

RECOGNITION HYPERMNESIA

by

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Abstract  
RECOGNITION HYPERMNESIA  
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Recognition hypermnesia--improved memory with repeated testing--is produced using non-standard tests that emphasize the role of retrieval in the recognition memory task. In a non-standard test of recognition, test items are not representations of the study items but are in some sense transforms of these items. The test items may be truncated or part-forms of study items, or paraphrases, for example.

Experiments 1, 2, and 3 sought to explore hypermnesia using stimuli that are typical in recognition and recall tasks in the laboratory: words and simply drawn pictures. The test items for these experiments were transforms, such that (depending on the experiment) pictures were tested with their verbal equivalents and words with their picture counterparts. The only successful condition in this set was Experiment 2, which separated pictures and words in the study phase. The picture-study group (tested with words) produced significant improvement over the course of three successive recognition tests.

A study by Erdelyi and Stein (1981) had produced one of the few clear-cut instances of recognition hypermnesia in

the literature, using cartoons with captions as stimuli. Experiments 4 through 8 were designed around this study. During the study phase, subjects were presented with a complete cartoon comprised of a picture component plus verbal caption. In Experiment 5 (*picture-only condition*) subjects were tested on the picture portion of each cartoon, replicating the Erdelyi and Stein (1981) findings of recognition hypermnesia when a part-form is used at test.

Experiment 4 (*picture-fragment condition*) cropped the stimulus even further, leaving only a quadrant of the picture for testing. Recognition hypermnesia was not obtained. Experiment 6 employed paraphrases of the stimuli, produced by rendering the visual elements of the cartoon in written form, resulting in a greater degree of hypermnesia than the pictures alone.

Experiment 7 produced the strongest results: highly significant recognition hypermnesia using latent content (a summary in words of the gist of each cartoon) for testing. The joining of verbal paraphrase with latent content in Experiment 8 proved to be a successful combination in producing recognition hypermnesia as well.

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## General Introduction

Although recall hypermnesia--improved recall with repeated testing--has been obtained in a wide variety of experimental conditions over the past century (see reviews by Erdelyi, 1996; Payne, 1987), only few successful attempts at producing *recognition* hypermnesia have been reported (English, 1942; English & Edwards, 1939; English, Welborn & Killian, 1934; Erdelyi & Stein, 1981; Kazén & Solis-Macías, 1999; Merikle & Reingold, 1991; Milner, 1968; Wallace, Colehart, & Forster 1970). Of these few positive reports, moreover, several are flawed methodologically. The objective of this dissertation is to clarify the status of recognition hypermnesia. Does it exist, and, if it does, under what conditions?

### *Historical Overview of the Course of Memory Over Time*

The most common (and quick) response to the question of what happens to memory over the course of time is that it declines. Formalized by Ebbinghaus in 1885 with his now famous (and ubiquitously cited) studies on "the saving of work in relearning," the Ebbinghaus curve of forgetting has become the benchmark for measurement of memory trends over time. Early on, however, there was evidence that memory could increase rather than decrease. In classical

conditioning, the spontaneous recovery from extinction is one example (Erdelyi, 1996).

The reference work on hypermnesia--upward trending memory--dates back to the seminal work of Ballard who, in 1913, tested young boys for their memory of lines of poetry. To his surprise when he returned (unannounced) two days after their first meeting, the boys' memory had improved from initial testing. With this new line of inquiry now open, Ballard concluded that up until then memory research had been one-sided in emphasizing that "the curve of remembering has but one tendency--a downward tendency". Ballard used a variety of stimuli during his many studies; his best results were with Latin nouns, for example. Others followed his work, replicating his finding with lines of poetry (Williams, 1926) as well as state names (Brown, 1923; for a review see Erdelyi, 1996). What is notable is that Ballard found that improvement did not occur if nonsense syllables were used as stimuli--just the study items designed and employed by Ebbinghaus.

The conclusion is that hypermnesia requires the use of effective stimuli as study material, though exactly what constitutes the effective stimuli is not altogether clear. The material should be meaningful: pictures, lines of poetry, well-learned material (e.g., Latin nouns and state names used by early experimenters). However, lists of words also fail typically to produce recall hypermnesia (Erdelyi,

1996; Payne 1987). Conceptually, the effective stimuli, according to Erdelyi (1996) must meet two requirements: (1) the material, even if initially inaccessible, should be retrievable over time and (2) the retrieved items must be recognizable--items that are retrieved should be recognized. Nonsense syllables and lists of words do not readily meet these joint criteria and it is noteworthy that it was the use of nonsense syllables and word lists that led to hypermnesia not simply being overlooked, but to being dismissed as a phenomenon--in his influential review of 1943, Buxton asserted that reminiscence was a "now you see it, now you don't phenomenon."

It should be noted that in addition to the stimulus problem, a semantic one also intervened: What Ballard termed "improvement"--what we now call hypermnesia--was incorrectly designated "reminiscence", by which Ballard meant memory recovery. Actually, reminiscence, in Ballard's sense of a stimulus item inaccessible in an earlier trial being recovered in a later trial, is completely reliable, even for nonsense syllables. It is hypermnesia, overall improvement in memory, that is dependent on stimulus conditions.

