REMEMBERING WORDS AND BRAND NAMES AFTER A PERCEPTION OF DISCREPANCY

by

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Abstract

A surprising violation or validation experienced during a remembering test induces the perception of discrepancy, causing a feeling of familiarity (Whittlesea & Williams, 1998; 2000; 2001a; 2001b). The experiments in this dissertation investigated whether that perception affects performance when it is experienced in the original encounter with a stimulus. A number of paradigms were used that have been previously found to be associated with creating the perception of discrepancy. In each experiment a portion of the target items were presented in a study phase in the context of a manipulation thought to induce the perception of discrepancy. In a subsequent recognition test, the earlier experience of that perception increased the accuracy of participants’ discrimination. However, when the subsequent task required a frequency judgment, that experience caused an illusion of repetition for items presented only once. The paradigm was also applied to and tested with brand names; however a different pattern emerged from that found using regular words. Thus, the perception of discrepancy in an initial encounter may be a valuable aid to later remembering; but can also cause systematic memory errors under some circumstances. The results extend the boundaries of the discrepancy-attribution hypothesis, demonstrating that the perception of discrepancy experienced in the past can affect the accuracy of current processing in more ways than one.

Keywords: fluency, discrepancy, familiarity, encoding, learning, memory, recognition, frequency, brand names
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Chapter 1: Introduction

Back in the days when people had pagers instead of cell phones, I remember experiencing an odd feeling: one day, sitting in my kitchen, I paged my brother, and even though I knew he would call right back, I became startled when I heard the phone ring. I didn’t experience this startle response when the phone rang in general. I wondered: how could the validation of an expectation be surprising? What is more fascinating about this example for me today, is that I can distinctly remember that phone call, and it stands out in my mind compared to all the other times that my brother has called me (with no page). At that time, surprise seemed to me to be a potent source of learning. In 2002, with my understanding that the experience of surprise is known to be a source of the feeling of familiarity when experienced during a remembering decision (e.g., Whittlesea & Williams, 2001a; 2001b) I wanted to examine whether surprise was a source of learning both words and brand names.

Before describing my journey of examining surprise as a source of learning, I will provide a brief description of the research which demonstrates the notion that surprise is the source of the feeling of familiarity during a remembering decision. As illustrated by Mandler’s (1980) famous example, an encounter with a marginal acquaintance often does not cause a subjective experience of familiarity when that person is met in an expectable context (e.g., encountering one’s butcher in his shop), whereas meeting that person in an unusual context (e.g., on the bus) may cause a powerful feeling of familiarity. Fluency of processing per se does not seem to be adequate to explain this

---

1 My supervisor suggested that I write this dissertation as a diary, rather than as an article. We have already written up select groups of experiments as articles (e.g., Kronlund, under review; Kronlund & Whittlesea, under review; Kronlund & Whittlesea, 2005).
phenomenon, because the fluency of processing the gestalt of the person’s face could be expected to be as great (or greater) in the former situation as the latter. Instead, Whittlesea and Williams (1998) suggested that it is the surprise caused by an experience of fluency in the latter case that is the direct source of the feeling of familiarity. They suggested that the experience of fluent processing in a context in which it should not be expected gives rise to a perception of discrepancy, signaling to the person that there is an inconsistency in their current experience, which must be resolved. In such a situation, one plausible way of resolving this perception is by attributing the unexpected fluency to a previous encounter with the person. By this account, the attribution of unexpected fluency to a source in the past is the direct cause of the subjective feeling of familiarity.

**Remembering after a Perception of Discrepancy**

Because the perception of discrepancy serves an alerting function, I believed that it may also serve as an occasion of learning, in addition to affecting feelings of remembering. In the butcher example, the perception of discrepancy created by the encounter of the butcher on the bus may cause that particular encounter to be discriminated accurately later from other, prior encounters with the butcher. The primary purpose of this dissertation is to demonstrate that, when a person is alerted to a stimulus, the person will experience that stimulus as having a rich subjective quality, and will more likely remember it on a subsequent occasion. In addition, I will demonstrate that an experience of rich subjective quality can also lead to an illusion of repetition.

In the remainder of the Introduction, I will describe the various paradigms which have been previously used to examine the feeling of familiarity, created through the development and resolution of expectations. I am defining familiarity as "the subjective
feeling of having prior experience, whether or not one actually has” (Whittlesea & Williams, 2000, p. 547). I will describe the standard results that have been observed using these paradigms, which have been interpreted to signify that the perception of discrepancy is the source of feelings of familiarity when experienced in a recognition memory test. I will then present a number of experiments whereby I used a modified version of each paradigm, attempting to place the critical manipulation (thought to induce the perception of discrepancy) during the study phase instead of the test phase of a memory experiment. By placing the critical manipulation in the study phase, I examined the affect of the perception of discrepancy on later judgments: I examined standard old/new recognition, and re-defined what a “false alarm” is by examining frequency ratings. To anticipate, my results showed that the experience of a perception of discrepancy increased the accuracy of participants’ later recognition of words and brand names. However, when the subsequent task required a frequency judgment, that experience caused an illusion of repetition for words and orthographically regular words presented once, but not for brand names that were presented once.

Note that I am not attempting to develop a theory of frequency per se (for a retrospective on this literature, see the review by Zacks & Hasher, 2002); instead, I am using the frequency judgment task as a tool for examining the consequences of experiencing the perception of discrepancy during learning. Thus, I will postpone my discussion of implications for the literature on frequency judgments until the General Discussion of Chapter 2.
Paradigms used to examine the Perception of Discrepancy during Learning

The Sentence Stem Completion Paradigm

The development and resolution of expectations can be illustrated by experiments conducted using the sentence stem completion paradigm, which creates processes that underlie the perception of discrepancy. I will describe the specific experimental results that this perception elicits (I will postpone discussion of other perceptions until the General Discussion of Chapter 2). Whittlesea and Williams (2001b) presented single words in a study phase. In the recognition test, they presented studied and unstudied words as terminal words of sentences. The sentence stems were of two types: high constraint (able to be completed sensibly by only a small number of words: e.g., “She swept the kitchen floor with a . . .”) and low constraint (able to be completed sensibly by many words: e.g., “She couldn’t find a place to put the . . .”). Thus, stems were completed either by a word shown during study (e.g., BROOM) or an equally sensible word that had not been shown during study (e.g., SPONGE). The result of interest is that high constraint stems caused an increase in both hits and false alarms of about 5% relative to low constraint stems; but only when the stems were separated from the target words by a short pause.

This pattern of recognition performance using sentence stems is highly stable, and has been replicated repeatedly (Whittlesea, 2002a; 2002b). Whittlesea and Williams (2001b) suggested that it results from a perception of discrepancy. They suggested that that perception, as well as the associated feeling of familiarity, develops in stages, involving expectation, inference, and attribution. A high constraint stem causes the person to develop a strong but indefinite expectation about what is coming next (i.e., a
readiness to incorporate one of a small number of concepts, without actually predicting any one of them). The pause causes an experience of uncertainty, a fleeting sense of suspense or realization that one does not know exactly what is coming. This experience of uncertainty causes the target word, when it is shown, to feel not just coherent with the stem, but surprisingly well-fitting. In the context of a recognition experiment, the participants unconsciously attribute the surprise to a prior experience of the target word, consciously experiencing the feeling of familiarity.

There is much evidence suggesting that the effect depends on an indefinite expectation. Whittlesea and Williams (2001b) demonstrated that any manipulation that would cause a definite expectation prevented the effect. For example, the effect does not occur if the target words are completely predictable from the stems (e.g., “Row, row, row your BOAT”). There is also convergent evidence that surprise is involved, rather than a heightened sense of fluency. When participants were asked to judge the predictability of target words presented after constraining stems, participants judged words to be less predictable when presented with rather than without a pause (Whittlesea, 2002b). That observation is opposite to what could be expected from an increase in fluency of processing. Instead, it is in line with the idea that the pause caused the words to feel somewhat surprisingly well fitting.

The phrase “waiting for the shoe to drop” provides an example of how a validation of expectation can be surprising. In the original story, a man comes in late at night to an inn. He sits on his bed, and drops one of his shoes on the floor, before realizing that the others in the inn were asleep. He then takes the other one off much more carefully than the first, and quietly puts it on the floor. As he’s falling asleep, he hears a
shout from the room below him, “I can’t sleep because I’m waiting for you to drop your other shoe!” The phrase, as it's used today, means that one is patiently waiting for something to happen, which is expected. The waiting period is a period of uncertainty; and when the outcome occurs, the person experiences a surprising resolution, because the person did not know exactly when it was to occur. Thus, the experience of a surprising validation is termed the “perception of discrepancy”, and not simply “discrepancy” because the term is not meant to describe the target--a “discrepant” target would not be an expected one—rather, it is meant to describe the subjective feeling of surprise, arising from some sort of uncertainty given the context.

For the current purposes it is important to note that, the presentation of the target word after a stem is not just an occasion for evaluating the goodness of the current event and experiencing a feeling of familiarity; it can be an instance of learning the target word, which can have consequences for later interactions with the same target. I suspected that the perception of discrepancy might not only be the source of feelings of familiarity when experienced at test, but might also be a fairly potent source of later remembering when experienced instead during a study episode. That idea is the basis of the first set of experiments in Chapter 2. As mentioned earlier, I suspected that the perception of discrepancy might also be a powerful source of learning brand names. That idea is the basis of the experiments in Chapter 3.

2 A discrepant or unexpected stimulus can also cause superior learning. That idea is the basis of the Rescorla-Wagner (RM) model in classical conditioning (e.g., Rescorla & Wagner, 1972). The ideas proposed in this dissertation differ from those in the RM model because in the RM model, surprise is defined by the stimulus; it determines whether or not an association will occur between the unconditioned and conditioned stimulus, but it also determines how much of an association will occur. Thus, the model does not differentiate between objective properties of a stimulus and the subjective experience of reality.
The HENSION Paradigm

The stem completion paradigm creates processes that underlie the perception of discrepancy through a surprising validation. The perception of discrepancy can also arise from a surprising violation arising from an unknown source. To provide an example, Whittlesea and Williams (1998) presented participants with well known stimuli (e.g., TABLE), fluent but novel stimuli, created by replacing one letter of an English word (e.g., HENSION, BARDEN, etc.), and novel, non-fluent stimuli (e.g., LICTPUB, STOFWUS, etc.). During a test phase, participants made recognition judgments on studied and non-studied stimuli of each category. The HENSION items produced the most false alarms (37% vs. 16% for the words).

Whittlesea and Williams (1998) reasoned that the HENSION items were processed very rapidly; participants expected them to be meaningful items. The mismatch in processing (expectation of meaning, violated by the end result of a lack of meaning) caused the perception of discrepancy towards those items at test. For items of this type, the perception of discrepancy, and accompanying feeling of puzzlement, was from an unknown source; in the context of a recognition experiment participants attributed the feeling to the past. There was no such mismatch for the other two types of items.

The results of this study, coupled with the results obtained using the stem completion paradigm (described above) led Whittlesea and Williams (1998; 2000; 2001b) to propose the discrepancy-attribution hypothesis. This hypothesis states that when there is any sort of mismatch between expected and actual performance on a given stimulus in a given context (in this case, the test context), the perceived discrepancy is consciously experienced as the feeling of familiarity, and unconsciously attributed to a prior experience of that stimulus. Note that the perception can arise from either a surprising
validation (as in the case of the stem completion paradigm) or a surprising violation (as in the case of the HENSION paradigm) arising from an unknown source. For the current purposes, I expected that, an initial encounter with a target such as HENSION would have different consequences for memory than having an encounter with a regular word, or an unpronounceable nonword. That idea is the basis for the second set of experiments in Chapter 2.

Other Applications

In Chapter 4, I will describe some studies that I carried out in addition to my dissertation studies. These studies were either (a) follow up studies to research completed as part of my MA, (b) part of collaborations with my former lab-mates, (c) carried out while supervising a directed studies student, or (d) done out of pure interest. These studies were examinations of other phenomena, including the mirror effect, the revelation effect, the DRM effect, and retrieval induced forgetting. I will describe each phenomenon in the following few paragraphs.

The Mirror Effect

Over the past 5 years I have had an interest in the mirror effect in recognition memory. The term “mirror effect” refers to the observation that a class of stimuli which produces more hits when old, compared to a second class, instead produces fewer false alarms when new. Mirror effects have been observed for stimuli differing on a number of dimensions, including concreteness, meaningfulness, and natural word frequency (e.g., Glanzer & Adams, 1985), which was the focus of the various studies that we have carried out (e.g., Whittlesea, Kronlund, Joordens, & Hockley, 2006).
In experiments of this type, participants typically study a list of high and low frequency words (e.g., TABLE and HIPPOPOTAMUS, respectively), and are then required to discriminate studied from unstudied words. In such experiments, accuracy is observed to be better for low than for high frequency words, both in terms of higher hit rates and lower false alarm rates. There are a number of "direct-access" accounts of the frequency-based mirror effect (e.g., Donaldson, 1996; Hirshman & Arndt, 1997; Glanzer & Bowles, 1976; Hockley, Hemsworth & Consoli, 1999; Reder et al., 2000; Wixted, 1992), which assume that the target makes direct contact with memory, and that there is no place for inference and attribution. I will focus on the direct-access account given by Joordens and Hockley (2000), because our other studies (e.g., Whittlesea, Kronlund, Joordens, & Hockley, 2006) as well as the ones I will report here were developed based on the assumptions of this account.

Joordens and Hockley (2000) suggested that low frequency words cause fewer feelings of familiarity than high frequency words, but are more recollectable. They suggested that familiarity reflects the extent to which a target matches the contents of memory: high frequency words, having more representations in memory, feel more familiar and so produce more false alarms. All else being equal, that factor would also tend to produce more claims of "old" for studied high frequency items. However, because low frequency words have been associated with fewer contexts in the past relative to high frequency words, their appearance on a study list would be more distinctive compared to a background of life experiences than would a similar occurrence of a high frequency word. In consequence, during the test, recall of a low frequency words' occurrence in the study list is less confusable with extra-list experiences, so that they are judged "old" more
often than high frequency words. That factor outweighs the familiarity factor, so that it reverses the relative rate of “old” claims for the two types of items, causing low frequency words to produce more hits.

I will focus on Joordens and Hockley’s (2000) account of familiarity and its influence on performance. High frequency words, being associated with more representations in memory, are processed more fluently than low frequency words. By Joordens and Hockley’s (2000) account, this fluency is directly experienced as familiarity, which explains why false alarms are higher for high frequency words in the mirror effect. However, that idea appears to conflict with intuitive evidence. I have sat in front of the computer in my lab cubicle almost every day for the past 5 years, so it is a high frequency and highly fluent stimulus; in the objective sense, the computer is highly familiar. Yet when I come in to the lab each morning, I do not ever experience “Gosh, that computer feels familiar! Where have I seen it before?” (cf. Whittlesea & Williams, 1998). That suggests that frequency need not translate directly into a subjective feeling of familiarity. Similarly, the words used in mirror effect studies are also occasionally encountered in general reading, but again, that experience is not usually accompanied by a feeling of familiarity.

Although this is only informal evidence, it suggests that the feeling of familiarity for high frequency words that occurs in recognition experiments may be due in part to the way that people interrogate their memory for those words, creating a perception of discrepancy, rather than a direct and automatic reaction to their frequency. We explored this issue in our earlier studies (see Whittlesea, Kronlund, Joordens, & Hockley, 2006).
However, we did not examine the notion of recollection. That is the basis of the first series of experiments in Chapter 4.

**The Revelation Effect**

Students in the Whittlesea lab were examining other recognition memory phenomena at the time that the discrepancy-attribution hypothesis was originally published. The work of Dan Bernstein, a former PhD student of Whittlesea, provides an example. His work focused on the revelation effect, which is the observation that revealing a word prior to making a recognition judgment about that word (e.g., NWIDWO – WINDOW) or an unrelated target word (e.g., NWIDWO – RAINDROP) increases one’s claims of having seen the target word before (Watkins & Peynircioglu, 1990; Westerman & Greene, 1998). It has been observed using words (Frigo, Reas, & LeCompte, 1999; LeCompte, 1995; Luo, 1993) faces (Bornstein & Wilson, 2004) and pictures in children and adults (Guttentag & Dunn, 2003).

Verde and Rotello (2004) showed that two separate processes underlie the revelation effect based on whether the anagram is the same word as the recognition target or an unrelated word. When the anagram and recognition target are the same, there is a change in memory sensitivity. Verde and Rotello reasoned that when familiarity increases, variability in familiarity distributions also increases, causing a reduction in the signal-to-noise ratio. When the anagram and target are unrelated words however, response bias is involved and there is no change in sensitivity. A possible explanation for this was originally offered by Niewiadomski and Hockley (2001), who argued that the unrelated problem solving (i.e., the revelation task) temporarily displaces the study-list context in working memory. In the absence of the study context, the subsequent
recognition decision is more difficult. As a consequence, participants adopt a more lenient criterion. Participants are able to set an appropriate criterion once the study list context is reinstated on subsequent trials with no problem solving task. Such criterion shift explanations are the prevailing accounts of the revelation effect.

Although many regarded the revelation effect to be limited to episodic memory tasks involving a study list (e.g., Bornstein & Wilson, 2004; Verde & Rotello, 2004), Bernstein, Whittlesea, and Loftus (2002) observed the effect in judgments of remote autobiographical memory and world knowledge. For example, Bernstein et al. found that participants increased their confidence that an event occurred in their childhood when the autobiographical event contained a key word as an anagram (e.g., "broke a DWINIWO [WINDOW] playing ball") as opposed to having the key word intact. They also found that participants believed answers to trivia questions more often when those answers appeared as anagrams (e.g., *fastest animal? ELPRAOD [LEOPARD]*). Such observations challenged criterion shift accounts by showing revelation effects without any study list (see also Bernstein, Godfrey, Davison, & Loftus, 2004; Frigo et al., 1999).

Whittlesea and Williams (2001a) speculated that an alternative account to the revelation effect may involve the perception of discrepancy. They introduced the idea that initially anagrams may appear to be difficult to solve. This local standard is compared to a contradictory feeling that is experienced once the rule is applied and the letters begin to form a coherent word, when participants experience an “aha!” feeling. In the case of the anagram being the same as the target, the solution is experienced as being surprisingly fluent. In the case of the anagram being different from the target, the target is experienced as being surprisingly fluent in the context of the local standard. In either
case, anagram solving results in the perception of discrepancy (i.e., mismatch between initial expectation and outcome), and a feeling of familiarity that is misattributed to the past. Bernstein et al. (2002) also incorporated the discrepancy explanation into their findings for a revelation effect in non-episodic memory tasks. Participants who answered trivia questions with either the target as an anagram (e.g., *fastest animal? ELPRAOD [LEOPARD]*) or following an anagram (e.g., *fastest animal? RTELEANX [EXTERNAL] LEOPARD*), interpreted the target as being surprisingly fluent for the context; the context having been established as a difficult one from the initial appearance of the anagram.

