COMPONENT TRANSFER: POSITIVE AND NEGATIVE TRANSFER EFFECTS ON CATEGORIZATION AND RECOGNITION ABILITY

by

Lisa D. Williams
M.A., Carleton University, 1993
Hons. B.A., Brock University, 1991

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Abstract

Prior experience of a word usually facilitates performance on a later occasion. Roediger (e.g., 1990) has provided a transfer appropriate processing (TAP) account of this facilitation. By this account, transfer depends on the type of task: some tasks benefit from earlier perceptual processing, whereas others require earlier conceptual processing. An earlier experience can also sometimes cause negative transfer, as in negative priming experiments. In this case, the effect is usually attributed to temporary inhibition of a logogen-type representation of the word (e.g., Tipper, 1985). In the first series of experiments, long-term priming, both positive and negative, are demonstrated within a conceptual task. Neither account is prepared to explain such effects. Instead, I argue for a component transfer account, in which the fundamental principle determining transfer is the match of very specific operations performed on earlier and later occasions. The second set of experiments investigates how recognition decisions are influenced by speeded and slowed performance. Recognition judgments have typically been theorized to be the result of increased specific familiarity of an item (i.e., fluency) or through retrieval of encoding context. The present studies demonstrate that nonfluent performance is not necessarily detrimental for recognition.

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Introduction: Part I

This dissertation offers an alternative framework for understanding how we are influenced by our past experiences—one that can account for both positive and negative influences on indirect memory performance. To do so, I address the notion of component transfer, specifying the content of mental representations, how representations are recruited, and how they affect performance. In Part I, a selective history of memory theory is presented in order to explain the founding ideas from which component transfer emerged. I then propose component transfer and offer experimental support for the framework. Part II furthers issues raised in Part I, and specifically addresses how recognition judgments can be influenced by both fluent and non fluent performance. A brief overview of recognition theory is presented to provide theoretical background and to indicate the generally agreed upon sources from which recognition claims can be based. This overview is followed by an investigation of how recognition can be influenced by positive and negative transfer.

Levels of Processing

Atkinson and Shiffrin (1968), in their modal framework, maintained that memory could be understood as information that is held and transferred between distinctive structural stores. The memorial fate of information was determined by the properties of the stores and control processes operating between the stores. Properties of the memory stores were thought to be constant and control processes were thought to be under individual control. Three stores were proposed, the sensory registers, the short term store and the long term store. Control processes included coding (which passed information from the sensory registers to the short term store); rehearsal (which copied information from the short term store into the long term store); and retrieval (which passed information back from the long term store to the short term store).

Although Atkinson and Shiffrin's (1968) modal framework could account for much of the literature at the time, the framework was quickly criticized on the grounds that control processes were too simplistically defined (e.g., Bjork & Whitten, 1974; Rundus, 1977) and that the defined properties of the stores were incorrect (e.g., Dale & McGlaughlin, 1971; Keppel & Underwood, 1962; Kroll et al., 1970; Murdock, 1961; Treisman, Russell & Green, 1975). As an alternative to this modal framework, Craik and Lockhart (1972) offered the levels of processing framework. This approach emphasized the attempt to understand mental processes and de-emphasized the importance of defining store properties.

Craik and Lockhart (1972) suggested that memory traces were to be understood as a by-product or record of the cognitive processes of encoding. Various forms of encoding were therefore predicted to have differential consequences for subsequent memory demands. As argued by Lockhart (1978), orienting task instruction (i.e., telling subjects to treat the stimulus in a particular way) provides experimental control over input processing. Later differences in recall can then be attributed to the differential memory benefits of the orienting tasks.

Craik and Lockhart (1972) proposed that the cognitive system was hierarchically organized and that stimuli were processed to different levels of analysis, starting with early sensory processing and terminating with later meaningful processing. For experimental purposes, they made the distinction among three types of qualitatively different domains of processing: graphemic, phonemic and semantic. Additional processing of a stimulus from a graphemic, to a phonemic, then to a semantic level was considered to result in a greater 'depth' of processing. Deep processing of the stimulus was proposed to create a more extensive memory record allowing the trace to become more durable. As a consequence, deeply processed stimuli would be most easily remembered.

Craik and Tulving (1975) added the concept of 'elaboration' of processing to the original depth of processing notion. This concept was added to the original framework to account for the findings that increased analysis of a stimulus at a particular depth (e.g., graphemic, phonemic, semantic) resulted in greater levels of retention. For example, responding positively rather than negatively to a meaning verification statement results in better recognition and recall (Craik & Tulving, 1975), or making several semantic decisions is better than a single decision (Tyler, Hertel, McCallum, & Ellis, 1979). The increase in retention from elaborate processing has been argued to be the result of associating that event with other events such that there are more retrieval access routes to the event (e.g., Anderson, 1976), or alternatively, by proposing that elaborate processing creates a distinctive trace, standing out relative to other meaningful knowledge (e.g., Ausubel, 1962; Craik, 1977; Murdock, 1960).

The levels of processing framework has been criticized on several grounds, including vagueness of terms, an over-reliance on encoding processes and independence of concepts. The most popular and potentially damaging criticism is that of circularity. Both Baddeley (1978) and Nelson (1977) have argued that the reasoning behind the framework is circular because there is no independent index for the concepts of depth or elaboration. They argued that the concepts are post hoc: any well remembered event was either more deeply or elaborately processed.

Lockhart and Craik (1978, 1990) addressed this circularity assumption by stating that the criticism is only partially correct, that it does apply to the notion of elaboration, but not to that of depth. The depth level of orienting tasks was predicted a priori and independent of the subsequently observed memory performance. They further argued that it would be very difficult, if not impossible, to actually find an independent index that could be validated. They suggested possible indices of the use of processing time or effort; however, they believed that using simplistic strategies would embody the circularity they were accused of. The authors noted that depth and elaboration were tentative terms meant only to characterize processes that required further specification through ongoing research. Most importantly, the authors emphasized that general principles and frameworks that are not immediately falsifiable by a critical test are required in cognitive psychology. Focusing only on a narrow hypothetico-deductive tradition generates data that have no significance apart from the theory they were meant to test, and once the theory is falsified, the data are discarded. They stressed that the major goal of theorizing should be to guide the data collection and that the data themselves then guide and constrain the subsequent theory construction.

True to this suggestion, the levels of processing framework was highly influential in changing both thinking and investigation relating to memory function. Regardless of the criticisms the framework has elicited, I believe that two key elements from this work must be retained in current memory theory. First is the suggestion that what is retained in memory is a record of the orienting task operations. Second is the emphasis on defining what types of processing are involved in different tasks.

Transfer Appropriate Processing

While the levels of processing framework stressed the importance of encoding processes, it was quickly noted that retrieval processes should also be considered important to the ability to remember. Morris, Bransford and Franks

(1977) offered the principle of transfer appropriate processing as an alternative to levels of processing. This principle states that performance on remembering tests will benefit to the extent to which the operations required to perform the test reinstate those formed during the study phase. Accordingly, a process will lead to better memory performance, not because it involves deep or elaborate processing, but because it is appropriate given the type of test that will be conducted.

To demonstrate this point, Morris et al. (1977) presented subjects with one of two incidental orienting tasks: they were required to judge either whether a target word (e.g., TRAIN) filled the meaning of a blanked word in a sentence (e.g., The ______had a silver engine.) or they were required to judge whether a target word (e.g., EAGLE) rhymed with another word (e.g., ______ rhymes with legal). Training tasks were therefore equivalent to the levels of processing orienting tasks involving either semantic or phonemic processing. Two tests were used, one being a standard recognition test where items were presented and subjects were required to identify if it was an item heard during the training, the second being a rhyming recognition test where subjects were asked whether a presented word rhymed with one of the training items (i.e., *regal* would be a "yes" response if eagle had been presented in training). In the standard recognition test, the semantic orienting task resulted in better recognition than the phonemic orienting task. Conversely, on the rhyming recognition test, the rhyming orienting task led to better recognition performance than the semantic task. Morris et al. (1977) interpreted their results as supporting transfer appropriate processing because the less deep rhyming process proved more valuable, or 'appropriate' for a later test requiring that rhyming operation. They stressed that no one process is equally valuable for all tests.

Although this finding supports the notion of transfer appropriate processing, whether it can be used to argue for disregarding the notion of depth (or elaboration) is questionable. Fisher and Craik (1977) replicated the results of

Morris et al. (1977) and found that although rhyme encoding followed by a rhyme recognition test led to better performance than did semantic encoding, semantic encoding followed by a semantic recognition still led to best overall performance. Hence, a semantic match was still better for recognition over a rhyming match. Fisher and Craik argued that semantic encoding leads to more specific retrieval cues, which in turn leads to enhanced discriminability from competing cues.

A proposal similar to the principle of transfer appropriate processing is the principle of encoding specificity (Tulving, 1972, 1983). According to this principle, recollection of an event depends on the interaction between encoding and retrieval event properties. Because study and test properties interact, both sets of conditions must be specified before meaningful statements can be made about memory processes. In essence, both transfer appropriate processing and encoding specificity state identical principles, and make identical predictions regarding cognition. However, if one were to take the terms of 'appropriate' and 'specificity' at face value, Tulving's wording seems to suggest that exact matches between training and test are required, whereas Morris et al.'s (1977) can be seen as more liberal, allowing for incremental benefits with increasing appropriateness.

Summary of the Early Frameworks

The levels of processing framework and the principle of transfer appropriate processing both stress the importance of understanding the processes underlying task demands. Both were offered as explanations of remembering. Whereas levels of processing stressed the importance of encoding conditions on remembering, transfer appropriate processing stressed the interactive nature of encoding and retrieval processes.

This emphasis on explaining remembering benefits did not address the issue of whether elaborate encoding or appropriate train-test conditions would also benefit performance on tasks other than recall or recognition. Beginning in the 1980's, researchers began to open their focus, and began to make distinctions between tasks that use factual knowledge (i.e., categorization, verification, perceptual identification) and tasks that require autobiographical knowledge (i.e., recognition, recall). Tasks that use factual knowledge have been variably termed implicit or indirect in that they do not require intentional remembering, whereas tasks that use autobiographical information have been termed explicit or direct in that they do require intentional remembering (Schacter, 1985; Richardson-Klavehn & Bjork, 1988). Both theories of levels of processing and transfer appropriate processing are often cited as explanations of current memory phenomena, including both indirect and direct findings. However, the theories as originally offered did not address indirect memory and these explanations are extrapolations from the original proposals.

Direct and Indirect Task Dissociations

The distinction drawn between direct and indirect memory tasks has proven to be more valuable than a simple definition of the types of information that can be asked of a subject in a task. Direct and indirect memory tests have been demonstrated to dissociate on several measures. For example, whereas a levels of processing orienting manipulation influences several direct tests of memory, the manipulation has little effect on indirect measures (Jacoby & Dallas, 1981).

These dissociations between direct and indirect tasks have been the cornerstone evidence to support the theoretical need for separate memory systems in multiple systems approaches to memory (e.g., Cohen & Squire, 1984; Schacter, 1985; 1990; Tulving, 1983; Tulving & Schacter, 1990). Under these accounts, each memory system holds different types of information about our past. Dissociations are explained as the result of different tasks accessing different memory systems for their respective pieces of information. For example, the episodic system contains time and event information and is therefore used in direct memory tasks, whereas the semantic system contains our abstracted conceptual knowledge and is therefore used during indirect tasks.

Arguing against these system frameworks, Roediger and colleagues (Roediger, 1990; Roediger & Blaxton, 1987; Blaxton, 1989; Roediger, Weldon & Challis, 1989; Srinivas & Roediger, 1990) have argued that memory task dissociations can be understood through a modified transfer appropriate processing account. Their framework is based on a combination of points drawn from earlier work (e.g., Jacoby, 1983; Jacoby & Dallas, 1981; Kolers, 1979, Morris, Bransford & Franks, 1977) and stresses three tenets. First, performance on a memory test will benefit to the extent that the operations required to perform the test reinstate those formed during the study phase. Second, tests can be characterized in terms of the extent to which they require primarily perceptual or primarily conceptual processing.[1] Third, dissociations are the result of comparing tests that invoke study operations relative to tests that do not.

Jacoby (1983) used this type of processing logic to explain his dissociation between the orienting tasks of reading and generating targets on the test tasks of recognition and perceptual identification. During study, subjects either read targets presented with no context (i.e., XXXX-up), read targets from an antonym context condition (i.e., down-up) or generated targets from antonym context condition (i.e., down-???). Subjects were then given either a recognition task (a direct task) or

[1]These authors specify that tests are unlikely to engage exclusively one type of processing, and that most tests likely involve a mixture of perceptual and conceptual processing.

perceptual identification task (an indirect task). Perceptual identification benefited from the read but not the generate study. Conversely, recognition benefited from generate but not read study. Jacoby reasoned that reading is a perceptually-driven task: reading a word relies on processing the physical features of a stimulus in order to say the target word. In contrast, generating an antonym is primarily a conceptually-driven task: it requires thinking about the meaning of a word and then thinking about the opposite meaning. Therefore, when the study task involved reading, it provided the perceptual processing information required by the perceptual identification test. When the study task involved generating the antonym, it provided conceptually-based processing which facilitated the recognition test.

Roediger and Blaxton (1987) have argued that their transfer appropriate processing account can explain much of the evidence that has been used to support multiple systems accounts of memory. They note that most experiments employ indirect tasks requiring primarily perceptually-driven processing and direct tasks requiring primarily conceptually-driven processing. Therefore, dissociations between types of indirect and direct tasks actually represent the transfer of appropriate perceptual and conceptual processing at test, and not the function of different memory systems. Blaxton (1989) provided support for this position by orthogonally manipulating indirect and direct tasks relative to perceptual and conceptual processing requirements. The perceptual based tasks she used were word-fragment completion (indirect task) and graphemic-cued recall (direct task) and the conceptually-driven tasks were general knowledge questions (indirect task) and semantic cued recall (direct task). Performance on the indirect and direct perceptually-driven tasks benefited from a study that involved reading but not generating a synonym. In contrast, performance on the indirect and direct conceptually-driven tasks benefited when study involved generating an item from a synonym but not from reading. Dissociations therefore were predicted by consideration of the types of processing demands between study task and test, and not by an indirect and direct memory system division (i.e., semantic and episodic systems).

Support for a Perceptual/Conceptual Processing Distinction

Over the last decade, the memory literature has become replete with papers demonstrating perceptual and conceptual processing dissociations. Providing a study that includes perceptual processing produces priming on tests requiring those perceptual operations. Perceptual priming is reduced or eliminated when the perceptual processing provided during study differs from test perceptual requirements. For example, words produce more priming than pictures do on a word-fragment completion task (Srinivas & Roediger, 1990; Weldon & Jackson-Barrett, 1993); words presented in one language do not prime their translation from another language (Durgunoglu & Roediger, 1987); a change in picture size between study and test decreases priming on a size judgment task and a picture fragment naming task (Srinivas, 1996); a change in visual format (upside down or backwards) reduces priming on word identification (Graf & Ryan, 1990); and a change in modality (auditory-visual) reduces perceptual priming (Blaxton, 1989; Graf & Mandler, 1984; Jacoby & Dallas, 1981; Rajaram & Roediger, 1993; Srinivas & Roediger, 1990). All cases demonstrate that a change in the perceptual requirements between study and test reduces indirect performance ability when the test is perceptually based.

Perceptual priming is shown to be relatively unaffected by the degree of conceptual processing of study words. Rating study items as pleasant/unpleasant does not aid word identification more than a study task involving rating font readability (Graf & Ryan, 1990). Searching for a specific letter during training results in better word stem completion than free associating during study (Java & Gardiner, 1991). Deep relative to shallow processing during training does not provide greater priming on word-fragment completion or perceptual identification (Blaxton, 1989; Jacoby, 1983; Jacoby & Dallas, 1981; but see Brown & Mitchell, 1994). Therefore, in contrast to perceptual based training, conceptual based training does not seem to influence indirect perceptual test tasks.