Let us now consider Ballard's work in greater detail. Ballard's 1913 monograph was entitled "Oblivescence and Reminiscence." *Oblivescence* was simply Ballard's term for forgetting. An item recalled on Test 1 ( $T_1$ ) but forgotten

on Test 2 ( $T_2$ ) is what Ballard meant by oblivescence. Obviously several items may be forgotten or oblivesced in  $T_2$  that were recalled in  $T_1$ . On the other hand, an item *not* recalled on  $T_1$  may be recovered in  $T_2$ . Such recovered items were designated as *reminiscence*. Actual recall level in  $T_2$  is a *balance* between oblivescence and reminiscence: If more items are reminisced than oblivesced, as tends to be the case, for example, with poetry and pictures, "improvement" or hypermnesia occurs. If the balance is negative, with more items oblivesced than reminisced, then the opposite of hypermnesia occurs, namely amnesia. Thus the balance between oblivescence and reminiscence determines whether amnesic or hypermnesic recall ensues. During the approximately fifty years between the Ballard studies and the 1970's when interest was renewed in hypermnesia, this key distinction between reminiscence and improvement (hypermnesia) was lost, leading to the rejection of the concept of upward-trending memory.

Although memory improvement had been virtually rejected in the experimental literature until the 1970s, it continued to be a lively notion in the clinical world. The recovery of lost or repressed memories had been key to early Freudian therapy, and continues to be in some modern offshoots. In *Studies on hysteria* (Breuer & Freud, 1895/1955), Freud documents his abandonment of hypnosis in favor of (for a short while) a "concentration" or "pressure" technique in

which the patient was repeatedly requested to concentrate and to keep trying to remember what seemed to be inaccessible. This technique may be viewed as a clinical version of multi-trial recall (Erdelyi, 1996).

Although the clinic was more at home with the phenomenon of recovered memories than experimental psychology, it suffered from a serious problem, the failure to distinguish true recoveries from false recoveries. In the laboratory this is not a problem because the experimenter can check a new response against the stimulus list. Clinicians have no veridical access to past events and so may--and often do--confuse false alarms with hits, with sometimes dreadful consequences in legal settings (e.g. Crews, 1995, *The memory wars: Freud's legacy in dispute*; Loftus & Ketcham, 1994, *The myth of repressed memory: False memories and allegations of sexual abuse*).

Over the last decade or so, both the clinic and the experimental laboratory have corrected some of their missteps. In the clinic there is a far greater caution about taking a recovery to reflect an actual past event. In the laboratory, the use of effective stimuli has led to a coherent picture of the phenomenon. Many studies of *recall hypermnesia* demonstrate that it is a robust phenomenon--as long as the appropriate stimuli are used. In a review in 1987, Payne concluded that recall hypermnesia can be produced virtually 100% of the time when meaningful pictures

are used, and just a little under 50% of the time if words are used. It may be added here that with nonsense syllables, the rate is about 0% (Erdelyi, 1996).

The story for recognition hypermnesia is quite different. As noted earlier, studies of recognition hypermnesia have been few, and a mere handful have produced positive results (and of these, only two are without serious methodological problems). Hypermnesia, therefore, has not been easily or reliably produced when recognition tests have been employed. In a 1987 experimental publication, Payne and Roediger concluded that recognition hypermnesia does not occur (this issue will be discussed in greater detail; see pp. 19-20).

Past research on recognition hypermnesia is now considered in some detail, along with theoretical efforts to distinguish between the processes underlying recall and recognition.

#### *Standard Recognition*

In the standard recognition task, study items and test items are identical: A number of stimuli are presented in the study phase and, on a later occasion (or on several later occasions), the stimuli or a subset are re-presented along with distractors and the subject attempts to recognize the original stimuli. Thus, recognition is tested by a *copy cue*, and the task is *identity matching* (Tulving, 1983).

An important methodological difficulty in producing recognition hypermnesia with a standard recognition test is that the most reliable stimuli--meaningful pictures--for obtaining recall hypermnesia produce exceedingly high initial levels of recognition memory. Subjects are extremely adept at discriminating between pictures they have seen a short time before and those they have not, even when given hundreds (Nickerson, 1965; Shepherd, 1967) or thousands (Standing, Conezio, and Haber, 1970) of pictures to remember. Because most of the successful recall hypermnesia studies have found effects using picture stimuli and not words, ceiling effects are a serious problem. In an unpublished study cited by Erdelyi and Stein (1981), a picture recognition memory task for 120 pictures resulted in a 99% hit rate for a 1% false alarm rate, translating to an impressive  $d'$  of (about) 4.65. Obviously, not much improvement in recognition memory is possible with such near-perfect initial performance. Thus, the problem of ceiling effects in picture recognition memory has to be surmounted somehow if growth in recognition memory over time, or recognition hypermnesia, is to be demonstrated.