I will present two separate lines of studies where I examined the feeling of familiarity in the context of anagram solving. In the first line of these studies, I examined recognition performance for words encountered after anagrams during study. That is, my research question was: given that anagram solving may allow the target word to be processed surprisingly fluently, what are the later consequences of experiencing such surprising fluency? I presented anagrams during the study phase of the experiment to determine what the consequences would be: would anagram solving lead to a subsequent increase in false alarms? In the second line of revelation studies, which were part of a collaboration with Dan Bernstein, we examined whether a basic revelation effect (i.e., a test-time effect, using recognition) would be observed using brand names as targets. More importantly, we examined whether a revelation effect would be found in preference ratings. I thought that finding such a preference effect would have important implications for theories of the effect and theories of brand preference, as well as significant implications for point-of-purchase marketing strategies.
The DRM Effect

Another effect that, if observed with brands, would have important implications for marketing is the DRM effect (Deese, 1959; Roediger & McDermott, 1995; see also Read, 1996). The DRM paradigm consists of showing participants lists of related words such as thread, pin, eye, sewing, sharp, point, thimble, haystack, thorn, hurt, injection, syringe, cloth, and knitting; participants falsely report (in the context of either a recall or a recognition task) having seen the non-presented critical lure, or “prototype”, needle, and are even more likely to do so if longer lists are used (e.g., Robinson & Roediger, 1997). The effect occurs regardless of whether the critical lure is presented after a rapid serial visual presentation of the associated list, or after the set of studied lists have been shown (e.g., Whittlesea, Masson, & Hughes, 2005). Presenting such a list of associates causes facilitation for critical lures on both direct and indirect tests including word association (McDermott, 1997), fragment completion (McKone & Murphy, 2000), and lexical decision (Hancock, Hicks, Marsh, & Ritschel, 2003). Warning participants about the illusion before they take the test has no consequence in abolishing the effect (Gallo, Roediger, & McDermott, 2001), however if the warning comes before the study session, the instruction attenuates the effect (Gallo, Roberts, & Seamon, 1997; Gallo, et al., 2001), suggesting that the illusion is created by the encoding process.

Spreading activation theories (Anderson & Bower, 1973; Collins & Loftus, 1975) have been common to explain the effect (e.g., Roediger, Balota, & Watson, 2001). However, more recently, spreading activation theories in general have been criticized by many (e.g., Kronlund, Whittlesea, & Yoon, in press; Whittlesea, 2002a; Whittlesea, Masson, & Hughes, 2005), and recent evidence for the DRM effect have been inconsistent with simple activation accounts (see Watson, Balota, & Roediger, 2003), and
have favoured attributional accounts (e.g., Gallo & Roediger, 2003; Whittlesea, 2002a). The common explanation has to do with fluency-attribution (e.g., Jacoby, Kelley, & Dywan, 1989). The study of associates allows the critical lure to be processed fluently; fluency is misattributed to prior experience (Gallo & Roediger, 2003; Roediger, McDermott, Pisoni, & Gallo, 2004).

I was granted permission by my department to act as a supervisor to directed studies students; I supervised an undergraduate student, Leanne Wagner3, and we performed a series of experiments together as part of her course requirement. Our experiments examined whether a DRM effect would occur with brands, and what implications that would have for theories of brand name recognition. Our experiments (Kronlund & Wagner, in preparation) will be described in Chapter 4. The project is ongoing; I will present only the experiments completed thus far. The results of these experiments also inspired some ideas that I examined in collaboration with another former lab-mate (Andrea Hughes) on the phenomenon of retrieval induced forgetting. I will postpone discussion of those ideas along with a brief description of our studies until the end of Chapter 4.

In summary, I will examine the consequences of experiencing the perception of discrepancy when studying words (Chapter 2) or brand names (Chapter 3). Chapters 2 and 3 make up my dissertation proper. I will also discuss my other lines of research completed during the tenure of my PhD, although in collaboration with others, and therefore are not the basis of my dissertation work (Chapter 4). I outline the experiments in Table 1.

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3 Leanne Wagner is now completing her M.A. in the Adler School of Professional Psychology.
Table 1

Outline of Experiments

<table>
<thead>
<tr>
<th>Chapter</th>
<th>Stimulus</th>
<th>Paradigm</th>
<th>Test</th>
<th>Result of interest</th>
</tr>
</thead>
<tbody>
<tr>
<td>2</td>
<td>Words</td>
<td>Stems during study</td>
<td>Standard old/new recognition</td>
<td>Remembering after a perception of discrepancy</td>
</tr>
<tr>
<td>2</td>
<td>Words</td>
<td>Stems during study</td>
<td>Frequency judgment</td>
<td>Remembering, and illusion of repetition, after a perception of discrepancy</td>
</tr>
<tr>
<td>2</td>
<td>Non-words</td>
<td>“HENSION” paradigm</td>
<td>Frequency judgment</td>
<td>Remembering, and illusion of repetition, after a perception of discrepancy</td>
</tr>
<tr>
<td>3</td>
<td>Brands</td>
<td>Stems during study</td>
<td>Standard old/new recognition</td>
<td>Remembering after a perception of discrepancy</td>
</tr>
<tr>
<td>3</td>
<td>Brands</td>
<td>Stems during study</td>
<td>Frequency</td>
<td>Remembering, but no illusion of repetition, after a perception of discrepancy</td>
</tr>
<tr>
<td>4</td>
<td>Words</td>
<td>Mirror Effect</td>
<td>Frequency judgment</td>
<td>Mirror pattern</td>
</tr>
<tr>
<td>4</td>
<td>Words</td>
<td>Anagrams during study</td>
<td>Frequency judgment</td>
<td>Decrease in accuracy after a perception of discrepancy, overcome by repetition</td>
</tr>
<tr>
<td>4</td>
<td>Brands</td>
<td>Anagrams during test</td>
<td>Memory &amp; Preference</td>
<td>Illusion of recognition &amp; preference</td>
</tr>
<tr>
<td>4</td>
<td>Brands</td>
<td>DRM</td>
<td>Memory &amp; Preference</td>
<td>Illusions of recognition, not preference</td>
</tr>
<tr>
<td>4</td>
<td>Words within categories</td>
<td>Retrieval induced forgetting</td>
<td>Recall; cued recall</td>
<td>Forgetting appears to be due to within- and between-category interference</td>
</tr>
</tbody>
</table>
Chapter 2: Remembering Words after a Perception of Discrepancy

Many theories of recognition memory are based on studies which examine accuracy towards words presented in some type of manipulation at test. An example is the work of Whittlesea and Williams (1998; 2001a; 2001b), who have examined the effect of varying levels of expectation and uncertainty on recognition memory for targets using a standard old/new recognition decision, to contribute to the understanding of the cognitive processes, or primitive perceptions, underlying claims of recognition. The assumption guiding some of this work is that, in order to understand the remembering process, one should examine the types of errors that people make. In the experiments presented in this chapter, I examined whether the same perceptions that are involved in remembering are also involved in learning. I too, attempted to answer this question by examining the types of errors that people make.

To achieve this end, I replaced some tools in the toolbox; I modified the standard paradigms that have been used in the literature thus far. I re-defined what an “error” in recognition is. I answered questions that were formerly unanswerable using the old tools.

In the remainder of this introduction to my experiments, I will describe previous research on the source of the feeling of familiarity. I will present the relevant research that has examined the likelihood that a word feels familiar when it is presented in the context of a sentence during a recognition memory test. In particular, I discuss the two major theoretical accounts of the feeling of familiarity for words in sentences: the fluency hypothesis and the discrepancy-attribution hypothesis. Next, I will present a number of
experiments where I examined recognition memory of words that were presented in sentences during study. I will then discuss the results of these experiments and consider both the theoretical and practical implications of my findings.

**The Feeling of Familiarity in the Moment**

**The Fluency Hypothesis**

To provide an example of the fluency-hypothesis, I will discuss Whittlesea’s (1993) study. Whittlesea (1993) examined the role that sentence stems have on recognition memory of target words. He showed participants a list of isolated words during a study phase. At test, he presented studied and unstudied target words in the context of sentence stems that were either fairly constraining (e.g., “The stormy seas tossed the . . .”), which can be sensibly completed by only a limited number of words (e.g., BOAT or SHIP) or quite non-constraining (e.g., “She saved her money and bought a . . .”) which can be sensibly completed by an unlimited number of words (e.g., LAMP, CAR, DRESS, etc.). The result of interest was that target words that were preceded by constraining sentence stems were pronounced faster (as indexed by response latencies) than were target words preceded by non-constraining sentence stems. Moreover, target words preceded by constraining sentence stems were judged to be seen in the earlier study phase about 5% more often than target words preceded by non-constraining sentence stems. Because the manipulation of constraint of the sentence stem was orthogonal to whether the target word was shown earlier or not, this increase in claims of recognition was an illusion of recognition. Whittlesea (1993) observed that the constraint of the sentence stem was associated with the fluency, or speed of processing the targets (as indexed by the response latencies); participants appeared to be using a “fluency
heuristic"; the sheer speed with which participants pronounced target words was used as an index of whether the word was previously seen. Thus, according to Whittlesea, this process involves an unconscious attributional process.

Whittlesea (1993) also examined pleasantness ratings for target words and again found that participants appeared to be using a fluency heuristic: words presented in constraining contexts were rated as more pleasant. Many investigators have made similar conclusions about the role of fluency in recognition, preference, or pleasantness (e.g., Higham & Vokey 2000; Jacoby, Kelley, & Dywan 1989; Janiszewski & Meyvis 2001; Joordens & Merickle 1992; Lee & Labroo 2004; Lindsay & Kelley 1996; Luo 1993; Masson & Macleod 1996; Mulligan & Hirshman 1995; Rajaram 1993; Shapiro, 1999; Verfaellie & Treadwell 1993). Similarly, this type of fluency has been reported to be the mediating factor between a brand's accessibility and its likelihood for inclusion into a consideration set (see Shapiro, 1999). Furthermore, this type of fluency effect on memory attribution has been found to affect stimulus-based choice (e.g., Lee, 2002).

**The Discrepancy-Attribution Hypothesis**

More recent research however, has established that it is not the fluent processing of the target per se, but rather the perception of discrepancy or surprise that is involved in creating the feeling of familiarity (e.g., Whittlesea & Leboe 2003; Whittlesea & Williams 1998, 2000, 2001a, 2001b). When re-examining Whittlesea's (1993) study, Whittlesea

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4 The term consideration set is used by consumer behaviour researchers to denote the brands that are considered when making a specific product choice. It is differentiated from the awareness set, which includes all the brands that are known by the consumer but are not considered when making the choice, and the universal set, which includes all the brands that exist in that product category but may or may not be known by the consumer.

5 The distinction between stimulus-based versus memory-based choice is used by consumer behaviour researchers to describe situations in consumer-related contexts whereby all the choices are present (e.g., choosing from a list of pizzerias in the phonebook) versus when they are absent (e.g., ordering a pizza without looking up pizzerias in the phone book), respectively.
and Williams (2001b) thought that the brief pause between the sentence stem and target word (which was inserted between the time when the participants were to read the sentence stem and when the target word was presented, to take the response latency) was critical to the illusion of recognition. Whittlesea and Williams tested this hypothesis by using the same design and procedures as that used by Whittlesea (1993), but presented half of the target words with a brief pause between the sentence stems and target words, and presented the other half with no pause. They observed that presenting the sentence stem and target all at once (i.e., as per the “no pause” condition), abolished the illusion of recognition for the constraining sentence stems.

That selective effect did not come about because the pause itself somehow enhances the fluency of processing of the target words following constraining sentence stems, or because it permits the participants to realize that their performance was fluent (see Whittlesea & Williams 2001b). The effect occurs because the participants are surprised (see Whittlesea 2002b). The effect seems to happen in three sequential stages involving expectation, uncertainty, and surprising resolution. The constraining sentence stem arouses an indefinite expectation, or a readiness to incorporate only a limited number of words whose meanings are consistent with the sentence stem (e.g., only BEACH, LAKE, WATER PARK, and possibly a few others are expected after “They swam and played at the . . .”). There is no projection of the specific target word. Next, the pause between the sentence stem and target allows the participant to realize that they do not know what target word is to come, and so it causes suspense, or a period of uncertainty. Finally, when the target word is presented after the pause, it is rapidly incorporated into the indefinite expectation prepared by the sentence stem. The only
difference between the “pause” and “no pause” conditions therefore is the uncertainty, created by the pause, which makes the target word surprising (see also Whittlesea 2002b, for a discussion on the creation of “surprise”). Surprise requires attribution: In the context of a recognition test, participants unconsciously attribute it to a prior experience of that word (Whittlesea & Williams 2001b).

A perception of discrepancy can be induced in other ways during the test phase of a recognition memory experiment (e.g., Kronlund & Bernstein in press; Whittlesea, Kronlund, Joordens, & Hockley, 2006; Whittlesea & Williams 1998; 2000; 2001a; 2001b; Whittlesea & Leboe 2003), and it has been examined in other contexts as well (e.g., Menon & Raghubir 2003; see also Huber 2004), but it has not been previously examined in the context of the study phase of a recognition memory experiment. In all of those studies, an illusion of recognition was caused by manipulating the test trials of the experimental situation in a way that would create a disparity between the participants’ expected and actual processing for each trial. Thus, in all of those studies, circumstances were so arranged that the participants experienced the perception of discrepancy during the moment that they attempted to perform a recognition decision.

However, in each of those experimental contexts, the disparity between the participants’ expected and actual processing can also potentially be an instance of learning, which can have consequences for later interactions with the same stimuli. In the case of the stem completion paradigm, the presentation of the target word after a stem is not just an occasion for evaluating the goodness of the current event and experiencing a feeling of familiarity; it can be an instance of learning the target word. I suspected that the perception of discrepancy might not only be the source of feelings of familiarity when
experienced in a test context, but might also be a fairly potent source of later remembering when experienced instead during study. That idea is the basis of the first series of experiments of this Chapter.

I will present a number of experiments which examined the effect that placing a target word after a constraining sentence stem during study has on later remembering of those targets. Having established that the critical factor in enhancing the feeling of familiarity in the test context is the pause after constraining stems, my experiments used only constraining stems, varying the use of a pause. However, no stems are presented at test.

**Experiment 1: Learning With and Without a Perception of Discrepancy**

Experiment 1a used a one-factor ("old at test" vs. "new at test") nested design, whereby the level of "old" contained 3 encoding levels ("stem with pause before target word" vs. "stem with no pause before target word" vs. "target word in isolation"). I expected that recognition memory for targets appearing after a stem and pause would be more accurate than recognition memory for targets appearing after a stem and no pause. Further, I expected that targets appearing after a stem and no pause would be more accurate than recognition memory for targets appearing in isolation.
**Method**

*Participants.* Twenty-two students from Simon Fraser University participated in Experiment 1a; 19 participated in Experiment 1b; 59 in Experiment 1c (14 in the pause group, and 15 each in the 3 other groups), and 27 in Experiment 1d.  

*Procedure.* I obtained 120 constraining sentence stems and associated target words from the Appendix of Whittlesea and Williams (2001b). For Experiment 1a, of the 120 target words, random assignment placed 60 target words each into the conditions of “old at test” and “new at test”. Nested within the level of “old at test”, random assignment placed 20 target words each into the three encoding levels: “stem and pause before target word”, “stem and no pause before target word”, and “target word in isolation”. For the target words placed into the two encoding levels containing sentence stems, the associated stem was included as part of the target set.

Before the study phase, the experimenter told each participant that they would receive an unspecified memory test following a study session. The experimenter told each participant that they were to be presented with some words and some sentences on a computer monitor. The experimenter asked each participant to read all words and sentences, and they were to try to pay particular attention to (a) any words that appeared in isolation, such as “BOTTLE”, and (b) the terminal words of each sentence, which would be presented in capital letters, such as the word “BOTTLE” at the end of “She drank from a water BOTTLE”.

During the study phase a computer monitor displayed the 60 target sets associated with the three encoding levels in a random order. The monitor displayed each target word  

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6 Experiments 1a to 1d were carried out in different semesters; participants were excluded from participating in more than one of these experiments.
in capital letters. When a stem preceded the target words, only the first letter of the stem appeared in capital letters; the stem was otherwise in lower case. Each target set (whether containing a stem or not) was presented in the center of the monitor.

For the “stem and pause” condition, the stem was presented on the monitor for 3000 milliseconds (msec) with three dots following it (e.g., “After dinner he watched TV on the…”). After the 3000 msec passed, the stem remained on the monitor and the 3 dots were replaced with the target word (e.g., “After dinner he watched TV on the COUCH”), and the stem and target word remained on the monitor for 1000 msec. Thus the pause between the stem and target onset was of varying duration, depending on the length of the sentence and the speed with which the sentence was read. For the “stem and no pause” condition, the stem and target were both presented on the monitor for 4000 msec (e.g., “She swept the kitchen floor with a BROOM”). For the “target in isolation” condition, the target word was presented for 1000 msec (e.g., “ISLE”).

Once all of the 60 target sets were shown, the monitor read “PLEASE CALL THE EXPERIMENTER”; the participant alerted the experimenter. The experimenter explained to each participant that the test was about to begin. The experimenter told each participant that no stems were to be presented at test; only words in isolation would appear on the monitor. The experimenter told each participant that they were to indicate whether each word had appeared during the study phase or not by pressing a button on a button box. Participants were to press a button labeled “OLD” if the word was shown in

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7 Whittlesea (2004) suggested that it takes about 2500 msec to read these stems, which depends on the speed with which the person reads. In the original studies using these stems, the stem was presented, at test, for 2500 msec with an additional 250 msec pause before the onset of the target (e.g., Whittlesea & Williams, 2001b). More recently, Whittlesea (2004) reported that the length of the pause is not critical; the effect is observed with pauses of anywhere between 250 to 750 msec. This means that the ideal range for the presentation of the stem (including the “pause”) is anywhere between 2750 and 3250 msec; I chose the middle of that range.
the study phase, either in isolation or at the end of a stem in capital letters, and were to press a button labeled “NEW” if the word was presented for the first time in the experiment. Because of this explanation, there was at least a 5 minute delay between the study and test phases.

During the test phase, no stems were used. A computer monitor displayed all of the target words shown during study (“old at test”) along with the words not previously shown (“new at test”), one by one, in a freshly randomized order. Participants indicated whether each word was “old” or “new” by pressing a button on a button box.

Experiment 1b was identical in all ways to Experiment 1a with the exception that the “stem and pause” condition was replaced by a “stem and generate” condition. In the “stem and generate” condition, the monitor displayed the stem for 4000 msec; participants were asked to make a mental guess about what word would be used to complete the sentence. After the 4000 msec passed, the monitor displayed the target for 1000 msec.

Experiment 1c employed a between-subjects design with 4 groups. As each participant entered the lab, the experimenter drew a number from 1 to 4 in order to randomly assign each participant to 1 of the following 4 groups: stem and pause, stem and no pause, target in isolation, and stem and generate. Participants in the stem and pause group completed an experiment analogous to only the “stem and pause” condition in Experiment 1a. Participants in the stem and no pause group completed an experiment analogous to only the “stem and no pause” condition in Experiment 1a. Participants in the target only group completed an experiment analogous to only the “target in isolation” condition in Experiment 1a. Participants in the generate group completed an experiment
analogous to the generate condition in Experiment 1b, with the exception that the monitor displayed the stem for an indefinite period; until the participants typed in a guess. After they had done so, the monitor displayed the target for 1000 msec.

Experiment 1d was identical in all ways to Experiment 1a with the exception that the “target in isolation” condition was replaced with what I have named the “alternate” condition. In the “alternate” condition, the stem was presented for 3000 msec with an alternate ending (e.g., “They swam and played at the BEACH”) and the terminal word was replaced by the target ending (e.g., “They swam and played at the LAKE”) for an additional 1000 msec. Participants were required to make a recognition claim about the target. Unstudied items presented as foils at test were never “alternates”.

Results and Discussion

An alpha of .05 is assumed throughout; only findings of interest are reported.

Probabilities of claiming “old” for Experiment 1a are presented in the top row of Table 2. I carried out 3 comparisons. The first compared the “old at test/target in isolation” with the “new at test” condition, which established that participants were accurate at discriminating between studied and unstudied words (.54 vs. .24), $F(1, 21) = 51.13, MSE = .02, p < .0001, \eta^2 = .77$. The second compared the “old at test/stem and no pause” with the “target in isolation” condition, which established that participants were more likely to claim “old” after seeing words with stems as opposed to in isolation (.68 vs. .54), $F(1, 21) = 11.84, MSE = .02, p = .002, \eta^2 = .36$. The third compared the “old at test/stem and pause” with the “old at test/stem and no pause” conditions, which showed that participants were more likely to accurately claim “old” for words with stems shown after
a pause as opposed to no pause (.74 vs. .68), $F(1, 21) = 4.84$, $MSE = .01$, $p = .039$, $\eta^2 = .18$.