Although less studied than perceptual transfer on indirect perceptual tasks, there have also been several demonstrations of perceptual transfer on direct perceptual tasks. As stated earlier, rhyming during training aids rhyme-cued recall (Morris et al., 1977).[2] A second example is provided by Challis's (1993) demonstration that rating study words for ascending and descending letter parts during training produces greater graphemic cued recall (e.g., 'eager' increased recall of study item 'eagle') over not presented items. This finding suggest that the overlap in perceptual processing between studied items and graphemic cues produced benefits on a direct perceptual task.

The transfer appropriate processing approach has also been extensively supported by studies demonstrating that conceptual based training aids direct conceptual tasks. Generating items rather than reading items in study consistently engenders greater recall and recognition (Jacoby, 1983; Slamencka & Graf, 1978; Roediger et al., 1989). Deep relative to shallow study processing of words or pictures also results in greater recall and recognition (Craik & Lockhart, 1972; Blaxton, 1989; Weldon & Coyote, 1996). Maintaining the same encoding context (word pairings) increases associate cued recall (Jacoby, 1994; Leboe & Whittlesea, 1999; McKoon & Ratcliff, 1979; Schacter & McGlynn, 1989; Tulving &

[2]It is rather unclear whether 'rhyming' is perceptual or conceptual, but because it does not require meaningful processing, but instead phonological based processing, it will be considered here as perceptual. The training items were auditorily presented so one would assume that the perceptual based processing of this system is phonological.

Thompson, 1973). For a final example, rating meaningfulness is more effective than searching for a letter in study for later recall of general knowledge questions (Challis & Sidhu, 1993).[3]

There have also been several demonstrations that conceptual study benefits indirect conceptual tests. For example, Srinivas and Roediger (1990) demonstrated that generating a target during study produced facilitation on a category generation test relative to having read items during study. Woltz (1996) demonstrated that making semantic comparisons about two auditorally presented words (e.g., large, big), relative to trials where no comparison was required (e.g., AUDITORY TONE, big) produced priming on a later visual semantic comparison task whereas the no comparison training did not. Schacter and McGlynn (1989) demonstrated that producing a sentence from two words rather than merely reading them increased the probability that the study item would be produced in a free association test task. Further, Hamann (1990) demonstrated that rating an item for pleasantness relative to a letter search task increased the production of that item in a general knowledge question test.

Problems for Roediger's Processing Distinction

Although there has been much support for Roediger and colleagues' version of transfer appropriate processing, there have been several findings that pose problems for the framework. Some investigators have demonstrated priming on indirect perceptual tasks stemming from conceptual training. Toth and Hunt (1990)

[3]It is important to note that although prior conceptual processing consistently aids standard recognition and recall, why these tasks are helped by earlier conceptual processing is unclear. It could be that any elaborate effort, be it perceptual or conceptual aids standard direct tests by increasing the extensiveness of the training event. Most studies involve non elaborate perceptual tasks. However, even mere repetition of a target during training can increase recognition (Jacoby, Jones & Dolan, 1998). Simple repetition does not require conceptual processing so this finding seems to imply that direct tests can benefit from any processing that increases the chances of contacting the earlier event, be that processing perceptual or conceptual.

demonstrated that perceptual identification can benefit from a generate training. When subjects were presented with a word fragment (missing one letter) to generate during study, and given that same word fragment at test, the generated study aided perceptual identification.[4] Masson and MacLeod (1992) also demonstrated similar results: generating targets from sentence cues during study produced as much priming in perceptual identification as targets read in isolation. These authors further demonstrated that generation training can aid perceptual identification so long as the specific processes involved in the generating task did not require integrating a target within a context. Priming was observed when the study involved 1) generating a target from a synonym, 2) generating a famous first name from an initial and last name, 3) generating a word from a fragment that was presented in a sentence, 4) when generated from an antonym and the first letter was supplied (e.g., drunk-s____) or 5) when a study list included a mix between synonyms and antonyms from which to generate the target. No benefit of generating a study item occurred if the study task involved integrating a stimulus within a context: priming is not observed when a word is presented 1) intact (i.e., not a fragment) within a sentence or 2) and subjects imaged the read sentence, or 3) with a unique modifier. MacLeod and Masson (1997) further clarified when generate training would not produce priming on a perceptual identification task: Only if several encoding tasks are presented during training in a blocked fashion will generated words produce less priming than read words. Taken these findings, conceptual processing can therefore invoke operations that transfer to perceptually driven tasks.

Further difficulty for Roediger's transfer appropriate processing account is provided by studies that fail to find conceptual transfer when supposed appropriate

[4]It could be argued; however, that the generate task used by Toth and Hunt (1990) was a perceptually and not a conceptually based task. Subjects were required to generate a letter, not a meaning. If so, then their generate study would create more elaborate perceptually based traces.

conceptual training was provided. Tenpenny and Shoben (1992) found that conceptual study does not consistently transfer to conceptual indirect and direct tasks. The authors demonstrated that test-cue typicality (e.g., for target word compassion: sympathy or happiness as context cues), a conceptual processing manipulation, influences category verification and semantic cued recall in opposite ways. Typical cues (i.e., sympathy) aid category verification, but atypical cues (i.e., happiness) aid semantic cued recall. Under Roediger's (1990) transfer appropriate processing account, cue typicality should influence both tasks in a similar fashion.

Cabeza (1994) also failed to demonstrate consistent effects of conceptual training, but on two conceptually indirect tasks rather than between a conceptual indirect and a conceptual direct task. At study, subjects either generated a category label for a target, or generated associates for the target. Greater priming from category label generation occurred on a category instance generation test; however, greater priming from word association study occurred on a word association test. Vaidya et al. (1997) found similar inconsistent effects on conceptual indirect tests. Generating study items relative to reading study items did not enhance priming for 1) word-cued association with strongly associated words, 2) for category verification or 3) for abstract/concrete verification– although generating study items did aid category-cued association.

The failure to show consistent effects from conceptual training has also been demonstrated to occur for conceptually direct tests. McDermott and Roediger (1996) failed to find parallel effects from a conceptual repetition study (e.g., for target word "puzzle", following it with jigsaw) on free recall, category instance generation and category cued recall. Conceptual repetition only benefited free recall.

I believe that the general problem with Roediger's (1990) transfer appropriate processing approach is the broad emphasis on perceptual versus conceptual processing. The above noted findings can all be explained by more precisely defining the types of component processing that is involved in both study and test tasks (for similar suggestions see also Masson & MacLeod, 1992; McDermott & Roediger, 1996; Tenpenny & Shoben, 1992; Toth & Hunt, 1990; Witherspoon & Moscovitch, 1989). An implicit acknowledgment in the transfer appropriate processing literature is that not just any perceptual operations will benefit later perceptual tasks. For example, changing presentation modality between study and test is expected to eliminate or reduce perceptual priming as the perceptual operations are no longer compatible. This acknowledgment has not been considered with respect to conceptual processing. Instead, there seems to be an implicit assumption that any conceptual processing will be appropriate for a later conceptual test. This assumption is faulty: One must specifically examine the processing skills acquired in a study task and determine whether those specific skills are appropriate for the specific conceptual demands of the test. As an illustration, there is no reason to assume that thinking about the flexibility of a rubber band will benefit a later thought process about how expensive rubber bands are, even though both tasks require conceptual processing. Roediger's distinction between perceptual and conceptual operations has led to erroneous assumptions of the appropriateness of transfer of these operations. Although this distinction was an attempt to more specifically define what was meant by Morris et al.'s (1977) vague notion of operations, this dichotomy is insufficient to accurately predict transfer.

Alternative Transfer Appropriate Processing Distinctions

Other researchers have suggested alternative processing distinctions on which to base the framework of transfer appropriate processing. One such account is provided by Graf and colleagues (Graf & Gaille, 1992; Graf & Mandler, 1984; Graf & Ryan, 1990). Rather than a distinction between perceptual and conceptual processes, Graf and colleagues define the critical processing distinction as between integrative and elaborative processing requirements. Integration results from processing that bonds features of a target into a coherent unit. Integration can occur if a subject processes a gestalt among separate units or conceives structure through concurrent stimulus feature processing. Elaboration results from any associative processing between a stimulus and context (e.g., relating the stimulus to other stimuli or prior knowledge). The authors assume that indirect and direct tasks differ in their engagement and emphasis on integrative and elaborative processing. They note that the combination in which the different processes are engaged depends on test situations, including available cues, instructions and individual motivation. Indirect tasks are assumed to engage primarily integrative processes and direct tasks primarily engage elaborative processes. Therefore, priming on indirect tests reflects an overlap between study and test integrative processing, and direct tasks benefit from an overlap in elaborative processes.

Graf and colleagues' (Graf & Gaille, 1992; Graf & Mandler, 1984; Graf & Ryan, 1990) version of transfer appropriate processing differs from Roediger and colleagues' version by more precisely defining perceptual processes in terms of what these processes involve: the unitizing of the perceptual features of a stimulus set. Although attempting to more clearly define the type of component processing required by indirect tests, this definition is highly restrictive. One can easily create an implicit test that is perceptually based yet would not benefit from a prior study that evoked integrative processing. For example, a study that integrated features by having subjects read a word would not facilitate a later indirect test involving letter identification (see Whittlesea & Brooks, 1988, for a reversal of the word superiority effect and a demonstration of a letter superiority effect). Further, one could argue that this version is only a redefinition of Roediger's version in that integrative processing could be paralleled to perceptual processing and elaborative processing to conceptual processing. Both concepts of perceptual processing and integrative processing are directed at physical aspects of the stimulus. Although conceptual processing implies meaningful processing, meaningful processing would often be involved in associating an item with its context or previous knowledge. Further, as argued by Masson and MacLeod (1992), priming on indirect tasks can be facilitated by contextual information. For example, Smith, MacLeod, Bain and Hopee (1989) demonstrated that repetition priming was stronger when targets were presented at test with previously studied primes, regardless of whether the prime-target pairings were the same or different from those at training. Benefit from a study context would not be predicted on indirect tests from Graf's version of transfer appropriate processing because these tests are assumed to rely on integrative rather than elaborative processing.

A final problem in distinguishing processing as integrative or elaborative is that there is no evidence that the processing actually differs between them. This dichotomy establishes that the focus of processing events can differ, being either directed solely at the item itself or at both the item and context. Processing in the latter case is obviously more resource demanding than the former as it requires the individual to focus on more material; however, it does not imply that there are two qualitatively distinct types of processing between the events. One could argue to drop the labeling of integrative processing and use only the one dimension of elaborative processing: Elaborative processing involves associating independent stimulus features, as well as contextual details. In this case the focus is on quantity of processing, not the type, and increasing the quantity of processing increases the quality of the trace. A similar argument has been proposed by Leboe and

Whittlesea (1999) against dual process theories of recognition (e.g., Mandler, 1980, 1991; Jacoby, 1991, 1994).

Masson and MacLeod (1992) have also offered an alternative processing distinction for the transfer appropriate processing framework, slightly different from that proposed by Graf and colleagues. Masson and MacLeod's distinction falls between interpretive processing and elaborative processing. Interpretive encoding involves the construction of an interpretation for a stimulus defined by the presentation context (e.g., the nature of the encoding task and other stimuli used in performing that task). Upon stimulus presentation, many interpretations of a stimulus will be recruited from memory to guide response. Discriminative processing uses contextual cues to filter between the alternatives until one specific interpretation for that context is chosen. The authors specify that competing interpretations are insufficiently supported by the cues and that they may be inhibited by the correct interpretation. Under this notion, cues that recruit memories for interpretive operations can be both perceptual and conceptual. In contrast to interpretive operations, elaborative processing operations are deliberate and reflective and they follow the initial interpretive processing operations. They can also involve both perceptual and conceptual based processing, depending on the nature of the elaborative tasks.

Under Masson and MacLeod's (1992) transfer appropriate processing account, priming on indirect tasks reflects increased efficiency at discriminative processing. Cues at test more readily recruit the correct interpretation of a stimulus. Any contextual change at test would modify the body of recruited representations, and would therefore weaken or eliminate priming effects (see Masson & MacLeod, 1992, p. 163). Benefits on direct tasks are considered to require conscious reflection of prior occurrence. They will therefore be sensitive to both interpretive and elaborative processing; however, particular benefits would occur from prior conscious elaborative processing.

Whereas Graf and colleagues' processing distinction can be likened to Roediger and colleagues' distinction, Masson and MacLeod's (1992) distinction can be interpreted as more in line with an automatic and controlled processing distinction (see Logan, 1988; Schneider & Shiffrin, 1977). The problem with this processing distinction is the difficulty in determining when processing is elaborative and therefore deliberate and conscious relative to when processing is merely interpretive. As argued by Jacoby and colleagues (Jacoby, 1991; Jacoby, Lindsay & Toth, 1992, Jacoby, Toth & Yonelinas, 1993), tasks are not "process-pure": a proportion of performance on implicit tests may stem from intentional use of memory as well as unintentional use. For example, correctly identifying a word on a perceptual identification test could be the result of a prior experience facilitating the perceptual processing of the item, or it could be the result of consciously remembering a study word that looks like the item that was just briefly displayed. Similarly, performance on explicit tests can also reflect use of both intentional and unintentional memory processes. Remembering an event can be unintentionally produced through contextual cueing of the current situation rather than a deliberate attempt to remember that event. Taken to the extreme, Whittlesea and colleagues (Leboe & Whittlesea, 1999; Whittlesea, 1997; Whittlesea & Williams, 1999a, 1999b, 1999c) have argued that all performance is produced unintentionally in that individual's responses are simply cued by an interaction between the stimulus of interest, task demands and prior history. Conscious feeling states are simply epiphenominal to the underlying unconscious mental processing.

A Component Processing Account

Moscovitch and colleagues (Moscovitch & Umilta, 1990, 1991; Moscovitch, Vriezen, & Goshen-Gottstein, 1993; Vriezen, Moscovitch & Bellos, 1995) have offered an account of priming based on specific processing components, rather than using a broad dichotomy between two types of processes. Under their account, memory tests require a set of component processes, and memory will benefit to the extent that critical component processes were performed at study. Although similar to the transfer appropriate processing 'overlap' assumption, components are considered as structural units, each responsible for a specific task function. Component processing is accomplished in separate memory systems, and these processes are assumed to be accomplished in separate areas of the brain. This account can therefore be considered as a hybrid between multiple systems and processing accounts for transfer.

Vriezen et al. (1995) propose that these components are hierarchically and sequentially accessed from each system. For example, the semantic system is not accessed until the earlier perceptual system has been accessed. Tasks are considered to leave representations only in systems in which component processing occurred. Tasks such as naming and lexical decision leave perceptual representations in the word form system, whereas meaningful tasks, such as categorization, leave representations in both the word form and semantic systems. Under this account, priming should be observed across tasks that operate at the same level of the hierarchy, providing that the tasks activate similar information about the items.

Supporting this claim, Vriezen et al. (1995) demonstrated that training involving only the word form system did not prime a test task requiring the semantic system: lexical decision training did not prime a categorization test. Priming on the categorization task would have required component processing in the semantic system. Conversely, they demonstrated that training requiring the higher semantic system did produce priming on a lower word form system test: categorization in training primed naming and lexical decision. The authors further demonstrated that tasks operating in the same system did prime each other: cross format priming was observed for lexical decision and naming tasks, and cross format priming was observed for categorizing according to dimension and size judgments.