A study by Payne and Roediger (1987) failed to obtain any evidence of recognition hypermnesia, even though they succeeded in obtaining recall hypermnesia with the same stimuli. Using words (common nouns) as stimuli, they

assessed hypermnesia using free recall, 4 Alternative Forced Choice (4AFC) and a Yes-No recognition task. Although repeated recall tests produced hypermnesia, the repeated recognition tests did not. Actually, although the 4AFC task did not produce a reliable change in recognition performance, the Yes-No recognition test yielded an amnesic outcome, perhaps due to the design of the test, which was comprised of 100 stimuli and 300 distractors (to parallel the 4AFC test).

To mitigate a ceiling effect--the mean proportion of items correctly recognized in the 4AFC task was .86--Payne and Roediger conducted a second series of experiments in which the recognition task was expanded to a 6AFC format, and distractors used were semantically related to each other and the target item. Subjects were asked to rate each item, during the study phase, according to a graphemic, imaginal, or semantic quality. This rating procedure introduced a differential depth of encoding aspect to the task and enabled the experimenters to examine performance across a range of performance levels. Subjects were then either given three recall tests or three recognition tests. While the semantic encoding condition produced the largest proportion of items either correctly recalled or recognized, hypermnesia was, again, only attained in the free recall task. The authors concluded that "hypermnesia occurs in recall but not in recognition."

Other attempts at producing recognition hypermnesia by reducing initial recognition level include those mentioned by Erdelyi and Stein (1981), who tried both very rapid presentation rates and the use of closely related distractors. Although initial performance levels were successfully degraded by both procedures, pilot work reported by the authors showed no promise of yielding recognition hypermnesia. In an earlier study, Erdelyi (1970) used a tachistoscopic stimulus exposure (500 msec.) that resulted in very degraded initial recognition performance ( $d'=.80$ ), but failed to yield recognition hypermnesia in subsequent testing.

Following the lead of the Roediger and Payne studies, Ottani and Hodge (1991) attempted to produce recognition hypermnesia through both differential processing (Experiment 1A) and, additionally, delay of task (Experiment 1B). In what they term "item specific processing," the subjects were asked to create an image for each of the 140 words that they studied. In the "relational" condition--a type of organizational and semantic processing--the subjects were asked to create an image for groups of three successive words. In a third condition, the control group, subjects were allowed to learn the words in any way that they wished. In the first experiment, after a two-minute filler task, the subjects were given three successive 2AFC recognition tests.

There was a four-minute silent think interval after both the first and second recognition tests. In the second experiment, subjects were not given immediate recognition tests; instead they returned after a one week delay for the (unexpected) repeated testing, administered in the same manner.

In designing these two experimental conditions, Ottani and Hodge split the processing in order to emphasize what they define as more of either a recall or recognition process. Citing a theoretical framework of Einstein and Hunt (1980), the expectation was that item specific processing, as it forces the subject to focus on the special features of each single word, would enhance the recognition process. The idea is that a more productive initial recognition performance will lead to improvement over repeated tests. The authors are here referring to "level of cumulative recall" -- an earlier theory of recall hypermnesia first proposed by Roediger and Payne (see Erdelyi, 1996 for a review). According to this theory, a lower level of performance will reach the asymptote faster so that, in a short duration test, it will have reached its maximum, unlike a higher level of performance which will not have time to do so. This leaves room for improvement in the course of a series of short tests. Relational processing,

based on the meanings of the study items, favors the recall process and therefore would not foster improvement in this setting (of only recognition testing).

The delay was introduced to decrease the subjects' reliance on familiarity, as it would necessarily fade over time, and increase the amount of retrieval work required. In essence, this was meant as a degradation of the stimulus items.

The results showed no improvement by any group in either the immediate testing or the delayed condition, nor was there any difference in recognition performance in general based on the variation in processing. Ottani and Hodge expressed surprise at these results noting that encoding strategies had previously been found to have an affect on tasks of free recall. What is not be surprising is that the mean proportion correct was quite high on the immediate tests: Averaged across processing conditions, these were .88, .86, and .86, for tests 1, 2, and 3 respectively. The introduction of a delay, although it did lower the performance level (to approximately .68 at the first recognition test), did not work to produce hypermnesia across the three recognition tests. Thus the diminution of familiarity alone did not create conditions necessary for hypermnesia to occur. The authors concluded that they had confirmed the assertion by Roediger and Payne that hypermnesia occurs in recall but not recognition.

Another attempt to induce recognition hypermnesia by differential encoding or processing strategies was made by Ottani and Simpson (1994). In this experiment, processing was further emphasized through a study list that was specially constructed to have relational properties. One group studied a list of words that were connected by taxonomic category. A separate group studied an unrelated list of words. Within each group, subjects were told to rate either the pleasantness of each word (on a five-point scale) or to sort the words by placing each under category labels on a poster board. In a third condition, the intentional learning condition, subjects were told to learn the list for an unspecified memory test. After a filler task, the subjects were given three successive Yes-No recognition tests. Although processing strategy did make a difference in overall recognition performance, there was no improvement over the course of the three tests. Once again the conclusion was that recognition hypermnesia does not occur with standard recognition testing.