The latter finding is especially astonishing given that participants had only 1000 msec to view the target word in the “pause” condition, but had full view of the target word for the entire 4000 msec in the “no pause” condition. This finding extends the effect of the critical pause from the recognition test phase (Whittlesea & Williams 2001b) to the study phase. Here, the constraint of the sentence stem created an indefinite expectation during the study phase, and the pause allowed participants to experience uncertainty before encountering the target word. Once the target word appeared, participants experienced a surprising resolution (i.e., the perception of discrepancy). Not knowing that the source of the surprise was from the pause, participants attributed the surprise to the actual target word. That is, during the moment of encountering the target word, participants experienced the target word as surprising or somehow unusual, causing it to stand out. This process added depth to the encoding process of the target word, allowing the target word to be more likely to be remembered later, even though at test the target word was shown in isolation, and so did not have an additional cue to help reinstate the encoding process.

One possible criticism of this experiment is that the combination of a high constraint stem and a pause might stimulate participants to guess the termination, before it is actually presented. That would also lead to better accuracy in the pause condition (the read/generate effect: Slamecka & Graf, 1978), and would not entail a role for the perception of discrepancy. Experiment 1b was conducted to test between these alternatives. It was identical in all ways to Experiment 1a, except that, when the
termination was missing, participants were given extra time to make a guess about what word would be used to complete the sentence.

### Table 2

*Experiment 1: Recognition Claims of Terminal Words of Sentences*

<table>
<thead>
<tr>
<th>Alternate</th>
<th>Generate</th>
<th>Pause</th>
<th>No Pause</th>
<th>Target only</th>
</tr>
</thead>
<tbody>
<tr>
<td>Exp 1a</td>
<td>n/a</td>
<td>.74 (.03)</td>
<td>.68 (.03)</td>
<td>.54 (.04)</td>
</tr>
<tr>
<td>Exp 1b</td>
<td>n/a</td>
<td>.82 (.04)</td>
<td>n/a</td>
<td>.54 (.05)</td>
</tr>
<tr>
<td>Exp 1c</td>
<td>n/a</td>
<td>.87 (.02)</td>
<td>.69 (.03)</td>
<td>.66 (.02)</td>
</tr>
<tr>
<td>Exp 1d</td>
<td>.66 (.03)</td>
<td>n/a</td>
<td>.61 (.03)</td>
<td>.55 (.03)</td>
</tr>
</tbody>
</table>

**Note:** Exp = experiment. Standard errors are reported in parentheses. Experiment 1c employed a between-subjects design. “Alternate” = alternate termination was presented before the actual target word was shown; claims of “old” are for the target. *For simplicity, I report the average claim of “old” for the new items across all 4 groups in Experiment 1c.*

As shown in the second row of Table 2, the resulting pattern of recognition claims was very different to that observed in Experiment 1a. First, there are higher hits for the generate condition in Experiment 1b than the pause condition in Experiment 1a. Second, there were lower false alarms when compared to Experiment 1a. I will not perform an extended interpretation of these results; my only concern with this experiment was to observe whether deliberate guessing caused a pattern of data similar to that in the earlier study. It seems clear that what happens when the participants make calculated guesses about terminations is very different to what occurs when there is only a short pause.
between the stem and target word. Thus the results of Experiment 1a do not seem to be
the result of generating, but instead the product of the perception of discrepancy in
reading the study words.

One limitation of the procedure used in Experiment 1b is that participants were
aware that they were to guess when the completion was absent, and therefore the demand
characteristics could have been higher than that in Experiment 1a. The use of a between-
subjects design in Experiment 1c dealt with this issue. A further limitation of the
procedure used in Experiment 1b is that I did not keep track of whether participants were
correct or incorrect in their guesses, and whether that had an effect on recognition.

Claims of “old” for Experiment 1c are reported in the third row of Table 2. I
carried out two comparisons of interest. The first was to assess whether there is a
difference in recognition accuracy between the generation group and the pause group,
and the second was to determine whether there was a difference in accuracy for trials
with correct versus incorrect guesses. Participants in the “generate” condition had higher
hits than participants in the “pause” condition (.87 vs. .69), and this was confirmed by an
independent samples t-test, \( t(27) = 4.67, p < .0001 \). This finding demonstrates that
something qualitatively different occurs when participants are asked to generate a
termination in a study session as opposed to when the termination is presented after a
brief pause. Accurate generation occurred only 33\% of the time\(^8\), however, there was
virtually no difference between recognition claims for correct versus incorrect guesses
(.87 vs .88), which was confirmed by a t-test of the difference score \( t(14) < 1 \). This

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\(^8\) This finding provides convergent evidence that the stems created only a general indefinite expectation
rather than a definite expectation.
finding is similar to what has been reported in the literature (e.g., Slamecka & Fevreiski, 1983), thus it appears to be a genuine generation effect.

Therefore it appears that the effect of the pause observed in Experiment 1a is not due to generation. It appears as though the effect is observed because participants have the sense that they do not know what is coming. It is a false sense because it is created by the pause, which creates uncertainty that would not otherwise be present (i.e., there is no uncertainty in the “no pause” condition).

Experiment 1d was carried out to provide convergent evidence that the effect of the pause observed in Experiment 1a was due to the sense that participants did not know what was coming. That is, the effect was due to the combination of expectation, uncertainty, and surprising resolution. In order to examine this issue, in the “alternate” condition, I presented the stem with an alternate ending (e.g., “They swam and played at the BEACH”) before presenting the stem with the target ending (e.g., “They swam and played at the LAKE”). Participants made recognition claims about target, not alternate, endings.

Claims of “old” for Experiment 1d are presented in the bottom row of Table 2. I carried out two comparisons of interest: one assessing the difference between seeing the target after an alternate ending as opposed to seeing the target after a stem with no pause, and the other assessing the difference between seeing the target after an alternate ending as opposed to seeing the target after a stem with a pause. Results demonstrate that showing an alternate ending before showing the actual target word compared to showing a target with no pause caused increased hits (.66 vs. .55), $F(1, 26) = 7.09, MSE = .02, p = .013, \eta^2 = .21$, but made no difference compared to showing a target with a pause (.66 vs.
$F(1, 26) = 1.27, MSE = .03, p = .27, \eta^2 = .04$. Therefore, it appears as though the effect of the pause obtained in Experiment 1a was due to the creation of the sense that participants did not know what was coming.

In summary, participants had superior recognition for target words following a constraining stem and pause as opposed to no pause. The constraint of the sentence stem created an indefinite expectation during the study phase, and the pause allowed participants to experience uncertainty before encountering the target word. Once the target word appeared, participants experienced the perception of discrepancy. Not knowing that the source of the surprise was from the pause, participants attributed the surprise to the actual target word, causing it to stand out. This process added depth to the encoding process of the target word, allowing the target word to be more likely to be remembered later.

**Experiment 2: Seeing Double after the Perception of Discrepancy**

In Experiment 2 I investigated the generality of this phenomenon to false alarms. In order to examine the affect that the perception of discrepancy during study has on both hits and false alarms for words presented without sentence stems at test, I re-defined what a “false alarm” is; I developed and employed a frequency judgment task. This allowed me to examine the affect of the pause manipulation at study on subsequent illusory recognition.

In standard old/new recognition, a false alarm is a claim of “old” when a word had not been previously seen in the experiment. Examining the affects of an encoding manipulation on illusory recognition is not possible using standard old/new recognition, unless, of course, illusory recognition is re-defined. I developed a frequency judgment
task for this purpose. The notion is that, if an encoding manipulation could potentially cause an illusory feeling of familiarity, it would demonstrate itself by a claim of “I’ve not only seen this before, I’ve seen it on many occasions”. I thought this paradigm would also have implications for advertising: marketers would ideally wish to show a product on only one occasion, and have consumers erroneously believe that, “I’ve seen this product on many occasions. It’s ubiquitous!”

To achieve this end, I created a design whereby words were presented either once or twice in study. In the first variant of this experiment (Experiment 2a), once presented words were presented either alone or following a high constraint stem and pause; twice presented words were presented either in isolation on both occasions or once alone and once following a high constraint stem and pause. Target words were presented in isolation in the test phase; participants were asked “Did this word occur twice in the study phase?” When a word was presented twice, a “yes” response was a hit; when a word was presented only once, a “yes” response was a false alarm. I expected that words shown only once in the context of a stem and pause would not only show increased hits relative to words shown in isolation, but also increased false alarms.

Method

Participants. Twenty-two Simon Fraser University students participated in Experiment 2a, and 19 in Experiment 2b.

Procedure. I used the high constraint stems used in Experiment 1, together with the target word used with those stems. For Experiment 2a, the experimenter told participants that they would get an unspecified memory test following a study session. During the study phase, a computer monitor displayed half of the target words in
isolation for 1000 msec each. The monitor displayed the remaining target words after
their respective constraining stems. The monitor displayed each stem for 3000 msec
before presenting the target word, thus allowing for a pause between reading the stem and
seeing the target word. The length of the pause was variable, depending on the speed of
reading of each individual participant. The monitor then displayed the target word in
capital letters along with its stem, for 1000 msec. Crossed with the manipulation of
isolated versus sentence presentation, the monitor displayed half of the target words once,
and half twice. In the latter condition, the monitor displayed the stem with the target word
on only one occasion and in isolation on the other\(^9\). At random, the monitor displayed
half of the words in this condition in isolation on the first occasion and in a sentence on
the second occasion, and the other half in the reverse sequence.

Thus the four conditions of Experiment 2a were: single presentation of a word in
isolation; single presentation in a sentence; double presentation of a word, both times in
isolation; and double presentation, once in isolation and once in a sentence. Random
assignment placed words into conditions and determined presentation order. During the
test phase, the monitor displayed all target words shown during study (in a freshly
randomized order). Participants indicated whether they had seen the target word once or
twice during study by pressing a button on a button box.

Experiment 2b was similar, except that the monitor displayed a complete sentence
on every trial in the study phase, half on one occasion, and half on two occasions.
Crossed with that manipulation, the monitor displayed both of the occurrences of a twice
presented sentence, or the only occurrence of a once presented sentence, with a pause on

\(^9\) I did not present sentences on both occasions because the second presentation would necessarily elicit a
validation of expectation. This notion is further explored in Experiment 2b, and discussed in the General
Discussion of this Chapter.
half of the trials. On trials meant to not have a pause, the monitor displayed the stem and target word together for 4000 msec. On the trials with a pause, the monitor displayed the stem for 3000 msec before displaying the target word, in capital letters, for 1000 msec. Thus the four conditions of Experiment 2b were: single presentation of a sentence without a pause; single presentation of a sentence with a pause; double presentation of a sentence, with a pause on both occasions; and double presentation of a sentence, without a pause on either occasion. The test was similar to that of Experiment 2a.

**Results and Discussion**

In Experiment 2a, participants were successful at the discrimination task, judging twice presented words to have occurred twice about 23% more often than once presented words, $F(1,21) = 92.07, MSE = .01, p < .0001, \eta^2 = .81$ (see left panel of Table 3). Presenting a target word in a sentence increased accuracy of reporting that it had occurred twice, (.60 vs. .53), $F(1, 21) = 5.84, MSE = .02, p = .026, \eta^2 = .24$. However, it also increased the false alarm rate (claiming “twice” for once presented words; 38. vs. .29), $F(1, 21) = 6.19, MSE = .02, p = .021, \eta^2 = .22$.

Thus presenting a sentence stem and pause during study increased the likelihood of judging both once and twice presented words to have been seen twice. However, this might not be an effect of the perception of discrepancy, rather the stem and pause during study may have acted to increase depth of processing, which has been shown to cause an effect similar to this in the one-versus-two judgment, increasing both accurate and
illusory claims of repetition (Kronlund & Whittlesea, 2005). Experiment 2b was conducted to decide between these alternatives.

Table 3
Experiment 2: Frequency Judgments of Terminal Words of Sentences

<table>
<thead>
<tr>
<th>Condition during study:</th>
<th>Experiment 2a:</th>
<th>Experiment 2b:</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Stem</td>
<td>No Stem</td>
</tr>
<tr>
<td>Frequency of Presentation:</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Once (false alarms)</td>
<td>.38 (.03)</td>
<td>.29 (.03)</td>
</tr>
<tr>
<td>Twice (hits)</td>
<td>.60 (.02)</td>
<td>.53 (.03)</td>
</tr>
</tbody>
</table>

Note: Standard errors are reported in parentheses

In Experiment 2b, participants were even more successful in the discrimination task, judging twice presented words to have occurred twice about 50% more often than once presented words, $F(1,21) = 92.07$, $MSE = .01, p < .0001, \eta^2 = .81$  (see right panel of Table 3). Relative to not presenting a pause, presenting a pause on both occurrences of twice presented words increased the hits (.81 vs. .57), $F(1, 18) = 38.61, MSE = .01, p < .0001, \eta^2 = .68$; but it also increased false alarms (.22 vs. .16), $F(1, 18) = 6.00, MSE = .01, p = .025, \eta^2 = .27$.

Because all target words had been seen in complete and constraining sentences in the study phase in this experiment, differences in degree or depth of elaboration seem

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10 The data of Experiments 1 to 3 in this Chapter, mostly obtained in 2003, were the motivation behind the experiment of Kronlund and Whittlesea (2005). The finding of an encoding variable (i.e., the pause) having the effect on increasing accurate and illusory claims of repetition made us question the results and arguments of Craik and Tulving (1975). We thus applied the once-versus-twice task to the standard levels of processing procedure and observed that, although increasing levels of processing increases hits, it also increases claims of “twice” for once presented items.
unlikely to have affected performance. Instead, I concluded that the effect of the pause on accurate and illusory claims of repetition was (at least in part, as discussed later) mediated by a perception of discrepancy in the study session.\(^{11}\)

These experiments demonstrate that experiencing a perception of discrepancy in the original event with the use of a sentence stem need not inevitably increase later accuracy (Experiment 1); instead, in this case, experiencing that perception during study biased the decision process toward the conclusion that words had been seen twice. The principle governing the affect of a perception of discrepancy on later processing seems clear: it enhances processing of the relationship between the item and its context in the original event. That assists the participant in a straight recognition test, allowing them to be more sensitive to recurrence at test. However, that enhanced encoding of the item-context relationship can only be used to determine that the item has been encountered at least once, which is of little help in a once-versus-twice decision, whereby participants have to rely on other characteristics of the stimulus, such as vividness, clarity, and ease of processing. On the assumption that multiple prior presentations augments such characteristics, influencing the subjective quality of the trace, the subjective quality can sensibly be used to argue back to frequency of prior experience. By enhancing encoding of the item-context relationship, the perception of discrepancy causes false claims about

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\(^{11}\) Another criticism of Experiment 2 is that it could be simply a replication of Experiment 1’s finding, but shifted along the frequency scale. Because a “new” option was not available, weaker versus stronger memory for a target could not have lead participants to classify the target as “old” versus “new”; the only way for them to express this difference was by using the “once” versus “twice” options. I thank an anonymous reviewer for pointing this out while reviewing our manuscript (Kronlund & Whittlesea, under review), which included Experiments 2a and 2b of this dissertation. As part of our studies in that manuscript, we replicated the finding of Experiment 2b with a “zero” option, demonstrating something that is qualitatively different from the demonstration that the perception of discrepancy leads to better memory for the encoding experience (Experiment 1).
once presented words because the subjective quality of the trace is used as a heuristic to infer multiple prior experiences. I call this the subjective quality heuristic.

A curious sidelight of this study is that two presentations of a word following a stem with versus without a pause causes a much greater difference in hits (24%; see Table 3, bottom row, right 2 columns) than does double presentation of a word with versus without one presentation following a stem and a pause (7%; see Table 3, bottom row, 2 left-most columns). That means that the second presentation of a word in a sentence context contributes a great deal to the accuracy of the decision. The curious aspect of this is that the second presentation of the sentence is identical to the first, just as the second presentation of a word alone is identical to the first. It seems unlikely that the person would experience the perception of discrepancy (surprise) on a second occurrence of the same sentence, even when the target word is separated from the stem by a pause. Instead, I suspect that this effect is mediated by a different mechanism: On the second occasion of seeing a stem, the person develops a definite expectation of what word is about to occur (an idea that is discussed later in detail). The pause then contributes to this learning experience by allowing the participant the opportunity to actually generate that word for themselves (an act that is verified by the presentation of the target word a moment later).

This act of generation does not assist the participant by enhancing the representation of the relationship between the stem and target word (which again would later only enable them to know that they had encountered that word at least once: useful information in a recognition test, but not in a once-versus-twice decision). Instead, it does so by allowing them to realize, at the moment of generation during the second study.
presentation, that they are experiencing this word for the second time, thereby encoding the word as a repetition at that time. In this case, a repetition can act as a “reminder” to participants that this is actually a repeat, which would make it much easier to decide, at test, that twice presented words were presented twice (cf. Hintzman, 2004). The effect is not seen in Experiment 2a because, although a second presentation is undoubtedly enhanced by the first (just as a second presentation of a word with a stem without a pause is enhanced in Experiment 2b), the participant cannot engage in the act of generation. Thus I do not conclude that the entire effect of the pause observed in Experiment 2b is due to the perception of discrepancy. However, the illusion of multiple prior presentations for once presented words is almost certainly a product of that perception.

This result has implications for advertising. I will postpone discussion of this issue until I have described the experiments that I conducted using sentence stems with brand names (Chapter 3). Next I will present a set of experiments that were conducted to explore the generality of this effect using a different paradigm.

**Experiment 3: Frequency Judgments of “HENSION”**

The perception of discrepancy is created by a surprising validation, as in Experiments 1 and 2, or by a surprising violation. For example, Whittlesea and Williams (1998) presented participants with well known stimuli (e.g., TABLE), fluent but novel stimuli (e.g., HENSION), and novel, unfamiliar stimuli (e.g., LICTPUB). During a test phase, participants made recognition judgments about studied and unstudied stimuli of each category. The HENSION items produced the most false alarms (Whittlesea & Williams, 1998), likely because participants expected that the HENSION items would elicit meaning, but were meaningless (see Whittlesea & Williams, 2000), thus
expectations about these items were surprisingly violated. Thus, this is another paradigm that can be used to examine the affects of the perception of discrepancy during study on later hits and false alarms.

I adapted the paradigm used by Whittlesea and Williams (1998) for the present experiment. Only the HENSION items and regular English words (e.g., TABLE) were used. In study, participants studied each target either once or twice. At test, participants indicated the frequency of occurrence of each target (i.e., “once in study” or “twice in study”). I expected that participants would have higher hits and higher false claims for once presented HENSION-type targets.

**Method**

**Participants.** Twenty Simon Fraser University students participated in Experiment 3a; 20 participated in Experiment 3b.

**Procedures.** For Experiment 3a, target items were 60 regular English words (e.g., TABLE, WINDOW, etc.) and 60 orthographically regular nonwords (e.g., HENSION, BARDEN, etc.) taken from Whittlesea and Williams (1998). The experimenter told participants that they would get an unspecified memory test following a study session. A computer monitor displayed all of the words and orthographically regular nonwords for 1000 msec each in a freshly randomized sequence for each participant, half of each type presented once, and half twice (also freshly randomized for each participant), for a total of 180 study trials. During the test phase, which consisted of 120 trials, the monitor displayed all words and orthographically regular nonwords shown in the study phase (in a freshly randomized sequence for each participant). Participants indicated whether they had seen the target once or twice during study by pressing a button on a button box.
Experiment 3b was identical in all ways to Experiment 3a with the exception that I used 60 orthographically irregular nonwords (e.g., LICTPUB, STOFWUS, etc.) taken from Whittlesea and Williams (1998) in place of the orthographically regular words. Thus Experiment 3b employed irregular nonwords and regular English words.