The Vriezen et al. (1995) findings suggest that processing dichotomies (e.g., Roediger et al., 1989) and typical system approaches (e.g., Schacter, 1990, 1992,: Tulving & Schacter, 1990) require additional assumptions to adequately explain priming across tasks. However, their component processing account needs theoretical clarification. It is unclear why processing in a lower level system would not produce at least some benefit for tasks needing higher systems. One would assume that in a hierarchical stage model, benefits in earlier stages should still benefit later stages, by speeding/aiding early level processing relative to items that have no such processing advantage (i.e., novel items). Further, the magnitude of repetition priming and cross task priming differs depending on task, yet there is no explanation as to why this would occur. Finally, although they stress the importance of the specificity of overlap in conceptual processes, they do not provide an adequate explanation of how some conceptual processes lead to transfer (e.g., size and dimension judgments) whereas others do not (e.g., size and man-made judgments). They merely state that conceptual tasks will demonstrate priming if in the same semantic 'domain'.[5]

[5]It is also important to note that task consistency (i.e., training task same or different at test) was always manipulated between subjects. Manipulating this factor within subjects may increase sensitivity to perceptual transfer on conceptual tasks.

Theoretical Oversimplifications of Transfer Theories

As can be seen in the preceding section, there have been several attempts to define the types of mental operations involved in transfer. These attempts involve defining mental operations in terms of dichotomies, except for the component processing account offered by Moscovitch and colleagues (Moscovitch & Umilta, 1990, 1991; Moscovitch et al., 1993; Vriezen et al., 1995). The attempt to divide cognitive phenomena into dichotomies is prevalent within the field of cognition. Dichotomies include conscious/unconscious, implicit/explicit, analytic/nonanalytic, automatic/controlled, familiarity/recollection, and interitem/intraitem, to name but a few. This tendency to dichotomize phenomena is perhaps an oversimplification of our theorizing, and may not truly define mental operations. Because cognitive processing is so complex and extensive, it is not likely that a distinction between any two types of mental operations will adequately explain and predict behaviour (see Whittlesea, 1997).

A second oversimplification in our theories of transfer has been to stress how our behaviour benefits from prior experience (see Richardson-Klavehn & Bjork, 1988 for similar commentary on the concentration on facilitation). The biasing implication of the transfer appropriate framework is that only 'appropriate' operations are transferred to guide performance. Roediger and colleagues' (Blaxton, 1989; Roediger, 1990; Roediger & Blaxton, 1987; Roediger, Weldon & Challis, 1989; Srinivas & Roediger, 1990) and Graf and colleagues' (Graf & Gaille, 1992; Graf & Mandler, 194; Graf & Ryan, 1990) versions of transfer appropriate processing state that operations will be recruited to the extent that they match current demands implying nonmatching operations are not recruited. Masson and MacLeod's (1992) version states that some competing traces are recruited but inhibited by the correct interpretation, implying that only the correct interpretation can be accessed. Finally, Moscovitch and colleagues' (Moscovitch & Umilta, 1990, 1991; Moscovitch et al., 1993; Vriezen et al., 1995) component processing account states that component operations performed in a particular semantic domain are not accessed by tasks using a different semantic domain. This implies benefits will only be observed when correct domains are accessed, but not that any harm can result from component operations in a different domain. Taken to the extreme, implicit (indirect) memory has even been defined in terms of observed facilitation. For example, Graf and Schacter (1985, p. 501) state "implicit memory is revealed when performance on a task is *facilitated* in the absence of conscious recollection" [my italics]. Under this emphasis, performance harmed by prior experience is not considered evidence of indirect memory.

Against this emphasis, several research areas have demonstrated that performance can be harmed by prior experiences. The proactive interference literature demonstrates that two inconsistent paired-associate learning experiences can produce a decrement in one's ability to recall the second learned associate (e.g., Peterson & Peterson, 1959; Underwood, 1957). Further, we also know that extensive prior history can interfere with performance that is inconsistent with that prior history. For example, having skilled typing abilities on a QWERTY keyboard makes it very difficult to learn to type on a DVORAK keyboard. Within the attention research literature, we also have evidence that slowed performance can be observed if one ignores a stimulus, then must attend that stimulus (e.g., Lowe, 1979; Tipper, 1985). The current theories of transfer do not account for these findings: these demonstrate that prior experience can also hurt performance. This is not to say that researchers have been unaware of negative influences on performance; but instead, have had a strong bias to concentrate solely on facilitative effects. I would like to propose a component processing framework for understanding transfer of processing which does not rely on a general distinction between two types of processing and which specifically addresses how transferred mental operations can both benefit and harm later performance.

The Component Transfer Framework

Memory can be conceived as a dynamic storehouse of processing traces that are awaiting requirement (e.g., Hintzman, 1986; Kolers, 1979; Kolers & Roediger, 1984; Jacoby, 1983; MacLeod & Masson, 1997; Whittlesea, 1997). These traces are recruited to guide all performance, whether the task is indirect or direct. Traces are recruited by being evoked by the stimulus that requires action, the understanding of task demands and the contextual information that is available in the situation (see Whittlesea, 1997).

A stored trace is envisioned as a mass of component processing skills which are specific to the original experience: If one had seen the item earlier, the trace will include an iconic component; if one had said the item earlier, the trace will include a phonologic component; and if one had interpreted the meaning of that item, the trace will include a semantic component, specific to the earlier interpretation.[6] How recruited traces influence performance will depend on the compatibility of the prior and present component processing requirements. Some components of recruited traces are 'appropriate' in that they are required by the present task for correct performance (i.e., a component skill involved in accomplishing the task). These appropriate components will facilitate performance to the extent that they are required in the current performance: If a recruited trace has an appropriate component that is central to current processing needs, this component will have greater facilitory impact on performance than an appropriate

[6]Unlike the Vriezen et al. (1995) component processing account, the present account does not hold that components are held in separate memory systems, nor are they hierarchically accessed.

component that is more peripheral to current demands. However, not all recruited components are appropriate. Some components of recruited traces are 'inappropriate' in that they are inconsistent with current task demands. These inappropriate components will slow processing to the extent that they interfere or are inconsistent with required demands of the task. Slow processing would be the result of requiring component modification to meet demands, and would likely require the additional recruiting of other traces containing appropriate components. Take the hypothetical (and simplified) example that current processing requires components A, B, and C. Recruited components include A, B, and D where component D would produce an antagonist or irrelevant interpretation of the event than that specified by the C requirement. Processing would be slowed as additional recruiting from other traces is needed to supply the necessary C component. In forced choice decisions, it is likely that recruiting the D component does not allow for response since its information is irrelevant to the task. In circumstances where responses are freely given, recruiting D could either slow processing or simply result in error (given that on a subset of responses, D is used in the interpretation rather than forcing additional recruitment of the C component).

How one performs on a task is the result of the combined influence of appropriate and inappropriate component operations. Performance will therefore range from highly efficient to highly inefficient, depending on the number of appropriate relative to inappropriate recruited components, as well as their requirement weightings for current processing. With respect to skill acquisition, benefits in performance are the product of increasing the number of traces that include appropriate components. Further, it is possible that with increasing experience, components may become refined by eliminating redundant or irrelevant elements, or by combining two component skills. For example, when reading the word LITTLE, a novice reader might independently process each letter

T, but with increasing experience, he will process the redundancy as a unit through either elimination of one of the letters or integration of the two letters, or alternatively, holistically identify the entire letter set.[7]

Describing performance as the result of component transfer can explain why performance appears stable in highly practiced tasks. People typically deal with objects for the same purpose, under the same environmental conditions. It is not surprising, therefore, that in these situations, the majority of transferred processing components are appropriate, and the result is highly efficient performance. However, a change in task demand is predicted to influence performance by increasing the probability that those traces now become incompatible with demands, and therefore originally appropriate components become inappropriate components. For a less extreme example than the QWERTY typing case given earlier, if you are a skilled skier and take a skiing lesson in which your instructor advises you to keep your elbows out to a greater degree when polling, this correction in pole position is difficult to accomplish because the task and contextual cues still recruit traces including 'close to body pole positioning' components which are now inconsistent with your demands.

With respect to traditional transfer appropriate processing theorizing, inappropriate transfer has likely not emerged for several reasons. First, research on priming has concentrated on positive priming effects of a previous experience and no condition has been included within these designs to test for inappropriate transfer. Second, over the last 10 years, research has focused on how different kinds of training exposures can affect different kinds of tests (e.g., indirect or direct tests of memory). Within these types of experiments, again, the focus has been on

[7]This point is not equivalent to Logan's (1988) theory of automaticity which holds that novice performance relies on an algorithm, and that experienced performance is the result of retrieving an instance. Under component transfer, both novice and experienced performance is the result of recruiting traces. The experienced performer has more traces to recruit, as well as better components within those traces (if components are holistic).

demonstrating differential positive effects of a previous experience on one type of test and not the other. Finally, the ability to observe inappropriate transfer can be masked by the use of inappropriate control conditions. Any given task requires multiple component processes. If you experience a stimulus for a particular purpose, and now encounter it for a different purpose, there will be some inappropriate component transfer; however, there will also be some appropriate component transfer. For example, if you hear the word "BANK" in terms of a river, then hear the word "BANK" in terms of a financial institution, the semantic component processing will be inappropriate, while the phonological component processing will be appropriate. This process-component complication necessitates the use of precise control baselines. Novel target presentations, as used for baseline control conditions in the transfer literature, do not provide an appropriate baseline for demonstrating inappropriate transfer: In nonmatching train/test conditions, old (training phase) stimuli still have appropriate perceptual based components that can be transferred at test. These items therefore have a processing advantage over novel stimuli. To illustrate, if a study experience involves identifying a stimulus, producing component A, a test task that involves both identifying and producing a meaning would partially benefit from a transferred A training component. The A component is appropriate for part of the test demands.

Part I Objective

Component transfer predicts positive and negative transfer can be observed, depending on the appropriateness or inappropriateness of recruited components. The purpose of the present research is to demonstrate that both positive and negative conceptual transfer can be observed following a single meaningful experience. This is attempted by manipulating the consistency in how individuals are required to categorize items on two occasions. Additional refinements to the component transfer framework will be demonstrated throughout the manuscript, helping to specify the extent to which performance will benefit or be harmed by a prior experience.

Experiment 1: Positive and Negative Transfer on Ability to Categorize

The purpose of the present experiment was to demonstrate positive and negative conceptual transfer from a single prior meaningful event. Subjects were required to categorize items in one of two ways on separate occasions: either according to an edible-inedible decision or a natural-artificial decision. In 'consistent' conditions, subjects classified items according to the same decision in training and test phases. In 'inconsistent' conditions, subjects classified items according to one decision during training and the other during test. All items presented during training have possible appropriate perceptual processing components that may be helpful on test categorization because categorization requires not only conceptual but also perceptual processing (cf. Vriezen et al., 1995). Comparing test categorization latencies of categorized items relative to novel items may therefore mask the positive or negative influence of conceptual components. To control for this possibility, a condition of naming items was included as a training phase. This inclusion allows for old named items to be compared to old categorized items to see the independent influence of the consistency of the conceptual processing component on test performance. Consistent conditions should result in positive priming through the ability to recruit conceptual components that are appropriate to test demands. If inappropriate conceptual components are also recruited in the attempt to perform, inconsistent conditions should result in negative priming.

Method

Subjects. Twenty subjects participated in this experiment. Subjects were university students who received credit for participation. All subjects were proficient in the English language, and had normal or corrected to normal vision.

Materials. A Macintosh IIci with a colour monitor was used to present the stimuli, and record accuracy and reaction time data. A two-row, seven-lever button box was used for subject response. The layout of the levers was such that three red buttons were aligned on the top row, and four telegraph keys were aligned on the second row. The first of the red buttons was used for all "Ready" signals and to name items, the telegraph keys were used for categorization responses. Subjects were instructed to use their dominant hand for categorization responses, and non dominant hand for ready responses. Subjects were also instructed to keep their dominant hand centered over the relevant category decision buttons.

The stimulus set consisted of 200 words that could be classified according to both category decisions. As such, 50 words were natural/edible items, 50 natural/inedible, 50 artificial/edible and 50 artificial/inedible (see Appendix). From this set, 160 items were randomly selected for each subject, chosen equally from each crossed-category type. These materials were used in all subsequent experiments.

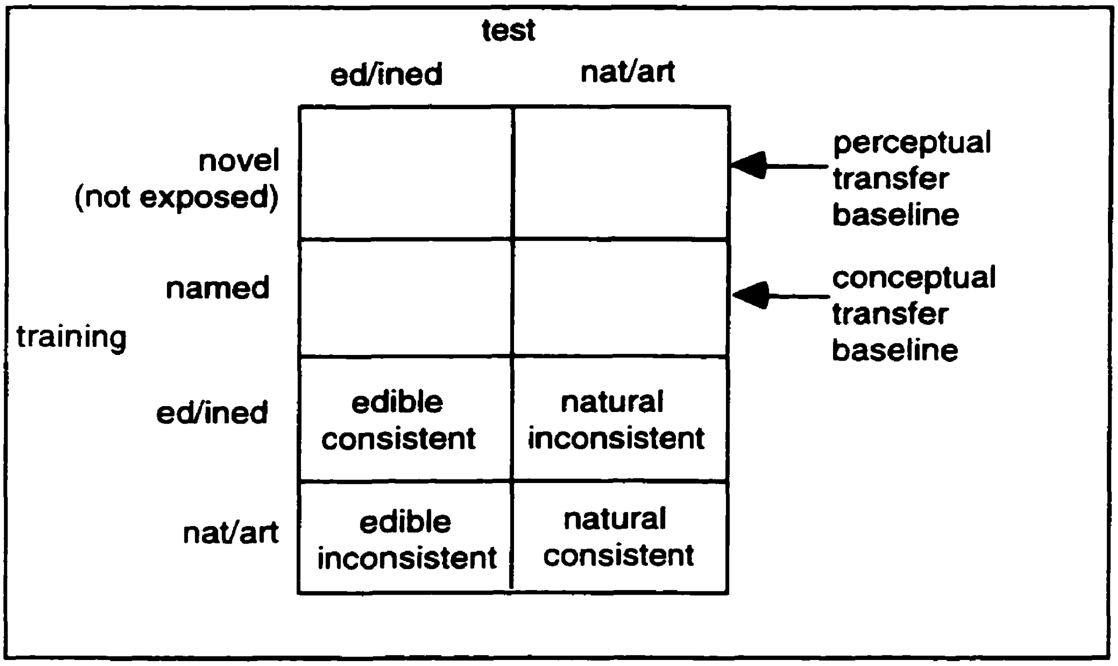
Procedure. The experiment consisted of two training phases followed by a test phase. During the first phase, subjects were required to name aloud the presented items. They were told that a general reading measure was being recorded. On each trial, the word "READY" was displayed on the screen. On a key press by the subject, "READY" disappeared and a warning stimulus ("++++") appeared on the screen for 500 milliseconds. The screen then blanked for 100 milliseconds, and the target word was presented. Subjects were instructed to push the button as they began to pronounce the word. At the end of Phase 1, a message appeared on the screen telling subjects that it was the end of the phase.

During Phase 2, subjects were required to categorize items according to edible/inedible and natural/artificial decisions. Items were presented in alternating decision blocks, for a total of 10 blocks (5 edibility, 5 naturalness). Each block started with two dummy trials (to assure that subjects were making the appropriate decision) followed by eight trials in which speed and accuracy of categorizing the items were recorded. Prior to the start of each block, a message was presented instructing subjects of the required category decision. Each category decision used two separate telegraph keys. Subjects were requested to keep their hand centered over the middle of the two keys relevant to each category decision. Identical to Phase 1, on each trial, the word "READY" was displayed on the screen and a key press by the subject initiated the timing signal, followed by the target word presentation. Subjects were instructed to push the appropriate category dimension button, and to state their decision aloud (e.g., if the target was "ORANGE" and the decision type "edible/inedible", they were to hit the "edible" button, and say edible aloud). At the end of Phase 2, a message appeared on the screen telling subjects that it was the end of the second phase.

