adverb suffix correct with a verb stem. Thus, the suffixes in the second condition were less familiar to the participants (Whittlesea et al., 1994).

Taken together, the pattern of results for all five experiments showed that participants were more accurate when their test phase task matched their training phase task along the dimensions of featural and holistic processing. However, they also demonstrated that there are many variables that work together to influence how people process a stimulus when they first encounter it, such as task demands (Experiment1), stimulus characteristics (Experiments 2 and 5), presentation order (Experiment 3), and the influence of the processing demands of another, simultaneous task (Experiment 4). As an example of how this interaction may influence processing strategies, consider the results of Experiment 5, in which Whittlesea et al. (1994) found that participants in the substituted suffix condition exhibited higher accuracy if they had been exposed to featural training during the study phase of the experiment, despite the holistic nature of the test task. Whittlesea et al. suggested that the unfamiliar suffixes may have caused participants to implicitly choose to employ featural processing at test in an effort to promote accuracy. This finding in particular suggests that participants are flexible in choosing the processing strategy for a particular cognitive task that is most likely to facilitate successful performance.

Research suggests that transfer appropriate and inappropriate processing along the dimensions of featural versus holistic processing may account for both the generality and the fragility of the verbal overshadowing effect (e.g., Macrae & Lewis, 2002; Whittlesea & Price, 2001). In addition, the findings of Whittlesea et al. (1994) suggest that many factors influence the choices people make regarding the processing of stimuli, and discovering what those factors are may offer a means of reducing the verbal overshadowing effect in applied settings, such as eyewitness testimony. It is important to note that a mismatch between featural encoding and holistic processing at test may reduce recognition accuracy through an influence on either familiarity (e.g., Whittlesea & Price, 2001) or recollection (e.g., Tulving & Thomson, 1973). The purpose of the current study was to investigate factors that may influence participants to engage in featural processing at the time of a recognition test.

CHAPTER 2

THE CURRENT STUDY

The principles of encoding specificity (Tulving & Thomson, 1973) and transfer-appropriate processing (Morris et al., 1977) share common ground in that both theories propose that the degree of match between encoding and retrieval conditions is an important factor in recognition performance. In addition, featural and holistic processing has been an area of interest to researchers in the domains of cognitive psychology (e.g., Macrae & Lewis, 2002; Schooler, 2002) and behavioural neuroscience (e.g., Le Grand, Mondloch, Maurer, & Brent, 2004). Previous research has revealed a bias toward using holistic processing when recognizing faces (e.g., Tanaka & Farah, 1993) and abstract shapes (Doan & Leboe, 2006). The current study explored factors that may influence people to switch to a featural processing strategy at the time of a recognition test. The purpose of the first experiment was to investigate whether participants would switch to featural processing if the test instructions emphasized the value of featural processing in promoting successful recognition of abstract shapes. The second experiment was designed to explore study factors that may influence participants to engage in featural processing during a subsequent test phase. More broadly, the objective of the current study was to examine whether participants would apply the principle of transfer-appropriate processing as a strategy to increase the likelihood of successful remembering.

It has been suggested that a match in processing along the dimensions of featural and holistic processing may play an important role in face recognition and may contribute to the verbal overshadowing effect (Schooler, 2002). The current research is based on a previous study that explored this issue as it pertained to recognition judgments in general. Doan and Leboe (2006) presented participants with abstract shapes during a study phase, and preceded each shape with an instruction to perform one of three tasks: count the number of points on a particular shape, tell the experimenter what the shape resembled (e.g., it looks like a teacup), or simply study the shape. It was expected that counting the number of points would induce a featural processing strategy, while making a resemblance judgment would induce a holistic processing strategy. Participants performed a recognition task during the test phase. As previously noted, research has demonstrated that recognition judgments are enhanced by holistic processing (e.g., Macrae and Lewis, 2002; Whittlesea & Price, 2001). Therefore, the holistic processing used to make the resemblance judgments matched the holistic processing that occurred during the test phase, whereas the featural processing employed to count points constituted a mismatch with the holistic processing that occurred during the test phase. Doan and Leboe predicted that recognition accuracy would be best for trials in which participants made resemblance judgments during the study phase, intermediate for shapes that were studied, and worse for trials in which participants counted the points during the study phase. Results were consistent with this prediction. However, resemblance judgments require a deeper level of processing, as they impose meaning on the shapes (Craik & Lockhart, 1972), suggesting that the enhanced recognition performance demonstrated for the resemblance judgment trials may have been the result of a levels of processing effect. Doan and Leboe ran the experiment again, but eliminated the resemblance condition from the study phase. Participants exhibited enhanced recognition performance in the study condition and impaired recognition performance in the count condition, supporting the argument that a mismatch between featural (count condition) and holistic (recognition judgments) processing impairs recognition performance.

To further investigate the role of processing match along the dimensions of featural and holistic processing, Doan and Leboe (2006) designed a second experiment to induce featural processing during the test phase. The study phase was the same as in the first experiment, but participants counted the points of the shapes before each test phase recognition judgment. Doan and Leboe (2006) expected that this manipulation would result in enhanced recognition performance for counting points during the study phase, and impaired recognition performance for resemblance and study conditions. When all three conditions (i.e., count, resemblance, and study) were present in the study phase the pattern of results was the same as Experiment 1, with enhanced recognition performance in the resemblance condition and impaired recognition performance in the count condition. However, when the resemblance condition was removed, the pattern reversed, with enhanced recognition performance during the test phase for shapes that were counted during the study phase and impaired recognition performance for shapes that were studied. This reversal provided support for the contention that the degree of match along the dimensions of featural versus holistic processing between study and test phases influences recognition performance, as participants were better at recognizing shapes processed featurally during the study phase when the test phase also utilized featural processing.

Doan and Leboe (2006) further investigated the factors that influence the processing strategies people choose to use during recognition judgments by conducting a third experiment in which they manipulated the proportion of count versus look trials during the study phase, with participants counting the points for 80% of the study trials. Doan and Leboe expected that participants would implicitly switch to a featural processing strategy when making recognition judgments, as featural processing would be more likely to promote success during the test phase because 80% of the study trials required featural processing. However, results indicated that participants' performance was impaired for shapes that were counted during the study phase, suggesting that there is a strong bias toward holistic processing for recognition judgments.

The current project was an extension of Doan and Leboe's (2006) research. The first experiment was designed to explore whether participants would switch processing strategies to facilitate successful recognition judgments. During the study phase, participants were presented with a series of abstract shapes; each shape was preceded by instructions to either look at the shape or count the points. Participants were divided into three groups for the test phase. All participants were presented with another series of abstract shapes, half *old* and half *new*. Participants made *old/new* recognition judgments for each shape. In addition, one group of participants judged whether they counted the shape during the study phase (*count source judgment* condition), a second group of participants judged whether they merely looked at the shape during the study phase (*look source judgment* condition), and a third group did not make any source judgments (*no source judgment* condition). After all the shapes were presented in the test phase, participants in each of the conditions were asked to estimate the percentage of shapes for which they employed the strategy of counting the points at *test* as a strategy to aid them in their memory performance. I predicted that if participants in the *count source judgment* condition switched to a featural processing strategy to help them remember shapes from the study phase they would exhibit better recognition for shapes whose points were counted during the study phase. My rationale for this prediction was that the *count source judgment* would induce featural processing during the test phase recognition task, constituting a featural processing match with the *count* study trials. I also predicted that participants in the *count source judgment* condition would exhibit higher estimates of counting the points of shapes at *test* as a strategy to aid in memory performance.

The second experiment employed a procedure developed by Jacoby et al. (2005). Participants were assigned to either a featural or a holistic experimental condition. In the study phase, participants in the featural condition viewed a series of shapes that were revealed on the computer screen one quadrant at a time, and participants in the holistic condition viewed each shape as integrated whole. All participants viewed the shapes as integrated wholes in the subsequent phases of the experiment. During the second phase of the experiment, all the study phase shapes were presented intermixed with an equal number of new shapes, and participants judged whether each shape had been presented in the previous study phase by making *old/new* recognition judgments for each shape. In the final phase of the experiment, participants viewed all the foils from the second phase of the experiment (i.e., novel shapes in Phase 2) intermixed with an equal number of new shapes. Participants performed *old/new* recognition judgments for these shapes. They were instructed to judge a shape as *old* if it had been presented at any prior phase of the experiment, and it was emphasized that this included shapes that were "new" in the previous recognition phase (i.e., Phase 2 foils). I predicted that participants would be biased during the second phase recognition test to engage in the same processing they used during the initial phase. This being the case, I expected participants in the featural condition to exhibit worse recognition for foils in the third phase of the experiment compared to participants in the holistic condition, as the holistic processing used during the final phase of the experiment would not match the featural processing they used during the intermediate second phase of the experiment.