*Recognition over very brief intervals.* In a qualitatively different type of recognition task, an increase in correct face recognition has been shown by both Milner (1968) and Wallace, Colehart, and Forster (1970). These experiments used very short time intervals between study and a standard recognition test. However, the

recognition hypermnesia produced here is not by the same subjects over repeated tests, i.e., it is a between-subjects effect.

In the Milner study, subjects studied 12 yearbook-type photographs, and were then asked, after a 90-second unfilled delay, to identify the 12 they had seen from an array of 25 photos. This study was designed to test recognition in patients with various types of lesions (right temporal, left temporal, and frontal), but what surprised the experimenter was that both normal control subjects and those with left temporal lesions did more poorly when asked to perform the same type of recognition task with no delay (rather than the 90 seconds) between study and test. Milner notes that the subjects voiced dismay at the immediate test, saying that the task was "bewildering" and that the sight of the larger group of test faces wiped out their memory of the original ones. The subjects' concerns raise the question of whether this outcome was the result of confusion or affect interfering with the memory task. It may also serve to explain this result not as a true increase, but as the marking of a time interval necessary for the processing or encoding of study items prior to testing. Studies using very rapidly presented visual stimuli have introduced the term "conceptual masking" to explain the poor recognition that results if study items are presented without sufficient

breaks between them (Intraub, 1999). The new stimulus is said to disrupt the processing of the old, preventing consolidation in memory.

The Wallace, Colehart, and Forster study was a follow-up of the Milner experiment. This time, hypermnesia occurred with a 45-second delay between inspection and test. As in the Milner experiment, the improved ability was not a function of repeated tests, but a comparison of different groups of subjects who studied the photographs (also 12) for either 45 or 15 seconds, and who then were tested at a predetermined delay (either 0, 45, 90, 180, or 360 seconds). None of the intervals other than the 45-second delay between inspection and retest showed a hypermnesic effect. This experiment replicated the Milner finding, but at a 45-second delay, and used college students rather than a patient population. The same experiment was conducted using children, aged 10 to 12 years as subjects. Though the results were not statistically significant, performance was better at the 45-second delay interval, demonstrating a similar trend. Thus there was some evidence for recognition hypermnesia but the specific effective time interval did not replicate (90 seconds vs. 45 seconds) and the time intervals between study and test were, in any case, fleeting.

*Recognition Hypermnesia and Hypnosis.* The reported use of hypnosis to increase memory has particular relevance to the question of recognition hypermnesia and its use in eye-

witness memory. Erdelyi (1988) surveyed the literature and found, surprisingly, that many of the experiments described as tests of "recall" were in reality recognition experiments: Experiments that test the subject's memory by asking leading questions (Did you see this man?) rather than true recall questions (Describe what you saw take place). It can readily be seen that the leading question is merely a variation on a standard yes/no recognition task. Summarized according to type of test, as well as the kind of materials used in the test, the results of the use of hypnosis to enhance memory are produced in Figure I.1.

Although it has been traditionally assumed that hypnosis has a facilitating effect on memory, inspection of this table reveals the unexpected conclusion that enhancement of memory is only found in the special case where stimulus material of high sense (pictures, stories, poetry, staged events) are used and when subjects are asked for recall of material rather than recognition. Low-sense material on recall tests (nonsense syllables, numbers) and recognition tests with either stimulus type show no facilitative effect.

In four cases of recognition with high sense material hypnosis appears actually to disrupt rather than augment memory. This disruption occurs in experiments where the leading questions are intentionally designed to mislead the subjects, prompting a positive response, even though it is

Figure I.1

		Recognition		Recall		
STIMULUS	Low-sense	0 <hr/> n = 1		00 00 00 00 00 <hr/> n = 10		
	High-sense	- - - - <hr/> n = 4	00 00 00 00 00 <hr/> n = 7	0 0 <hr/> n = 2	+/0 +/0 <hr/> n = 2	+++ +++ +++ ++ ++ <hr/> n = 13

Figure I.1. Effect of hypnosis on memory as a function of type of stimulus and memory test. Key to outcome symbols: +, positive (enhancement) effect; +/0, positive (enhancement) effect, but not with respect to all control conditions; 0, null outcome or nonsignificant trend; -, negative (decrement) effect. From "Hypermnnesia: The Effect of Hypnosis, Fantasy, and Concentration", by M. H. Erdelyi, 1988, in H. Pettinati (Ed.), *Hypnosis and Memory*, p. 65.

an incorrect one. Hypnotized subjects may therefore be exhibiting more compliance with experiment-induced suggestions, rather than a disrupted memory. In those experiments that use a 2AFC recognition test, this evident response bias effect is absent and there is no difference in performance between subjects who have been hypnotized and those who have not. When response bias is controlled, therefore, hypnosis has no facilitating effect on recognition.

In addition, the apparent enhancement of memory through hypnosis in tests of recall with high sense material need not imply that hypnosis is effective, because the improvement may be due solely to a standard hypermnesia effect, i.e., an increase due to repeated effort (Erdelyi 1998, 1996). Experiments on this issue show that, in fact, hypnosis is incidental to the results, or more accurately, has no effect either way: As can be expected, repeated recall tests with highly memorable material lead to improved memory. There was no increase, using these same materials, with repeated recognition tests. Erdelyi concluded that hypnotic hypermnesia is an "empty set of hypermnesia." Thus, hypnosis has nothing to do with the results, including the null or negative effects for repeated recognition testing, and so once more, no experimental evidence is found for recognition hypermnesia.