Subjects were given a five minute break during which they chatted with the experimenter, and were then instructed on Phase 3 requirements. They were told that all procedures were identical to Phase 2, a break was just given in order to rest a bit. No mention was made regarding the re-presentation of some items. Phase 3 consisted of 10 alternating decision blocks, each block consisted of 18 words: two initial dummy trials followed by 16 trials in which categorization latency and accuracy were recorded. For each category decision, 20 items were previously named, 20 items were previously categorized according to the same category decision, 20 to the opposite category decision, and 20 items were novel.

For the sake of simplicity and brevity, conditions will be termed relative to the category decision that was made at training then test, and only one dimension of the category decision will be labeled. Therefore, edible-edible will refer to items that were categorized according to an edibility decision at training and test, natural-edible will refer to items categorized according to the naturalness decision at training and edibility decision at test. Natural-natural will refer to items categorized according to the naturalness decision at training and test and edible-natural will refer to items trained on the edibility decision and tested on the naturalness decision. With respect to the two control conditions for each category decision, named items will be compared to novel items (i.e., items not exposed in either training phase) to demonstrate perceptual component transfer from prior exposure. Named items are compared to consistent and inconsistent categorization conditions to demonstrate conceptual transfer from prior categorization (See Figure 1). For analyses, test latencies are conditioned on correct test categorization. Means for conditions are based on trimming the three fastest and slowest latencies per condition.

Figure 1: Summary figure for the training and test conditions used in Experiment 1.



Results and Discussion

Categorization latencies and errors for phase 2 will first be analyzed to see if the categorization decisions differed in terms of speed and accuracy of response. Test (phase 3) categorization latencies will then be addressed to see if the consistency of categorization between training and test phases influenced categorization latencies.

Phase 2: Training Categorization Latencies and Accuracy.

During Phase 2, items categorized according to the edible decision (899 ms) were judged faster than those categorized according the natural decision (1130 ms), $F(1,19) = 182.86$, $MSe = 2834.17$, $p = .000$. Subjects also made more errors on the natural decision (13%) than on the edible decision (7%), $F(1,19) = 13.30$, MSe = 31.76, p = .002. These findings, combined with subjective report, indicate that the naturalness decision was more difficult than the edibility decision.

Phase 3: Test Categorization Latencies.

As observed on training categorization accuracy, more errors were committed on the naturalness decision (10%) then on the edibility decision (4%). Categorization latencies from Phase 3 can be seen in Table 1, and transfer effects between conditions can be seen in Table 2. To examine transfer effects stemming from a perceptual source, named items where compared to novel items, for both category decisions. Having previously named an item facilitated later categorization of that item, but only significantly under the edibility decision. Named items were categorized 33 ms faster than novel items on the edibility decision ($F(1,19) = 7.25$, $MSe = 1510.99$, $p = .014$) and 24 ms faster on the naturalness decision ($F(1,19) = 2.47$, $MSe = 2279.78$, $p = .132$). These findings partially support the claim that prior perceptual exposure can facilitate later performance by providing appropriate perceptual based components required for a categorization decision. It is likely that perceptual transfer, producing only small benefits on performance, are masked within conceptual tasks that have more variable latencies. This would account for the failure to find significant priming on the naturalness decision in the present study, as well as the similar finding by Vriezen et al. (1995, Exper. 4). The perceptual transfer findings justify the use of previously named items as a baseline (rather than novel items) to examine the independent influence of prior conceptual processing on later conceptual test requirements. Previously categorized and named items can be equated for perceptual based processing but differ with respect to conceptual processing.

Table 1. Test categorization latencies (ms) in Experiment 1.

	Test Task:	
Training Task:	edible/inedible	natural/artificial
novel	819	977
named	786	953
edible/inedible	765	972
natural/artificial	815	888

Table 2: Transfer Effects between Test Conditions in Experiment 1.

	Test Task	
Training Task:	edible/inedible	natural/artificial
Source: Perceptual (Relative to Novel)		
name	-33	-24
Source: Conceptual (Relative to Name)		
edible/inedible	-21	+19
natural/artificial	+29	-65

To examine whether positive conceptual transfer resulted from consistent categorization, items classified in consistent conditions were compared to items that were categorized at test but had been named in training. Edible-edible decisions were classified 21 ms faster than named-edible items, $F(1,19) = 4.31$, $MSe = 942.59$, $p = .052$. Natural-natural decisions were classified faster (65 ms) than named-natural items, $F(1,19) = 9.87$, $MSe = 4312.31$, $p = .005$. The positive transfer observed for the consistent categorization conditions support the notion that a prior event can contain an appropriate conceptual component that can be recruited to guide and aid performance.

To examine inappropriate transfer from conceptual components, items categorized in the inconsistent conditions were compared to items that had been named in training. Items in the edible-natural condition were categorized on average 19 ms slower than named-natural items; however, this slowing was not significant, $F(1,19) = 1.33$, $MSe = 2561.34$, $p = .263$. It is important to note that although edible-natural latencies were not significantly slower than previously named items, the typical advantage of prior conceptual processing was eliminated by the inconsistency of the category decisions. Items in the natural-edible condition were categorized significantly slower (29 ms) than named-edible items, $F(1,19) = 19.20$, $MSe = 438.11$, $p = .000$. Prior conceptual processing that interprets an item in a fashion unsuitable for test conceptual requirements is demonstrated to result in negative transfer. Even though the item had been conceptually processed, the conceptual based processing was inappropriate when transferred to guide test performance and slowed categorization.

The present findings support predictions of the component transfer framework. A prior experience can be recruited to guide performance, and having appropriate components for current demands facilitates performance. Component transfer predicts that the observed facilitation will increase to the extent that recruited processing traces contain increasing amounts of appropriate components. Having an appropriate perceptual component can facilitate performance as was evident by the advantage of previously named over novel items on edibility decisions. However, having both appropriate perceptual and conceptual components resulted in greater facilitation. Most importantly, the present experiment also demonstrates that a prior processing event can be recruited even though it contains an inappropriate conceptual component, and that when recruited, it can have a negative impact on performance.

This pattern of findings cannot be explained in terms of cognitive models that posit that repetition priming is due to residual activation or inhibition of a concept node from the initial priming experience: the length of time between the initial and latter events was sufficiently long as to have restored a resting activity level (c.f. Forster & Davis, 1984). Further, standard transfer appropriate processing accounts would predict that a prior conceptual experience would facilitate later conceptual processing. Having consistently categorized an item would be predicted to be better than having inconsistently categorized an item; however, inconsistent categorization would still be predicted to demonstrate greater facilitation over having previously named an item. Therefore, these transfer appropriate processing explanations also cannot account for the present findings. Finally, Moscovitch et al.'s (Moscovitch & Umilta, 1990, 1991; Moscovitch et al. , 1993; Vriezen et al., 1995) component processing account would predict either that inconsistent categorization would demonstrate positive priming (if the type of conceptual processing led to the correct semantic domain) or no priming (if component processes were held in a not accessed semantic domain). Like other models, Moscovitch et al.'s component processing account does not address the possibility of involvement of inappropriate components.

Interestingly, the data seems to indicate that larger positive and negative transfer were observed if the training categorization experience was a naturalness decision. A reasonable explanation for this magnitude difference is that naturalness decisions involve more elaborate conceptual processing than edibility decisions. This suggestion is similar to the concepts of elaborate processing or spread of encoding, offered by levels of processing theorists (e.g., Craik & Tulving, 1975). As discussed earlier, using such a concept runs into problems of circularity;

however, it does seem to capture the effect. Further, this suggestion is supported by both longer reaction times and more errors for naturalness decisions during training (cf. Lockhart & Craik, 1990). In addition, during debriefing, subjects frequently reported having had greater difficulty with the naturalness decision.

If the naturalness decision involves more extensive conceptual processing, larger priming effects could occur for two reasons. First, a more elaborate component could affect the required amount of process modification. If the recruited component is elaborate and contains appropriate component processing skills, little process modification would be required for current performance and large positive priming would be observed. If the recruited component is elaborate and contains inappropriate component processing skills, large amounts of process modification would be required for correct performance and more time would be needed before response is possible. Second, a more elaborate component would have increased probability of being recruited for current performance (cf. Craik, 1977; Jacoby & Craik, 1979; Murdock, 1960). Increasing the probability that a particular component will be recruited will increase the proportion of trials per condition that are directly influenced by that particular training experience. It is likely that these two reasons are not independent, but interactive in their effects on increasing observed priming. In the following experiment, a test of whether naturalness decisions involve more elaborate conceptual processing than edibility decisions is attempted.

Experiment 2: Elaborate Processing Increases Ability to Recall

Greater positive and negative priming seemed to be observed in Experiment 1 when the original categorization experience was a naturalness decision. I have suggested that this is the result of an elaborate conceptual component having greater influence on current performance. If this hypothesis is correct, a convergent measure would be the demonstration of greater ease at generating these experiences in a free-recall test (for similar logic, see Anderson, 1976; Ausubel, 1962; Craik & Tulving, 1975; Murdock, 1960). In the present experiment, subjects categorized items according to both edibility and naturalness decisions, and were then given a surprise recall test. If more items categorized according to the naturalness decision are recalled over items categorized according to the edibility decision, the recall data would suggest that conceptual components, created under a naturalness decision, are more accessible, likely due to more elaborate processing.

Method

Subjects. Eighteen subjects participated in this experiment. Subjects were university students who received credit for participation. All subjects were proficient in the English language, and had normal or corrected to normal vision.

Procedure. From the previously described stimulus set, 80 words were randomly selected for each subject, and for each category decision. Items were presented in alternating decision blocks, as in Experiment 1. Both categorization latency and accuracy were recorded during the training phase. Following training, a 5 minute delay was given, and then subjects were then given a surprise free-recall test, in which they were instructed to write down any word they had categorized, regardless of how they had categorized the item. No time limit was given, with the restriction that at least ten minutes of effort was required.

Results and Discussion

Training categorization latencies and errors will first be analyzed to examine whether naturalness decisions took longer to process, and produced more errors than the edibility decision (as was observed in Experiment 1). Probability of recalling categorized items are then examined.

Training Categorization Latencies and Accuracy.

Naturalness decisions (1313 ms) took 294 ms longer to answer than edibility decisions (1019 ms), $F(1,17) = 70.15$, $MSe = 11055.78$, $p = .000$. Further, 10% more errors were made for naturalness decisions (16%) than for edibility decisions (6%), $F(1,17) = 54.33$, $MSe = .00$, $p = .000$. These findings replicate those observed in Experiment 1 and suggest that not only is more extensive processing required for the naturalness than the edibility decisions, but that that processing is more difficult.

Probability of Recalling Categorized Words.

More importantly, subjects were better at recalling items that had been categorized according to a naturalness decision (33%) over those categorized according to an edibility decision (25%), $F(1,17) = 10.13$, $MSe = 42.85$, $p = .005$. This finding provides convergent evidence for the hypothesis that conceptual components created during a naturalness decision are more elaborate than those of the edibility decision. Having a greater ability to recall items categorized according to a naturalness decision supports that these traces are more readily generated when explicitly required. This increased ability to be generated during recall is consistent with the claim that naturalness decisions involve more elaborate processing than do edibility decisions. Involving more elaborate processing, naturalness components would be assumed to have a greater probability of being recruited to guide indirect performance. This finding therefore supports the hypothesis that the greater priming following naturalness training decisions observed in Experiment 1 was due to the creation of elaborate conceptual components.

Taken together, the results of Experiment 1 and 2 demonstrate that conceptual processing has been treated much too simplistically by Roediger's version of transfer appropriate processing. Processing an item for meaning does not necessarily aid tests that have conceptual processing requirements. Further, all conceptual tasks are not equal. Each conceptual experience creates highly specific processing components within a trace, and those components are highly specific in effect when transferred. Conceptual events provide qualitatively different types of experiences and they vary in degree of elaboration.

Note that elaborative processing has typically been operationalized in terms of effort involved in orienting tasks. For example, elaborate processing has been operationalized in terms of one or several semantic decisions regarding an item (Johnson-Laird, Gibbs & de Mowbray, 1978; Ross, 1981) or in terms of reading a word versus generating the word from a fragment (Jacoby & Cuddy, 1981; Tyler et al., 1979). Elaboration has also been operationalized in terms of how individuals respond to items, where positive responses (e.g., Target: Nurse, Question: Associated with Health?) are considered more elaborate than negative responses (e.g., Target: Nail, Question: Associated with Soft?) (Craik & Tulving, 1977). An implicit assumption in the literature has been that different category decisions are equivalent in terms of processing elaboration. However, it is likely that no two category decisions will produce symmetrical effects when crossed for consistency because they cannot be equated for degree of elaborative processing. Vriezen et al.'s (1995, Exper. 6) findings are consistent with this assertion. Categorizing items according to a dimension judgment took longer and produced more errors than categorizing items according to a size judgment. The priming from the more difficult dimension judgment also resulted in a larger magnitude of positive priming than the size judgment.

Admittedly, defining which tasks produce more elaborate processing is not an easy venture and could run into problems of circularity. However, it is possible, a priori, to speculate on the needs of a task, and to try to estimate which needs would be more easily fulfilled than others. For example, it is likely that deciding a word is a synonym to another word involves less elaborate processing than deciding a word is an antonym to another word. Deciding antonym status involves both thinking about a word's meaning as well as its opposing meaning whereas synonym decisions require only thinking about its meaning. Although before Experiment 1 I had not considered that the categorization tasks differed in elaborative processing requirements, the naturalness decision is one that is more unusual relative to typical experience than is the edibility decision. For example, for the word BUTTER, we typically treat it in an eating context, we do not typically make butter. The present findings suggest that this level of thinking is required to make more precise predictions on the interactive effects of orienting and testing tasks.

Experiment 3: Perceptual or Conceptual Elaboration?

I have argued that greater priming occurs following the natural decision because these traces contain more elaborate conceptual components. Being more elaborate, these traces are more likely to be recruited to guide performance. However, a competing hypothesis exists for the greater magnitude of priming following the naturalness orienting task. In the first two experiments, naturalness decisions took longer to answer than edibility decisions. Naturalness decisions were therefore presented on screen for longer periods. It is possible that the traces created during naturalness decisions are not more conceptually elaborate, but merely more perceptually elaborate.

The present study was designed to demonstrate that the greater priming following the naturalness decision was due to more elaborate conceptual based components and not perceptual based components. This is accomplished by eliminating the competing hypothesis by controlling for presentation time. If items remain on the screen for a set time during training, and greater priming is still observed for items categorized according to the naturalness decision, it is likely that the differences in priming are not due to perceptual elaboration but instead due to elaborate conceptual processing.

Method

Subjects. Nineteen subjects participated in this experiment. Subjects were university students who received credit for participation. All subjects were proficient in the English language, and had normal or corrected to normal vision.

Procedure. All procedures were identical to Experiment 1, except that during both training phases (naming and categorization), items were presented for 200 ms, and the screen blanked until response.

Results and Discussion

Categorization latencies and errors for phase 2 will first be analyzed to see if the types of categorization decisions differed with respect to speed and accuracy of response. Test categorization latencies will be addressed to see if the consistency of categorization influenced categorization latencies.

Phase 2: Training Categorization Latencies and Accuracy.