Experiment 1

Based on previous research (e.g., Doan & Leboe, 2006; Macrae & Lewis, 2002; Schooler & Engstler-Schooler, 1990; Tanaka & Farah, 1993), I expected that participants in the *look source* and *no source judgment* conditions would primarily rely on a default tendency to process the shapes holistically during the recognition test, which would represent a match with the holistic processing participants engaged in when simply looking at the shapes during the study phase. This being the case, I predicted that participants in the *look source* and *no source judgment* conditions would show a similar pattern of results and would exhibit a lower likelihood of judging shapes that were counted during the study phase as *old* relative to their judgments of *old* for shapes that were merely looked at during the study phase. I also predicted that this disadvantage for shapes counted during the study phase would be reduced for participants in the *count* *source judgment* condition, as I expected that the emphasis on the shapes for which the points were counted in the previous study phase would induce participants to engage in featural processing during the test phase. I anticipated that participants in the *count source judgment* condition would engage in a strategy of counting the points of shapes during the recognition test in an effort to facilitate accessing their prior experiences of counting the points of shapes earlier in the experiment. In that case, the test phase processing of shapes would more often represent a match with the featural processing used to count the points of shapes during the study phase. On many trials, this strategy of engaging in featural processing of test shapes would also generate a processing mismatch for test shapes that were processed holistically during the study phase (i.e., shapes from the *look* and *no source judgment* conditions). Thus, unlike the predicted pattern of results for the *look* and *no source judgment* conditions, my expectation was that participants in the *count source judgment* condition would judge shapes from the *count* condition as *old* at a higher rate than participants from the other source judgment conditions. I also expected that participants in the *count source judgment* condition would report higher estimates of having counted the shapes during the test phase as a strategy to aid recognition.

Method

Participants

Seventy-four undergraduate students (32 males, 42 females) enrolled in an introductory psychology course at the University of Manitoba participated in this experiment in exchange for partial course credit. There were 25 participants each in the *count source and no source judgment* conditions and 24 participants in the *look source judgment* condition. All participants were under 30 years of age ($M = 20.19$).

Apparatus and stimuli

The stimuli were 160 shapes developed by the author. Examples of the shapes are displayed in Figure 1. E-prime programming software (Psychology Software Tools, 2002) was used to present the stimuli and record participant responses, and the experiment was conducted using a Dell computer with a 17-inch colour monitor.

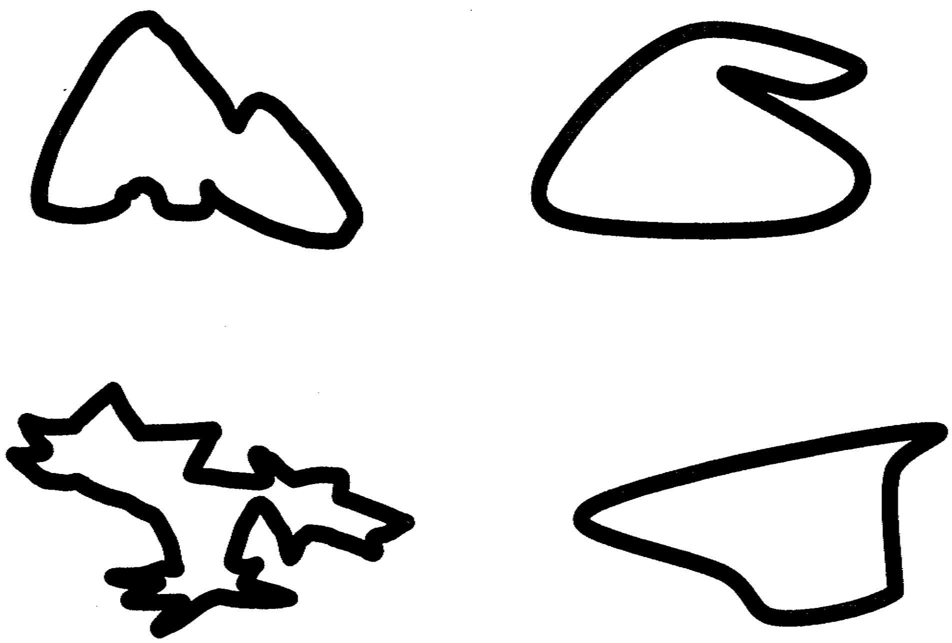

Figure 1. Four examples of abstract shapes presented during Experiment 1.

Procedure

The experiment consisted of a study phase and a test phase. There was a total of 80 shapes presented during the study phase, and a total of 160 shapes (80 *old* and 80 *new*) were presented during the test phase. Four versions of the experiment were generated to ensure that, across participants, each shape appeared equally often in each experimental condition. The experimenter gave verbal instructions regarding study phase tasks to each participant before initiating the experiment. The instruction, *Click mouse to begin trial*, appeared on the computer screen before the study phase of the experiment, and the instruction to, *Please Press "b" to Begin Test Phase*, preceded the test phase of the experiment.

Study phase. Each trial of the study phase began with the presentation of one of two instructions informing participants as to the task they would be required to perform upon presentation of the shape for that trial: *Count the number of points* (count instructions) or *Study the following shape* (look instructions). Half of the 80 study shapes followed the presentation of *count* instructions, and the other half were preceded by *look* instructions. Shapes preceded by *count* and *look* instructions were presented in random order. On *count* trials, participants were instructed to count the number of points on the shape and report the number to the experimenter after the shape disappeared from the screen. In addition, participants were instructed that an answer was required for all *count* trials, and they were asked to give their best estimate (based on the number of points already counted) if the shape disappeared from the screen before they finished counting. On *look* trials, participants were told to look at the shape for as long as it remained on the screen. After presentation of the *count* or *look* instructions, a series of five fixation crosses (+ + + + +) appeared at the center of the computer screen for 500 milliseconds (ms), followed by a shape that remained on the screen for four seconds. After four seconds, a prompt to, *Click mouse to begin trial*, appeared on the screen. This prompt remained on the screen until participants clicked the mouse.

Test phase. Participants were assigned to one of three conditions for the test phase: the *no source judgment* condition, the *count source judgment* condition, and the *look source judgment* condition. Before starting the first test phase task, all participants were told that a series of shapes would be presented to them, half of which were presented in the study phase and half of which were not presented in the study phase. Participants in the *no source judgment* condition were instructed that their task was to judge shapes as *old* or *new* during the test phase, and that they were to answer by pressing the "c" button on the keyboard if their answer was *old* and the "m" button on the keyboard if their answer was *new*. These keys were marked with stickers indicating *old* or *new*. Participants in the *count source judgment* condition were told that they would be asked to make an *old/new* recognition judgment, receiving the same instructions for this task as those given to the participants in the *no source judgment* condition. Participants were also instructed that, for shapes they identified as *old*, they were required to judge whether or not they counted the points of the shape during the study phase, providing their answer by pressing the "v" button on the keyboard if their answer was *yes* and the "n" button on the keyboard if their answer was *no*. These keys were marked with stickers indicating "yes" or "no". Participants in the *look source judgment* condition were given the same recognition and source judgment instructions as participants in the *count source judgment* condition, except that, for shapes identified as *old* at test, they were instructed to make a source judgment as to whether or not they merely looked at the shape during the study phase.

For all three conditions, each test trial began with the instruction to, *Click mouse to begin trial.* After the mouse click, five fixation crosses (+ + + + +) appeared at the center of the computer screen for 500 ms, followed by a shape that remained on the screen for four seconds. Each shape was accompanied by the question *"Is it old or new?"* on the screen below the shape. Participants in the *no source judgment* condition proceeded to the next test trial after making their recognition judgment. Participants in the *count source judgment* and the *look source judgment* conditions made a recognition judgment followed by one of two questions that appeared on the computer screen: *Did you COUNT THE POINTS of this shape during the study phase?* (for the *count source judgment* condition) or *Did you SIMPLY LOOK at this shape during the study phase?* (for the *look source judgment* condition). After making their source judgment, participants in the *count source judgment* and *look source judgment* conditions proceeded to the next test trial.