**Results and Discussion**

Claims of “twice” (hits and false alarms) for Experiment 3a are reported in the left panel of Table 4. Participants judged twice presented items to have occurred twice about 22% more often than once presented items, $F(1, 19) = 50.74, MSE = .02, p < .0001, \eta^2 = .73$. Relative to performance for the words, participants had higher hits for orthographically regular nonwords than words (.57 vs. .46), $F(1, 19) = 6.32, MSE = .02, p = .021, \eta^2 = .26$, as well as higher false alarms for orthographically regular words than words (.40 vs. .20), $F(1, 19) = 33.07, MSE = .01, p < .0001, \eta^2 = .64$.

<table>
<thead>
<tr>
<th>Frequency of Presentation</th>
<th>Exp 3a</th>
<th>Exp 3b</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Hension</td>
<td>Table</td>
</tr>
<tr>
<td>Once (false alarms)</td>
<td>.40 (.03)</td>
<td>.20 (.03)</td>
</tr>
<tr>
<td>Twice (hits)</td>
<td>.57 (.04)</td>
<td>.46 (.04)</td>
</tr>
</tbody>
</table>

*Note: Standard errors are reported in parentheses.*

One potential criticism of Experiment 3a is that it may be the case that participants are using the unconscious intuitive theory, “it’s a nonword, it stands out now so I will respond ‘twice’”. If this were the case, participants may be more likely to
respond “twice” upon seeing any nonword during the test phase. To test this prediction, orthographically irregular nonwords taken from Whittlesea and Williams (1998; e.g., LICTPUB) were used in the current experiment. Whittlesea and Williams (1998) showed that in the context of a recognition experiment, false claims of “old” are very low for such irregular nonwords compared to orthographically regular nonwords (9% vs. 37%). If, in Experiment 3a, participants were using a heuristic causing them to increase claims of “twice” to all nonwords, then participants should respond similarly to the LICTPUB items as they did to the HENSION items in Experiment 3a.

Claims of “twice” (hits and false alarms) for Experiment 3b are reported in the right panel of Table 4. Participants judged twice presented items to have occurred twice about 24% more often than once presented items, $F(1, 19) = 73.80, MSE = .01, p < .0001, \eta^2 = .80$. Participants were just as accurate for the words as they were for the orthographically irregular nonwords, both in terms of hits (.59 vs. .45), $F(1, 19) = 3.65, MSE = .06, p = .071, \eta^2 = .16$, and in terms of false alarms (.29 vs. .28), $F(1, 19) < 1$. Thus when a target that creates the perception of discrepancy (e.g., HENSION) is presented during the study phase, participants later falsely claim to have seen it twice, accompanied by an increase in accuracy (Experiment 3a). This increase in false claims is not simply due to the fact that nonwords are involved because such false claims do not occur for other types of nonwords (e.g., LICTPUB), which are accurately remembered.

The implications of the results of Experiment 3 are that only certain types of nonwords elicit illusory claims of repetition, when the task requires a frequency rating. This is important for the development of unstudied brand names: orthographically regular nonwords (e.g., HENSION) create illusory claims. After the introduction of such types of
brands, consumers may erroneously remember having encountered them on multiple prior occasions\textsuperscript{12}.

**General Discussion**

The idea that a perception of discrepancy can cause feelings of familiarity has now been extensively documented, and examined using a variety of paradigms. In all of those studies, however, an illusion of recognition was caused by manipulating the test trials of the experimental situation in a way that would create a disparity between the participants’ expected and actual processing for each trial. Thus, in all of those studies, circumstances were so arranged that the participants experienced the perception of discrepancy in the moment that they attempted to perform an old/new recognition decision. In the current studies, I examined whether, in each of these experimental contexts, the disparity between the participants’ expected and actual processing can also be an instance of learning. I suspected that the perception of discrepancy might not only be the source of feelings of familiarity when experienced at test, but might also be a fairly powerful source of later remembering when experienced instead in a study episode. That idea was the basis of Experiments 1 to 3 in this Chapter.

Until now, the perception of discrepancy has been investigated only within the context of test trials. That is important because one of the prime functions of that perception is to alert the person to a potential prior experience of a stimulus, by creating a feeling of familiarity in the moment. However, the results of Experiments 1 to 3 reveal a second, potentially more important, role of that perception: that it can cause a person to

\textsuperscript{12} I will not discuss Experiment 3 further. Ideally, I should have examined the effects of all three types of stimuli in one experiment.
integrate the components of an event to a greater degree than they would otherwise. That
can increase the accuracy of later recognition, at least when tested in old/new recognition,
as shown in Experiment 1.

*Illusory Remembering versus Real Remembering*

The results of Experiments 2 and 3 demonstrate that the perception of discrepancy
in an original experience can later lead to an illusion of repetition; the studies by
Whittlesea and Williams (2001b) and Whittlesea (2002a, 2002b) demonstrate that the
perception of discrepancy occurring at the time that the person attempts to remember can
also cause an illusion of recognition. Moreover, the perception of discrepancy induced by
the insertion of a pause between stems and target words (Experiments 1 and 2) was itself
illusory: normatively, the target words merely fit their context well. The participants’
surprise upon experiencing coherent target words after a pause and constraining stem is a
result of their interpretation of their performance, not a product of the target itself (that is
why we speak of a *perception* of discrepancy, rather than *discrepancy*).

The occurrence of those illusions is valuable in establishing how the perception of
discrepancy causes feelings of familiarity, through the development of expectations,
evaluation of outcomes relative to those expectations, and attribution of a perceived
disparity to a plausible source. However, the occurrence of such illusions does not mean
that the perception of discrepancy ordinarily causes illusory recognition; it did so in those
studies because the situation was rigged to produce erroneous evaluations, using a
procedure (e.g., the pause) that people would rarely have encountered in their daily lives
and so would not know how to discount. In fact, it is possible that the perception of
discrepancy ordinarily causes appropriate feelings of remembering. For example, in a
standard recognition experiment, items shown earlier are more easily processed on a subsequent occasion (repetition priming; e.g., Scarborough, Cortese & Scarborough, 1977). That facilitation causes the fluency of processing to be greater than could normatively be expected for that item; the perception of discrepancy between expectation and outcome thus serves as a useful basis for discriminating between studied and unstudied test items. The perception of discrepancy creates similarly beneficial effects in more natural settings, as can be illustrated using the example of the “butcher on the bus” (Mandler, 1980) discussed earlier.

The Perceptions of Discrepancy and Integrality

In another variant of the stem completion paradigm, Whittlesea (2002b) presented high constraint (e.g., “The policeman identified himself with his BADGE”) and low constraint (e.g., “On the corner of the table there was a bit of BLOOD”) sentences during study. At test, the sentences were either identical or completed by a new termination (e.g., “The policeman identified himself with his CARD” or “On the corner of the table there was a bit of PAINT”). Participants had to indicate whether test sentences were identical to studied sentences. The result of interest is the observation of approximately equal hits, but fewer false alarms, for low constraint sentences as opposed to high constraint sentences. This result has been replicated repeatedly (e.g., Whittlesea, 2004; Whittlesea & Koriat, 2006).

This pattern of effect comes about in a different way than that which comes about through the perception of discrepancy at test. It comes about through the development of definite expectations, creating a perception of integrality rather than through the
development of indefinite expectations responsible for the perception of discrepancy\textsuperscript{13}. That is because presenting a sentence during study causes the person to integrate or unitize its parts by thinking about the theme or schema of the sentence as a whole. This schema can serve as an expectation about how subsequent processing of an event should unfold.

Low versus high constraint stems cause expectations differing in specificity, such that the meaning of schemas formed from sentences with low constraint stems is dominated by the meaning of the target word, whereas the meaning of schemas formed from high constraint sentences is less specific to the target word and relatively more determined by the meaning of the stem. Thus, for example, the high constraint sentences “The policeman identified himself with his BADGE” and “The policeman identified himself with his CARD” have much the same meaning. On the other hand, the low constraint sentence “On the corner of the table there was a bit of BLOOD” suggests something quite frightening whereas “On the corner of the table there was a bit of PAINT” suggests a minor accident. One effect of this difference is that high constraint stems are more effective as cues for recalling the last word (Whittlesea, 2002b); another is that the participants are less accurate in predicting their later ability to remember low

\textsuperscript{13} Because of their differential origins in indefinite versus definite expectations, the perception of discrepancy typically causes inconclusive feelings of remembering (a generic feeling of “familiarity”, unaccompanied by an ability to identify the specific source of that feeling), whereas the perception of integrality is typically accompanied by more categorical and well defined cognitions about the past. However, unlike two process accounts of remembering (e.g., Atkinson & Juola, 1973; Gardiner & Conway, 1999; Jacoby, 1991; Mandler, 1980; Tulving, 1985), which assume that familiarity and recall of context are directly linked to different forms of representation or process, the SCAPE framework (Whittlesea, 1997) assumes that either subjective experience can be caused by either perception, depending on the context within which they are interpreted. See Bodner and Lindsay (2003) for a similar perspective.
constraint sentences, even though those sentences later cause more accurate remembering (Whittlesea & Koriat, 2006).

These definite expectations are aroused by re-presentation of sentences in test. Sentences that are identical to ones seen earlier validate these expectations, causing a perception of integrality (wholeness, or unitariness). That perception in turn produces a higher rate of hits than occurs for the same target words presented either alone or in sentences when complete sentences are not presented in study. The difference in false alarm rates occurs because of the difference in specificity of schemas formed from low and high constraint sentences: because the latter are less specific to the particular target word, a different word can sometimes be substituted (e.g., CARD for BADGE) without the participant realizing it, so long as the overall meaning of the sentence is preserved.

Although complex, these results are not really surprising. People remember extended events better than single, isolated occurrences, and remember surprising events better than events that, although consisting of novel combinations of familiar units, can be assimilated easily by existing knowledge structures. What is interesting about the current pattern of data is the interaction between two important aspects of remembering, the subjective experience that the participant has during an initial encounter with a target and a later encounter, and the quality of the representation that is encoded on the first encounter and that controls processing of the second (cf. Whittlesea, 1997).

**The Discrepancy-Attribution Hypothesis versus Other Accounts**

In Experiments 1 and 2, I observed that presenting a pause before the target word of a study session increased hits in a recognition test but also increased false alarms in a frequency test. This effect of the pause stands as a challenge to most accounts of learning
and remembering discussed below. Before describing those accounts, I will suggest my approach, which takes into account both the objective properties of the experience and the meta-processing that participants apply to their experience of those properties. The SCAPE framework (Whittlesea, 1997; Whittlesea & Leboe, 2000) provides one avenue to this perspective. By this account there are two separate functions of mind, production and evaluation; the former due to cued traces, interacting with the task and context, prepared by the stimulus; the latter due to making an attribution about the quality and content of processing and the mental content, arriving at a perception and resulting attribution, guided by salient aspects of the task and intuitive theories of cause and effect. Production and evaluation are constructive processes that occur with every interaction with the environment. They are functions that collectively occur during reading, learning, performing a recognition decision, or making an aesthetic judgment. “Remembering” is thus an attribution to the past or to multiple experiences in the past.

Production and evaluation operate on an ongoing basis, thus, in a memory experiment, both functions operate during study, and again at test. In Experiments 1 and 2, it appears as though the pause, and corresponding perception of discrepancy, was contributing to the richness and depth of processing the target words. That is, the perception, experienced during learning, caused participants to experience these words as being somewhat special. This depth later led to increased recognition accuracy, but the same depth was used heuristically by participants to infer multiple prior presentations of the target. Thus, heuristic processes were present during both stages: of learning and remembering.
Signal Detection and Global Matching Accounts. Two common accounts of remembering include the signal detection (e.g., Donaldson, 1996; Glanzer, Kim, & Adams, 1998; Miller & Wolford, 1999; Wickens & Hirshman, 2000; Wixted & Stretch, 2000), and global matching approaches, which postulate that test cues activate many memory trace(s), depending on the degree of similarity between the cue and trace(s); a criterion is used to decide old/new decisions (e.g., Eich, 1982, Gillund & Shiffrin, 1984; Humphreys, Bain, & Pike, 1989; Murdock, 1982), or apparent frequency (Hintzman, 1988; Murdock, Smith, & Bai, 2000; Shiffrin, Ratcliff, & Clark, 1990; Shiffrin, 2003; Shiffrin & Steyvers, 1997; see also Dougherty, Gettys, & Ogden, 1999). I do not argue that signal detection and global matching accounts are not useful in making predictions about the coming to mind of ideas. They do make accurate claims about the source of mental content, which is dependent upon prior experiences, or objective familiarity. However, they have no proposed mechanism for dealing with the effect of the pause, and accompanying evaluation processes that appear to take place during the study experience, and again during the testing experience. The effect of the pause appears to be mediated by the quality of the experience, rather than the frequency of occurrence of the stimulus. I do not argue that such accounts cannot be modified to accommodate my observations; but I do argue that in order to do so, they would have to be substantially modified to take into account not only objective characteristics of the experience, but also the subjective reactions that people experience in processing those characteristics.

Signal detection and global matching accounts assert that there is a direct correspondence between production and phenomenology. If this were correct, I would not observe such an effect of the insertion of a brief pause on both accurate (Experiment
1) and illusory (Experiment 2) claims of prior experience. What such accounts lack then is the ability to make predictions about (a) how expectations help form a memory trace, and interact with the subsequent evaluative component that is involved during learning that memory trace, and (b) how expectations, both previous and current, interact with the target content to lead to differing attributions: to one or multiple prior experiences.

*The Source Monitoring Framework.* Another account that is limited in its ability to make predictions about how expectations interact with the target to lead to attributions about multiple prior experiences is the source monitoring framework (e.g., Johnson, Hashtroudi, & Lindsay, 1993; Mitchell & Johnson, 2000). According to the source monitoring framework, hypothetical concept nodes, as well as event (or “episodic”) nodes, are linked together in a network; nodes become activated whenever a person engages in any sort of cognitive process (e.g., during encoding, etc.). Once nodes are re-activated (e.g., during a remembering task, etc.), the traces are attributed to a particular source. When a person attempts to make an attribution about the source, or reality, of a mental representation, the accuracy of such a judgment depends on a number of factors, including the level and type of details that were originally encoded, the person’s ability to access these details, and strategies used when attempting to reconstruct them (e.g., Lindsay, 1994). Memory errors occur when the person does not employ adequate strategies to make effective use of the source details.

Source is defined as “a variety of characteristics that, collectively, specify the conditions under which a memory is acquired (e.g., the spatial, temporal, and social context of the event; the media and modalities through which it was perceived)” (Johnson, Hashtroudi, & Lindsay, 1993, p. 3). According to this framework, people make
use of specific, qualitative details, or other, more general characteristics of mental representations (such as fluency of processing) in an attempt to come to a conclusion about the source of the representation, which could be an internal (imagined) or external (real) event (Johnson, Hashtroudi, & Lindsay, 1993). Given that memories for externally generated events tend to contain more details than internally generated ones (e.g., Johnson, Foley, Suengas, & Raye, 1988), people will use such details to make an external attribution. Another way in which people can use perceptual characteristics of mental representations is by using their fluency of processing inferentially to determine if the given event actually occurred. Thus, “remembering” is a product of a decision-making process of attributing current experience to the past.

In the case of my results, participants appear to be making selectively adequate use of the subjective quality of the trace, which they appear to use to their benefit in an old/new decision, and use to their detriment in a once/twice decision. Further, the source monitoring framework does not provide any motivated mechanism (beyond “activation”) that would adequately make predictions about the cognitive processes underlying learning, and how such processes interact with the processes involved during an attribution to the past. That is, the framework’s focus is on evaluative decisions that are conducted during the decision-making process, rather than during the learning process.

Fuzzy-Trace Theory. The evaluative processes involved in learning are also not clearly explicated in fuzzy-trace theory (Reyna & Brainerd, 1995a; 1995b). In terms of learning, according to fuzzy-trace theory, a “verbatim” trace is laid down, which contains information about source (Reyna & Brainerd, 1995a) or of the actual experience (Reyna & Brainerd, 1995b), and a “gist” trace is extracted from the event independently, but in
parallel (e.g., Brainerd & Reyna, 2002), which contains information about the event’s meaning or sense (Reyna & Brainerd, 1995b).

In terms of remembering, verbatim traces are “episodically instantiated representations”, whereas gist traces are “episodic interpretations of concepts (meanings, relations, patterns)” (Brainerd & Reyna, 2002, p. 165). Accurate remembering occurs either because of specific recollection (i.e., verbatim traces can include vivid details such as echoing in the mind’s ear; Brainerd, 2003) or general familiarity (i.e., due to gist traces containing the meaning of the event). On the other hand, false memory is due to gist traces, and may be opposed by verbatim traces (e.g., Brainerd, 2003). For example, falsely remembering needle after hearing a series of words related to sewing occurs because needle is consistent with the gist of the original experience (e.g., Brainerd & Reyna, 2002). As another illustration, phantom recollection (i.e., illusory recollection in the mind’s eye or the mind’s ear) is due to gist, whereas true recollection is due to verbatim traces (e.g., Brainerd, Payne, Wright, & Reyna, 2003). In support of these notions, remembering performance based on verbatim versus gist traces is dissociable (e.g., Brainerd, 2003).

It is important to note that verbatim traces are thought to influence accurate remembering, both in terms of increasing hits (e.g., by creating robust verbatim traces), and reducing false alarms (e.g., Brainerd, Reyna, Wright, & Mojardin, 2003). Applying fuzzy-trace theory to my results, it seems that it would predict that the perception of discrepancy would be added to the gist trace, but not to the verbatim trace\textsuperscript{14}. What is not clear is how fuzzy-trace theory would predict that it is gist-based, and not verbatim-based.

\textsuperscript{14} I would like to thank Dan Bernstein for pointing this out to me.
traces that seem to dominate in the learning and remembering processes, having the effect of increasing both hits (Experiment 1) and false alarms (Experiment 2).

Based on my results I suggest that the common underlying mechanism for both accurate and illusory claims is the interaction between the constructive production of mental events and the accompanying evaluation that takes place, both during learning, and at test. In the case of Experiments 1 to 3, vividness, clarity, and ease of processing are all factors involved during learning, and at test, when the subjective quality of the trace is used as a heuristic to infer one (or more) prior experience(s). Unlike the assumptions of fuzzy-trace theory however, I argue that representations of events, as well as the gist-like interpretations of those events, are created through a constructive process involving the development and resolution of expectations, and that, both the representation (mental contents), and the interpretation (evaluation) influence the accompanying attribution that takes place. In the case of Experiment 1, during learning, an attribution was made to the stimulus (i.e., that it was special). At test, an attribution was made to the past for words that had been seen earlier. I believe that fuzzy-trace theory would have to be modified to account for the data in Experiments 1 to 3.

**Judgments of Frequency**

My intention is not to provide an account for “frequency ratings” as opposed to “recognition memory”; rather, I attempt to provide a framework that outlines the common mechanisms and processes across tasks and contexts (cf. Whittlesea, 1997). I believe that each task does not itself require its own theory (cf. Johnson, 2005). In an attempt to provide such an all-inclusive account, Hintzman (2004) provided evidence contrary to the notion that recognition judgments and frequency ratings can be attributed
to uni-dimensional familiarity, and proposed that repetitions can act as “reminders” to participants; ratings of frequency are based on recollection of reminding. As outlined earlier, repeating a word after a sentence stem can act as a reminder to participants, thus the affect of the pause on accurate claims of “twice” in Experiment 3b was in part due to “reminding”, or encoding the word as a repetition. However, my finding of illusory claims of frequency (Experiment 3b) demonstrates that reminders are not necessary to elicit ratings of multiple frequencies; rather, the subjective quality of the trace is used inferentially to report multiple frequencies. I believe that this is a component of the constructive function of mind, which is chronically evaluative, evaluating the quality and content of mental contents, and comes to an attribution about the source of that content, based on what is present and relevant in the given moment, given the task at hand.