During Phase 2, items categorized according to the edibility decision (656 ms) were responded to faster than those categorized according to the naturalness decision (858 ms), $F(1,18) = 33.77$, $MSe = 10020.25$, $p = .000$. Subjects also made more errors on the naturalness decision (12%) than on the edibility decision (8%), $F(1,18) = 11.81$, $MSe = 15.35$, $p = .003$. These findings replicate training data patterns observed in both Experiments 1 and 2. Because items for both category decisions were presented visually for equal lengths of time, the longer reaction times for naturalness decisions can be assumed to involve more extensive conceptual processing demands.

Phase 3: Test Categorization Latencies.

More errors were committed on naturalness decisions (9%) than on edibility decisions (5%). Categorization latencies from Phase 3 can be seen in Table 3 and transfer effects between conditions can be seen in Table 4. To examine transfer effects stemming from a perceptual source, previously named items were compared to novel items, under both category decisions. Having previously named an item assisted later classification of that item. On the edibility decision, previously named items were categorized 81 ms faster than novel items, $F(1,18) = 5.08$, $MSe = 12387.18$, $p = .037$. For the naturalness decision, named items were categorized 53 ms faster than novel items, $F(1,18) = 3.21$, $MSe = 8279.94$, $p = .090$. These findings replicate Experiment 1 results and again demonstrate that prior perceptual-based processing can assist a latter categorization task which includes the perceptual component processing demands.

Table 3: Test categorization latencies (ms) in Experiment 3.

	Test Task	
Training Task:	edible/inedible	natural/artificial
novel	850	961
name	769	908
edible/inedible	737	902
natural/artificial	814	839

Table 4: Transfer effects between test conditions in Experiment 3.

	Test Task	
Training Task:	edible/inedible	natural/artificial
Source: Perceptual (Relative to Novel)		
name	-81	-53
Source: Conceptual (Relative to Name)		
edible/inedible	-32	-8
natural/artificial	+45	-69

Of prime interest in the current study is whether the previously observed pattern of conceptual priming occurs when the training categorization was controlled for on-screen presentation time. Under these circumstances, larger priming effects from prior naturalness processing cannot be interpreted as due to a perceptual advantage resulting from longer visual presentations. Edible-edible items were categorized 32 ms faster on average than named-edible items, $F(1,18)$

= 3.71, *MSe* = 2624.56, *p* = .070. Items in the natural-natural condition were categorized 69 ms faster than named-natural items, *F*(1,18) = 10.62, *MSe* = 4316.85, *p* = .004. Replicating the consistent condition results observed in Experiment 1, edibility training produced marginal positive transfer, whereas naturalness training produced significant positive transfer on consistent test categorization (even though the naturalness decision involves more variable latencies). It is likely that this difference is due to a reduced ability to demonstrate transfer from a nonelaborate conceptual component: these traces have a reduced probability of being recruited. Further, the present findings support that the greater priming stemming from the naturalness decision was conceptually and not perceptually based. If perceptually based, greater positive priming would not have been observed for the natural-natural condition because presentation duration was controlled. Greater positive priming in Experiment 1 can therefore be attributed to more elaborate conceptual processing demands.

Subjects categorized edible-natural items as fast as named-natural items, *F*(1,18) = 0.21, *MSe* = 1795.73, *p* = .651. Natural-edible items were categorized significantly slower (45 ms) than named-edible items, *F*(1,18) = 5.76, *MSe* = 3425.85, *p* = .027. This finding replicates the negative transfer for this condition in Experiment 1, and indicates that the negative transfer is stemming from recruitment of an inappropriate conceptual component.

In sum, negative and positive transfer were observed when the initial processing event was the more elaborate naturalness decision and less transfer was observed from the less elaborate edibility decision. Experiment 1 findings were replicated under conditions in which presentation time was controlled. Taken with the results of Experiment 2, it is safe to conclude that the asymmetry in priming between category decisions is due to better conceptual rather than perceptual based processing following a naturalness decision.

General Discussion: Part I

In support of the component transfer framework, both facilitation and decrement on indirect memory performance were observed following a single consistent or inconsistent conceptual experience. In Experiment 1, a prior experience of naming an item facilitated test time edibility decisions. This finding supports the notion that prior visual exposure to words can provide appropriate perceptual based components necessary for identifying a word during categorization. When training and test category decisions were consistent, facilitation in categorization was observed, supporting the notion that having appropriate conceptual components to recruit facilitates performance. Further, the magnitude of observed facilitation is dependent on the quantity of recruited appropriate components. Greater positive priming is observed when the original experience involves more elaborate processing. This point is demonstrated by greater priming following the more elaborate naturalness decision, over that of the less elaborate edibility decision.

In further support of the component processing framework, a single prior inconsistent experience can be detrimental to categorizing. Controlling for appropriate perceptual components made available from prior exposure of items allows for the demonstration that a single conceptual experience can slow categorization. This finding is extremely interesting because prior conceptual experience has typically been theorized to be beneficial for later conceptual processing (e.g., Roediger & Blaxton, 1989), or irrelevant for different conceptual processing needs (e.g., Vriezen et al., 1995). The component processing framework, in contrast, predicts facilitation of performance only when central processing demands are congruent with current demands and decrements in performance when central processing demands are incongruent.

The present findings therefore suggest that more specific descriptions of mental operations are required in order to understand transfer effects. Several authors have drawn the same conclusion, including Moscovitch and colleagues (Moscovitch & Umilta, 1990, 1991; Moscovitch et al., 1993; Vriezen et al., 1995; Witherspoon and Moscovitch, 1983), Masson and MacLeod (1992), Tenpenny and Shoben (1992) and McDermott and Roediger (1996), yet none has suggested that inappropriate processing components may be recruited and impair indirect memory performance.

Understanding Transfer: Feasibility of Component Transfer

Defining specific component processing skills is not an easy task. It requires an in-depth analysis of each training task to understand what components are likely to be encoded into the memory trace. It also requires an understanding of which components are likely required in the test task to weigh the benefits and costs of recruited components. To make the situation more complex, one must also weigh the relative need of recruited components for test performance to accurately predict their relative facilitory and decremental effects.

Further complexity can be seen in defining what constitutes an inappropriate component. Although I was able to demonstrate that a change in conceptual interpretation resulted in inappropriate transfer, changing the conceptual interpretation between study and test is not always predicted to harm another conceptual task's performance. I believe that inappropriate transfer was demonstrated in the current studies (Experiments 1 and 3) because the category decisions led people to think very different things about the items, similar to thinking about a homophone in terms of one meaning and then another (e.g., Tulving & Thompson, 1973). If the first interpretation is semantically related to the later test interpretation, one would expect a benefit from the earlier experience (see Vriezen et al., 1995). In this case, appropriate meaningful processing can be recruited; it is just not as appropriate as would be a repetition of the initial interpretation. For example, thinking about whether a Jack Russell is a small or large dog would be predicted to facilitate later thinking about whether a Jack Russell would make a good ground-hog hunter. The second interpretation would be assisted by small size information provided by the initial interpretation.

Although the level of a priori analysis on the part of the researcher is much more demanding under the component transfer framework than under frameworks that specify dichotomous processes, I believe the framework is preferable for several reasons. First, dichotomous distinctions between types of processing have been unsuccessful at accurately predicting transfer, particularly with respect to conceptual transfer. Second, the component transfer framework focuses the understanding of transfer on a more rudimentary level of analysis. It requires us to understand the fundamental processing skills required by tasks. Third, this framework emphasizes that encoding processes are extremely important for the ability to observe priming. The elaborateness of the original experience is important in determining the likelihood that that trace will be recruited to guide performance. Although a similar principle was stressed by levels of processing theorists, there has been a strong inclination to equate encoding and retrieval importance. Test circumstances guide the direction of process recruitment; however, they will only be successful to the extent that the initial trace can be made available. Component transfer therefore offers a valuable alternative to transfer appropriate processing.

Repetition Priming: The Result of Activation and Inhibition?

Component transfer is a framework to guide the understanding of both positive and negative priming on indirect memory performance measures. Benefits and decrements in performance are the result of a backward acting process, such that present circumstances recruit prior processing experiences. Performance is determined by the extent to which appropriate and inappropriate resources are made available. This perspective denies that repetition priming is the result of residual activation or inhibition of a concept in memory. Activation theories are forward acting, such that the initial processing experience indirectly influences later performance: the initial event causes a change in the activity level of a concept, the second event occurs within a time frame in which the activity is still altered (e.g., Meyer & Schvendevelt, 1971). If the activation of a concept is higher than baseline, speeded performance is observed, but if lower than baseline, slowed performance is observed. Under component transfer, traces do not have activity levels to be modified, nor do they change when used. Traces are merely cued by need.

Whittlesea and Jacoby (1990) offered this same backward acting explanation to account for semantic priming. To demonstrate that current processing demands recruit prior processing events, and not that a first processing event determines the second event, they used a two-prime procedure. Subjects saw two prime words followed by a target word to name. The first prime was presented for 50 ms, and was the same word as the target. The second word was semantically related to the target and presented for 150 ms. The critical manipulation was whether the second prime word was in normal (e.g., tree, green, <u>tree</u>) or alternated case (e.g., tree, gReEn, <u>tree</u>). Spreading activation accounts would predict that either both conditions would show equal target latency priming or that the alternated condition would result in less priming. If one assumed that concepts receive the same amount of activation from normal and alternated case presentations, the conditions would show equal latencies. If instead alternated words do not readily activate their concepts because of the presentation distortion, this condition would demonstrate less priming of the target. According to the backward acting explanation, the alternated condition should result in more target priming. When the second word is in alternated case, processing is made difficult which increases the need to recruit resources (i.e., the first prime). By recruiting the first prime event to assist the second prime's identification, the first prime is readily available for target identification. Consistent with this prediction, naming latencies were faster in the alternated over the normal case condition. Therefore, this backward acting explanation has already proven valuable in understanding the nature of priming.

As stated in the Introduction, memory research has barely addressed impaired performance. However, there are several demonstrations of hindered performance within other cognitive research areas, such as in the selective attention literature. When slowed performance is observed, it is theorized to be the result of inhibition (cf. Brainerd, 1995; Bjorklund & Harnishfeger, 1990; Dempster, 1995; Hasher & Zacks, 1988; Tipper, 1985). Inhibition is an active process that suppresses nodes that are distracting, competing or irrelevant to task demands. These models therefore include both activation and inhibition mechanisms to account for benefits and decrements in latencies.[8] Component transfer offers an alternative way to understand slowed performance, without need of either mechanism.

Take for example the phenomenon labeled 'the negative priming effect' (cf. Tipper, 1985). The typical procedure to produce this effect involves a prime and

[8]Most models actually include several inhibition mechanisms because one is insufficient to account for inconsistent findings (e.g., Dempster, 1995; Harnishfeger, 1995; McDowd, Oseas-Kreger, & Filion, 1995).

probe trial. During both prime and probe events, one stimulus is to be attended, and the other is to be ignored. On some trials, the stimulus that is ignored during the priming event is again presented during the probe event, but now as the item to be attended. Relative to novel items, previously ignored but now attended items are slower to be identified. Theoretically, it is argued that selecting against the item in the prime event initiates an inhibitory mechanism to suppress the item's node and that this suppression has not subsided by the time of the subsequent probe event. This results in a longer time to sufficiently activate the concept for identification.

Component transfer predicts the 'negative priming effect' because the purpose for encountering the item is inconsistent between prime and probe events. When one attends a stimulus, one does so with the intention of doing something, such as to name the item. When one ignores a stimulus, that stimulus is also encountered and processed for a purpose. Ignoring is the intention of avoidance and nonresponse. This processing purpose provides a learning event on how to treat that item in the future. Although ignoring likely involves nonelaborate processing, it does define the manner in which to deal with a stimulus. Treating a stimulus with the purpose to ignore it in the prime event is inappropriate if recruited by the probe event that requires acting on the item. Although nonelaborate traces have a reduced probability of being recruited for later performance, contextual similarity and the quick time frame between prime and probe events promotes the recruitment of the prime trial. Thus, the 'negative priming effect' can be due to an inconsistency in the processing components between the prime and probe trials and not to inhibitory processes.[9]

[9]Ignoring can be elaborate if the distractor is interfering and takes great effort to avoid. Note that the more elaborate the ignoring demands, the greater the negative priming should be. This prediction holds in the negative priming literature. Increasing distractor interference on prime target identification during the priming event produces greater negative priming on the probe event (e.g., Neill & Lissner, 1988; Valdes & Neill, 1993).

Although the 'negative priming effect' is a short term phenomenon (but see Treisman & DeShepper, 1996), a similar component processing explanation can be made for performance that is slowed in the long term, such as in the human latent inhibition paradigm (Ginton, Urca & Lubow, 1975). Within this paradigm, one group of subjects is given a number (typically 10-100) of pre-exposures to a stimulus (e.g., a tone or light) which is followed by no reinforcement. In a later test phase, there is an attempt to teach the subject that the pre-exposed stimulus is of value and is now reinforced. Compared to control subjects that are not pre-exposed to the stimulus, pre-exposed subjects are slower to learn the new association. This paradigm is believed to measure a basic, automatic inhibitory function (see Lubow, 1989; McDowd et al., 1995). Inhibition is proposed to be initiated towards the pre-exposed stimulus during the training phase which then produces inhibition of processing that stimulus at test. Hence, the 'latent' inhibition creates the poor learning in the test phase. It is important to note that this inhibitory mechanism is different from that hypothesized to account for the short term 'negative priming effect'. The later inhibitory mechanism cannot account for long term effects because its inhibition is temporary.

Like the 'negative priming' paradigm, the 'latent inhibition' paradigm involves an inconsistency between initial and later processing purposes for a stimulus. This processing inconsistency leaves open the possibility that this effect is not due to inhibition, but instead to inappropriate component transfer. The ability to demonstrate a long term effect from ignoring is likely due to the sheer number of ignore encounters for the stimulus during training. During the pre-exposure phase, appropriate transfer would be occurring with each additional 'ignore the stimulus' event, and the skill of ignoring that distractor is predicted to improve over the training phase. At test, the presentation of the stimulus, now not for ignoring purposes but for attending and further action, counters one's prior training history.

Recruited training traces contain inappropriate components which guide the subject to continue to treat the stimulus in a manner different from that which is now required.

Accounting for slowed performance through appeal to inhibitory mechanisms therefore seems unnecessary. Doing so requires at least two separate inhibition mechanisms (and theories) to account for both short and long term effects. However, there is no experimental support that two or more mechanisms exist: the proposal is based on the attempt to explain different phenomena and not an empirical test, such as a dissociation between the two (or more) hypothetical mechanisms. Cognitive psychology may well benefit from unifying theories that can account for more than a single effect. Component transfer has this ability and can explain both positive and negative, short and long term effects through the same processes.

Summary Part I

Component transfer defines memory as a store of traces consisting of highly specific integrated processing components. Components are the processing events required by the original task, and are specific to the task demands. Within a trace, components will vary in their elaboration: with every task, some aspects are central and receive more elaboration while other aspects are either supportive or peripheral and receive less elaboration. Further, different tasks vary in elaborative processing demands: some tasks require more extensive processing than others. Because performance is guided by recruitment of past processing events, there is a strong interaction between present requirements and an individual's prior history of experience. Recruiting prior traces can be both facilitative and decremental to current performance, depending on the appropriateness of past and present component requirements. Further, the magnitude of positive and negative transfer will depend on the elaborative nature of the original task. Increasing elaboration will increase the probability of recruiting the prior processing event, and will therefore increase the influence on performance.

In support of component transfer, both positive and negative transfer was observed following a single prior categorization that was consistent or inconsistent with a later interpretation of a stimulus. Further, the magnitude of priming was dependent on the degree of elaboration of the component within the recruited trace: more elaborate processing resulted in greater positive and negative priming.