At the end of the test phase, the following question appeared on the computer screen for participants in all three conditions: *For what percentage of test trials do you think that you counted the points of the shape to help you decide whether or not you saw the shape in the previous study phase?.* Participants were instructed to report their estimate to the experimenter.

Results and Discussion

Source Judgments

Judgments of previously counting the points of a shape in the study phase were calculated for the *count source* and *look source judgment* conditions. Participants in the *count source judgment* condition were asked, *Did you COUNT THE POINTS of this shape during the study phase?,* and participants in the *look source judgment* condition were asked, *Did you SIMPLY LOOK at this shape during the study phase?.* Therefore, judgments of counting during the study phase were calculated for the *look source* *judgment* condition by subtracting the proportion of shapes judged as "simply looked at" during the study from one (count claims = 1 – look claims) to obtain the proportion of shapes they judged as counted during the study phase.

Table 1

Mean proportion of shapes claimed counted (p(claimed count)) as a function of test condition (count source vs. look source), study presentation (old vs. new), and study instructions (count vs. look).

	Test Condition	
	Count Source	Look Source
Study Presentation		
Count		
p(claimed count)	.60	.49
SE	.04	.04
Look		
p(claimed count)	.34	.28
SE	.03	.03
New		
p(claimed count)	.52	.40
SE	.03	.04

Note. Proportion of shapes claimed to be "counted" were calculated from shapes correctly judged as "old" for shapes presented with "count" and "look" instructions during the study phase; Proportion of new shapes claimed to be "counted" were calculated from new shapes incorrectly judged as "old"; SE refers to the between-participants standard error of the proportion of shapes judged as counted for each condition.

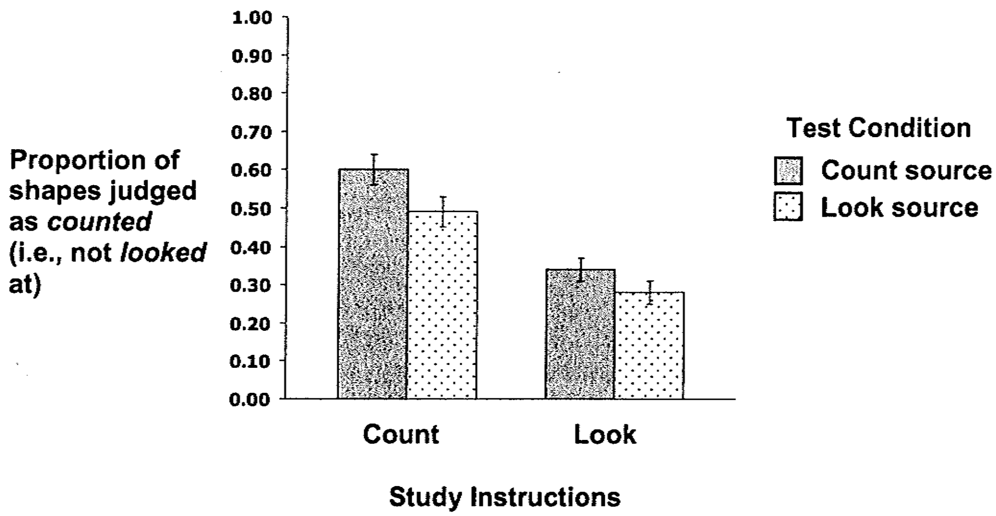

Figure 2. Bar graphs displaying the proportion of shapes participants judged as counted during the study phase as a function of study instructions *(count vs. look)* and test condition *(count source vs. look source).* Error bars represent the between-participants standard error of the proportion of shapes judged as counted for each condition.

The proportion of shapes judged as counted for each participant were submitted to a mixed design Analysis of Variance (ANOVA), treating study presentation (*count* vs. *look*) as a within-participant factor and source judgment condition (*count source* vs. *look* source) as a between-participants factor. This analysis revealed that, overall, participants in the *count source judgment* condition were more likely to claim that shapes were counted during the study phase compared to participants in the *look source judgment* condition, $F(1, 46) = 481.34$, $MSe = .058$, $p < .001$. There was also a main effect of study presentation, $F(2, 92) = 33.28$, $MSe = .020$, $p < .001$. Separate repeated measures ANOVAs were conducted to examine this effect further, comparing participants' likelihood of judging shapes as previously counted for every possible pairing of study presentation conditions. This analysis revealed that participants were about 24% more likely to claim that shapes had been previously "counted" when they actually were counted before than when they were simply looked at during the study phase (.55 vs. .31), $F(1, 46) = 63.32$, $MSe = .020$, $p < .001$. Likewise, participants were about 9% more likely to judge previously counted shapes as counted before than novel shapes (.55 vs. .46), $F(1, 46) = 7.31$, $MSe = .021$, $p < .01$. Participants were also about 15% *less* likely to claim that previously looked at shapes were counted before than novel shapes (.31 vs. .46), $F(1, 46) = 30.58$, $MSe = .017$, $p < .001$. There was no significant interaction between study presentation and source judgment condition, $F < 1$. Table 1 displays the mean proportion of study (count and look) and novel shapes claimed at test to have been counted during the study phase. Figure 2 displays the mean proportion of count and look shapes claimed at test to have been counted during the study phase. Taken together, these results suggest that participants were somewhat accurate in their source judgments, with enhanced source judgments of counting the points if the question at test emphasized counting the points during the study phase (i.e., *count source* judgment condition).

Old/New Discriminability and Bias

The proportion of shapes judged as *old* in each condition, d' (d-prime), and C-scores (Snodgrass & Corwin, 1988) were calculated for each participant. For all conditions, the proportion of *old* judgments made for shapes that were presented in the study phase served as the hit rate and the proportion of *old* judgments made for new shapes served as the false alarm rate. D' was used to evaluate participants' ability to discriminate between *old* and *new* shapes, as it reflects the tendency to respond *old* to *old* shapes relative to the tendency to respond *old* to *new* shapes. An inability to discriminate between *old* and *new* shapes is reflected by a d' score of zero. Scores above zero reflect an ability to discriminate between *old* and *new* shapes, with discriminability increasing as d' scores increase.

C was computed to measure response bias. C-scores above 0 reflect a conservative response bias, meaning a bias to call both *old* and *new* shapes *new,* and C-scores below 0 reflect a liberal response bias, meaning a bias to call both *old* and *new* shapes *old.* A C-score of 0 indicates a neutral response bias. A liberal response bias would mean that participants were more inclined to call shapes *old*, which would be reflected in an increase in both hits and false alarms. Conversely, a conservative response bias would mean that participants were more inclined to call shapes *new*, which would be reflected in a decrease of both hits and false alarms.

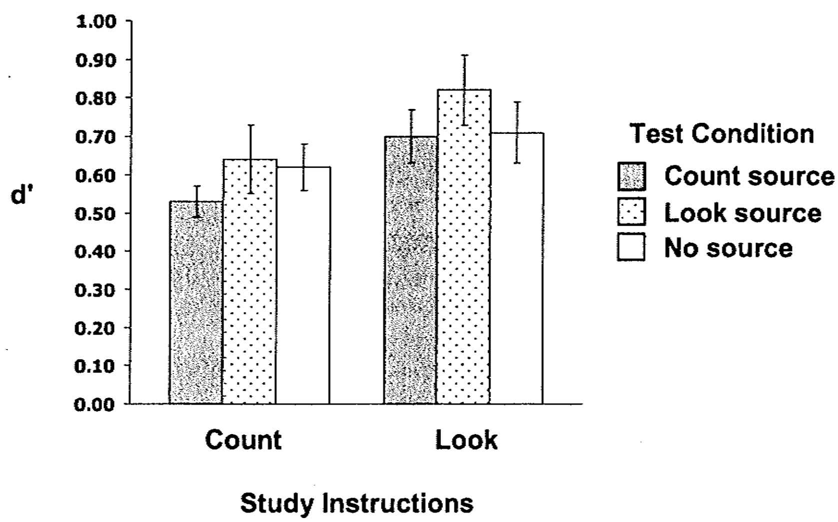

Figure 3. Bar graphs displaying mean d' scores as a function of study instructions (*count vs. look*) and test condition (*count source vs. look source vs. no source*). Error bars represent the between-participants standard error of the d' scores for each condition.