*Recognition Hypermnesia with Non-Standard Recognition Tests*

The present section reviews the experimental literature involving non-standard recognition tests, a designation given to recognition tests where test items are not representations of the study items (i.e., copy-cues) but are in some sense transforms of the study items. For example, test items may be truncated or part-forms of study items, enhanced versions, or paraphrases. Although this type of recognition is "non-standard" by usual laboratory procedures, it is actually more congruent with real-life recognition tasks.

*Paraphrase test items.* The early studies of English, Wellborn and Killian (1934) used prose materials (several paragraphs of text for study). Single sentences that were either verbatim repetitions or paraphrases of the original material were used in the recognition task, which was a true-false test.

Examples of both types of test items are given below:

- |   |  |
|---|--|
| <p>1. Pupils are endowed with the tendency to organize knowledge.<br/>(<i>verbatim; true</i>)</p>   | <p>1. Children are naturally inclined to classify facts.<br/>(<i>paraphrase; true</i>)</p>   |
| <p>2. Advocates of specific drill deny that pupils can learn how to deal with number combinations without specific drill upon them.<br/>(<i>verbatim; false, i.e., words have been omitted</i>)</p> | <p>2. Proponents of definite repetition believe it is necessary to have definite repetition of every number fact.<br/>(<i>paraphrase; false</i>)</p> |

There were several intervals of time between the reading of the passage and the recognition tests in this series of experiments. For example, tests were given at 10 minutes (the 'immediate' test), 1 day, 14 days and 30 days; in another, at 10 minutes and then 55 days, and in still another at 10 minutes, 1 day, 3 days and 71 days. The results showed an increase in correct identifications of paraphrased, but not verbatim sentences over repeated tests (a correct identification was one that the subject marked as true, in agreeing that it conveyed an idea in the passage read).

These results, however, are suspect because the study material was taken from a psychology text or published articles on educational psychology and the subjects used were students in elementary, educational, or advanced psychology (Woodworth, 1938; Buxton, 1942). Any observed increment could therefore easily be explained by the students' increased knowledge of the subject area, accrued in the course of their studies, which was continuing as the experiment progressed.

While transfer of learning is highly plausible in the instances where the time between study and test ranged from 2 weeks to 2 months, the interval of 1 day may seem to be exempt from this criticism. An argument can be made, however, that even this short space of time (presumably from one class meeting to another) could have afforded the

students an opportunity either to purposefully or incidentally check the substance of the material they were tested on, resulting in the observed increase in correct identification on subsequent tests.

English, Wellborn and Killian (1934) did attempt to address this possible transfer of learning phenomenon in the last experiment of their series. There was a control group that was tested and retested after an interval of fifty-five days without prior reading of the passage. An additional change was made in these studies. Paraphrase test items were replaced by summary items. These test items, as the name implies, summarize a paragraph of the tested material and are not merely re-workings of single sentence.

The authors state that there was a "small increase in scores" for both verbatim and summary items in the control group, concluding that neither the gain in summary items nor the loss of verbatim items (noted in the earlier studies) is "attributable in any marked degree to what the subjects learned in the ordinary course of events". However, in his article that is a critique of these experiments, Buxton (1942) reports that by his calculations, the summary items increased by 37% and the verbatim items by 7% in the control group. He uses the difference between summary and verbatim items to give weight to the transfer of learning artifact, arguing that the specific facts covered by a verbatim item (and learned in a class) are more likely to be forgotten

than the bigger chunks of subject matter contained in a summary item. Thus, this last experiment by English, et al., does not appear to derail the transfer of learning explanation for their results.

English and Edwards (1939) continued their line of inquiry with a similar study, using fifth and sixth grade children. The children read an unfamiliar folk tale and were tested by either multiple choice or true-false recognition tests. The items on these tests were either verbatim items or summary items (constructed as described in the English, Wellborn and Killian study). The children were tested immediately and, without warning, thirty days later. The opportunity for a transfer of learning was lessened in this experiment by the use of folk-tale type stories, though it could also be argued that the children may have been both familiar with and exposed to similar stories over the course of the study.

The authors report the mean error scores for each test, rather than the number of correct responses, noting that the verbatim items resulted in more errors from immediate to delayed test than the summary items. Analyzing the results from this different perspective (what English and Edwards term as a "slightly altered technique of measurement") one might be able to say that, over time, the summary items faded less than the verbatim items. However, this is not hypermnesia.

Thus, the studies that produced possible recognition hypermnesia were undermined by methodological issues such as lack of a control group and transfer of learning. The better designed study did not truly yield recognition hypermnesia, except for some decline in errors.