“Subjective Quality” and the Availability Heuristic

Many readers may question the difference between what I am proposing occurs during the frequency rating and what occurs during other frequency ratings. More specifically, the processes that I outlined occurred during the test phase of the frequency judgment task (e.g., Experiment 2) may appear to be similar to the process of using the “availability heuristic” (Tversky & Kahneman, 1973), which could involve the same process as what I am proposing. The availability heuristic can be described as both (a) a strategy for concluding that more easily remembered events occur more frequently, and (b) a theoretical account for the observation of a tendency for people to overestimate objective frequency of emotionally charged or vivid events. The mechanism for “availability” could be objective familiarity (Bearden & Wallsten, 2004; Dougherty, Gettys, & Ogden, 1999; Hintzman, 1988), “ease of retrieval” (e.g., Schwarz, et al., 1991),
or an estimate based on the number of instances that come to mind (Tversky & Kahneman, 1973).

I believe that the "availability heuristic" stems from the use of the subjective quality of the trace, which is cued by the prior experience of the learning process (and the corresponding perceptions that were involved), and relies upon the cognitive processes of production and evaluation. Thus my account of the availability heuristic is distinct from recent accounts of availability that fail to account for the evaluative component of mind\textsuperscript{15}, and how expectations and intuitive theories of cause and effect operate during both the learning experience (e.g., hearing about a shark attack on the news), and the coming to the conclusion that a given event occurs frequently (e.g., concluding that shark attacks are on the rise). I speculate that the foundation of the availability heuristic, too, is the perception of discrepancy, created through the development and resolution of expectations. More specifically, it may be the case that, say, hearing about a shark attack on the news was surprising given the context, and this is the basis for the erroneous judgment that tends to occur about shark attacks.

**Conclusion**

The perception of discrepancy is probably a fairly rare experience. Certainly, the occurrence of feelings of familiarity, which is thought to be a consequence of that perception, is fairly rare: most people do not experience a strong subjective feeling of having prior experience more often than once a day or week. That perception may be of particular importance in understanding certain puzzling phenomena that have to do with surprise at the time of encoding, such as flashbulb memory, or surprise at the time of

\textsuperscript{15} For a notable exception, see Dougherty and Franco-Watkins (2003), who discussed the role of the source monitoring framework in frequency judgments.
remembering, such as the effects of being reminded of something by someone else, after a series of failures. It may also be important in understanding effects of novelty and surprise in aesthetic or emotional reactions.
Chapter 3: Remembering Brand Names after a Perception of Discrepancy

Imagine you and a friend are watching your favourite television show, and a commercial break comes on. You are both craving pizza, so your friend grabs a phone book, and tries to quickly sort through the listings of home delivery pizza services. You on the other hand come up with a list of pizza delivery services off the top of your head and dial the number before the end of the commercial break. The former search would create a stimulus-based consideration set, as the pizzeria choices are listed; the latter would create a memory-based consideration set as the pizzeria is chosen without any aide. A mixed-choice task would involve both types of sets (e.g., if the friend looking through the phone book was also internally generating candidates; Lynch & Srull, 1982).

The role of brand recognition and recall on consumer decision making has been well documented. Establishing control over consumer memory is most important for marketers, especially those developing strategies for branded items (Aaker, 1991; Keller, 1993, 1998). Making a brand accessible in memory substantially increases that brand’s likelihood of being included in the consideration set (Nedungadi, 1990); such salience, defined as which brands consumers are likely to think about (cf. Miller & Berry, 1998), drives market share differences (Ehrenberg, Barnard, & Scriven, 1997; Miller & Berry, 1998).

Remembering Brand Names

Research on brand name recognition has included memory theories and paradigms developed during the 1970s, a time when memory investigators attempted to
determine the factors associated with enhanced memory accuracy, or quantity of memory (Koriat, Goldsmith, & Pansky, 2000). One method used to enhance the coming to mind of brands is the use of generation. The generation effect is the observation that items that have been generated are more memorable than items that have been simply read (Slamecka & Graf, 1978). When this method is used with brand names (i.e., by omitting key elements of an ad, participants are left to generate either the brand name being advertised, or the category for the brand name), generation increases recall (Sengupta & Gorn, 2002; see also McCann, 1995).

Another factor that influences brand name recognition is encoding variability, which occurs when a target appears in different ways during encoding. When used with brand names, different presentation methods of the same brand were more memorable than when the same presentation was simply repeated after long intervals (Singh, Linville, & Sukhdial, 1995; Unnava & Burnkrant, 1991). In other work, success in enhancing memory of advertisements occurred when there was a match between the type of cue and affect during encoding and later remembering (encoding specificity; Friestad & Thorson, 1993).

Accurate recall and recognition of brand names has also been found to be enhanced by the use of scents associated with brands during the study phase of the experiment. The effect is observed regardless of whether the scent is compatible with the brand name category or not (Morrin & Ratneshwar, 2003). Recent research has also examined factors influencing greater elaboration during advertisements (Priester & Godek, 2004), as well as factors influencing associations formed between consumers and
brands (called "self brand connections"; see Escalas, 2004), such as using narratives to allow the consumer to form a personal connection to the brand.

Researchers have adopted the above-mentioned procedures to increase memory accuracy for brand names. Few researchers, however, have attempted to create illusory memory attributions about brand names. The current perspective of memory investigators has shifted in focus from memory quantity towards memory quality (Koriat, Goldsmith, & Pansky, 2000), or the phenomenological aspects of memory processes, inference, and attribution. I believe it is important to examine these aspects of brand name recognition. Popular brands (e.g., AT&T) have been found to have high false alarms rates (i.e., consumers erroneously believe that they appear at events such as the Superbowl), a finding which is thought to be caused by high familiarity of the brand (see Kirshnan & Shapiro, 1996). Such findings have been observed outside of a controlled laboratory environment. I believe that it would be beneficial to consumer researchers if such observations were replicated in a lab setting because such findings would add to the understanding of the underlying mechanisms of memory for brands. Further, such a replication would contribute to the understanding of the means in which brands become included in a consideration set: whether based on actual prior experiences or no direct prior experience.

The aim of the experiments in this Chapter is to extend the "pause" effect described in Chapter 2 (see Experiments 1 and 2) to brand name recognition. The experiments presented here, consistent with the theme of this dissertation, will focus on studies manipulating the pause during study\(^\text{16}\). I will present two experiments. The first

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\(^\text{16}\) I also attempted to replicate Whittlesea and Williams' (2001b) original experiment with brands: I presented brands following high-constraint stems at test, with or without a pause; participants made a
adopted a standard old/new recognition decision at test; the second adopted a frequency judgment at test.

**Experiment 4: Learning Brands With and Without a Perception of Discrepancy**

I used a one-factor ("old at test" vs. "new at test") nested design, whereby the level of "old" contained 3 encoding levels ("stem with pause before target brand" vs. "stem with no pause before target brand" vs. "target brand in isolation"). I expected that recognition memory for brands appearing after a stem and pause would be more accurate than recognition memory for brands appearing after a stem and no pause. Further, I expected that brands appearing after a stem and no pause would be more accurate than recognition memory for brands appearing in isolation.

**Method**

*Participants.* Twenty-five Simon Fraser University students participated.

*Procedure.* I chose 60 brand name categories (e.g., JEANS, COLA, DETERGENT, CIGARETTES, etc.). For each of the 60 categories, I created a constraining sentence stem (e.g., for the jeans category: "Her dad’s favorite jeans are his pair of..."). I also chose three exemplars per category (e.g., for CIGARETTES: CAMEL, CRAVEN A, MARLBOROS). The sentence stems and exemplars for the 60 brand categories are shown in Appendix A. I used random assignment of one of the three exemplars per category per participant, whereby participant #1 may have been assigned LEVIS, COKE, TIDE, CRAVEN A, and participant #2 may have seen WRANGLER, standard recognition decision. I failed to observe the same results as that found using words; there was no difference between pause and no pause conditions.
PEPSI, SUNLIGHT, MARLBOROS, and so on. Of those 60 exemplars, random assignment placed 30 exemplars each into the conditions of “old at test” and “new at test”. Nested within the “old at test” condition, random assignment placed 10 exemplars each into the following encoding conditions: “stem and pause before target brand”, “stem and no pause before target brand”, “target brand in isolation”. Figure 1 depicts the random assignment procedures and design. The remaining procedure was identical to that used in Experiment 1a, with the exception that in the experimenter’s instructions, “words” was replaced with “brand names”.

**Figure 1**

*Design and Random Assignment Procedures for each Participant*

<table>
<thead>
<tr>
<th>Category</th>
<th>Exemplars</th>
<th>Assignment of exemplar</th>
<th>Assignment to Conditions</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. CIGARETTES</td>
<td>CRAVEN A → MARLBORO</td>
<td>MARLBORO</td>
<td>new at test</td>
</tr>
<tr>
<td></td>
<td></td>
<td>CAMEL</td>
<td></td>
</tr>
<tr>
<td>2. COLA</td>
<td>COKE → JOLT</td>
<td>PEPSI, JOLT</td>
<td>stem and pause/old</td>
</tr>
<tr>
<td>3. DETERGENT</td>
<td>SUNLIGHT → TIDE</td>
<td>TIDE</td>
<td>stem and no pause/old</td>
</tr>
<tr>
<td></td>
<td></td>
<td>CHEER</td>
<td></td>
</tr>
<tr>
<td>4. JEANS</td>
<td>LEVIS → LEVIS</td>
<td>WRANGLER, DIESEL</td>
<td>no stem/old</td>
</tr>
<tr>
<td>60. COMPUTERS</td>
<td>COMPAQ → DELL</td>
<td>DELL</td>
<td>stem and pause/old</td>
</tr>
<tr>
<td></td>
<td>DELL</td>
<td>IBM</td>
<td></td>
</tr>
</tbody>
</table>
Results and Discussion

Results fully replicated those of Experiment 1a. Probabilities of claiming “old” are presented in Table 5. I carried out 3 comparisons. The first compared the “old at test/target in isolation” with the “new at test” condition, which established that participants were accurate at discriminating between studied and unstudied brand names (.75 vs. .04), $F(1, 24) = 324.60, MSE = .02, p < .0001, \eta^2 = .93$. The second compared the “old at test/stem and no pause” with the “target in isolation” condition, which established that participants benefited from seeing brand names with stems as opposed to in isolation (.84 vs. .75), $F(1, 24) = 12.87, MSE = .01, p = .001, \eta^2 = .36$. The third compared the “old at test/stem and pause” with the “old at test/stem and no pause” conditions. Participants were more likely to accurately claim “old” for brand names with stems shown after a pause as opposed to no pause (.92 vs. .84), $F(1, 24) = 8.40, MSE = .01, p = .008, \eta^2 = .24$.

Table 5

Experiment 4: Recognition Claims of Terminal Brands of Sentences

<table>
<thead>
<tr>
<th>p (claim “old”)</th>
<th>Condition during study</th>
<th>New</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Pause</td>
<td>No Pause</td>
</tr>
<tr>
<td>.92 (.02)</td>
<td></td>
<td>.84 (.02)</td>
</tr>
</tbody>
</table>

Note: Standard errors are reported in parentheses.

Given that participants were shown one of three potential candidates after each sentence stem, it is highly unlikely that participants could have generated the specific
brand name that was actually presented in the pause condition. Although highly constraining, the sentence stem created only an indefinite expectation, such that a specific brand category was anticipated during the brief pause. Once the brand name appeared, participants in this condition experienced the perception of discrepancy, which was attributed to the brand name, enhancing the depth of processing of the target brand, making it appear to be somehow special. That added depth was used during the test phase to come to the conclusion that that brand name was seen earlier.

**Experiment 5: Frequency Discrimination of Brand Names**

I investigated the generality of this phenomenon to reports of frequency. Similar to Experiment 2b, brand names were presented either once or twice at study. Once presented brands were presented after constraining stems, either after a pause or after no pause, and either once or twice. Target brands were presented in isolation during the test phase; participants were asked “Did this brand occur twice in the study phase?” When a brand was presented twice, a “yes” response was a hit; when a brand was presented only once, a “yes” response was a false alarm.

**Method**

*Participants.* Twenty-five Simon Fraser University students participated.

*Procedure.* The stimuli were identical to those used in Experiment 4. The design and procedure was identical in all ways to that used in Experiment 2b.

**Results and Discussion**

Results are summarized in Table 6. Participants were successful at the discrimination task, judging twice presented brands to have occurred twice about 65%
more often than once presented brands, \( F (1, 24) = 274.41, MSE = .04, p < .0001, \eta^2 = .92 \). Relative to not presenting a pause, presenting a pause on both occurrences of twice presented brands increased the hits (.80 vs. .68), \( F (1, 24) = 18.41, MSE = .01, p < .0001, \eta^2 = .43 \); but did not increase the false alarms (.09 vs. .08), \( F (1, 24) < 1 \).

Thus, brand names appear to be remembered differently than words (Experiment 2) in that there is no illusion of repetition for brands. Taken together the results of Experiments 4 and 5 demonstrate that, when a pause is used with brands during study, there is an increase in memory accuracy when either standard old/new recognition is tested (Experiment 4), or frequency ratings are used (Experiment 5). However, there is no accompanying increase in false claims (Experiment 5).

**Table 6**

*Experiment 5: Frequency Judgments of Brand Names Presented after Stems*

<table>
<thead>
<tr>
<th>Frequency of Presentation</th>
<th>Pause</th>
<th>No Pause</th>
</tr>
</thead>
<tbody>
<tr>
<td>Once (false alarms)</td>
<td>.09 (.02)</td>
<td>.08 (.02)</td>
</tr>
<tr>
<td>Twice (hits)</td>
<td>.80 (.04)</td>
<td>.68 (.04)</td>
</tr>
</tbody>
</table>

*Note:* Standard errors are reported in parentheses.

**General Discussion**

The results of Experiments 4 and 5 demonstrate that the use of a pause between a stem and target brand in an original experience with that brand can later lead to increased recognition accuracy, but no illusion of repetition. The affect of the pause in Experiment 4 was almost certainly a product of the perception of discrepancy; however, the affect of the pause in Experiment 5 was likely a product of the perception of integrality.
Remembering after the Perceptions of Discrepancy and Integrality

As discussed in Chapter 2, low versus high constraint stems cause expectations differing in specificity, such that the meaning of schemas formed from sentences with low constraint stems is dominated by the meaning of the target word, whereas the meaning of schemas formed from high constraint stems is dominated by the stem. In Experiments 4 and 5, I used high constraint stems, however, I believe that the meaning of each sentence as a whole was determined by the specific brand that was used as a termination.

Presenting a constraining sentence during study causes the person to develop a general, indefinite expectation for the given brand category. For example, reading “She washes her clothes using...” causes a person to form a general indefinite expectation for a brand of laundry detergent, without specific projection of the exact brand that is to be shown. Upon reading the target brand, the person forms a schema for the sentence, or a general impression of the brand in the context of the stem (e.g., if the stem were completed with “TIDE” one may imagine their mother standing by her washer, with a specific shade of red on a box of detergent in the background; for “SUNLIGHT” one may imagine soccer players with grass-stained shirts, reminiscent of a recent SUNLIGHT ad). Thus, a specific schema is developed, which is determined by the person’s perception of the given brand (e.g., “washing grass stains with SUNLIGHT”).

The difference between the pause and no pause trials, then, is that the pause causes the given brand to feel special, just as it did for words in Experiments 1 and 2. That is, the perception of discrepancy induced by the insertion of a pause between stems and target brands was illusory: normatively, the target brands would merely fit their context well. The participants’ surprise upon experiencing coherent target brands after a
pause and constraining stem is a result of their interpretation of their performance, leading them to think that the brand is somehow special. This caused participants to be more likely to accurately claim to have seen the brand once in Experiment 4.

A different process occurred in Experiment 5, which used repetition. That is because, during the second presentation, the person forms a *definite* expectation of what brand is about to occur. The pause then contributes to this learning experience by allowing the participant the opportunity to actually generate that brand for themselves (an act that is verified by the presentation of the target brand a moment later). This act of generation allows them to realize, at the moment of generation during the second study presentation, that they are experiencing this brand for the second time, thereby encoding the brand as a repetition at that time, which would make it much easier to decide, at test, that twice presented brands were presented twice.

The question that remains then, is why do participants not demonstrate an increase in false claims in Experiment 5? I speculate that the answer lies in the overall false alarm rate in Experiment 4. Participants claim “old” at a rate of 4% for unstudied brands (see Table 5), versus a rate of 24% for unstudied words (in Experiment 1a; see Table 2). I believe that this is because of the specific schemas that are formed during study, which are more specific for the brands, then for the words. Although the pause, in the first presentation of Experiment 5, causes that brand to feel special, the “reminder” that is given on the second presentation (by the pause) is interpreted by the participants to mean that the brand has been seen twice. Participants do not appear to be using a subjective quality heuristic; rather, they are using a heuristic based on the vividness of the schema, which is determined by the specificity of the schema. When the schema is less
specific (Experiment 2), participants will rely more on the subjective quality of the trace; when the schema is more specific (Experiment 5), participants will rely more on the reminder than the subjective quality of the trace.

A New Mirror Effect?

In attempting to answer why it is that participants do not demonstrate an increase in false claims in Experiment 5, I noticed a serendipitous element of the data of Experiment 1a and Experiment 5: When combined, they form a mirror effect. A mirror effect is the observation that, when two target classes are compared, one class of stimuli shows greater hits and fewer false alarms than the other target class. Mirror effects have been observed for words of high and low concreteness (i.e., words high in concreteness produce higher hits and fewer false alarms than words low in concreteness, e.g., Hockley 1994) and for words of high and low frequency (i.e., low frequency, or uncommon words, show higher hits and fewer false alarms than high frequency, or more common words; e.g., Glanzer & Adams 1985). The data of Experiments 1a and 5 are summarized in Table 7 show a mirror effect between words and brands: brands show higher hits and fewer false alarms than words17.

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17 I replicated this effect using a within-subjects design using high frequency words and high frequency brands (i.e., the “prototypical brands”; obtained from Kronlund & Wager, in preparation, discussed in Chapter 4).
Table 7
Mirror Effect of Words and Brand Names

<table>
<thead>
<tr>
<th></th>
<th>Hits (collapsed across 3 encoding levels)</th>
<th>False Alarms</th>
</tr>
</thead>
<tbody>
<tr>
<td>Experiment 1a (words)</td>
<td>.65</td>
<td>.24</td>
</tr>
<tr>
<td>Experiment 5 (brand names)</td>
<td>.84</td>
<td>.04</td>
</tr>
</tbody>
</table>

Concreteness. I carried out an additional study whereby I presented only the words and the brands, and asked participants to rate each item as being either “concrete” or “abstract”. Words were more likely to be rated as concrete than were brands, $t(19) = 3.97, p = .001$ (2-tailed). This finding is opposite to what would be expected if this mirror effect was based on concreteness: mirror effects obtained with words differing in concreteness show that words high in concreteness produce higher hits and fewer false alarms than words low in concreteness.

Word Frequency. Even more puzzling is that the data of these experiments show a mirror effect between common words and common brand names. The targets used in Experiment 1a were high frequency words, occurring 40 to 100 instances per million according to the Thorndyke and Lorge (1944) count (see Whittlesea & Williams 2001b for a description of their selection). The brand names used in Experiment 4 are also quite common, although there is no available frequency count that is directly comparable to...
that of Thorndyke and Lorge (1944) to determine if they are actually as common as the words used\(^{18}\).