Table 2

Mean proportion of shapes judged as old (p(claimed old)) and mean d' and β scores as a function of test condition (count source vs. look source vs. no source), study presentation (old vs. new), and study instructions (count vs. look).

	Test Condition					
	Count Source		Look Source		No Source	
Study Presentation	Old	New	Old	New	Old	New
Study Instruction						
Count						
p(claimed old)	.56	.36	.58	.35	.53	.30
SE	.03	.02	.03	.03	.03	.02
d'	.53		.64		.62	
C	.10		.12		.24	
Look						
p(claimed old)	.63	.36	.64	.35	.56	.30
SE	.02	.02	.03	.03	.02	.02
d'	.70		.82		.71	
C	.01		.02		.20	

Note. D' is a measure of participants' ability to discriminate between old and new shapes; C is a measure of participants' bias to judge shapes as old vs. new; SE refers to the between-participants standard error of the proportion of shapes judged as old for each condition. As displayed in the table, within each test condition, the same proportions of old responses in response to new shapes were used as the basis for calculating d' and C for both the count and look study instruction conditions.

D' scores were analyzed using a mixed-design Analysis of Variance (ANOVA), treating study instruction (*count* vs. *look*) as a within-participant factor and source judgment condition (*count* vs. *look* vs. *none*) as a between-participants factor. This analysis revealed no significant main effect of source judgment condition, $F < 1$, and no interaction between study presentation and source judgment condition, $F < 1$. There was a main effect of study presentation, $F(1, 71) = 10.76$, $MSe = .074$, $p < .01$, with participants in all conditions exhibiting a greater ability to discriminate between *old* and *new* shapes for shapes presented holistically during the study phase (i.e., *look* instructions) compared to shapes presented featurally during the study phase (i.e., *study* instructions). Table 2 displays the mean proportion of shapes judged as *old* and the mean d' and C scores, and Figure 3 displays the mean d' scores.

C-scores revealed a slightly conservative response bias, meaning that participants were biased to respond *new* to all shapes, with mean C-scores above 0 for all three groups. These scores were submitted to a mixed-design Analysis of Variance (ANOVA), treating study instruction (*count* vs. *look*) as a within-participant factor and source judgment condition (*count source* vs. *look source* vs. *no source*) as a between-participants factor. This analysis revealed a significant main effect of study presentation, $F(1, 71) = 11.02$, $MSe = .019$, $p = .001$, with participants exhibiting a more conservative response bias for shapes that were counted during the study phase compared to shapes that were simply looked at (.15 vs. .08). There was no significant main effect of source judgment condition, $F(2, 71) = 1.779$, $MSe = .222$, $p > .05$, and no interaction between study presentation and source judgment condition, $F < 1$. Separate analyses revealed that d' scores differed significantly from zero for participants in the count source condition for shapes that were counted during the study phase, $F(1, 48) = 150.76$, $MSe = .024$, $p < .001$, and for shapes that were looked at during the study phase, $F(1, 48) = 91.91$, $MSe = .068$, $p < .001$. D' scores also differed significantly from zero for participants in the look source condition for shapes that were counted during the study phase, $F(1, 46) = 47.95$, $MSe = .102$, $p < .001$, and for shapes that were looked at during the study phase, $F(1, 46) =$

85.37, *MSe* =.095, p <.001. Finally, d' scores differed significantly from zero for participants in the no source condition for shapes that were counted during the study phase, $F(1, 48) = 104.62$, *MSe* =.046, p <.001, and for shapes that were looked at during the study phase, $F(1, 48) = 77.40$, *MSe* =.081, p <.001. Thus, although C-scores revealed a slightly conservative response bias, the d' analysis revealed that participants in all conditions were able to distinguish between *old* and *new* shapes, and this discrimination was best for shapes that were presented holistically at study. These results suggest a bias to use holistic processing during recognition, even when tasks at test emphasize featural processing (i.e., *count source judgment* condition).

Count-at-Test Estimates

The processing strategy used during the test phase (i.e., counting points/featural vs. looking/holistic) can only be inferred from the *old/new* recognition test results. To more directly assess the strategy that participants' employed during the test phase, all participants were asked to provide an estimate of the percentage of trials for which they counted the points of the shape as a strategy to aid them in making their recognition judgments. I predicted that participants in the *count source judgment* condition would provide a higher count-at-test estimate compared to participants in the *look source* and *no source judgment* conditions. The mean count-at-test percentage estimates for each source condition are displayed in Table 3 and Figure 4.

Table 3

Mean percentage of trials for count-at-test estimates as a function of test condition (count source vs. look source vs. no source)

Test Condition	Percentage	SE
Count source	38.10	6.00
Look source	31.85	5.70
No source	19.92	4.79

Note. SE refers to the between-participants standard error of the percentage of shapes claimed counted for each condition.

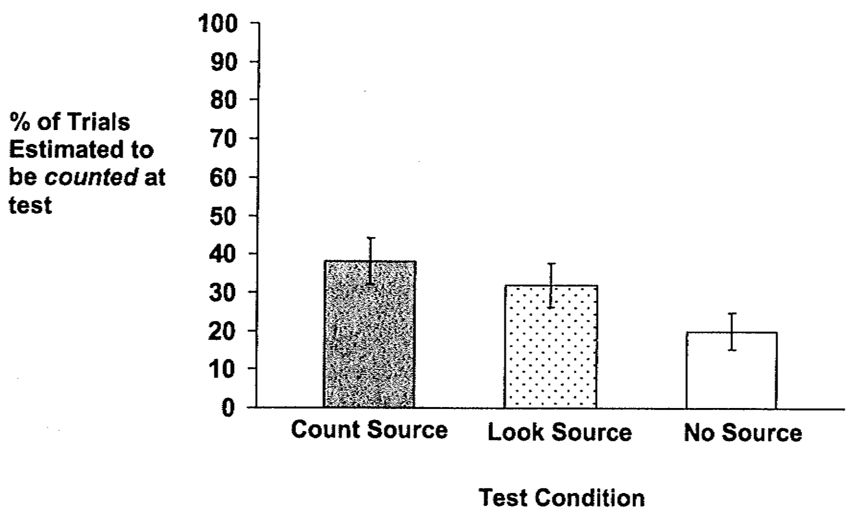

Figure 4. Bar graphs displaying participants' count-at-test estimates as a function of test condition (*count source vs. look source vs. no source*). Error bars represent the between-participants standard error of the percentage of shapes claimed counted for each condition.

The count-at-test estimates were submitted to a one-way ANOVA, treating source judgment condition (*count source* vs. *look source* vs. *no source*) as a between-participants factor. Results approached significance, $F(2, 71) = 2.78$, $MSe = .075$, $p = .069$, and separate one-way ANOVAs were performed to further examine this effect. This analysis revealed a significant difference between the *count source* and the *no source judgment* conditions (38.10% vs. 19.92%), $F(1, 48) = 5.48$, $MSe = .074$, $p < .05$. There was no significant difference between the *count source* and *look source* judgment conditions, $F < 1$, or between the *look source* and *no source judgment* conditions, $F(1, 47) = 2.59$, $MSe = .067$, $p > 05$. Thus, participants in the *count source* judgment condition reported using counting the points as a test phase strategy to aid recognition at a significantly higher rate compared to participants in the *no source* judgment condition.

In summary, participants in the *count source judgment* condition reported a higher estimate of counting the points of shapes during the test phase as a strategy to help them remember than participants in the *no source judgment* condition, but this strategy did not provide an advantage for recognizing shapes presented featurally during the study phase. Participants in the *count source judgment* condition demonstrated a similar pattern of *old/new* discrimination as participants in the *look source* and *no source judgment* conditions in that they were better able to discriminate between *old* and *new* shapes when the study shapes were presented holistically compared to study shapes presented featurally. Although these results are contrary to my prediction that participants in the *count source judgment* condition would demonstrate higher *old/new* discrimination for *old* shapes that were presented with featural instructions during the study phase compared to the other source condition groups, these results are consistent with research demonstrating a strong bias toward using holistic processing when making recognition judgments pertaining to abstract shapes (e.g., Doan & Leboe, 2006). The principle of transfer-appropriate processing would suggest that the source of this advantage is a holistic/holistic processing match between study and test conditions. This is supported by research that has revealed that a match in processing along the dimensions of featural and holistic processing between study and test conditions aids recognition, whereas a mismatch along these dimensions impairs recognition (Doan & Leboe, 2006).