*Part-form test items.* Erdelyi and Stein (1981) did succeed in demonstrating recognition hypermnesia with a non-standard approach. In this experiment, they addressed the problem of a ceiling by using a modified recognition testing technique in which a component of, rather than the whole stimulus, was tested for recognition. Instead of merely recognizing the whole, the subjects needed to decide if the part presented had been a constituent of the entire stimulus that they had seen.

In this study, a large list of cartoons was presented to the subjects. Each cartoon was comprised of a picture component plus a verbal caption. Two experimental groups were tested. In the study phase, one group of subjects was shown cartoons with captions that matched (were configured, i.e., funny). The other group studied cartoons that were mismatched (unconfigured, not funny). An example of each type appears in Figure I.2. Subjects were then tested on recognition of either just the cartoon or just the caption.

Erdelyi and Stein's rationale was that, presumably, the subjects had to generate mentally the missing portion of the stimulus, and consequently expend retrieval effort prior to

Figure I.2

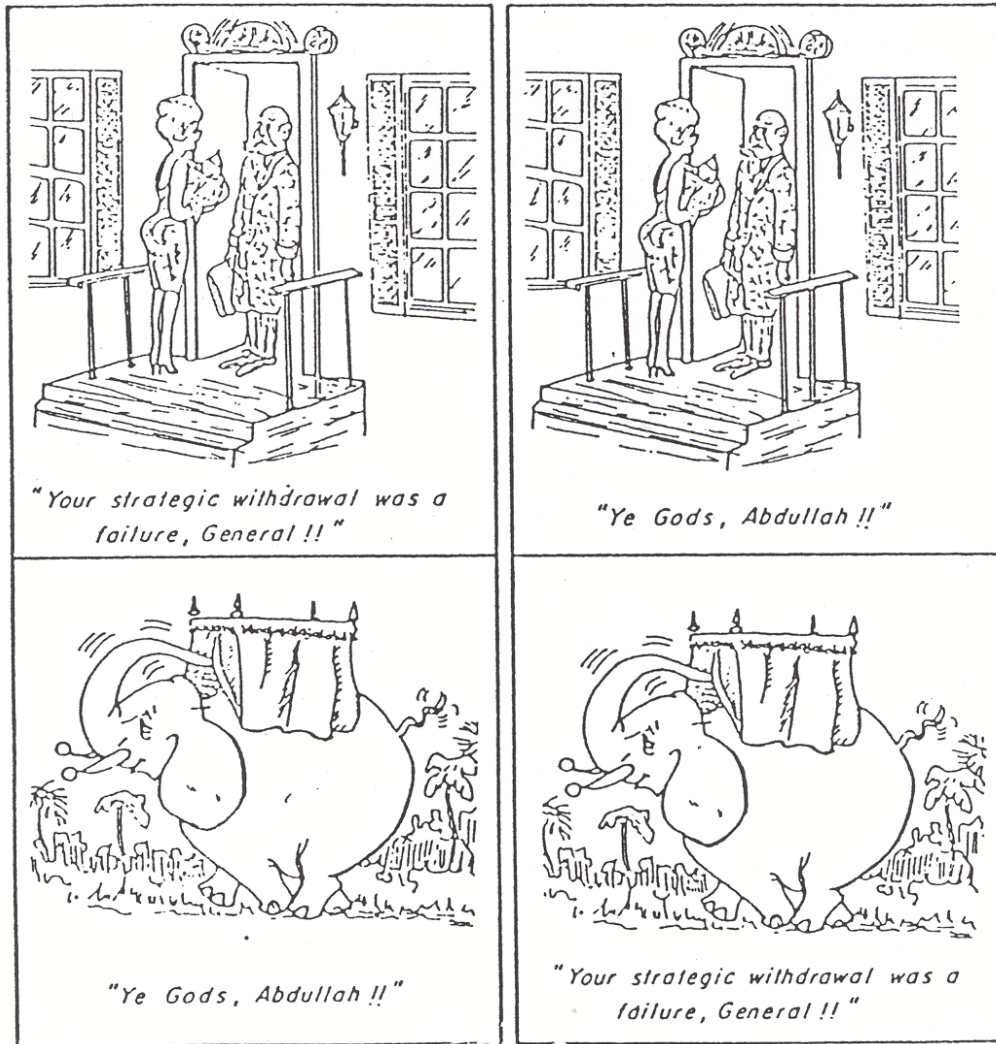


Figure I.2. Examples of configured cartoons (left panel) and non-configured counterparts (right panel). From "Recognition Hypernesia: The Growth in Recognition Memory ( $d'$ ) Over Time with Repeated Testing" by M. H. Erdelyi and J. B. Stein, 1981, *Cognition*, 9, p. 26.

a recognition decision. It is this active, effortful search and retrieval process that may be absent in the standard recognition task but maybe integral to recall and to hypermnesia (Erdelyi and Becker, 1974; Erdelyi, 1984).

Erdelyi and Stein's finding was that recognition memory ( $d'$ ) for the pictures from configured cartoons increased over three recognition trials while memory for pictures from unconfigured cartoons did not. The verbal captions of either type did not show any increase. Thus, in this experiment, a straightforward recognition task was transformed into one that required retrieval effort for the missing part of the stimuli. Retrieval effort, presumably, was ineffective in the unconfigured stimuli, as one component did not elicit or match the other. Also, the procedure diminished ceiling performance enough to allow room for the growth of recognition memory in subsequent tests. The key to the successful results, according to Erdelyi and Stein, was the necessity of initiating a search for components of the studied stimuli which made retrieval a non-trivial and active process. No replication of this unconventional study has, as yet, been published.