This finding has important implications for theories of the mirror effect in word frequency. Many memory investigators have argued in various ways that remembering takes place using two qualitatively different bases: one based on conscious recollection, the other based on the feeling of familiarity (e.g., Atkinson & Juola 1973, 1974; Mandler 1980, 1991; Tulving, 1985, 1995). Applied to the mirror effect for word frequency, Joordens and Hockley (2000) suggested that low frequency words are less likely than high frequency words to cause a feeling of familiarity, but are more recollectable. They claimed that the feeling of familiarity is based on the extent to which the word matches the contents of memory. Because low frequency words have fewer representations in memory than high frequency words, their appearance during a study phase would be distinctive compared to one's background of life experiences. This distinctiveness, or recollection factor therefore would outweigh the familiarity factor, causing low frequency words to produce more hits than high frequency words.

To the contrary, because high frequency words have more representations in memory, and are processed fluently, these words should be more likely to elicit the feeling of familiarity than would low frequency words. In consequence, during the test phase of a recognition memory experiment, recognition of the occurrence of a high frequency word from the study phase is more confusable with extra-study list

\(^{18}\) Other consumer related studies examining effects of frequency of occurrence of brands on recognition (e.g., Kirshnan and Shapiro 1996) have used brand names such as "stamp" jeans. I question the use of such brand names in these types of studies, and the usefulness of the reported frequencies because the reported frequency of "stamp" could include the frequency of occurrence of it's other meanings, not just the brand's actual frequency.
experiences, so that these words are judged “old” more often, producing more false alarms.

An interesting note is that, during the debrief session, most participants in Experiment 4 exclaimed intuitively that they were using somewhat of a “recall to reject” strategy (Rotello & Heit 2000), in that they claimed that they believed that they would have recalled a specific prior episode if they had seen a brand name earlier. If they did not recall a specific episode, then they rejected having seen the brand name. This observation, although based on participants’ subjective reports, provides support that recognition of brand names operates through recollection, just as recognition of low frequency words does (e.g., Arndt & Reder 2002; Joordens & Hockley 2000). This interpretation, however, is inconsistent with the actuality that the brand names used in the experiments in this Chapter are very common, perhaps even more common than the high frequency words used in Experiment 1, and so should be associated with many representations in memory, and should be processed fluently. I would have expected that, given the commonness of the brand names used here, that they would have operated on the familiarity factor.

Perhaps future research on this new mirror effect can provide insight into theories of the mirror effect of word frequency, and help specify the distinction (or similarity) between familiarity and recollection. It may be the case that study-list context is important in enhancing recollection for brand names: brands are typically encountered in advertising or shopping contexts, therefore their appearance in a study phase is unique, increasing recollection to surpass familiarity. Thus, a possibility could be that, even though common brand names may be processed fluently, the fluency of processing is not
used in the same fashion as would be the case for regular words. I am currently running further studies to examine this issue.

Application

Television and web advertisements often contain written sentences ending with key words (e.g., MINIVAN), or brand names (e.g., WINDSTAR). A recent television ad for the new Toyota Camry provides an example of an ad employing a written sentence stem to present the brand name in question. At the end of the ad segment, the words “The modern family sedan” appeared, and following a brief pause, the brand name “CAMRY” appeared adjacent to the sentence stem. Both the sentence stem and the brand name were presented in silence, allowing viewers of the ad to read it, perhaps to encode the brand name in a way that can later be remembered. The effectiveness of the presentation of brand names in sentences in this way, although used as a technique in advertisements such as the one described here, has not been examined empirically. The experiments in this Chapter provide insights into the underlying cognitive mechanisms involved when consumers encounter such brands in ads, and suggest that the optimal presentation method for brands in sentences is through the use of a pause between the stem and the brand.

Limitations and Future Research. At the expense of maintaining high internal validity, Experiments 4 and 5 lacked external validity. First off, the written forms of brand names did not include distinguishing colors or other associations usually included in their visual presentations (in television or web advertisements). Future research should incorporate actual images and logos, perhaps presenting the logo after the sentence stem and pause (e.g., “The modern family sedan... CAMRY” alongside the Toyota logo).
Second, participants in Experiments 4 and 5 were told that they were in a “memory experiment” and thus were likely intentionally remembering the brand names, which may not always occur when people are subjected to the intended real world counterpart (i.e., advertisements), which may be more incidental. Future research may wish to test the effect of inserting a pause between sentence stem and target by having participants engage in a divided attention task during study. Furthermore, dependent measures should include brand choice, rather than recognition. This is not to say that the results of Experiments 4 and 5 are not important; brands that have increased memory accessibility have an advantage to less accessible brands (e.g., Nedungadi, 1990); advertisers are interested in ways in which to enhance memory for actual brand names in ads, as opposed to the actual ad itself (see Kirshnan & Shapiro 1996).

Third, participants were asked to read each sentence and target word, so it is not clear how these results extend to the usefulness of a pause in voice ads (e.g., Chattopadhyay et al., 2003) or how the critical pause interacts with spoken versus written sentences (e.g., Tavassoli, 1995). It may also be beneficial to use this paradigm with other dependent measures including free recall accuracy and pleasantness ratings.

Conclusion

Perhaps the most important contribution of the experiments presented here is that people approach and evaluate brand names differently than they do for words. It may be the case that people have different expectations about brands, and so process their fluency differently, and make use of schemas differently, than they do for words.
Chapter 4: Other Applications

In this final Chapter, I will describe some studies that I carried out in addition to my dissertation studies, which were follow up studies to research completed as part of my MA, or part of collaborations with former lab-mates or my former student. The first set of studies that I will describe are applications of the once-versus-twice task to other recognition memory phenomena (e.g., the mirror effect and the revelation effect) that I thought would provide insights into the underlying mechanisms involved in the phenomena in a way in which would contribute to theory. The second series of studies that I will describe are extensions of certain phenomena to brand names (e.g., the revelation effect and the DRM effect). Finally, I will briefly describe a line of work where I examined the phenomenon of retrieval-induced forgetting.

Experiment 6: Word Frequency and Frequency Judgments

The mirror effect is the observation that once class of stimuli (e.g., low-frequency words) produces more hits but fewer false alarms than another class of stimuli within the same category (e.g., high-frequency words; Glanzer & Adams, 1985). Two-factors have been used to explain the mirror effect of word frequency: recollection and familiarity. Joordens and Hockley (2000) used the qualitative differences logic to demonstrate that the hit portion of the word frequency mirror effect is mediated primarily by recollection whereas the false alarm portion of the effect is controlled primarily by familiarity. Recollection is the subjective state typically associated with “remember” judgments whereas familiarity is usually associated with “know” judgments (Tulving, 1985).
“Recollection refers to the specific contents of the retrieved representation” (Joordens & Hockley, 2000, p. 1549). That is, the more memorable the stimulus, the easier it is to recollect, which can be used to explain why recollection opposes the influence of familiarity. A participant encountering a new low frequency word during the test phase may have the following experience: “I would have known if this word was in the study phase”. In other contexts, this “I would have remembered” feeling is called the “recall to reject” strategy (Clark & Gronlund, 1996; Rotello, Macmillan & van Tassel, 2000; Rotello & Heit, 2000; Rotello, 2001). “Recalling to reject” is the process of rejecting test foils, which are similar to the studied items, as a result of the coming to mind of mismatching information about the source of the trace.

The standard test procedure used to examine the mirror effect in word frequency consists of the following. Half of the items presented in the test phase have been shown once in the study; all have been seen many times previously before the experiment. The challenge for the participants in such a study is thus to discriminate between items that have been presented within the experimental context in addition to the many other contexts from those that have not been seen within the study session. To me, what is most important about the notion of recollection being involved in this test context, specifically the “recall to reject” strategy, is that participants are usually made aware that some words are “new” in the experiment. Participants are presented with the task of discriminating between studied and unstudied items in such a recognition memory test. This led me to question which strategy is used when participants are making a decision about high and low frequency words in the absence of unstudied items at test. I changed just one detail of the standard recognition procedure: I presented each word that would later be presented
in test either once or twice in the study phase. At test, all items were old, participants made a decision about each items’ frequency of occurrence in the study phase.

Because participants could not recollect having encountered a low frequency word once in the experiment, I suspected that there would be no basis for recollection-based (or remember-based) responding. Further, because no unstudied items were presented at test, I suspected that there would be no basis for using a “recall to reject” strategy. The question that remains is: will a mirror effect be observed such that low frequency words demonstrate higher hits and fewer false alarms than high frequency words?

**Method**

**Participants.** Eighteen Simon Fraser University students participated.

**Procedures.** I selected two sets of 60 words from the MRC Psycholinguistics database. One set (low frequency) was rated 1-15 per million in the Lorge-Thorndyke count. Examples include CASKET, FORCEPS, and JANITOR. The other (high frequency) was rated 40-100 per million. Examples include ALCOHOL, DAISY, and PASTURE. All words were 5-7 letters in length, 2 to 3 syllables long, and had relatively high concreteness ratings (as specified in the database). During the study phase, computer monitor displayed 30 words of each type only once, and 30 of each type twice, in a random order, re-randomized for each participant, for 1000 msec each. Because half the words were presented twice, there were 180 study trials. During the test phase, the monitor displayed all of the words shown in the study phase (in a freshly randomized order) and participants indicated whether they had seen the target once or twice in the study phase by pressing a button on a button box. There were 120 trials in this test.
Results and Discussion

A 2 X 2 Repeated Measures ANOVA was used to analyze effects of study frequency and word frequency. Results are summarized in Table 8. Participants were successful at discriminating between once and twice presented stimuli in study, $F(1,17) = 84.96$, $MSE = .01$, $p < .0001$, $\eta^2 = .83$. Claims of “twice” did not differ based on word frequency, $F(1, 17) < 1$, however, the study frequency by word frequency interaction was significant, $F(1, 17) = 6.78$, $MSE = .00$, $p = .019$, $\eta^2 = .30$, revealing a mirror pattern.

Table 8
Experiment 6: Frequency Ratings of High and Low Frequency Words

<table>
<thead>
<tr>
<th>p (claim “saw word twice during study”):</th>
<th>High</th>
<th>Low</th>
</tr>
</thead>
<tbody>
<tr>
<td>Word Frequency</td>
<td></td>
<td></td>
</tr>
<tr>
<td>High</td>
<td>.21 (.03)</td>
<td>.17 (.02)</td>
</tr>
<tr>
<td>Low</td>
<td>.41 (.03)</td>
<td>.45 (.04)</td>
</tr>
</tbody>
</table>

Note: Standard errors are reported in parentheses.

This mirror effect persists despite a lack of opportunity to use the recollection factor or the “recall to reject” strategy. However, recollection may be playing a factor in this mirror effect in a way which was not explained by Joordens and Hockley (2000). What could “recollection” be in this case? Could it be the recall of two contexts versus only one context in the study phase? Perhaps recollection is a factor which influences low
frequency words during the study phase, allowing low frequency words to stand out. If the recollection factor causes low frequency words to stand out in study, perhaps the "recall to accept" strategy is used at test (Rotello, 2001). If this is the case, then any manipulation used during study which makes each context (each occurrence) stand out should increase accuracy at test.

**Experiment 7: Increasing Recollection during Study**

Recollection is described as conscious access to details of an item's prior occurrence (see Joordens & Hockley, 2000). These details are assumed to aid in the accurate discrimination of studied and unstudied low frequency items during test. Experiment 6 provided evidence that this process cannot be used to explain the hit portion of the once-versus-twice version of the mirror effect, as no unstudied items were presented at test. Perhaps a special type of encoding occurs for low frequency words during the study phase, which can be used to explain the accuracy of such words. If participants are not able to use a "recall to reject" strategy (as all words are studied in this paradigm), perhaps they can draw upon some kind of "recall to accept" strategy (Rotello, 2001). If this is the case, specific details about the item's prior occurrence may be used to "accept" a target as occurring either once or twice, therefore recollection is still being used.

In this experiment, a manipulation is made whereby an items' frequency of occurrence is made to stand out during the study phase. Half of each type of word (high and low frequency) is presented once, the other half twice. For the items presented twice, half are presented in red on the first occasion and black on the second. The other half of the items presented twice are presented in black on both occasions. If recollection is playing a role in the hit portion of this mirror effect, it is expected that trials in the twice/red first condition will be judged with more accuracy than trials in the twice/all black condition.
Method

Participants. Eighteen Simon Fraser University students participated for course credit.

Procedures. I used the same stimuli and procedures as those used in Experiment 6. The only exception is that the monitor displayed half of the twice-presented words in red on the first occasion and black on the second; and the other half of the twice-presented words in black on both occasions. Random assignment placed words into “red first” or “both black” conditions.

Results and Discussion

A 2 X 2 Repeated Measures ANOVA was used to analyze effects of study frequency and word frequency. Results are summarized in Table 9. Participants were successful at discriminating between once- and twice-presented stimuli in the study phase, \( F(1, 17) = 49.40, \text{MSE} = .01, p < .0001, \eta^2 = .74. \) Claims of “twice” did not differ based on word frequency, \( F(1, 17) = 2.23, \text{MSE} = .02, p = .153, \eta^2 = .13. \) The study frequency by word frequency interaction was present, although it failed to reach conventional levels of statistical significance, \( F(1, 17) = 3.97, \text{MSE} = .02, p = .063, \eta^2 = .20. \) For the words presented twice during the study phase, it appears as though there is a significant increase in hits for high frequency words when comparing the “red first” trials with the “both black” trials, \( F(1, 17) = 6.83, \text{MSE} = .01, p = .018, \eta^2 = .29. \) This was not the case for the low frequency words, \( F(1, 17) < 1. \)

The increase in hits for high frequency words that were presented in red could be due to the added distinctiveness due to the red font. This could have created a basis for using a “recall to accept” strategy for the high frequency words. However, participants
did not benefit from added contextual information during the study phase for the low
frequency words. I speculate that these results were obtained because participants have
"bad norms" for high frequency words (cf. Whittlesea, Kronlund, Joordens, & Hockley,
2006). Providing additional information during the study phase may have caused
participants to have a better local norm for each high frequency word, which allowed
them to better discriminate between once and twice presented high frequency words at
test. This was not the case for low frequency words because it may be that participants
have "good norms" for those words.

Table 9
Experiment 7: Frequency Ratings of High and Low Frequency Words

| Frequency of presentation | Word Frequency | |
|---------------------------|----------------|
|                           | High | Low |
| Once (false alarms)       | .22 (0.03) | .20 (0.02) |
| Twice (hits)              |       |       |
| Red First                 | .45 (0.05) | .46 (0.04) |
| Both Black                | .35 (0.05) | .46 (0.04) |

Note: Standard errors are reported in parentheses.

I have not performed any additional experiments in this line of work. I suspect
that further work in this area using the once-versus-twice task will help shed light onto
theories of the mirror effect in word recognition. It may also help to shed light into
theories of other types of mirror effects.

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Experiment 8: Frequency and the Revelation Effect

The results of the previous experiments inspired me to examine other paradigms using the frequency judgment task. I was especially interested in examining test-time manipulations which increase both hits and false alarms (as in the case of the paradigms used by Whittlesea and Williams). One such manipulation was anagram solving. As outlined earlier, unscrambling an anagram prior to making a recognition judgment about that target word or an unrelated word increases one's claims of having seen the target word before (the revelation effect; Watkins & Peynircioglu, 1990; Westerman & Greene, 1998). To achieve this end, target words were presented once or twice in study, crossed by that factor, half of the targets were preceded by an unrelated anagram which participants had to solve. During the test phase, all targets were studied and were presented in isolation (i.e., with no anagram solving); participants made a frequency judgment about the target in study 19.

I had participants solve unrelated anagrams before targets during study because I thought that if the target itself was the anagram to be solved, I would be examining conditions which could potentially create a generation effect (cf. Slamecka & Graf, 1978). I expected that the anagram would set a local norm for the target, such that participants would experience the perception of discrepancy by the surprising fluency of the targets appearing after an anagram. This would then lead to increased hits and false alarms for items in the anagram conditions.

19 This design is different than that of Bornstein & Neely (2001), who presented intact words during study either on one, two, four, or eight occasions; participants viewed anagrams at test before making a frequency estimation; frequency ratings were higher for revealed as opposed to intact words.
Method

Participants. Twenty-seven Simon Fraser University students participated in Experiment 6a; 18 participated in Experiment 6b; and 32 participated in Experiment 6c.

Procedure. A computer program created anagrams of 60 words (e.g., CANARY, BOOTH, AGENCY, etc.) that were 5 to 8 letters in length and of moderate familiarity and concreteness (obtained from the MRC Psycholinguistic Database). Before the study phase, the experimenter told participants that they would receive an unspecified memory test following a study session. The experimenter asked participants to solve any anagrams that appeared during the study phase. Before the study phase began, the experimenter explained the anagram procedures, telling each participant that anagrams could be solved according to a rule. The rule for the 5 letter anagrams was 21435; the 6 letter rule was 214356; the 7 letter rule was 2143567; the 8 letter rule was 21435678. For example, in the anagram, ISEDWALK, the 2 in the rule refers to the second letter in the anagram ("S"), which must be placed in the first position of the solved version (S...); the 1 in the rule refers to the first letter in the anagram ("I"), which must be placed in the second position of the solved version (i.e., SI...), and so on until the anagram is solved (SIDEWALK). The experimenter explained how to solve the anagrams by providing the example AWETR = WATER and posting the rule on the computer monitor.

During the study phase a computer monitor displayed the 120 target words in capital letters for 1000 msec each in random order for each participant. Half were presented once, half twice, for a total of 180 study trials. Half were preceded by an anagram that was to be solved. Assignment of anagrams with words was randomly determined and re-randomized for each participant. Note that in the “twice/anagram”
condition, an anagram appeared on only one of the two appearances of the target, which was randomly determined to be the first or the second of the two presentations.

Once the study phase was complete, the participant called over the experimenter; the experimenter explained the test procedures. Because of this, there was approximately a 5-minute delay between study and test. During the test phase, a computer monitor displayed all target items shown in study; participants were to indicate if each had occurred once or twice.

Experiment 8b was identical in all ways to Experiment 8a except for the addition of one factor: delay between anagram and target. Thus I employed a 2 x 2 x 2 design: targets were presented once or twice at study, with either an anagram or no anagram, and there was either a 200 msec delay between the participant’s typed solution and the presentation of the target (as per Experiment 8a) or a 1000 msec delay. Note that study time for each target remained at 1000 msec as was the case in Experiment 8a.

Experiment 8c was identical to Experiment 8a except for the addition of one factor: time spent viewing the target. I varied the amount of time the target was presented on the monitor, to see if more study time helped participants, thus I employed a 2 x 2 x 2 design. Targets were presented once or twice in study, with either an anagram or no anagram, and the target was presented for either 1000 msec (as per Experiment 6a) or for 2000 msec. I expected more claims of “twice” for targets presented for 2000 msec as opposed to 1000 msec. Note that there was a 200 msec delay between the participant’s typed solution and the presentation of the target (as per Experiment 8a).
Results and Discussion

Results for Experiment 8a are presented in Table 10. A 2 X 2 Repeated Measures ANOVA was used to analyze effects of study frequency and anagram solving. Participants were not successful at the discrimination task, judging twice-presented words to have occurred twice equally as often as once-presented words, $F(1, 26) = 1.04, MSE = .01, p = .318, \eta^2 = .05$. Presenting a target word after an anagram did influence claims of "twice" however, $F(1, 26) = 16.17, MSE = .01, p < .0001, \eta^2 = .38$, interaction, $F(1, 26) = 23.13, MSE = .01, p < .0001, \eta^2 = .47$. The anagram solving appeared to have the opposite effect to that found at test, but only for the once-presented items, $F(1, 26) = 29.64, MSE = .01, p < .0001, \eta^2 = .54$.