I had anticipated that participants in the *count source judgment* would engage in a strategy of counting the points of shapes during the recognition test in an effort to facilitate access to their prior experience for having counted the points of shapes earlier in the experiment, and that this would result in a recognition advantage for shapes presented featurally during the study phase. However, previous research has suggested that participants do not easily modify their processing strategy to enhance recognition performance (Doan & Leboe, 2006), and it may be that the test manipulation used in this experiment was not strong enough to induce featural processing. Shapes in both phases were presented as integrated wholes, and featural processing was induced during the study phase by asking participants to count the number of points on the shape. During the test phase, participants again viewed all shapes as integrated wholes, and participants in the *count source judgment* condition were asked to identify whether they counted the points of a shape during the previous study phase. Although participants in this group reported higher claims of counting shapes during the study phase and higher estimates of counting as a strategy to aid recognition, it may be that asking participants to make a count source judgment is not enough to cause them to rely primarily on featural processing of shapes at the time of test. For example, participants in this group may have employed featural processing only if holistic processing failed to aid their recognition judgment. Alternatively, these participants may have used holistic processing when making recognition judgments, and employed a featural strategy to aid them in making source judgments. Thus, the advantage of a match in featural processing between study and test phases may have existed only for the count source judgments. However, it is important to note that participants in the *count source judgment* condition estimated counting the points at test as a strategy to aid recognition for less than 20% more trials compared to participants in the *no source judgment* condition (38.10% vs. 19.92%). This small difference might not have exerted any influence on *old/new* discriminability for shapes encoded featurally or holistically.

Although these findings suggest that participants are biased to use holistic processing when making recognition judgments, other researchers (e.g., Macrae & Lewis, 2002) have demonstrated that participants will use featural processing at the time of a recognition test. Thus, the purpose of the second experiment is to further examine factors that contribute to promoting featural processing at test. There are three fundamental differences between the first and second experiments. First, Experiment 1 employed a test phase manipulation to attempt to induce featural processing at test, whereas Experiment 2 employed a study phase manipulation. Second, instructions were used to manipulate holistic and featural processing of shapes in Experiment 1. Although the instructions to count the points of a shape directed participants to focus on the parts of each shape and, thus, promoted featural processing, it is a weak experimental manipulation in that one cannot guarantee that participants will focus only on the parts of the shape and will not engage in holistic processing of the shape to some degree. In Experiment 2, shapes were presented as integrated wholes (holistically) or one quadrant at a time (featurally). This is a stronger manipulation of featural processing in that participants are prevented from viewing the shape as a whole on these trials because only one quadrant of the shape is visible on the screen. In addition, the quadrants are presented out of order (i.e., they are not presented in a clock-wise or a counter-clockwise manner) to prevent participants from forming a holistic representation during the recognition test. This design afforded more experimental control over the processing participants engaged in during the study phase and allowed for a more precise evaluation of holistic and featural processing. Finally, Experiment 1 included featural and holistic processing as a within-participants factor, with 50% of shapes encoded featurally and 50% encoded holistically. It might be that the equal likelihood of encoding shapes featurally and holistically at study was not enough to overcome the bias to use holistic processing during the recognition test, despite count source judgments that emphasized the featural processing of many of the study shapes. In contrast, Experiment 2 employed a between-participants manipulation of featural versus holistic encoding of shapes, such that each participant processed all shapes during the initial study phase in either of those two ways. Thus, participants in the featural condition would view all shapes featurally, which is a stronger manipulation that might overcome the holistic processing bias and promote featural processing at the time of the Phase 2 recognition test.

Experiment 2

In Experiment 2, I attempted to gain more control over featural processing by presenting shapes one quadrant at a time, with the other quadrants occluded to prevent holistic processing of the shape. The purpose of Experiment 2 was to evaluate the effect of study phase processing on subsequent processing in the context of a recognition test. I used a three-phase experimental design developed by Jacoby, Shimizu, Velanova, & Rhodes (2005). Jacoby et al. (2005) presented a series of words in the first phase of the experiment, and manipulated depth of encoding by requiring participants to perform pleasantness judgments (deep processing condition) or vowel judgments (shallow processing condition). An equal number of *old* and *new* words were presented in the second and third phases of the experiment, and participants performed *old/new* recognition judgments for each word. All the words from Phase 1 and an equal number of new words (foils) were presented in Phase 2. An equal number of *old* and *new* words were also shown in Phase 3. Participants in the deep processing condition exhibited better recognition performance in the third phase of the experiment compared to participants in the shallow processing condition. The significance of this finding is that the *old* stimuli presented in Phase 3 were the foils from Phase 2. Thus, participants had not viewed these words in the first phase of the experiment, yet recognition was still better for these words if participants engaged in deep processing during the first phase of the experiment.

The authors contended that participants in the deep processing condition carried the deep processing used in Phase 1 into the second phase of the experiment, possibly engaging in pleasantness judgments as a strategy to aid them in making their recognition judgments in Phase 2. Thus, these participants encoded the foils from Phase 2 more deeply than did the participants in the shallow processing condition. Consistent with the levels of processing framework (Craik & Lockhart, 1972), deeper encoding of the words produced enhanced recognition accuracy in the final phase of the experiment, compared to shallow encoding.

In Experiment 2, I used an analogous procedure to evaluate the impact of Phase 1 processing of an abstract shape on subsequent processing along the dimensions of featural versus holistic processing. This experiment consisted of three phases, and participants were assigned to either a featural or a holistic condition. In the first phase, each shape was presented one quadrant at a time (featural condition), or as an integrated whole (holistic condition). All shapes were presented holistically in the second and third phases of the experiment for both conditions. In Phase 2 all the shapes from Phase 1 and an equal number of *new* shapes (foils) were presented, and participants made *old/new* recognition judgments for each shape. Phase 3 was the same, except that the Phase 2 foils served as the *old* shapes. The purpose of this experiment was to determine whether the processing used to encode shapes in the first phase would bias participants to use that same type of processing during the second phase. For example, participants who viewed the shapes featurally in Phase 1 would tend to engage in featural processing of both *old* shapes and *new* shapes (foils) as a strategy to aid recognition during Phase 2. This type of bias would reveal participants as applying the principle of transfer-appropriate processing as an active strategy for increasing success in remembering. By engaging in the same type of processing associated with the study phase during a later test phase, participants would increase the match between the study and test phases. In turn, this strategy would enhance the probability of participants gaining access to representations in memory for experiences that occurred during the study phase.

Based on Jacoby et al.'s (2005) findings, I predicted that participants would use featural processing when making recognition judgments during Phase 2, as the value of using featural processing as a strategy to aid recognition during the second phase of the experiment would be highlighted by using featural processing on 100% of the Phase 1 trials. In consequence, participants in the current experiment should be impaired at recognizing Phase 2 foils as *old* during the subsequent Phase 3 recognition test in the featural condition relative to the holistic condition.

There are two possible sources for this impairment. First, a tendency to engage in featural processing during the Phase 2 recognition test would mismatch with the holistic presentation of shapes during Phase 3. Second, featural encoding generally produces impaired recognition performance in the future, independent of whether processing engaged in during the recognition test is featural or holistic. In this way as well, a tendency to encode Phase 2 foil shapes featurally would impair recognition of those shapes during Phase 3.

Recently, with the same abstract shapes used in the current study, Doan, Finnegan, and Leboe (2007) demonstrated these two sources of impaired recognition performance when the encoding of shapes was made featural by revealing them one quadrant at a time. They presented participants with both featural (i.e., one quadrant at a time) and holistic (i.e., an integrated whole) shapes during both study and test phases. They found that, although shapes encoded featurally were recognized better if they were presented featurally at test, participants' ability to discriminate between *old* and *new* shapes was significantly less for shapes presented featurally at both study and test than for shapes presented holistically at both study and test. This suggests that stimuli encoded using featural processing produce a less accessible memory representation compared to stimuli encoded holistically, which is further impaired by presenting those shapes holistically at the time of test. Therefore, I predicted that recognition performance in Phase 3 would be worse in the featural condition than in the holistic condition.