Introduction: Part II

The preceding section demonstrated that both facilitation and decrement can result from a single prior event that is consistent or inconsistent with later processing requirements. This demonstration raises some interesting questions regarding how one can decide something has been experienced previously. The second set of experiments was designed to examine how recognition processes are influenced by the consistency of performance.

Recognition Theories

Mandler (1980, 1991) proposed a two-process theory to account for recognition judgments. Under this theory, two processes influence the access to mental representations: intraitem and interitem integration. Intraitem integration is an automatic process that focuses on the perceptual, featural and intrastructural aspects of an event. This process can result in an "old" response by producing a subjective feeling of familiarity: intraitem integration is directly responsible for the conscious feeling state. Interitem integration is a deliberate and controlled process which involves relating the said event to other events and representations. This process can result in one recognizing an event by recall of the inclusive other-event information. Therefore, under Mandler's theory, there is a direct relationship between activating a memory trace and conscious awareness of the past. An encounter with a stimulus lays down a trace in memory that varies in its integrative qualities. Later activation of a trace, which depends on how integrated it is, causes resonance in consciousness, resulting in a feeling of familiarity or knowledge of oldness.

Jacoby and colleagues (Jacoby & Dallas, 1982; Jacoby, Kelly & Dywan, 1989) have suggested that the relationship between feelings of familiarity and representations in memory is indirect, mediated by an unconscious attribution regarding the fluency of current performance. Prior experience of a stimulus facilitates processing on a later occasion (i.e., priming); and that fluency can be attributed to a source in the past. For example, if a subject reads an item quickly, this speed in reading can be attributed to having seen the word in a previous list, providing no obvious situational factors can be judged as responsible for this ease. Attributing fluency to a past experience results in the conscious feeling of familiarity.

Correlational research has supported the fluency attribution hypothesis, demonstrating that items that are most fluently processed (as measured in terms of ability to identify) are claimed to be recognized more often than less fluently processed items (Jacoby & Dallas, 1981; Johnston, Hawley, & Elliot, 1991; Verfaellie & Cermak, 1999). Experimental support has also been demonstrated in studies aimed at arbitrarily increasing processing speed through manipulations of current circumstances: making processing fluent for subjects by manipulating factors of which they are unaware increases their claims of recognition. For example, Whittlesea (1993) presented subjects with short lists of words, each word being presented for 67 ms. Following the rapid list, subjects read a sentence stem missing its terminal word (e.g., The stormy seas tossed the). The terminal word was then presented to be named, and subjects were asked whether that terminal word had been presented in the preceding rapid list. Unknown to subjects, sentence stems were either predictive (e.g., the stormy seas tossed the BOAT) or unpredictive (e.g., she saved up her money and bought a BOAT) of the terminal word. Predictive stems significantly increased the fluency of reading the terminating word (130 ms of priming). With respect to claims of recognition, targets following predictive stems were claimed to be old more often than those following unpredictive stems, whether they actually had been in the list (hits) or not (false alarms). On trials in which the target was in the rapid list, claims of recognition could be based either on a feeling of familiarity or on recollection of contextual detail of the list. However, on trials in which the target was not presented in the rapid list, claims of recognizing the target could only be based on a feeling of familiarity, as there was no earlier event information to recollect. Apparently, subjects were sensitive to the increased ease of reading these novel targets and falsely attributed this fluency to prior presentation. This finding offered strong support for the indirect attributional approach to feelings of familiarity because claims of familiarity were produced without the existence of a prior memory trace to activate.

Although the fluency attribution hypothesis was offered as an explanation for the source of feelings of familiarity, Jacoby (1991, 1994) has recently proposed a dual process theory to account for recognition memory. Under this account, recognition decisions are based on two distinct types of information that are controlled by two distinct processes. One basis is the quality of processing the item itself and the second basis is by generating contextual information regarding the initial event. The former is controlled by the process of familiarity whereas the latter is controlled by the process of recollection. The familiarity process is believed to be unconscious and automatic whereas recollection is held to be conscious and deliberate.

Mandler's (1980, 1991) and Jacoby's (1991, 1994) recognition accounts differ with respect to the processes responsible for decisions and with respect to whether traces are directly or indirectly involved in decisions. However, they are consistent with respect to the possible sources of information that can be used to make positive recognition decisions: from information about the item itself or from information about the context surrounding the original event.

Arguing against the need for dual processes in recognition, Whittlesea (1997) has offered a 'SCAPE' framework (for Selective Construction and Preservation of Experience) of memory (see also Leboe & Whittlesea, 1999; Whittlesea & Williams, 1998; Whittlesea & Williams, 1999b, 1999c). Under the SCAPE framework, memory serves two functions: to produce and evaluate processing performance. The production function involves the recruitment of prior processing experiences. The evaluation function involves monitoring the coherence of produced processing aspects and attributing that perception to various sources. All processing events involve a stimulus compound which consists of a stimulus, a purpose and a context. This stimulus compound acts to cue memory representations that involved similar tasks, structures and contexts. Cued traces guide the processing of the compound, producing the new experience.

Under the SCAPE framework, memory produces behaviour and does so not only in the control of performance on indirect tasks, but also on direct tasks. This framework holds that the only difference between direct and indirect task performance is task requirement. Both tasks require people to produce an identity and memory accomplishes this production, for both types of tasks, in the same manner. However, the direct task also requires people to associate the identity production with a prior occasion. Whittlesea (1997) has argued that this production of contextual information is performed in the same fashion as the production of the identity information. The produced identity now forms part of the stimulus compound to cue contextual information. Once context production is accomplished, produced aspects are evaluated and attributed to various sources, producing various feeling states.

Whittlesea and Williams (1999a, 1999b, 1999c) have proposed that claims of prior experience can result from the perception of coherence or discrepancy. If during production, the flow of processing is well-structured and integrative, the evaluation of this production results in the perception of coherence, and people can attribute this 'coherence' to prior experience. For example, in identifying your partner in your kitchen, all processing aspects of your partner and kitchen flow efficiently. In the context of being asked if you know this person (admittedly unusual), this coherence can be attributed to knowing your partner—but it does not sponsor a strong subjective state of familiarity. The perception of coherence in this case is more likely to sponsor a feeling of 'you've asked me a silly question'. If instead the production of some aspects of processing are efficient but not quite readily fitting with other aspects, the result is the perception of discrepancy. The authors claim that the perception of discrepancy is highly motivating, and creates the desire to attribute the discrepancy to some source. Discrepant processing, when attributed to the past, results in strong feelings of familiarity. For example, seeing the clerk from the corner store on the bus would involve somewhat efficient person processing; however, people on the bus are not expected to be processed fluently. The fluent clerk processing is at odds with the expectation that strangers are on the bus and these individuals should not be processed fluently. This discrepancy between expected and actual processing results in a surprising feeling, producing a strong feeling of familiarity for the individual. Thus, an evaluation resulting in the perception of coherence can give rise to the subjective feeling state of knowing, whereas an evaluation resulting in the perception of discrepancy can give rise to spontaneous feelings of familiarity. In both cases, the quality of processing is evaluated and gives rise to different subjective feeling states; however, the processes by which the feeling states arise are identical.

Whittlesea and colleagues (Leboe & Whittlesea, 1999; Whittlesea, 1997; Whittlesea & Williams, 1999b, 1999c) have therefore been able to account for recognition by invoking a single process framework whereby item and context information are produced by the same mechanism. The need to invoke two independent processes to account for recognition memory may therefore be unnecessary. However, dual process theories have received wide attention and have proven valuable in stimulating research over the last twenty years. Further research is required to decide the more valuable approach.

Can Recognition Decisions be Influenced by Nonfluent Performance?

As demonstrated in Part I, positive and negative transfer can be observed by manipulating the conceptual consistency between training and test processing demands. This methodology therefore allows for an interesting new avenue of investigation with respect to how inconsistencies between experiences influence the ability to recognize. Prior research has demonstrated that a lack of similarity between training and test tasks results in a recognition failure (cf. Tulving & Thompson, 1973) or at least poor recognition relative to matching conditions (cf. Morris et al., 1977). However, the negative priming on categorization latencies observed in Experiments 1 and 3 suggests that the earlier inconsistent experience was recruited.[10] Because the inconsistent event is recruited using the present methodology and results in nonfluent categorization (negative transfer), it would be interesting to see if or how recognition ability following such performance is influenced.

The present research is not directed at critically deciding between the dual or single process recognition theories. Instead, it merely investigates how nonfluent performance influences recognition decisions. Under both recognition accounts, elaborate processing during a training phase should result in greater claims of recognition by providing increased ability to access contextual information. Whether the relative amounts of fluency during test-time categorization will differentially influence recognition is more difficult to predict.[11] For consistent categorization conditions, recognition can stem from fluent item processing being attributed to prior experience, or from having appropriate retrieval cues to access contextual information regarding the original experience. For inconsistent categorization conditions, item processing is not fluent, and task based retrieval cues do not support access to contextual information. These facts lead to the prediction that inconsistent processing should result in poor recognition ability. However, inconsistent conditions involve conceptual processing and conceptual processing is known to aid recognition (e.g., Craik & Lockhart, 1972; Roediger & Blaxton, 1987). Further, it is possible that the influence of inconsistent processing on recognition may depend on the degree of elaboration of the original orienting task. Recognition decisions may actually benefit from a prior elaborate inconsistent experience because these processing experiences have an increased probability of being recruited to guide performance. Inappropriate conceptual components,

[10]Despite the lack of conceptual similarity between events, it is likely that the perceptual similarity promoted the recruitment of the training experience.

[11]Categorization latency is used as an index of processing fluency. Some have argued that such latencies are not direct indices of fluency (Poldrack & Logan, 1998; Whittlesea & Williams, 1998), which is more likely experienced as subjective ease than speed. Categorization latencies are only used as an index because there is as yet no more direct index of psychologically effective state.

even though inconsistent with test demands, may provide positive information that the item was experienced during the training phase. Theoretically, this could occur through influencing either contextual access or item familiarity. In terms of contextual access, the recruited conceptual component may be able to cue additional contextual information for the recognition decision or perhaps the mere presence of the component provides contextual information (e.g., the particular coming to mind of a specific interpretation is indicative of the prior encounter).[12] In terms of item familiarity, people may be sensitive to nonfluent processing and can attribute their lack of fluency to the past (e.g., "I did poorly, I must have encountered that item differently before."). Because significant negative transfer is only observed if the original categorization decision is elaborate, it is possible that only the elaborate inconsistent condition (i.e., natural-edible condition) provides sufficient processing fluency change to be sensed. The following studies were aimed at investigating these possibilities.

Experiment 4: The Influence of Categorization Consistency on Recognition

The present experiment examines how conceptual processing consistency influences recognition decisions. Although many studies have shown that a consistent prior experience can lead to greater claims of recognition, no study has investigated how a *recruited* inconsistent conceptual experience can influence recognition. Inconsistent processing encounters have traditionally been assumed to result only in poor recognition. In the present experiment, the methodology used in Experiment 1 is replicated, with the addition of a recognition decision following

[12] Note that contextual access has typically been interpreted as additional information around the stimulus identity, such as the location or time of the encounter. I refer to contextual access as event detail, as well as identity information (i.e., the coming to mind of a particular meaning for the word). These two sources are treated as contextual in that they are both pieces of generated information transforming the physical stimulus (for a discussion of the information heuristic see Whittlesea & Leboe, 2000).

test-time categorization. This methodology enables a test of whether inconsistent processing always leads to poor recognition, or whether in some cases, it can benefit recognition.

In Part I, consistent categorization conditions were demonstrated to produce positive priming on test categorization latencies. Consistent conditions might be predicted to show better recognition over items that were previously named. This prediction is consistent with both the principles of encoding specificity (Tulving, 1972) and transfer appropriate processing (Morris et al., 1977). Matching encoding and retrieval operations should not only increase conceptual fluency but should also provide appropriate contextual retrieval cues. This finding would also be expected from a levels-of-processing assumption (Craik & Lockhart, 1972). Categorizing an item would involve more elaborate encoding than would naming an item. Categorizing would therefore assist contextual access. Further, greater recognition ability could be observed for the natural-natural condition over the edible-edible condition. In Part I, natural-natural processing led to greater priming over that observed for edible-edible processing. If individuals are sensitive to relative amounts of fluency, this prediction could hold.

For inconsistent conditions, categorization latencies were demonstrated to be either not speeded relative to previously named items (for the edible-natural condition) or slowed relative to previously named items (for the natural-edible condition). Although both conditions violate encoding specificity/transfer appropriate processing 'match' requirements, they are conceptually processed at training. These theories could either predict that recognition ability for inconsistent conditions would equal that of previously named items, or would be slightly better than previously named items.

Method

Subjects. Twenty subjects participated in this experiment. Subjects were university students who received credit for participation. All subjects were proficient in the English language, and had normal or corrected to normal vision.

Procedure. All procedures were identical to Experiment 1, with the inclusion of a recognition decision following test-time categorization. Subjects were unaware of the recognition decision during the training phases. During the test phase, subjects were instructed to first classify the item, and then to decide whether the item had occurred in either of the training phases. They were instructed to try to keep these decisions separate, to concentrate first on categorization, and then on recognition. They were also warned that the categorization decision was a timed response, and that the recognition decision was not. Subjects classified the target by pressing the appropriate category button. Following that button press, the screen blanked, and then the message "old or new?" appeared on the screen. Subjects were instructed to press one of two center buttons to indicate the old/new status of the item. Although effort was made to keep the categorization reaction times uncontaminated by the subsequent recognition decisions, it must be noted that reaction times are likely contaminated. They were included solely to provide a general latency pattern replication of Part I.

Results and Discussion

Categorization latencies and errors during phase 2 are first addressed, followed by categorization latencies during phase 3. Finally, the probabilities of recognizing items following test categorization are examined.

Phase 2: Training Categorization Latencies and Accuracy.

Items were categorized faster under the edibility decision (867 ms) than under the naturalness decision (1055 ms), $F(1,19) = 48.39$, $MSe = 7318.93$, $p = .000$. Subjects also made more errors on the naturalness decision (14%) than on the edibility decisions (6%), $F(1,19) = 26.47$, $MSe = 23.57$, $p = .000$. These findings replicate training data patterns observed in earlier studies, with both reaction time and error data indicating naturalness decisions are more elaborate than edibility decisions.

Phase 3: Test Categorization Latencies.

As noted earlier, categorization latencies are likely contaminated by the subsequent recognition decision, and are merely provided to demonstrate a general latency pattern. This claim is supported by the longer average latencies observed in the current study relative to Experiments 1 and 3. Subjects made more errors on naturalness decisions (11%) than on edibility decisions (5%). Categorization latencies from Phase 3 are presented in Table 5 and transfer effects for conditions are summarized in Table 6. To examine transfer from a perceptual source, named items where compared to novel items, for both category decisions. Unlike previous studies, naming an item did not result in significantly faster test categorization scores. On the edibility decision, previously named items were classified 47 ms faster than novel items, $F(1,19) = 20.7$, $MSe = 10513.34$, $p = .167$. On the naturalness decision, named items were classified 27 ms slower than novel items, $F(1,19) = .96$, $MSe = 7247.97$, $p = .339$. It is likely that the failure to replicate perceptual priming is the result of small effect sizes being contaminated by increased variability from the recognition decision processing.

Table 5. Test categorization latencies (ms) in Experiment 4.

	Test Task	
Train Task:	edible/inedible	natural/artificial
novel	1217	1333
name	1170	1360
edible/inedible	1154	1358
natural/artificial	1230	1267

Table 6: Transfer effects between test conditions in Experiment 4.