Table 10
Experiment 8: Frequency Ratings for Words following Anagrams

<table>
<thead>
<tr>
<th>Frequency of Presentation:</th>
<th>Presentation type during study:</th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>No Anagram</td>
<td>Anagram</td>
<td></td>
</tr>
<tr>
<td>Once (false alarms)</td>
<td>.37 (.03)</td>
<td>.21 (.03)</td>
<td></td>
</tr>
<tr>
<td>Twice (hits)</td>
<td>.29 (.02)</td>
<td>.33 (.03)</td>
<td></td>
</tr>
</tbody>
</table>

Note: Standard errors are reported in parentheses.

It appears as though the anagram, which may create a local standard, is causing a decrease in the experience of richness and depth of encoding for targets during study, causing participants to later be less likely to claim "twice" for targets that appeared after an anagram, but only for once presented items in study. Somehow the second presentation counteracted the effect of the anagram. I speculated that the result came about either because participants (a) do not have sufficient time to switch tasks between
solving the anagram and re-focusing on studying the target words, or (b) do not expend much *effort* studying the targets following the anagram solving.

**Task-Switching Hypothesis**

In Experiment 8b, I delayed the amount of time between when the participant typed the anagram solution and when seeing the target. I expected that participants would have more claims of “twice” for targets following the 1000 msec delay as opposed to the 200 msec delay (i.e., there would be more “recovery” time). There was virtually no difference in claims of “twice” between long and short delays, $F(1, 7) < 1$.

**Allocating Appropriate Rehearsal Strategies Hypothesis**

In Experiment 8c I varied the amount of presentation time for the target, to determine if more study time helps participants. I expected more claims of “twice” for targets presented for 2000 msec as opposed to 1000 msec, likely due to increased “forced” elaboration time. The increased time made virtually no difference, $F(3, 1) = 2.80, \text{msec} = .01, p = .106, \eta^2 = .11$. I did not perform any further analyses on these data and did not wish to examine why the anti-revelation effect occurred\(^{20}\).

**Other Revelation Effect Studies**

In this section, I describe some collaborative work that I have conducted throughout my graduate career whereby I examined phenomena related to consumer memory. To provide an example of a research question I examined, imagine someone shopping for an Mp3 player for the first time. What factors govern whether this consumer

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\(^{20}\) Other studies have also shown either an elimination of the revelation effect (e.g., Westerman, 2000; using recollection-based recognition) or an anti-revelation effect (e.g., Hicks & Marsh, 1998; using forced-choice recognition).
buys Brand X over Brand Y, in the absence of prior experience with either? In the following section, I will describe some experiments where I examined the way in which other prior experiences might influence this shopper’s preference for one brand over the other. To do this, Dan Bernstein and I examined decisions about brand recognition and preference in the context of the revelation effect.

We showed that solving an anagram, before making a recognition decision about a brand enhances one’s claims of having previously seen that brand and one’s preference for that brand (Experiment 1, Kronlund & Bernstein, in press). Participants were shown isolated brands during a study phase. At test, they were asked to solve anagrams that appeared, to indicate whether each brand that followed the anagram was “old” (shown during the study phase) or “new” (not yet shown), and to make a preference rating for each brand. Overall, participants claimed to have seen more old, than new, brands and claimed to have seen more brands following an anagram as opposed to no anagram. Also, participants had higher preference ratings for brands seen in study, and also had higher preference ratings for brands following an anagram as opposed to no anagram. These results were obtained regardless of whether the anagram consisted of an unrelated regular word (e.g., CANARY) or an unrelated brand name.

We then questioned whether these results hold in the absence of a study phase. Besides, in the real world, people do not study a list of brands before shopping. We thus asked participants to make “confidence ratings of knowing” each brand during high school (henceforth C-ROKs) and then to make a preference rating for each brand. We replicated our earlier results: anagram solving caused increases in C-ROK ratings, and in preference ratings (Experiment 2, Kronlund & Bernstein, in press).
We realized that the revelation effect in preference, however, was obtained by asking participants for a preference rating after having completed some type of memory judgment. Thus, in our most recent work (Kronlund & Bernstein, in preparation) we demonstrated that the preference effect occurs either before, or in the absence of, such a memory task. We had participants make preference ratings before C-ROK ratings, and in a separate experiment, participants made only preference ratings. Again, anagram solving caused increased preference ratings.

These illusions of brand name recognition and preference can be added to the growing literature on false positives in memory. Although the magnitude of this effect was quite small, it is consistent with that found in the literature on the revelation effect. More importantly, when applied to any business venture, it would never be considered a small amount, as it translates into large-scale margins (i.e., a 3% increase on $3,000,000 in sales is $90,000). These results introduce the possibility that the actual brand seen in the moment matters less than the decision making processes that came immediately before seeing the brand. In a shopping context, this may involve processing of other brands (e.g., of a chocolate bar), although it may also involve the processing of ordinary words (e.g., on a store display or magazine cover).

**The DRM Effect with Brand Names**

In this section, I will describe a series of studies conducted in collaboration with an undergraduate student, Leanne Wagner, whom I supervised. In our project, we applied the DRM effect to brand names, which has important implications for theories of brand recognition. I will first briefly outline some of the literature on brand recognition, and then describe our experiments, and their contribution to theory and practice.
The Effects of Prior Experiences with Competitors

Accessibility of a brand determines whether it will be included in a consideration set (Nedungadi, 1990), thus it would be most important to determine how effects of prior experiences influence accessibility and salience, even if the prior experience does not include an actual presentation or encounter with the given brand. Effects of priming on major and minor brands within a given product class has been examined. Priming has been found to increase consideration-set membership of the major brand within a minor subcategory (e.g., CPLUS within the minor subcategory of “Orange Soda” within the “Pop” product category), but not the major brand within a major brand category (e.g., COKE within the major subcategory of “Cola” within the “Pop” product category), suggesting that only brands in minor subcategories will benefit from advertising effects of competitors (Nedungadi, 1990). For example, advertising for SPRITE and MOUNTAIN DEW would be beneficial to a more minor brand within the Pop category, such as DR. PEPPER, as opposed to a major brand within that category, such as COKE.

This finding of priming effects of only the minor subcategory brand is surprising, especially in light of the recent developments from cognitive psychology on the DRM effect (Deese, 1959; Roediger & McDermott, 1995; see also Read, 1996), which would suggest the most benefit for major brands in major subcategories. The purpose of the following experiments, conducted by Leanne Wagner and myself and unpublished (Kronlund & Wagner, in preparation), is to perform a re-inquiry into the findings of Nedungadi (1990) in light of the recent developments of the DRM effect. Our hypotheses were developed from the DRM framework, and are in direct contradiction of the findings of Nedungadi (1990). We aim to explore the following hypotheses. First off, we expect that when associates of a brand category are shown to participants, the non-presented
product category lure (e.g., Vehicle) will be falsely reported as having been studied earlier. Second, when associates of a brand category are shown to participants, the non-presented major brand lure (e.g., COKE) will be falsely reported as having been studied earlier. Third, when associates of a brand category are shown to participants, the non-presented minor brand lure (e.g., DR. PEPPER) will be falsely reported as having been studied earlier, but not to the same degree as the major brand lure. Finally, we expect that when associates of a brand category are shown to participants, the non-presented major brand lure (e.g., COKE) will be associated with higher preference ratings compared to non-presented major brand lures for lists not shown to participants.

**Brand Generation**

To develop his set of major and minor brands within a given product class, Nedungadi (1990) required that participants generate, and group together, exemplars of fast food chains and condiments. We performed a more elaborate and extensive series of pilot studies, and did not limit the number of potential product classes to be used. For the first of the two pilot studies, 16 students from Simon Fraser University participated. We made certain that the participants in our pilot studies were obtained from the same participant pool as those who would take part in our subsequent studies.

The experimenter provided all 16 participants with 63 product categories (e.g., Condiments, Popcorn, Vehicles, etc.) and asked them to generate and write down 15 associates (i.e., words that best describe the brand category). The experimenter also asked each participant to provide the most representative, or prototypical, brand name for each brand category. As an example, the experimenter provided an example using the category
Cola with the associates: *fizz, caffeine, red, soda, pop, drink, sugar, sweet, vending, can, bottle, diet* and the prototype COKE.

Of the associates and prototypes provided by participants for each of the 63 categories, we selected the 28 that had produced at least 5 prototypical brands (generated across participants) for use in the next pilot study. For that study, 16 students from Simon Fraser University participated. The experimenter provided participants with the 28 categories selected from the first pilot study along with each category’s prototypical brand names and associates in alphabetical order (e.g., Condiments: FRENCH’S, HEINZ, HELLMAN’S, etc.; associates: Dijon, hotdog, ketchup, mayonnaise, mustard, etc.). The experimenter asked participants to numerically rank order each of the brand names and associates in the order that best represented each category. The experimenter specifically instructed participants to not make the ranking “a wish list” or a “judgment call”, rather, to rank order the brands and associates based on familiarity. In keeping with this, the experimenter explained to participants that HEINZ would ideally be ranked higher, or more prototypical of “Condiments” than DAVE’S HOT SAUCE. Similarly, the associate *ketchup* should be ranked higher than squeeze or spread. We obtained a mean average ranking for each brand and associate. From this, we determined the final rank of each brand and associate within each category.

**Experiment 9: Category Recognition**

The goal of this experiment was to determine if the DRM effect could be observed for category names. Such a finding would provide us with the basis for further examination of the effect using major and minor brand names within each category.
Method

Participants. Twenty students from Simon Fraser University participated for course credit.

Stimuli. We used the 28 category names, the list of prototypical brands, and the list of associates obtained in our pilot studies. Thus our stimuli consisted of 28 category names, 5 brand names per category, and 9 associates for each category. For example, the category Pop was comprised of the brand names as ranked: COKE, PEPSI, SPRITE, MOUNTAIN DEW, and DR. PEPPER; and the associates as ranked: can, drink, soda, bottle, caffeine, diet, sweet, carbonation, and fizz.

Design. The design matched that of Whittlesea (2001a). This was a 2 x 2 design, making four conditions: studied list/category lure shown at test, studied list/associate shown at test, non-studied list/category lure shown at test, and non-studied list/associate shown at test. Random assignment placed 14 of the lists in the “list during study” level, and 14 into the “non-studied” level (re-randomized for each participant). We did not present any category names during the study phase, but wished to examine recognition performance for category lures of studied and non-studied lists. Thus, the test items consisted of the category lures of 7 “list during study” categories; a studied associate (or brand, which was randomly determined) of the remaining 7 “list during study” categories; the category lures of 7 of the non-studied lists, and an associate (or brand, which was randomly determined) from the other 7 non-studied lists.

Procedure. Participants were tested individually. During the study phase of the experiment a computer monitor displayed the study lists, in random order, save the category names. For each list, the monitor displayed the items in two rows of 7, containing a mix of brands and associates, in random order (and re-randomized for each
participant). The onset of each studied list was self paced; controlled by pressing a button on a button box.

Once finished reading the 7 studied lists, the participant called over the experimenter, who was waiting in another room. The experimenter then explained the requirements of the test phase, which required that participants indicate whether each target was shown earlier or not. Because of this, there was a delay of about 5 minutes between study and test.

Based on the 4 conditions described above, there were 28 test items made up of the following: category lures for half of the lists shown during study, category lures for half of the lists not shown during study, a randomly chosen associate or brand name for the other half of the lists shown during study, and a randomly chosen associate or brand for the other half of the lists not shown during study. During the test session, a monitor displayed the 28 items individually, in random order. The participants were asked to decide if they had seen each target during the study phase by pressing a button on a button box.

Results and Discussion

Probabilities of claiming “shown earlier” for Experiment 9 are depicted in Table II. Results showed that participants had higher claims of “shown earlier” for associates seen than category lures. They also had higher claims of “shown earlier” for words associated with lists shown during study. A 2 x 2 ANOVA confirmed this: Participants had higher claims of “shown earlier” for associates than for category lures, \( F(1, 19) = 4.31, \text{MSE} = .06, p < .052, \eta^2 = .18 \), and for category lures and associates of lists shown during study (as opposed to category lures and associates for lists not shown during
study), $F(1, 19) = 345.59$, $MSE = .02$, $p < .0001$, $\eta^2 = .95$. Note that category lures were never shown during study, only their respective lists were. The interaction was significant, $F(1, 19) = 5.88$, $MSE = .05$, $p = .025$, $\eta^2 = .23$.

Table 11

**Experiment 9: Recognition of Category Lures and Associates**

<table>
<thead>
<tr>
<th>Test Item:</th>
<th>Status of List</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Shown earlier</td>
</tr>
<tr>
<td>Category lure</td>
<td>.46 (.07)</td>
</tr>
<tr>
<td>Associate</td>
<td>.71 (.06)</td>
</tr>
</tbody>
</table>

*Note:* “Category lure” was the category name (e.g., Pop). “Associate” could have been an associate (e.g., caffeine) or a brand (e.g., SPRITE), which was randomly determined. Standard errors are reported in parentheses.

Consistent with the first prediction, participants were more likely to claim “shown earlier” for category lures associated with studied lists as opposed to category lures for lists not shown during study (.46 vs. .06), $F(1, 19) = 50.82$, $MSE = .03$, $p < .0001$, $\eta^2 = .73$. Note that this was an illusion of recognition, as category lures were never shown during study. This result provided us with the motivation for examining the effect with major and minor brand names.

**Experiment 10: False Memories of Brand Names**

The purpose of the following experiment was to determine if the highest ranked brand names (i.e., the most prototypical brands) would demonstrate the same effect as
that found in Experiment 9 with the category lures. That is, under the conditions of study or non-study, we wanted to determine whether major brand lures would be falsely reported as having occurred during study.

**Method**

*Participants.* Twenty students from Simon Fraser University participated.

*Procedure.* We used the same stimuli and procedures as those used in Experiment 9, with the exception that the category names were included during study, and the highest ranked brand name was not shown during study, and was used as the critical lure (henceforth "major brand lure").

**Results and Discussion**

Probabilities of claiming "shown earlier” for Experiment 10 are depicted in Table 12. Results showed that participants had higher claims of “shown earlier” for associates seen than major brand lures. They also had higher claims of “shown earlier” for words associated with lists shown during study. A 2 x 2 ANOVA confirmed this: Participants had higher claims of “shown earlier” for associates than for major brand lures, $F (1, 19) = 21.75, MSE = .03, p < .0001, \eta^2 = .53$, and had a higher probability of claiming “shown earlier” for major brand lures of lists shown during study as well as associates shown during study, $F (1, 19) = 102.64, MSE = .02, p < .0001, \eta^2 = .84$. Note that major brand lures for lists shown during study were not shown during study, only their respective lists were. The interaction was not significant, $F (1, 19) = 1.66, MSE = .06, p = .213, \eta^2 = .08$. 
Table 12
Experiment 10: Recognition of Major Brand Lures and Associates

<table>
<thead>
<tr>
<th>Test Item</th>
<th>Status of List</th>
<th>Shown earlier</th>
<th>Not shown earlier</th>
</tr>
</thead>
<tbody>
<tr>
<td>Major Brand Lure</td>
<td>Shown earlier</td>
<td>.35 (.05)</td>
<td>.08 (.03)</td>
</tr>
<tr>
<td>Associate</td>
<td>Not shown earlier</td>
<td>.60 (.06)</td>
<td>.19 (.04)</td>
</tr>
</tbody>
</table>

*Note:* “Major Brand lure” was the most prototypical brand (e.g., COKE). “Associate” could have been an associate (e.g., caffeine) or a non-prototypical brand (e.g., SPRITE), which was randomly determined. Standard errors are reported in parentheses.

More importantly, consistent with the prediction, participants were more likely to claim “shown earlier” for major brand lures of studied lists as opposed to major brand lures for lists not shown during study (.35 vs. .08), $F(1, 19) = 22.18, MSE = .03, p < .0001, \eta^2 = .54$. We interpreted this to mean that despite the pre-experimental familiarity of these lures (which can be indexed as .08) participants still falsely reported having encountered them experimentally, above and beyond what they would have reported without studying their respective lists.

We also observed that participants were quite accurate at remembering associates (and other brands) for lists presented during study (.60). This is not surprising as participants must have elaborated a great deal on the brand category, which is consistent with previous literature on brand name recognition. What was inconsistent with that reported in the literature, however, is that we observed illusory recognition for major brand lures of studied lists. This is the first demonstration of such an effect using brands,
and, while it is consistent with literature on the DRM effect, it is inconsistent with Nedungadi's (1990) predictions.

**Experiment 11: Recognition of Minor Brand Lures**

We hypothesized that a DRM effect would also be observed if participants were shown the lowest ranked associate (i.e., the least prototypical). However, we expected that the DRM effect for the minor brand lures would not be as strong as the DRM effect found for major brand lures. Note that this hypothesis is contrary to Nedungadi's (1990) hypothesis, who would predict the most facilitation for minor brands.

**Method**

*Participants.* Twenty students from Simon Fraser University participated.

*Procedure:* We used the same stimuli and procedures as those used in Experiment 10, with the exception that the major brands were included during study, and the lowest ranked brand name was not shown during study, and was used as the critical lure (henceforth “minor brand lure”).

**Results and Discussion**

Probabilities of claiming “shown earlier” for Experiment 11 are depicted in Table 13. Results showed that participants had higher claims of “shown earlier” for associates seen than minor brand lures. They also had higher claims of “shown earlier” for words associated with lists shown during study. A 2 x 2 ANOVA confirmed this: Participants had higher claims of “shown earlier” for associates than for minor brand lures, $F (1, 19) = 79.62$, $MSE = .03$, $p < .0001$, $\eta^2 = .81$, and for minor brand lures and associates of lists shown during study, $F (1, 19) = 107.07$, $MSE = .02$, $p < .0001$, $\eta^2 = .85$. Note that minor
brand lures for lists shown during study were not shown during study, only their respective lists were. The interaction was significant, $F(1, 19) = 35.27, MSE = .02, p < .0001, \eta^2 = .65$.

Table 13

*Experiment 11: Recognition of Minor Brand Lures and Associates*

<table>
<thead>
<tr>
<th>Status of List</th>
<th>Shown earlier</th>
<th>Not shown earlier</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Test Item:</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Minor Brand Lure</td>
<td>.19 (.04)</td>
<td>.04 (.01)</td>
</tr>
<tr>
<td>Associate</td>
<td>.71 (.05)</td>
<td>.16 (.04)</td>
</tr>
</tbody>
</table>

*Note:* "Minor Brand lure" was the least prototypical brand (e.g., DR. PEPPER). "Associate" could have been an associate (e.g., caffeine) or a non-prototypical brand (e.g., SPRITE), which was randomly determined. Standard errors are reported in parentheses.

Recognition of minor brand lures was an illusion, as participants were more likely to claim "shown earlier" for the minor brand lures associated with lists shown during study as opposed to the lowest ranked brands for lists not shown during study (.19 vs. .04), $F(1, 19) = 16.51, MSE = .01, p < .001, \eta^2 = .47$. What is more important for the present purposes is an examination of the effect sizes across experiments. As reported for Experiment 10, the $\eta^2$ for the illusion for the major brand lure was .54. A more direct comparison is an independent samples $t$-test comparing the difference score for the illusion reported in Experiment 10 with major brand lures (.35 vs. .08) versus the same difference score in the present experiment with minor brand lures (.19 vs. .04). Such a test revealed a significant difference between groups, $t(38) = 1.65, p = .053$ (1-tailed).
This analysis reveals that, consistent with our prediction, the illusion was more pronounced for the major than the minor brand lures. This finding is inconsistent with the results and predictions of Nedungadi (1990)\textsuperscript{21}.

\textit{Experiment 12: Brand Name Recognition and Preference}

Some researchers have explored preference and attitudes towards brand names (e.g., Perfect & Askew, 1994). Janiszewski (1993; Janiszewski & Meyvis, 2001) provided considerable evidence that preference for brand names and advertisements can be altered by repeated incidental exposures of the brand or ad (i.e., the mere-exposure effect; Zajonc, 1968). The common explanation for such a preference effect is that repetition creates fluent processing of the brand or ad; instead of correctly attributing the source of this processing fluency to the repetition, people misattribute it to liking the brand or ad (see Janiszewski & Meyvis, 2001). Such misattributions arise when the source of the processing fluency is obscure, otherwise a correction process occurs and fluency is attributed to a source in the past (see Winkielman, Schwarz, Reber, & Fazendeiro, 2003). More recent research however has demonstrated that fluency per se is not necessary to elicit a preference effect in brands (e.g., Kronlund & Bernstein, in press).