Method

Participants

Forty undergraduate students (20 males, 20 females) enrolled in an introductory psychology course at the University of Manitoba participated in this experiment in exchange for partial course credit. There were 20 participants each in the featural and holistic conditions. All participants were under 30 years of age ($M = 21.98$).

Apparatus and Stimuli

The apparatus and stimuli used in the second experiment were the same as those used in the first experiment, with the exception that 20 additional shapes were added to the stimuli, for a total of 180 shapes. In addition, all shapes were represented holistically (i.e., the shape appeared on the screen as an integrated whole) or featurally (i.e., the shape was divided into four quadrants, with three quadrants occluded and one quadrant visible at any given time). Figure 5 displays an example of a featural shape and the order in which the quadrants were revealed.

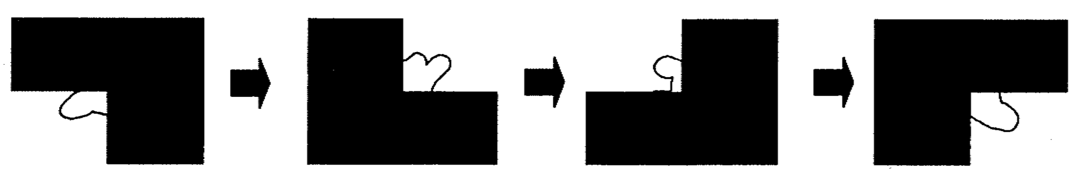

Figure 5. An example of a featural shape and the order of presentation of the quadrants.

Procedure

This experiment consisted of three phases. Sixty shapes were presented in Phase One of the experiment, 60 shapes from Phase 1 and 60 new shapes (or foils) were presented in Phase 2 of the experiment for a total of 120 shapes, and 60 Phase 2 foils and 60 novel shapes were presented in Phase 3 of the experiment for a total of 120 shapes. Overall, 180 shapes were presented throughout the experiment. Six versions of the experiment were generated to ensure that, across participants, each shape appeared equally often in each experimental condition. Participants were divided into two conditions. In the featural condition, the shapes in the first phase of the experiment were revealed one quadrant at a time. The order that the quadrants were revealed was bottom-left quadrant, upper-right quadrant, upper-left quadrant, and lower-right quadrant, as displayed in Figure 5. The experimenter gave verbal instructions before each phase of the experiment, and these instructions were also presented on the computer screen. The instruction, *Please press "b" to (start the experiment/begin the next phase of the experiment)*, appeared on the computer screen before each phase of the experiment.

Phase 1. Participants were assigned to either the featural or the holistic condition for the first phase of the experiment. Participants in both groups were presented with 60 shapes in random order and were instructed to simply look at each shape as it appeared on the screen in preparation for a later memory test. In the featural condition, shapes were presented one quadrant at a time, with each quadrant remaining on the screen for one second. In the holistic condition, shapes were presented as an integrated whole and remained on the screen for four seconds. In both conditions the instruction, *Click mouse to begin trial*, appeared before each shape presentation. Once the participant clicked the mouse, a series of five fixation crosses (+ + + + +) appeared at the center of the computer screen for 500 ms, followed by the presentation of the shape.

Phase 2. All of the shapes previously shown in Phase 1 and an equal number of new shapes were presented holistically and in random order for all participants in the second phase of the experiment. Before starting the second phase, participants were told that a series of shapes would be presented to them, and that they would see all of the shapes from the first phase and an equal number of new shapes. Participants were instructed that their task was to judge shapes as *old* (encountered in Phase 1) or *new* (not encountered in Phase 1), and that they were to respond by pressing the "c" button on the keyboard if their answer was *old* and the "m" button on the keyboard if their answer was *new.* These keys were marked with stickers indicating *old* or *new.*

Each test trial began with the presentation of five fixation crosses (+ + + + +) at the center of the computer screen for 500 ms, followed by a shape that remained on the screen for four seconds. The disappearance of each shape was followed by the question, *Is it old or new?*, at the center of the computer screen. Once participants made their response, the instruction, *Click mouse to begin trial*, replaced the request for the old/new response on the computer screen. At the end of the second phase of the experiment participants were instructed to let the experimenter know they were ready to proceed to the final phase of the experiment.

Phase 3. All procedures were identical to those of the second phase of the experiment, with the following exceptions. Sixty foils from the second phase (i.e., novel shapes from the second phase) and an equal number of new shapes were presented in random order in the final phase of the experiment. Participants were instructed that they were to judge any shapes previously presented in any phase of the experiment as *old*. It was emphasized that this included shapes that were *new* in the second phase of the experiment.

Results and Discussion

Phase 2

The proportion of Phase 2 shapes judged as *old* in each condition, d', and C-scores were calculated for each participant. For all conditions, the proportion of *old* judgments made for shapes that were previously viewed in the first phase served as the hit rate and the proportion of *old* judgments made for new shapes served as the false alarm rate.

Table 4

Mean proportion of Phase 2 shapes judged as old (p(claimed old)) as a function of Phase 2 presentation (old vs. new) and Phase 1 condition (featural vs. holistic). Mean d' and C-*scores are also provided as a function of Phase 1 condition (featural vs. holistic).*

	Phase 1 Condition			
	Featural		Holistic	
Phase 2 Presentation	Old	New	Old	New
p(claimed old)	.55	.47	.59	.30
SE	.03	.03	.03	.03
d'	.19		.81	
C	-.03		.16	

Note. D' is a measure of participants' ability to discriminate between old and new shapes; C is a measure of participants' response bias; "old" refers to shapes previously presented in Phase 1; "new" refers to shapes shown in the second phase but not in the first phase. SE refers to the between-participants standard error of the proportion of shapes judged as old for each condition.

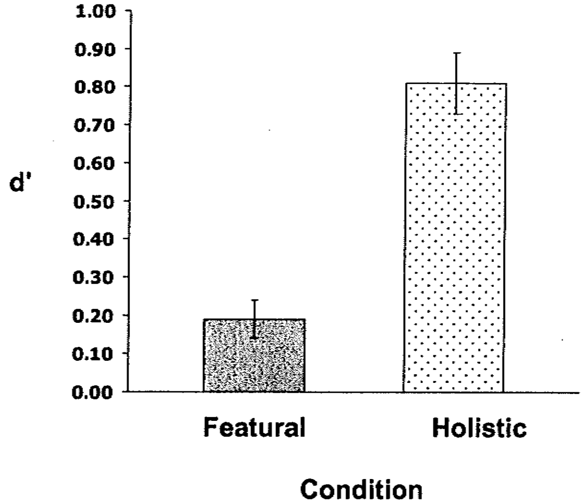

Figure 6. Bar graphs displaying mean d' scores for Phase 2 as a function of condition (*featural vs. holistic*). Error bars represent the between-participants standard error of the d' scores for each condition.

D' scores were analyzed using a one-way ANOVA, treating Phase 1 presentation (*featural* vs. *holistic*) as a between-participants factor. This yielded a significant difference between the groups, $F(1, 38) = 42.51$, $MSe = .091$, $p < .001$, with participants in the holistic condition better able to discriminate between *old* and *new* shapes than participants in the featural condition (.81 vs. .19). Table 4 displays the mean proportion of shapes judged as *old* in Phase 2 and the mean d' and C-scores. Mean d' scores are also displayed in Figure 6.

C-scores revealed a slightly liberal response bias (-0.03) in the featural condition and a slightly conservative response bias (.16) in the holistic condition. These scores were submitted to a one-way ANOVA, treating Phase 1 presentation (*featural* vs. *holistic*) as a between-participants factor. This revealed no significant difference between the groups, $F(1, 38) = 2.958$, $MSe = .123$, $p > .05$. Separate analyses revealed that d' scores differed significantly from zero for participants in the featural condition, $F(1, 38) = 13.82$, *MSe*

=.026, $p < .05$, and the holistic condition, $F(1, 38) = 101.15$, $MSe = .065$, $p < .001$. Thus, d' scores revealed that participants in both conditions were able to discriminate between *old* and *new* shapes, and this discrimination was best when shapes were presented holistically in all three phases of the experiment. This suggests that shapes encoded featurally produced a less accessible memory representation compared to shapes encoded holistically.