	Test Task	
Training Task:	edible/inedible	natural/artificial
Source: Perceptual (Relative to Novel)		
name	-47	+27
Source: Conceptual (Relative to Name)		
edible/inedible	-16	-2
natural/artificial	+60	-93

With respect to conceptual transfer, subjects categorized edible-edible items 16 ms faster than named-edible items, but this pattern was not significant, $F(1,19) = .71$, $MSe = 3736.78$, $p = .411$. This lack of significant positive priming could be due to the contaminating effects of the recognition decision; however, the effect sizes for edible-edible priming in Experiments 1 and 3 were quite small. As argued previously, it may be difficult to show conceptual priming from an earlier nonelaborate experience. The natural-natural items were categorized 93 ms faster than named-natural items, $F(1,19) = 5.22$, $MSe = 16283.61$, $p = .034$. This finding replicates the positive priming observed following the more elaborate categorization decision.

Named-natural items were categorized as fast as edible-natural items, $F(1,19) = .00$, $MSe = 11283.18$, $p = .989$. Again, significant negative priming was not observed if the original event was not elaborate; however, the benefit of prior conceptual processing was eliminated. Items categorized in the natural-edible condition were significantly slower (60 ms) than named-edible items, $F(1,19) = 7.70$, $MSe = 4637.68$, $p = .012$. This finding replicates the negative transfer observed for this condition in earlier studies.

Phase 3: Recognition Probabilities.

Probabilities of claiming stimuli "old" are presented in Table 7. There was no difference between category decisions in terms of false alarms, $F(1,19) = .10$, $MSe = .01$, $p = .757$. This finding suggests that subjects did not use a global strategy in deciding items were old based on the more fluent edibility decision. One can therefore safely compare the hit data between category decisions because they are not biased in favor of the edibility decision.

Table 7. Probability of claiming items "old" for the recognition decisions in Experiment 4.

	Test Task	
Train Task:	edible/inedible	natural/artificial
Hits		
name	53	49
edible/inedible	77	67
natural/artificial	83	78
False Alarms		
novel	17	16

Items previously categorized were recognized better than items that had been previously named. Edible-edible items were recognized 24% better than previously named-edible items ($F(1,19) = 18.33$, $MSe = .03$, $p = .000$) and natural-natural items were recognized 29% better than previously named-natural items ($F(1,19) = 35.01$, $MSe = .02$, $p = .000$). These findings support a levels of processing notion—meaningful processing led to better recognition. Further, they are consistent with transfer appropriate processing and encoding specificity predictions: invoking the same encoding and retrieval operations led to greater recognition. This increased ability to recognize categorized items can stem either from conceptual fluency or from greater contextual access.

The two consistent category conditions did not differ from each other ($F(1,19) = .10$, $MSe = .01$, $p = .757$) even though greater positive priming was observed on the naturalness categorization latencies. This finding suggests that although people are senstive to fluency, they may not be sensitive, or alternatively responsive, to relative *amounts* of conceptual fluency within a recognition task. Further, this finding implies that the ability to generate contextual detail of the training experience did not differ between the category decisions even though the naturalness decision was demonstrated as more elaborate. This finding is somewhat puzzling as one would predict that more elaborate training processing would result in greater recognition over less elaborate processing. The lack of recognition difference between category decisions could perhaps be explained as the result of a processing interaction between the ease stemming from prior experience and test-task complexity. Although greater ease occurs from a prior naturalness experience, the test decision is still relatively more difficult than the edibility decision which could reduce perceived subjective ease. However, test decision ease did not influence false alarms, so this suggestion is somewhat weak. An alternative possibility for the lack of difference between consistent categorization conditions is that within a recognition task, people evaluate positive evidence (from available item or context information) and once sufficient evidence is amassed, the response is made. Having additional evidence may therefore not be incorporated into the evaluation.

For inconsistent conditions, items in the natural-edible condition were recognized 30% better than named-edible items ($F(1,19) = 37.69$ $MSe = .02$, $p = .000$) and items in the edible-natural condition were recognized 18% better than named-natural items ($F(1,19) = 15.70$, $MSe = .02$, $p = .001$). These findings replicate typical depth of processing effects, in that deeper processing leads to better recognition. However, items in the inconsistent conditions are not fluently processed relative to previously named items, therefore the greater ability to recognize these inconsistent items is likely due to either sensitivity to non fluent processing and/or an increased ability to access contextual detail of the earlier experiences.

Most interesting in the recognition data is the superiority in recognition for the natural-edible condition. The natural-edible condition resulted in 16% greater recognition over the edible-natural condition ($F(1,19) = 27.92$, MSe = .01, $p = .000$), 6% greater recognition over the edible-edible condition ($F(1,19) = 4.30$, MSe = .01, $p = .052$), and 5% greater than the natural-natural condition ($F(1,19) = 4.22$, MSe = .01, $p = .054$). Both theories of encoding specificity (Tulving, 1972) and transfer appropriate processing (Morris et al., 1977; Roediger, 1990; Roediger & Blaxton, 1987) predict greatest recognition for consistent training and test conditions, and conversely, worst recognition for inconsistent conditions. Against these predictions, these findings demonstrate that an inconsistency between training and test experiences is not always detrimental to one's ability to recognize. In line with these theories' predictions, the edible-natural condition did result in 11% lower recognition ability than the natural-natural condition ability ($F(1,19) = 12.35$, MSe = .01, $p = .002$) and 10% lower recognition ability than the edible-edible condition ability ($F(1,19) = 10.72$, MSe = .01, $p = .004$). Consistent with earlier speculation, what seems to be the mediator for predicting whether categorization inconsistency results in good or poor recognition is the degree of elaboration during the training experience. If conceptual processing is elaborate during a training experience, a consistent testing experience is not required for recognition.

As stated in the discussion of recognition theories, claiming an item to be old can result from fluent item-based processing or from access to contextual information regarding the prior event (Jacoby, 1991, 1994; Mandler, 1980, 1991). Inconsistent encoding and retrieval conditions would decrease conceptual fluency (relative to consistent conditions) and reduce contextual access by providing invalid retrieval cues. This proposal is consistent with the findings of greater recognition of the consistent conditions over the edible-natural condition: the difference in recognition could be explained as the result of inappropriate test retrieval cues and less fluent processing. However, if the lower recognition was simply the combined result of these attributes, the natural-edible condition should have also resulted in lower recognition: but the opposite occurred, recognition was actually better in this condition relative to consistent conditions.

To account for the present results, one could claim either that subjects are sensitive to nonfluent processing, or that inappropriate components are involved in supplying contextual information.[13] Interpreting the recognition results as sensitivity to nonfluent processing would mean that the quality of conceptual processing was evaluated as less fluent than would be expected if not previously exposed. This perception of discrepancy would then be attributed to the past, resulting in claims of recognition. The proposal of sensitivity to nonfluent processing could account for the findings of greater recognition of the natural-edible condition over previously named items and edible-natural items. However, it could not account for greater recognition of edible-natural items over previously named items because these items were equal in fluency.

Interpreting the recognition findings as the result of increased contextual access means that the inappropriate component either cued additional contextual detail surrounding the original event or directly provided contextual information in the coming to mind of the specific interpretation of the prior event. This claim would account for the greater ability to recognize natural-edible over edible-natural and previously named items, as well as the greater recognition of edible-natural over previously named items. Nonelaborate conceptual components have a reduced probability of being recruited to guide processing relative to elaborate conceptual components. The inappropriate edibility component would therefore be less available at test to provide contextual information relative to inappropriate naturalness components. However, the nonelaborate edibility training still provides greater component availability over named items which have no

[13]Whether these sources are processed independently or not cannot be here determined. They are treated as independent merely to examine which source can best explain the pattern of results.

conceptual component. The recognition difference between the natural-edible, edible-natural and named conditions would therefore be the result of a decreasing probability of recruiting the training experience due to decreased elaborative processing. Results are therefore consistent with the hypothesis that contextual access differed among the conditions.

Although recognition can be based on the quality of item based processing and/or contextual recollection, the present findings can be understood by considering variation in degree of contextual access. To account for recognition ability for both consistent and inconsistent conditions, available conceptual components either cued additional contextual information, or the components themselves provided the needed contextual information (i.e., the components dictate an interpretation consistent with the original task). Although edible-edible items rely on a less elaborate conceptual component, they do have the advantage of test time retrieval cues to compensate for this deficiency.

Experiment 5: Ability to Identify Training Context

In the previous experiment, providing consistent training and test decisions resulted in recognition benefits; however, providing individuals with an elaborate training decision and an inconsistent test decision facilitated recognition to a greater extent. Further, inconsistent categorization, even when the original decision was conceptually nonelaborate, resulted in greater claims of recognition over previously named items. The recognition ability observed following consistent categorization can result from conceptual fluency and having both a conceptual component and situational cues supportive to contextual access. The recognition ability observed in the inconsistent conditions may be explained through contextual access provided from the conceptual component (given that the nonelaborate conceptual component is recruited to a lesser extent than the elaborate training component).

The argument that a recruited inappropriate component, without appropriate situational retrieval cues, can provide contextual information is speculative. In the present experiment, a more specific context recognition task is used in order to examine whether contextual access differs between conditions. The speculation that the different degrees of elaboration during training causes differential recruitment of components would be supported if the ability to identify how one encountered items in training is better for the natural-edible items than the edible-natural items, and better for the edible-natural items than the named items. This finding would suggest that the recruited inappropriate component does provide contextual information, resulting in recognition benefits.

The general procedure of Experiment 4 is replicated; however, rather than a simple old/new recognition decision following test-time categorization, subjects are now required to identify the original context of the item following categorization. They were instructed to identify whether the item was a novel item, whether they had named the item, or whether they had categorized the item according to either the naturalness or edibility decisions.

Meaningful processing resulting from categorizing training items was predicted to result in a better ability to identify training contexts of categorized over named items. This would be expected under the assumption that meaningful processing creates more extensive contextual detail on which to base a context claim. Consistent conditions were predicted to show equal ability, having the benefits of conceptual fluency, appropriate situational cues and conceptual components that support the correct context identification. The edible-natural condition was predicted to have lower context identification than both consistent conditions and the natural-edible condition due to a reduced probability of recruiting the nonelaborate conceptual component. This condition should still demonstrate better context identification over the named conditions due to greater probability of recruiting a conceptual over perceptual events. Finally, the natural-edible condition was predicted to have equivalent or better contextual identification relative to the two consistent conditions due to a high probability of recruiting the elaborate inappropriate conceptual component. This pattern of context identification would account for the differing recognition probabilities observed in the previous experiment.

Methods

Subjects. Nineteen subjects participated in this experiment. Subjects were university students who received credit for participation. All subjects were proficient in the English language and had normal or corrected to normal vision. Two subjects were dropped from analysis for selectively (+80%) claiming the edibility context choice, leaving a total of 17 subjects.

Procedure. All procedures were identical to Experiment 4, with the only change being a more specific recognition decision. During the test phase, subjects were instructed to first categorize items, and they were then required to decide if and how they had previously experienced the item. They therefore had one of four choices to make: that the item was novel, previously named, previously categorized according to the edibility decision or previously categorized according to the naturalness decision. Following test categorization, the screen blanked, and then the four decision possibilities were displayed on the screen in an order corresponding to the appropriate button responses on the button box. Although effort was made to keep the categorization decisions separate from the subsequent context decisions, latencies are likely contaminated. Latencies were included solely for a general latency pattern replication.

Results and Discussion

Categorization latencies and errors for phase 2 are first analyzed. Categorization latencies for test categorization are then addressed. Finally, the probability of identifying training context data are analyzed and interpreted.

Phase 2: Training Categorization Latencies and Accuracy.

Replicating the training effects observed in earlier studies, items categorized according to an edibility decision (940 ms) were responded faster than those categorized according to a naturalness decision (1166 ms), $F(1,16) = 53.47$, $MSe = 8094.25$, $p = .000$. Subjects also made more errors on the naturalness decision (14%) than on the edibility decisions (9%), $F(1,16) = 6.33$, $MSe = 30.47$, $p = .023$.

Phase 3: Test Categorization Latencies.

Categorization latencies are likely contaminated by the subsequent context identification decision. They are included for indication of general latency pattern. Categorization latencies from Phase 3 can be seen in Table 8, and transfer effects are summarized in Table 9. Subjects committed more errors on naturalness decisions (8%) than edibility decisions (5%). To examine transfer stemming from a perceptual source, previously named items where compared to novel items for both category decisions. On the edibility decision, previously named items were classified similarly to novel items, $F(1,16) = .38$, $MSe = 25299.92$, $p = .545$. On the naturalness decision, named items were classified 133 ms slower than novel items, F(1,16) = 4.07, MSe = 37076.22, p = .061. These findings are likely due to latency contamination.

Table 8. Test categorization latencies (ms) in Experiment 5.

	Test Task	
Train Task:	edible/inedible	natural/artificial
novel	1666	1875
name	1699	2008
edible/inedible	1668	1998
natural/artificial	1838	1942

Table 9: Transfer effects between test conditions in Experiment 5.

	Test Task	
Training Task:	edible/inedible	natural/artificial
Source: Perceptual (Relative to Novel)		
name	+33	+133
Source: Conceptual (Relative to Name)		
edible/inedible	-31	-10
natural/artificial	+139	-66

Items in the edible-edible condition were classified as quickly as named-edible items, F(1,16) = .46 MSe = 18694.67, p = .509. Similarly, items in the natural-natural condition were categorized 66 ms faster than named-natural items; however, not significantly, F(1,16) = .88, MSe = 42350.37, p = .361. Although incompatible with most standard priming research, the failures to demonstrate positive priming from a conceptual repetition is likely due to contaminated reaction times. As in Experiment 4, latencies are much longer than in earlier studies when only a categorization decision was required.

For inconsistent conditions, edible-natural items were classified as fast as named-natural items, $F(1,16) = .02$, $MSe = 48261.01$, $p = .894$. However, significant negative priming (139 ms) was still observed for the natural-edible items relative to named- edible items, $F(1,16) = 7.92$, $MSe = 20753.28$, $p = .012$. This finding replicates the negative priming observed for this condition observed in Part I; however, the magnitude of the effect is much larger then previously observed.

Phase 3: Training Context Identification.

The current experiment was designed to investigate how the consistency of experience and degree of elaborative encoding influences the ability to accurately identify how one originally experienced an item. The data are first collapsed into a standard old/new recognition division to compare the present recognition pattern with that of the previous experiment. Claims of "old" include decisions in which subjects claimed they had encountered the item during training (claims of named, edibility, or naturalness), regardless of the accuracy of the context claim. Probability of claiming items "old" are presented in Table 10. Next, the data on accurate identification of training context are addressed.

Table 10. Collapsed probability of claiming items "old" on the context identification test in Experiment 5. "Old" responses include items claimed to have been named, or categorized according to either categorization decision.

	Test Task	
Train Task:	edible/inedible	natural/artificial
Hits		
name	62	58
edible/inedible	88	83
natural/artificial	89	89
False Alarms		
novel	19	25

False alarms to novel items did not differ between category decisions, $F(1,16) = 3.03$, $MSe = 107.08$, $p = .101$. Consistent with Experiment 5, having categorized items in training led to greater claims of old than having named items in training. Comparisons between specific category conditions relative to the named conditions can be seen in Table 11. Most importantly, both inconsistent conditions again resulted in higher recognition claims over previously named items, suggesting recruited inappropriate conceptual components provide contextual information regarding the prior event. Sensitivity to nonfluent performance would only account for greater claims of recognition for the natural-edible condition because this condition is less fluent than the name-edible condition. Edible-natural and name-natural conditions are equally fluent therefore recognition differences cannot be accounted for by sensitivity to nonfluent performance.

Table 11. Statistics comparing the relative probability of claiming items "old" for items that were named versus those that were categorized in Experiment 5.