The purpose of the following experiment is to examine the effects of exposure of DRM lists on preference ratings of major brand lures. Will participants have higher preference ratings for major brand lures of lists shown during study? Nedungadi's (1990) study found that external cues had separate and different affects on brand consideration (i.e., memory-based tasks) and evaluation (i.e., preference). Contrary to this notion, we

\textsuperscript{21} The manipulations used in Experiment 10 (major brand lure) and Experiment 11 (minor brand lure) should have been carried out in one experiment. This is a major limitation that affects the interpretations of these studies; we will be addressing this limitation in future studies.
expected that the illusion of recognition reported earlier would be observed with preference ratings.

**Method**

*Participants.* Twenty-two students from Simon Fraser University participated.

*Procedure:* We used the same design and procedures as that used in Experiment 10 (using major brand lures), with the exception that after participants made their recognition decision at test, they rated their preference for the target on a scale of 1 to 7 (1 = not at all; 7 = very much). Due to the nature of this experiment, associates that were not brand names (e.g., fizz, caffeine, etc.) could not be employed at test. Therefore, as opposed to the fore-mentioned experiments, this one differed in that the “associates” at test were always non-major brand names chosen at random (e.g., either PEPSI, SPRITE, MOUNTAIN DEW, or DR. PEPPER).

**Results and Discussion**

Probabilities of claiming “shown earlier” for Experiment 12 are depicted in the left panel of Table 14. Participants had higher claims of “shown earlier” for non-prototypical brands seen as opposed to major brand lures. They also had higher claims of “shown earlier” for brands associated with lists shown during study compared with brands associated with lists not shown at study. A 2 x 2 ANOVA confirmed this: Participants had higher claims of “shown earlier” for non-prototypical brands than for major brand lures, $F (1, 21) = 10.46$, $MSE = .06$, $p = .004$, $\eta^2 = .33$, and for brands of lists shown during study versus unstudied brands, $F (1, 21) = 85.90$, $MSE = .04$, $p < .0001$, $\eta^2 = .80$. Note that major brand lures for lists shown during study were not shown during
study, only their respective lists were. The interaction was significant, \( F(1, 21) = 58.71, MSE = .02, p < .0001, \eta^2 = .74. \) Replicating Experiment 11, recognition of major brand lures was an illusion, as participants were more likely to claim “shown earlier” for such lures as opposed to lures for lists not shown during study (.36 vs. .21), \( F(1, 21) = 11.98, MSE = .02, p = .002, \eta^2 = .36. \)

Preference ratings (out of 7) are depicted in the right panel of Table 14. Results showed that participants had higher preference ratings for major brand lures than for non-prototypical brands. They also had higher claims of “shown earlier” for brands associated with lists shown during study as opposed to non-studied brands. A 2 x 2 ANOVA confirmed this: Participants had higher preference ratings for major brand lures than for non-prototypical brands, \( F(1, 19) = 25.33, MSE = .41, p < .0001, \eta^2 = .55, \) and for brands of lists shown during study as opposed to non-studied brands, \( F(1, 19) = 10.43, MSE = .19, p < .004, \eta^2 = .33. \) Note that major brand lures for lists shown during study were not shown during study, only their respective lists were. The interaction was significant, \( F(1, 21) = 5.51, MSE = .31, p = .029, \eta^2 = .21. \) Contrary to our prediction however, the illusion of recognition reported earlier could not be extended to preference, as there was no difference in preference ratings for major brands lures associated with studied versus non-studied lists (4.87 vs. 4.85), \( F(1, 19) < 1. \)


Table 14

Experiment 12: Recognition and Preference of Brand Lures and Associates

<table>
<thead>
<tr>
<th>Test Item:</th>
<th>Shown earlier</th>
<th>Not shown earlier</th>
<th>Preference Ratings (out of 7)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Shown earlier</td>
<td>Not shown earlier</td>
<td>Shown earlier</td>
</tr>
<tr>
<td>Major Brand Lure</td>
<td>.36 (.05)</td>
<td>.21 (.06)</td>
<td>4.87 (.21)</td>
</tr>
<tr>
<td>Non-Major Brand</td>
<td>.77 (.04)</td>
<td>.13 (.03)</td>
<td>4.46 (.22)</td>
</tr>
</tbody>
</table>

Note: "Major Brand lure" was the most prototypical brand (e.g., COKE). The "Non-Major Brand" was one of the four non-prototypical brands (e.g., PEPSI, SPRITE, MOUNTAIN DEW, or DR. PEPPER), which was randomly determined. Standard errors are reported in parentheses.

Our findings are consistent with previous literature in that, at test, participants have higher preference ratings for studied as opposed to non-studied brands (e.g., D'Souza & Rao, 1995). Surprisingly however, no difference in preference ratings were found for major brand lures of lists that were studied versus those that were not studied. Perhaps this is a ceiling effect for preference, and the effect in preference can only reveal itself if the next-to-most prototypical brand (e.g., PEPSI) is tested. We will explore that idea in future studies.

General Discussion

The purpose of this study was to re-examine Nedungadi (1990) in light of the DRM effect originally observed by Deese (1959), and more recently reported by Roediger and McDermott (1995). We attempted to use more extensive and appropriate pilot studies than Nedungadi (1990) did; we used a controlled context and conditions, allowing us to compare across studies. We also used 28 brand categories as opposed to two, which better allowed us to generalize our findings to other brand categories.
We observed that participants falsely reported having studied brand names such as COKE after seeing only associates (e.g., pop, fizz, caffeine, etc.) as well as direct competitors (e.g., PEPSI, MOUNTAIN DEW, etc.) We also attempted to extend the effect to preference ratings of prototypical brands. The illusion did not occur for preference ratings; however, we demonstrated that increased preference judgments are affected by actual prior study. We suspected that we did not find an illusion of preference because of a ceiling effect.

The Future of the DRM Paradigm

We believe that this paradigm can be effective for examining brand salience and accessibility: Managers could potentially use it as a technique to determine the rate of report for their brand (i.e., by operationally defining it as the "lure") when compared to other brands within the same category. For example, the marketing managers of JVC would ideally want to determine, experimentally, how often consumers in their target market falsely report JVC after seeing: big monitor, picture, plasma, SAMSUNG, SHARP, SONY, and so on, and use that knowledge to determine future marketing strategies, or use it as a baseline to evaluate trends, experimentally. On the other hand, it would be useful for the makers of JVC to determine whether presenting JVC as part of a list causes participants to erroneously report having encountered a competitor, and which competitor that may be. Other testing methods may also include stimulus-based and memory-based brand choice and choice deferral.

One question that remains is whether this paradigm can also be used and applied using brand logos and pictures of the associates: on a computer display, in a magazine layout, or on a web-based layout. That is, if only pictures were shown (instead of words,
as in the current experiments), would a DRM effect be observed? In other studies using pictures, the DRM effect was attenuated. For example, using standard DRM lists, Schacter et al. (1999) presented pictures along with each study item (e.g., for the sleep list: a picture of a bed with the word “bed”, and picture of a pillow with the word “pillow”, and so on). This procedure was effective in reducing false reports of the critical lure. Schacter et al. argued that participants were using a distinctiveness heuristic\(^{22}\): making use of detailed recollection to make their decision. Thus, another question that remains is whether a DRM effect for brands would occur if pictures were shown in addition to the actual brand names.

**Experiments on Forgetting**

In the following section I will describe some work that I have carried out in collaboration with my former lab-mate, Andrea Hughes (Kronlund & Hughes, 2005). As part of her dissertation, Hughes performed an examination of the phenomenon of retrieval induced forgetting (RIF). Her main goal was to determine if the psychological construct of inhibition was necessary in explaining the effect. I will first describe the retrieval practice paradigm used that produces the observation of RIF, I will highlight the main findings of Hughes’ work, and I will also briefly describe a number of studies that Hughes and I carried out together.

In the typical retrieval practice paradigm there are three phases. In the first phase, participants are asked to study 6 items from 8 categories. For example, for the fruit

\(^{22}\) The distinctiveness heuristic is different from other heuristics described in this dissertation in that distinctiveness is thought to be a response mode whereby participants make remembering decisions based on the metacognitive expectation that they should remember vivid details of things encountered in the past. Applied to the DRM paradigm, when pictures are used, the lack of distinct information (which is expected for pictures) is thought to be indicative that the item has not been seen, and it can be “turned off” if it is not thought to be useful by the participants for reducing errors (e.g., Dodson & Schacter, 2002).
category, participants would study apple, orange, pear, strawberry, banana, and kiwi. For the weapons category, subjects would study gun, rifle, and so on. During the retrieval practice phase, half the items from half the categories are practiced, using fragment completion. Each target is practiced 3 times. After a 5 minute delay, participants are cued with each category and are required to name all of the exemplars that were studied in the first phase. The standard procedures are summarized in Figure 2.

Figure 2
Standard Retrieval Practice Paradigm

<table>
<thead>
<tr>
<th>Study Phase</th>
<th>Retrieval Practice</th>
<th>Delay</th>
<th>Recall Test</th>
</tr>
</thead>
<tbody>
<tr>
<td>6 items/8 categories</td>
<td>Fragment Completion 10 sec/item (3X)</td>
<td>5 min</td>
<td>Cued Recall 30 sec/category</td>
</tr>
<tr>
<td>FRUIT-apple</td>
<td>FRUIT ap___</td>
<td></td>
<td>FRUIT ?</td>
</tr>
<tr>
<td>FRUIT-strawberry</td>
<td>FRUIT ba___</td>
<td></td>
<td>ANIMALS ?</td>
</tr>
<tr>
<td>FRUIT-kiwi</td>
<td>FRUIT pe___</td>
<td></td>
<td>WEAPONS ?</td>
</tr>
<tr>
<td>FRUIT-orange</td>
<td></td>
<td></td>
<td>DRINKS ?</td>
</tr>
<tr>
<td>FRUIT-banana</td>
<td></td>
<td></td>
<td>FISH ?</td>
</tr>
<tr>
<td>FRUIT-pear</td>
<td></td>
<td></td>
<td>etc.</td>
</tr>
</tbody>
</table>

The standard result is that repeated practice in recall of some members of a class (e.g., some members of the FRUIT class) impairs later recall of other members of the class, but not members of other classes (Anderson, Bjork & Bjork, 1994). This notion assumes a network organization of memory that operates under the principles of activation and inhibition (Anderson et al., 1994; 2000). According to Anderson’s account, when participants study items from different categories, those items become “activated” within the memory system. The notion is that repeated practice of some
members requires suppression or inhibition of un-practiced members of that category, and inhibition persists and prevents later recall, thus recall of those un-practiced members is impaired. Note however, that practice on apple, orange, and pear, for example, impairs later recall of other members of the FRUIT class, but not members of other classes (Anderson, Bjork & Bjork, 1994). Thus, there can be no inhibition across categories.

As part of her dissertation, Hughes carried out a number of studies that I will briefly describe here. She demonstrated that the observation of RIF is eliminated when (a) more time is provided to participants during recall, (b) no distinction is made between the retrieval practice and final recall phases, (c) when the dependent measure is changed to reaction time and participants are forced to report un-practiced items first. Hughes argued that her data do not support an inhibition account of retrieval induced forgetting; instead they suggest that the effect is driven by a capacity-limited system which is susceptible to simple interference.

I thought there could be two possible types of interference that could be taking place, and further, interference could be overcome by appropriate cues and a match in context (to study) during recall. The interference could be either within categories, or between categories. I thought that (a) each target was too similar to each other, and that, if a high frequency word, or brand like COKE, were in the un-practiced items from the practiced categories, it would certainly be reported, and (b) 8 categories was likely enough categories to create some sort of added stress on the system, causing a prioritization system which creates the effect, and that, with fewer categories, the effect would not be observed. If either of these hypotheses were to be born out, there would not be a place for inhibition.
In order to examine (a) above, we used standard DRM lists, placing strong associates in the unpracticed set, which, according to Anderson, should receive more inhibition than weak associates. We found that we were able to eliminate the effect. To examine (b) above, I carried out a between-subjects experiment: one group performed the standard testing procedure with 8 categories, another with 6 categories, and another with only 4 categories. I found that the amount of RIF decreased systematically as the number of categories decreased.

In order to overcome this “interference” that I thought was a function of both the similarity of each target to one another (i.e., within-category interference) and the number of categories (i.e., between-category interference), I thought that test-time cues could be used to assist participants in recovering the “forgotten” items. Thus, RIF is essentially due to a “retrieval” problem, not an “encoding” problem (cf. Gardiner, Craik, & Birtwistle, 1972). We therefore modeled our experiments after that of Gardiner, Craik, and Birtwistle (1972), who showed that “release from proactive interference” (Wickens, Born, & Allen, 1963) occurs when participants are provided with subset cues during recall. We showed “release” when participants were given subset cues during recall, or after unsuccessful recall.
References


Kronlund, A. (under review). Remembering words and brand names after a perception of discrepancy. *Journal of Consumer Research*.

Kronlund, A., & Bernstein, D. M. (in preparation). Unscrambling words increases brand name preference, but does preference depend on brand name recognition?


Appendix A

She washes her clothes using TIDE
SUNLIGHT
CHEER
Her favorite chocolate bar is SNICKERS
MARS
OH HENRY
He does all his banking at the local CIBC
ROYAL BANK
CANADA TRUST
She mopped the kitchen floor using MR CLEAN
PINE SOL
MURPHY'S OIL
His mom cleans the washroom with VIM
FANTASTIK
LYSOL WIPES
Her dad's favorite jeans are his pair of LEVIS
WRANGLER
DIESEL
He loved the smell of his girlfriend's shampoo
PANTENE
FINESSE
HERBAL ESSENSES
The runners on the track team all wore NEW BALANCE
ASICS
SAUCONY
The snowboarders' jackets were all HELLY HANSEN
QUIKSILVER
WEST BEACH
The business man bought all his supplies at STAPLES
GRAND AND TOY
OFFICE DEPOT

She always tuned in for news to CNN
GLOBAL NEWS
CTV NEWS
He wanted an unstudied truck so he bought a DODGE
FORD
CHEVy
The student's unstudied laptop was a DELL
HEWLETT PACKARD
MACINTOSH
He secretly bought her engagement ring at SPENCE DIAMONDS
PEOPLE'S JEWELERS
TIFFANY'S
They watched the Canuck's game at the local MALONE'S
EARLS
SAMMY J PEPPERS
Dog owners like the feed their dogs IAMS
PEDIGREE
DOG CHOW
Professional and amateur photographers use KODAK FILM
FUJI FILM
BLACK'S FILM
Canadian hockey fans on the east coast prefer the LEAFS
HABS
SENATORS
The travel center recommended flights with AIR CANADA
WEST JET
JETSCO
He enjoyed learning by watching TLC, DISCOVERY CHANNEL, A & E. As part of her yogurt diet she ate DOLE, NEILSON, YOPLAIT. For breakfast the children ate the cereal CHEERIOS, CAPTAIN CRUNCH, CORN FLAKES. For her son's cough she gave him some ROBUTUSSIN, HALLS, VICKS. For her headaches she always took ADVIL, TYLENOL, MOTRIN. Mom buys all her groceries at SAFEWAY, EXTRA FOODS, SUPERSTORE. He disapproved that his teenage daughter shopped at OLD NAVY, LE CHATEAU, DYNAMITE. My family just bought a unstudied couch at IKEA. THE BRICK, LEON'S. His very first car at age 16 was a HONDA, CHRYSLER, VOLKSWAGON. The pantyhose she chose to wear was by SECRET, WONDERBRA, CAMEO. The teens bought their CDs on sale at A & B SOUND, HMV, FUTURE SHOP. They both smoked and preferred MARLBOROS, CRAVEN A, CAMEL. The fast food joint they went to late at night was MCDONALDS, WENDYS, BURGER KING. The department store she registered at was THE BAY, SEARS, JC PENNY. They got the best long distance rates with AT & T, TELUS, PRIMUS. They bought all of their cat food at BOSLEY'S, PETSMART, PETCETERA. His grad gift was an expensive watch made by ROLEX, TAG HEUER, ESQ. She just bought new purse and matching wallet made by NINE WEST, MUNDI, PERRY ELLIS. The unstudied shirt she bought her son was TOMMY HILFIGER, RALPH LAUREN, NAUTICA. The clock radio in her bedroom was a PANASONIC, SONY, JVC. He dreamt about one day driving a FERRARI, LAMBORGHINI, PORSCHE. All AAA hockey players' gear is made by BAUER, CCM, ITECH. The hotel they stayed at when they visited was the HYATT, HOWARD JOHNSON, HOLIDAY INN.
She needed unstudied tires for her car so she went to FIRESTONE, DUNLOP, PIRELLI. They saw whales and dolphins at SEA WORLD, THE VANCOUVER AQUARIUM, MARINE LAND. To paint the kids' bedrooms they found the right color at BENJAMIN MOORE, GENERAL PAINT, COLOUR YOUR WORLD. Before renovating they got advice from the people at LOWE'S, HOME DEPOT, HOME HARDWARE. The best beer commercials are those made by BUD LIGHT, MOLSON, LABATT'S. Girls prefer to use razors made by BIC, GILETTE, SCHICK. On his way to work he got coffee at STARBUCKS, SECOND CUP, SEATTLE'S BEST COFFEE. The photocopier in the office was an old XEROX, CANON, PANASONIC. The internet services they used were by AOL, MSN, BELL. Down the street the gas was full serve at PETRO CANADA, SHELL, ESSO. If it had vodka in it she could tell if it was FINLANDIA, SKYY, ABSOLUT. The cola that she preferred to drink was PEPSI, COKE, JOLT. She had her car radio programmed to JR FM, 99.3 THE FOX, 97 KISS FM. When she snacked during studying she ate LAYS, DORITOS, HOSTESS. She thought the best tupperware was made by RUBBERMAID, ZIPLOC, GLAD. The only cookies that tasted like grandma's were CHIPS AHOY, OREOS, NEWTONS. In the freezer the choice of frozen juices to make included MINUTE MAID, NESTEA, FRUITOPIA. The type of soccer cleats worn by them was ADIDAS, NIKE, UMBRO.
### Appendix B

<table>
<thead>
<tr>
<th>POP</th>
<th>FRENCH FRIES</th>
<th>RUNNING SHOES</th>
</tr>
</thead>
<tbody>
<tr>
<td>COKE</td>
<td>MCDONALD'S</td>
<td>NIKE</td>
</tr>
<tr>
<td>PEPSI</td>
<td>NY FRIES</td>
<td>ADIDAS</td>
</tr>
<tr>
<td>SPRITE</td>
<td>BURGER KING</td>
<td>REEBOK</td>
</tr>
<tr>
<td>MOUNTAIN DEW</td>
<td>WENDY'S</td>
<td>NEW BALANCE</td>
</tr>
<tr>
<td>DR. PEPPER</td>
<td>MCCAIN'S</td>
<td>ASICS</td>
</tr>
<tr>
<td>CAN</td>
<td>FAST FOOD</td>
<td>BASKETBALL</td>
</tr>
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<td>DRINK</td>
<td>FRIED</td>
<td>WALKING</td>
</tr>
<tr>
<td>SODA</td>
<td>BURGERS</td>
<td>FEET</td>
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<tr>
<td>BOTTLE</td>
<td>SALTY</td>
<td>EXERCISE</td>
</tr>
<tr>
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<td>FATTY</td>
<td>JOGGING</td>
</tr>
<tr>
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