Phase 3

The proportion of Phase 3 shapes judged as *old* in each condition, d', and C scores were calculated for each participant. For all conditions, the proportion of *old* judgments made for shapes that were presented as foils in the second phase and subsequently presented again in the third phase served as the hit rate and the proportion of *old* judgments made for new shapes served as the false alarm rate.

Table 5

Mean proportion of Phase 3 shapes judged as old (p(claimed old)) and mean d' *and* C-*scores as a function of Phase 3 presentation (old vs. new), and Phase 1 condition (featural vs. holistic).*

	Phase 1 Condition			
	Featural		Holistic	
Phase 3 Presentation	Old	New	Old	New
p(claimed old)	.62	.43	.67	.39
SE	.03	.03	.02	.03
d'	.50		.77	
C	-.07		-.07	

Note. D' is a measure of participants' ability to discriminate between old and new shapes; C is a measure of participants' response bias; "old" refers to shapes previously presented as foils in phase 2; "new" refers to shapes shown in the third phase only. SE refers to the between-participants standard error of the proportion of shapes judged as old for each condition.

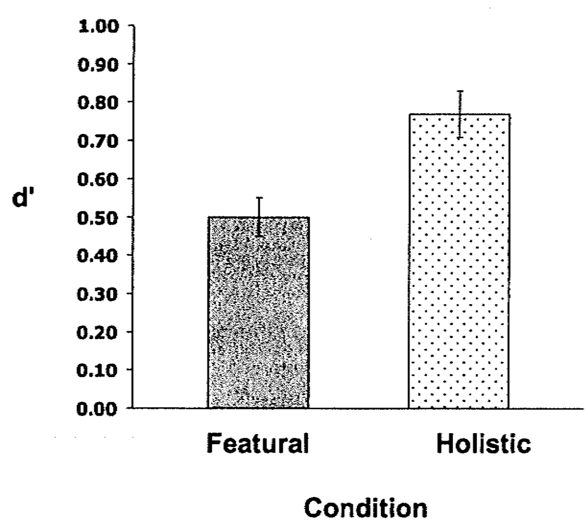

Figure 7. Bar graphs displaying mean d' scores for Phase 3 as a function of condition (*featural vs. holistic*). Error bars represent the between-participants standard error of the d' scores for each condition.

D' scores were analyzed using a one-way ANOVA, treating Phase 1 presentation (*featural* vs. *holistic*) as a between-participants factor. This yielded a significant difference between the groups, $F(1, 38) = 11.85$, $MSe = .062$, $p = .001$, with participants in the holistic condition better able to discriminate between *old* and *new* shapes than participants in the featural condition (.77 vs. .50). Table 5 displays the mean proportion of shapes judged as *old* in Phase 3 and the mean d' and C-scores. Mean d' scores are also displayed in Figure 7. Thus, participants in the featural condition were less able to discriminate between *old* and *new* shapes in the third phase, despite the fact that the *old* shapes had been presented holistically in both the second and the third phases for both conditions. This would suggest that participants in the featural condition used featural processing when encoding the Phase 2 foils.

C-scores revealed a slightly liberal response bias, with a mean score of -0.07 for both groups. These scores were submitted to a one-way ANOVA, treating Phase 1 presentation (*featural* vs. *holistic*) as a between-participants factor. There was no significant difference between the groups, $F < 1$. Separate analyses revealed that d' scores differed significantly from zero for participants in the featural condition, $F(1, 38) = 88.00$, $MSe = .028$, $p < .001$, and the holistic condition, $F(1, 38) = 176.50$, $MSe = .033$, $p < .001$. Thus, the d' scores revealed that participants in both conditions were able to discriminate between *old* and *new* shapes, and this discrimination was best when shapes were presented holistically in all three phases of the experiment. This suggests that the memory representation for shapes encoded featurally is less accessible than the memory representation for shapes encoded holistically.

In summary, Experiment 2 results were consistent with my expectation that participants would be less able to discriminate between *old* and *new* shapes when shapes were presented featurally (i.e., one quadrant at a time) in the first phase of the experiment compared to participants who viewed the shapes holistically in Phase 1. These result are interesting, given that Doan and Leboe (2006; Experiment 3) did not observe an advantage for featural shapes at the time of a recognition test when shapes were presented featurally (i.e., instructions to count the points of the shape) on 80% of study trials, suggesting that participants did not readily switch to featural processing during the recognition test. However, there are two differences between Doan and Leboe's earlier experiment and the current experiment. First, as previously noted, presenting shapes one quadrant at a time is a stronger manipulation of featural processing than instructions to count the points. Second, the current experiment required participants to engage in featural processing on all trials in the first phase of the experiment. It may be that the value of featural processing at the time of recognition was more salient to participants in the current experiment, as they did not view any of the Phase 1 shapes holistically.

The only difference between the groups in this experiment was that participants viewed shapes featurally (featural condition) or holistically (holistic condition) during the first phase of the experiment. All shapes in Phases 2 and 3 were presented holistically to both groups of participants. The critical feature of the second experiment is that participants made *old/new* recognition responses to Phase 2 *foils* and an equal number of new shapes during the Phase 3 recognition test. The significance of this detail is that participants did not encounter the foils until they appeared as *new* shapes in the second phase and, thus, recognition of those shapes in the final recognition test was based solely on the encounter with those shapes during the second phase. Thus, this experimental design allows for a closer examination of the processing strategies that participants employ to help them make recognition judgments. The results from the current experiment suggest that using featural processing during Phase 1 influenced participants to use featural processing as a strategy to aid them when making recognition judgments in Phase 2. This impaired participants' ability to discriminate between *old* and *new* shapes in the third phase of the experiment. There are two potential explanations for these findings.

First, as previously noted, a tendency to engage in featural processing during the Phase 2 recognition test would mismatch with the holistic presentation of shapes during Phase 3. According to the principle of transfer-appropriate processing (Morris et al., 1977), a processing match between an initial encounter with a stimulus and a subsequent encounter with a stimulus aids recognition, whereas a mismatch impairs recognition performance. Thus, for participants in the featural condition, the mismatch between featural processing in Phase 2 and holistic processing in Phase 3 resulted in a disadvantage in discriminating between *old* and *new* shapes. Second, featural encoding typically generates a less accessible memory representation compared to holistic encoding (Doan et al., 2007).

It is worthwhile speculating as to why featural encoding of shapes by quadrants impairs recognition performance. As noted earlier, Doan et al. (2007) demonstrated that the ability to discriminate between *old* and *new* shapes was poorer for shapes presented featurally at both study and test compared to shapes presented holistically at both study and test. Thus, keeping a match in processing between study and test constant, featural encoding produces a less accessible memory representation than holistic encoding. There are several reasons why this may be the case. Depth of encoding (Craik & Lockhart, 1972) may explain this impairment in that featural processing may be a shallower form of encoding than holistic encoding. Alternatively, it may be that holistic processing results in a more distinctive memory representation (von Restorff, 1933) compared to featural processing. For example, reading the word "car" alone would create a less distinctive representation than reading the word "car" in the context of the sentence "The woman bought a lime green sports car". Similarly, seeing one quadrant of a shape may produce a less distinctive representation compared to seeing the quadrant within the configuration of the whole shape. These issues are considerations for future research.

CHAPTER 3

GENERAL DISCUSSION

Phenomena such as the verbal overshadowing effect (Schooler & Engstler-Schooler, 1990) provide an opportunity to study fundamental principles underlying memory, while simultaneously highlighting the real-life implications of research conducted within the domain of cognitive psychology. Some researchers (e.g., Macrae & Lewis, 2002; Schooler, 2002) propose that the verbal overshadowing effect occurs when there is a mismatch between the holistic processing used during encoding a stimulus and the featural processing used when attempting to recognize that stimulus. Research suggests that participants are biased to engage in holistic processing when making recognition judgments (e.g., Doan & Leboe, 2006), but it is thought that the featural processing used to provide a verbal description of a difficult-to-describe stimulus biases an individual to use featural processing at the time of a recognition test (Macrae & Lewis, 2002; Schooler, 2002). The experiments in this thesis were designed to investigate factors that contribute to switching to a featural processing strategy when making recognition judgments. The broader goal of this thesis was to examine whether participants will use the principle of transfer-appropriate processing as a strategy to promote successful remembering. Thus, although the current study looked specifically at the impact of featural and holistic processing on recognition of abstract shapes, the greater value of the research described in this thesis lies in its potential to further an understanding of basic principles underlying human cognition.