*Recognition hypermnesia for subliminal items.* Two findings of recognition hypermnesia have been found in the literature on subliminal perception. These type of studies may be considered "non-standard" in that the test items are clear (or enhanced) versions of the study items.

Merikle and Reingold (1991) reported what might be best characterized as an example of intra-test hypermnesia, i.e., increased recognition performance from an earlier to later phase of the same test, using only words as stimuli. Two discrimination measures were used in these experiments, designed as investigations of perception without awareness. A recognition task (old-new) provided a direct measure of memory. Subjects' memory was also measured by an indirect judgement question: Words were presented against a background mask and subjects were required to state whether the word stood out against the background (high contrast) or blended in (low contrast). The intent of this experiment was to show that direct indices of memory such as recognition tests may fail where indirect measures succeed. This effect has been demonstrated by Kunst-Wilson and Zajonc (1980) and replicated by Mandler (1987) and Seamon (1983), amongst others. Using the subjective contrast question as an indicator, Merikle and Reingold replicated the Kunst-Wilson Zajonc (1980) effect: Subjects chose the subliminal (at-chance) words at an above-chance level.

The intra-test hypermnesia in this experiment was obtained with unattended words from the study phase of the experiment, a kind of selective attention task which required the subjects to name aloud, as quickly as they could, the one word of a pair of words that had an arrow pointing to it. At test, recognition of the attended words

was quite high, but the recognition of unattended words was at chance. Erdelyi (1986) had suggested that in investigations of subliminal perception a single test may not suffice as a measure of absolute subliminality (i.e., chance performance) because of possible hypermnesia. In an exploration of this possibility, Merikle and Reingold divided the analysis of the recognition test for at-chance (unattended) words into Blocks (Block 1 = the first third of the test, Block 2 = the second third, and Block 3 = the final third of the recognition test). It was with this analysis that hypermnesia was obtained. Recognition on Block 3 increased significantly relative to Block 1. Interestingly, the subjective contrast measure, which had initially been at an above-chance level at Block 1, decreased to a chance level at Block 3 (see Figure I.3, which shows the results of both the initial experiment and a replication of it).

It should be noted, however, that Merikle and Reingold's result might be an artifact produced by an increasing ease at the task as the test progressed. At the start of a test there may be confusion as to task demands, or nervousness in confronting a new test, as had occurred in the Milner (1968) experiment. As confusion dissipates and gives way to practiced skill the subject may simply be able

Figure I.3

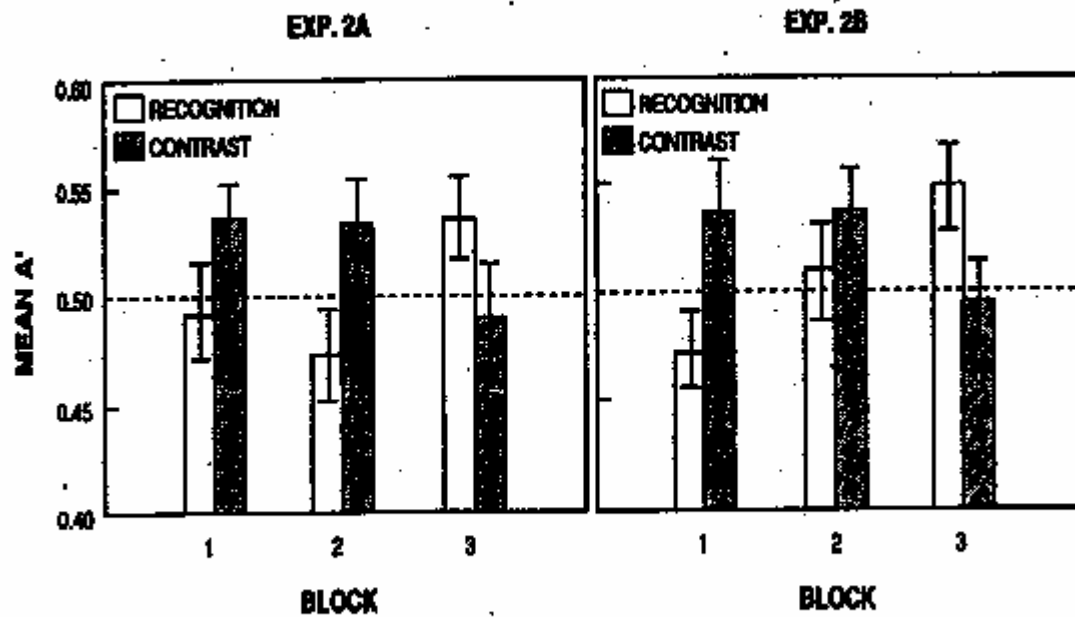


Figure I.3. Recognition ("Direct") and contrast ("Indirect") performance measures in Blocks 1, 2, and 3 in two experiments (2A and 2B). From "Comparing Direct (Explicit) and Indirect (Implicit) Measures to Study Unconscious Memory" by P. Merikle and E. Reingold, 1991, *Journal of Experimental Psychology: Learning, Memory and Cognition*, 17, p. 230.

perform better. Nonetheless, the result is interesting in several respects. It differentiates itself from previous inter-test (multi-trial) hypermnnesia experiments in succeeding with words as the sole stimuli. In addition, because the hypermnnesia occurred within the space of a single test, there is question of whether extra retrieval effort was involved, identified earlier as integral to hypermnnesia (Erdelyi and Becker, 1974; Erdelyi, 1984).