Comparison	(df)	MSe	F	p<
test edibility:				
named vs. edibility training	1,16	96.69	57.56	.000
named vs. naturalness training	1,16	59.47	104.66	.000
test naturalness:				
named vs. naturalness training	1,16	163.33	50.58	.000
named vs. edibility training	1,16	168.75	31.48	.000

Comparing the categorized at training and test conditions, recognition ability did not differ between the natural-natural and edible-edible conditions ($F(1,16) = .39$, $MSe = 30.51$, $p = .543$), nor between either consistent conditions and the natural-edible condition (edible-edible: $F(1,16) = .25$, $MSe = 73.07$, $p = .623$; natural-natural: $F(1,16) = .01$, $MSe = 52.30$, $p = .907$). In the previous experiment, recognition claims were greater for the natural-edible condition relative to consistent conditions; here, it is of the same magnitude. What is important; however, is the replication of the failure to observe a recognition deficit for an inconsistent processing condition relative to consistent conditions. Items in these three conditions were recognized significantly better than items in the edible-natural condition (edible-edible: $F(1,16) = 5.67$, $MSe = 37.50$, $p = .030$; natural-natural: $F(1,16) = 5.68$, $MSe = 57.08$, $p = .030$; natural-edible: $F(1,16) = 6.75$, $MSe = 52.76$, $p = .019$). These findings replicate those observed in the previous study. The lower recognition of the edible-natural items is likely due to reduced recruitment of a nonelaborate conceptual component and invalid situational retrieval cues.

Probabilities of accurate identification of training context are presented in Table 12. As predicted, the ability to identify training contexts was superior for items that had been categorized in training relative to those that had been named. Statistics for specific advantages of conceptual over perceptual training can be seen in Table 13. These findings are consistent with the notion that conceptual processing leads to more elaborate traces relative to perceptual processing, and in turn, increases one's ability to identify contextual detail of prior experience.

Table 12. Probability of correctly identifying training context of items following test-time categorization decision in Experiment 5.

	Test Task	
Train Task:	edible/inedible	natural/artificial
name	29	25
edible/inedible	58	49
natural/artificial	59	63
novel	81	74

Table 13. Statistics comparing the accuracy of identifying the original training context of items that were named versus those that were categorized in Experiment 5.

Comparison	(df)	MSe	F	p<
test edibility:				
named vs. edibility training	1,16	128.69	51.28	.000
named vs. naturalness training	1,16	127.82	51.63	.000
test naturalness:				
named vs. naturalness training	1,16	101.70	49.29	.000
named vs. edibility training	1,16	102.03	49.65	.000

Ability to identify the training context for the edible-natural condition items was worse (9%) than items in the edible-edible condition ($F(1,16) = 4.43$, $MSe = 170.13$, $p = .052$), those in the natural-natural condition (14%) ($F(1,16) = 17.69$, $MSe = 99.82$, $p = .001$) and those in the natural-edible condition (10%)($F(1,16) = 3.64$, $MSe = 247.61$, $p = .075$). The poor recognition observed in Experiment 4 for the edible-natural condition can therefore be explained as the combined effects of low conceptual fluency (i.e., least change in priming) and poor contextual access relative to other categorization conditions. Note the marginal identification differences between edible-natural items and those categorized under the edibility test decision (edible-edible and natural-edible) are likely due to a general greater accuracy at identify training context following edibility decisions (57%) than those following a naturalness decision (53%), $F(1,16) = 6.01$, $MSe = 33.52$, $p = .026$. As noted earlier, it may be more difficult to separate current from past processing when current task processing is elaborate.

The final issue in the current experiment is whether the benefit in recognition for the natural-edible condition can be accounted for by greater contextual access provided by the recruited elaborate, yet inappropriate, conceptual component. As stated above, context identification in this condition was better than that of the edible-natural condition. Context identification of natural-edible items was equivalent to that of the edible-edible items ($F(1,16) = .05$, $MSe = 128.49$, $p = .823$) and that of the natural-natural condition ($F(1,16) = 1.33$, $MSe = 108.18$, $p = .265$). Although the natural-edible condition lacked appropriate retrieval cues and processing fluency relative to consistent conditions, subjects were as accurate at identifying training context. If the original processing event is recruited, the inappropriate conceptual component can provide contextual information regarding prior experience.

While an elaborate inappropriate component can slow categorization performance, the conceptual component nevertheless provides subjects with contextual information relevant to the prior experience. The present findings suggest that contextual access may be sufficient information on which to base recognition judgments. It is possible that the contextual information supplied by the inappropriate conceptual component compensates for a lack of conceptual fluency. This implies that inconsistencies between training and test conditions will only reduce recognition if the original event involves nonelaborate processing: Nonelaborate processing reduces contextual information availability.

Taken together, the current studies suggest that recruited conceptual components influence the fluency with which one can process events, either assisting or interfering with accurate response. Whether the component results in fluent or nonfluent processing, the availability of that component provides contextual aid. Although dual process theories suggest that information based processing and contextual detail are separate processes, the present findings can be explained with use of one process. Under a dual-process account, an attribution regarding fluency or lack of fluency can result in an "old" claim. As a separate process, the recruited processing components are then involved in recruiting additional contextual information regarding the prior event to support an "old" decision. Under a single process account, the appropriateness of the component results in fluent or nonfluent performance which can be evaluated and attributed to the past; however, the interpretive information provided by the conceptual component can also be evaluated and attributed to the past. Under this account, the contextual detail is provided in the conceptual component.

General Discussion: Part II

Part II examined how the consistency of processing during indirect memory performance influences evaluative processes required during a subsequent direct memory decision. Prior research has demonstrated that claims of recognition can be based on information regarding the quality of item-based processing or through information specifying contextual detail of the prior experience. However, past research has concentrated on demonstrating that perceptual and conceptual fluency can induce feelings of familiarity, and appropriate retrieval cues can help one access contextual details of the prior event. Although some believe that these two sources of information stem from independent processes (Jacoby, 1991, 1994; Mandler, 1980, 1991) whereas others hold that a single process is sufficient (Gruppuso, Lindsay & Kelley, 1997; Leboe & Whittlesea, 1999), the current research cannot separate between these positions, but can be understood according to either position. The present intention is to understand how the consistency of experiences influence the availability of these different sources of information.

Categorizing items at study resulted in greater claims of recognition over having simply named items. This finding supports the notion that having meaningfully processed items provides better contextual information surrounding the initial event, and that that context provision can assist individuals in accessing their past (e.g. Craik & Lockhart, 1972; Jacoby, 1983). For this recognition benefit, meaningful processing does not have to be consistent between experiences: Both inconsistent conditions led to greater recognition over previously named items. These findings suggest that the conceptual component from the earlier event was available and could provide information regarding the prior experience. Novel to the literature is the finding that switching conceptual tasks between study and test is not necessarily detrimental to the ability to recognize. Experiment 4 demonstrated that when orienting tasks differed between study and test, and when the initial orienting task was conceptually nonelaborate (i.e., the edibility decision), the probability of recognizing the item was reduced relative to consistent conceptual events. However, when orienting tasks differed between study and test, but the initial orienting task was conceptually elaborate (i.e., the naturalness decision), recognition ability was greater than that of consistent categorization conditions.[14] The ability to recognize items in this inconsistent condition cannot be attributed to conceptual fluency: These items were categorized non fluently in terms of both raw latencies and relative priming.

Elaborate Encoding Tasks: Implication for 'Transfer Appropriate Processing'

Current versions of transfer appropriate processing (e.g., Morris et al., 1977; Roediger & Blaxton, 1987) have difficulty with the current findings. These accounts hold that performance on memory tests reflect the extent to which test processing

[14]Note that in Experiment 5, recognition probabilities of consistent conditions were equivalent to that of the natural-edible condition. The difference in findings may be accounted for by a change in task demands: context identification is a more difficult decision relative to a straight old/new decision. However, whether recognition is greater or equivalent to consistent conditions, the central issue is that the natural-edible condition is not worse than consistent conditions.

skills match those invoked in the training processing. The extent of match was highest when orienting tasks were consistent and lowest when inconsistent. Yet the ability to recognize items in the natural-edible condition was better than (or equivalent to in Experiment 5) that of the consistent conditions. Further, although Roediger and colleagues' transfer appropriate processing account predicts that prior conceptual processing leads to greater recognition over prior perceptual processing, it is unclear whether recognition following inconsistent conceptual processing should equal or exceed that of prior perceptual processing. In the current studies, inconsistent conditions involve conceptual processing during training, but that processing is not appropriate for conceptual test operations. Both inconsistent conditions led to greater recognition over having named items during training, therefore inconsistent conceptual processing (providing that processing is recruited), can improve recognition. The present findings suggest that although matching training and test operations can benefit recognition, such matching is not required. Instead, the degree of elaboration of the prior processing influences the availability of components for test evaluation. Increasing the elaborative nature of the encoding processing reduces the need for matching retrieval conditions. This qualification suggests that transfer appropriate processing should not be considered a replacement for a levels of processing type account of memory performance. Rather, transfer appropriate processing and elaborative encoding need to be considered in tandem.

The Influence of Item and Context Information in Recognition

Two sources of information can lead individuals to claim items have been previously experienced, information based on the quality of item processing or information regarding the context of the event. With respect to information based in the quality of item processing, extra perceptual and conceptual fluency has been demonstrated to increase claims of recognition when items are old as well as novel (Jacoby & Dallas, 1981; Johnston et al., 1991; Verfaellie & Cermak, 1999; Whittlesea, 1993; Whittlesea & Williams, 1998, 1999a, 1999b, 1999c). With respect to contextual information, many experiments have demonstrated that supplying original contextual information can aid accurate recognition. Examples include providing a trained paired associate (Leboe & Whittlesea, 1999; Light & Carter-Sobell, 1970; Tulving & Thompson, 1973) or a similar type of task (Craik & Tulving, 1977; Morris et al., 1977). Whereas some theorists believe that these sources involve independent processes (Jacoby, 1991; 1996; Mandler;1980; 1991), others believe these processes are not independent and can be accounted through invoking a single process (Curran & Hintzman, 1995, 1997; Graf & Komatsu, 1994; Gruppuso et al., 1997; Hintzman & Curran, 1997; Joordens & Merikle, 1993; Leboe & Whittlesea, 1999), there is firm agreement that either source can be the basis of a recognition claim.

The current findings suggest that fluent processing is not necessary for claims of recognition. The less fluent inconsistent conditions resulted in higher claims of recognition over the equally (for the edible-natural condition) or more fluent (for the natural-edible condition) named conditions. There are two possible ways in which nonfluent processing can lead to claims of recognition. The first possibility is that people are sensitive to poor quality processing, such that that processing seems discrepant (e.g., worse than if you had not encountered the item before) and is attributed to the past (see Whittlesea & Williams, 1998; 1999a; 1999b; 1999c). Such a possibility; however, needs to explain how one distinguishes between nonfluent processing stemming from novelty and nonfluent processing stemming from inconsistent experience. The second possibility is that people are not sensitive to the lack of fluency per se; but instead, that the inappropriate component recruited during inconsistent processing provides contextual information regarding the original event. Experiment 5 supported this possibility by demonstrating that subjects were as able to identify the training context of the natural-edible condition items as when categorization decisions were consistent. Further, context identification of both inconsistent conditions was greater than that of the named conditions. These findings suggest that recruited conceptual components, whether appropriate or inappropriate for current demands, provide access to contextual information. Access could either involve the component recruiting additional prior event information, or alternatively, that the component itself provides contextual information through the specific coming to mind of a particular interpretation.

What is interesting to note is that recognition and context identification claims are not additively influenced by the availability of both item and context based information. It seems that the availability of either source of information is sufficient to attribute one's performance to prior experience. In standard recognition studies (i.e., a simple old/new judgment is required), item processing has typically been a helpful source to the evaluation process. In the present research, item based processing is poor, and as such, works against the contextually accessed information by suggesting the item had not been previously encountered. However, available conceptual information enables the subject to discount this lack of item based fluency and attribute the processing event to the past.

There have been several demonstrations that people can discount salient sources of fluency and not falsely attribute any fluent performance to prior experience. For example, Jacoby and Whitehouse (1989) in a repetition priming paradigm, presented subjects with long or short prime durations. When subjects were aware of the primes in the long presentations, they accurately discounted the additional fluency stemming from that source. However, when subjects were unaware of the source of the fluency (short presentations), subjects falsely attributed the primed fluency to prior experience. Similarly, Whittlesea and Williams (1999) found that the fluency from rhyme priming could be discounted only when target words were presented intact, but not when targets were presented as fragments. They suggested that the additional difficulty of the fragment solution backgrounded the rhyming task. Subjects were no longer focused on the source of rhyming fluency for the recognition decision, but instead used that fluency in the service of the fragment task. The current research supplies additional information regarding the relationship between fluency and recognition. Not only can subjects discount fluency to other salient sources, but they can also make claims about their past without use of fluency at all.

Summary Part II

Research on recognition has demonstrated that maintaining consistent training and test circumstances promotes recognition. The present set of experiments demonstrate that recognition following inconsistent conceptual experiences is not necessarily poor. An inconsistency between training and test tasks is detrimental for recognition only if the original task is of a nonelaborate nature. To the extent that encoding tasks are elaborate, the less the need for test circumstances to match those invoked during training. This principle holds even when indirect task performance is not fluent (i.e., negative transfer conditions). Recruited conceptual components can provide contextual information regarding the prior experience, allowing for a positive recognition claim.

Further research varying the types of processing skills involved in consistent and inconsistent processing is needed. This work would clarify whether it is the degree of *conceptual* elaboration that produced the observed effects or whether any elaborate processing is sufficient. A particularly relevant avenue would be to manipulate perceptual elaboration to demonstrate negative perceptual transfer.

Appendix

edible / natural	edible / artificial	inedible / natural	inedible / artificial
cow	butter	cactus	train
lamb	porridge	grass	playdough
pork	sandwich	crow	cupboard
corn	omelet	worm	flute
milk	cracker	tree	phone
apple	tart	fox	table
water	pudding	vine	paint
snail	broth	dandelion	stove
olive	cereal	cloud	fridge
walnut	taffy	sun	bureau
alfalfa	sucker	sap	book
lettuce	marshmallow	gorilla	tape
almond	pie	ruby	paper
mushroom	icing	rainbow	computer
potato	cocktail	diamond	road
orange	soup	lizard	car
grape	applesauce	dirt	bleach
crab	pasta	dolphin	ink
octopus	fudge	algae	stadium
bean	quiche	flea	bulldozer
cherry	lemonade	wax	harp
tuna	stew	hemlock	barbecue
wheat	muffin	mercury	tent
egg	casserole	sea	cigarette

Appendix con.'t

edible / natural	edible / artificial	inedible / natural	inedible / artificial
salmon	bread	cat	parachute
squash	fruitloops	dog	glue
peanut	granola	pearl	bathtub
cabbage	cake	baby	roof
mint	spaghetti	human	engine
oregano	cookie	daffodil	watch
tomato	tofu	violet	box
onion	tortilla	tornado	bed
raisin	jelly	ant	canoe
plum	mayonnaise	virus	glass
broccoli	pancake	butterfly	fork
clam	sausage	thunderbolt	elevator
chicken	nachos	mouse	soap
chive	chips	spider	tunnel
duck	coleslaw	sky	figurine
sugar	yogurt	meteorite	toothpick
rice	pizza	toad	ladle
pea	juice	bush	boot
lentil	creamer	glacier	ski
caviar	ketchup	seagull	shirt
strawberry	stuffing	seahorse	kitchen
pecan	cheese	starfish	couch
turnip	icecream	pelican	pot
turkey	beer	jungle	shorts
cucumber	salad	daisy	statue
deer	hamburger	pond	knife

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