The combined results of the two experiments described in this thesis suggest that participants will use the principle of transfer-appropriate processing (Morris et al., 1977) to aid recognition, but they do not do so easily. The first experiment revealed that participants were biased to use holistic processing at the time of recognition, despite conditions that highlight the value of using featural processing to promote successful remembering. Although these results were not consistent with my prediction that emphasizing featural processing during the test phase would encourage participants to switch to a featural processing strategy when making their recognition judgments, they did confirm earlier findings (Doan & Leboe, 2006) that suggested that there is a strong bias toward holistic processing at the time of a recognition test. Thus, highlighting featural processing at the time of the recognition test was not enough to encourage participants to switch to a featural processing strategy to aid recognition. However, this experiment was limited in that all the shapes were presented as integrated wholes, and featural processing was encouraged by asking participants to count the points of each shape. Although this instruction was designed to encourage participants to focus on the parts of the shape, there was no way to guarantee that participants would not process these shapes holistically. In addition, the first study was a mixed design that included featural and holistic processing as a within-participant factor. It is possible that requiring participants to process shapes featurally and holistically on an equal number of study trials was not a strong enough manipulation to promote featural processing and overcome the holistic processing bias in the count-source condition. To address these limitations, Experiment 2 was a between-participants design, with all shapes in Phase 1 presented featurally (featural condition) or holistically (holistic condition). In addition, more experimental control was gained over featural processing by presenting the featural shapes to participants one quadrant at a time.

The results of Experiment 2 suggest that participants will apply the principle of transfer-appropriate processing in an effort to promote successful remembering. In the featural condition, the featural processing used during Phase 1 appeared to carry over into the second phase of the experiment, resulting in poorer discrimination between *old* and *new* shapes in Phase 3 compared to participants in the holistic condition. As noted earlier, there are two potential explanations for the results of Experiment 2. First, research suggests that featural encoding produces less accessible memory representations compared to holistic encoding (Doan et al., 2007). Second, according to the principle of transfer-appropriate processing (Morris et al., 1977), the mismatch between the featural encoding of the shapes in Phase 2 and the holistic presentation of shapes in Phase 3 reduces the participants' ability to discriminate between *old* and *new* shapes.

Overall, the results of the current experiments, in combination with previous research (e.g., Doan et al., 2007; Doan & Leboe, 2006), indicate that the impact of featural and holistic processing on explicit recognition memory is a complex issue that requires more investigation. The current experiments support previous research demonstrating that a match in processing along the dimensions of featural versus holistic processing enhances recognition, whereas a mismatch impairs recognition (Doan et al., 2007; Doan & Leboe, 2006; Macrae & Lewis, 2002). The results of Experiment 2 suggest that people will strategically apply the principle of transfer-appropriate processing in an effort to aid recognition. It is important to note that the current study does not provide evidence as to whether people employ this strategy consciously or unconsciously, but it is plausible to suggest that both conscious and unconscious applications of this principle may occur. For example, some participants may consciously choose to focus on the quadrants of holistic *test* shapes if they noted that they encountered all *study* phase shapes one quadrant at a time, while other participants may carry their Phase 1 processing over into Phase 2 without a conscious intention to do so. Finally, the current research is consistent with the proposal that featural encoding produces a less accessible memory representation compared to holistic encoding, even when stimuli are processed featurally at test (Doan et al., 2007).

The findings reported in this thesis are the proverbial tip of the iceberg, as there are many questions yet to be answered regarding how explicit recognition memory is impacted by featural and holistic processing. Perhaps the most compelling finding in this research is that Experiment 2 suggests that people are strategic in using the principle of transfer-appropriate processing, even if they are not consciously aware of this principle. This implies that people are flexible in using cognitive processing when responding to task demands. However, this study also revealed a strong bias to use holistic processing during recognition judgments, and results were consistent with the contention that featural processing is a less reliable means of encoding compared to holistic processing (Doan et al., 2007). Thus, the current experiments provide important information in terms of understanding the impact of featural versus holistic processing on explicit recognition memory and lay the groundwork for future research, but the crucial questions of why featural encoding produces a less accessible memory representation compared to holistic encoding and what causes people to use featural processing during recognition judgments remain largely unanswered.

As previously noted, one potential explanation for why featural encoding creates a less accessible memory representation compared to holistic encoding lies in the levels of processing framework (Craik & Lockhart, 1972). Perhaps holistic encoding is a deeper form of processing in that participants are able to impose some meaning on the shapes as they view them, whereas featural encoding reflects shallow processing. Alternatively, it may be that holistic representations are more distinctive (von Restorff, 1933) and, thus, are more likely to be remembered.

Experiment 2 demonstrated that participants will switch to featural processing in Phase 2 if 100% of the shapes were processed featurally in Phase 1. Future research can use this paradigm to investigate when participants will reinstate Phase 1 processing in subsequent phases. For example, if participants process 75% of the shapes in Phase 1 featurally, will this be enough to cause them to implement featural processing during Phase 2? Doan and Leboe (2006) found that participants continued to engage in holistic processing at test even when 80% of the shapes were processed featurally at study. However, the experimental design used in Experiment 2 provides a new paradigm with which to measure the effects of study processing on subsequent processing. This paradigm exhibits more control over featural processing, and is a more sensitive measure of the impact of study phase processing on subsequent processing.

Conclusion

The significance of the experiments presented in this thesis lies not only in the answers they provided, but also in the questions that they generated. Specifically, the combined results of both experiments reveal a complex interaction of fundamental principles underlying cognitive processes in general, such as transfer-appropriate processing (Morris et al., 1977) and depth of encoding (Craik & Lockhart, 1972). Thus, one cannot say that featural and holistic processing impact recognition through the principle of transfer-appropriate processing alone, as the ability to discriminate between *old* and *new* shapes appears to be influenced by the quality of encoding as well as by the degree of match between study and test. However, the current research revealed that people will switch to featural processing when making recognition judgments, indicating the use of transfer-appropriate processing as a strategy to aid recognition. Jacoby, Bishara, Hessels, and Hughes (2007) suggested that participants engage in "effortful reinstatement" (p. 214) of context to aid remembering, and one basis of this reinstatement of context may be to employ the same processing during retrieval that was used at the time of encoding (i.e., transfer-appropriate processing). As previously noted, the current research does not provide evidence as to whether participants consciously attempted to instate a match between encoding and retrieval processing in an effort to improve their recognition performance or whether they employed this strategy unconsciously, but this is an area for future research. Thus, the current studies fit into a larger body of research that is attempting to define human memory by attempting to answer questions regarding the fundamental principles underlying remembering, the role of consciousness in remembering, and the factors that promote or impede successful remembering. In keeping with these broad goals, future research should examine how and when participants employ the transfer-appropriate processing principle as a strategy to aid successful remembering, investigate the factors that contribute to switching to featural processing when making recognition judgments, and define the qualitative nature of featural and holistic processing. Thus, the experiments reported in this thesis have theoretical implications in terms of promoting a deeper understanding of the broader principles of human cognition.

Aside from its theoretical value, the current research also has important implications in the real world. The verbal overshadowing effect has been discussed throughout this thesis, and understanding the role of featural versus holistic processing in increasing or reducing successful recognition is significant in the domain of eyewitness testimony. Reports of people identified by eyewitnesses and incarcerated for crimes that DNA evidence later demonstrates they did not commit illustrate the potentially devastating costs of impaired recognition. However, featural and holistic processing impact numerous aspects of life, such as navigating one's way through a busy city intersection during rush hour traffic and focusing on details, such as speed or street signs, while maintaining an awareness of the overall traffic scene. In the case of explicit recognition memory, featural processing appears to produce more impairment compared to holistic processing and, thus, it is necessary to understand the factors that contribute to this impairment. It is equally necessary to understand the conditions in which featural processing might be advantageous, and the ways in which that advantage can be maximized. For example, when does a match between featural processing at study and test produce a greater benefit for recognition than the overall benefit typically observed for holistic encoding? Conversely, when is the advantage of holistic encoding more important than the advantages obtained when there is a match in featural processing during study and test? In other words, the question is not whether the sum is greater than its parts but, rather, *when* is the sum greater than its parts?

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