The opposing progress over time of an indirect and direct measure had been suggested by Erdelyi (1986) in his discussion of the "methodological indeterminacy" of the absolute (chance) threshold with which to measure subliminality. With this demonstration of intra-test hypermnnesia, it is made more concrete: Not only what question is asked, but when it is asked, and for how long, may determine the accuracy or plausibility of a given measure of memory or perception (for an in-depth treatment of the time issue see Erdelyi 2004a & b).

In another subliminal perception experiment, this time involving recognition performance on two separate tests, Mandler, Nakamura, and Van Zandt (1987) reported an increase in memory on a second test of recognition. This study was designed to extend the Kunst-Wilson Zajonc effect beyond judgements of affect to any relevant judgment about a stimulus. The presentation of unmasked irregular geometric shapes for very brief durations (1 or 2 ms) was followed by

either a recognition test (old or new) or a preference test of one of three types: Which of two presented shapes was liked better, which was darker, which was lighter? Immediately following the first test, the recognition group and the preference group (only) were asked to perform a second test.

Although the authors did not assess the difference between the two tests statistically, there was at least a hypermnesic trend in recognition, with the first test increasing from a below or sub-chance level of 46.7% to a recognition level of 52.5% on the second test (The possibility of sub-chance perception has been discussed by Erdelyi, 2004a & b and Ionescu & Erdelyi, 1992). The preference judgement decreased from 61.7% to 56.7%, a result which may also confirm the opposing directions of direct and indirect measures of awareness over time, proposed by Erdelyi and shown in the Merikle and Reingold study. Here again, the direct measure (recognition) has increased over time, at least numerically, while the indirect measure (preference) has decreased.

*Transformations of test items.* Kazén and Solis-Macías (1999) reported recognition hypermnesia in two experiments using format transformation of stimulus items from study to test. Subjects studied a list of 40 common words but were tested on the pictorial referents (drawings) of these items. In the first experiment, the subjects were divided into a

recall-then-recognition group or a recognition-then-recall group. The recognition test was designed as a modified forced-choice test where the subjects had to pick out all 40 of the studied items from the given array of 80 items. In the recognition-then-recall group, subjects took two immediate recognition tests followed by two forced recall tests; the opposite occurred for the recall-then-recognition group.

The experimenters report significant hypermnesia based on a pooled analysis of the recognition tests in both conditions, stating that there was a non-significant main effect for test order. Inspection of the tabled results and graphs, however, show that further analysis is informative. The larger increase (6.0%) occurred between the two recognition tests that followed tests of recall. In the complementary experimental condition, when the two recognition tests preceded recall testing, the increase is 2.2%. Administering a recall test prior to the recognition test can be seen as forcing the subjects into an active retrieval mode prior to recognition and possibly priming retrieval processing during the subsequent recognition tests. Kazén and Solis-Macías appear to have designed their experiment as a literal implementation of the two-stage model of recognition: Generate (in the recall phase of the experiment), then check and identify retrieved items by recognition in the follow-up set of tests.

The second experiment of Kazén and Solis-Macías was designed to align more closely with traditional techniques of recognition testing. A 3AFC test was employed and the total number of recognition tests was increased to three. There were no recall tests employed before or after recognition.

The subjects were presented with 48 common words; after a two-minute filler task they were given the first of three successive recognition tests. Subjects were instructed to identify the one drawing in a row of three that depicted a word they had previously seen. The results showed significant hypermnesia between the first and third recognition tests.

Unfortunately, there appears to be a serious design flaw in this experiment. The same foils were used in each successive recognition test, but were linked with different targets in each booklet. This repeated use of the same foils over successive tests would seem to make the old items easier to identify in each subsequent test, particularly as the percent correct was high at the first recognition test (77.8%). The subjects have already correctly identified about 37 items, and correctly rejected the two distractors matched with them. Now (newly) presented with already rejected distractors, the remaining old items are easily identifiable. For example: on the first test the subject is presented with "cat", "flower" and "table" as one of the

3AFC test questions. The subject identifies "cat" as old, simultaneously categorizing the other two as new. On the second test, the subject is now presented with "boat", "flower" and "table". Having already rejected "flower" and "table" as new items the first time around, "boat" is now a stand-out as an old item.

In their first experiment, Kazén and Solis-Macías produced recognition hypermnesia by encouraging the retrieval process. Kazén and Solis-Macías posit that a transform provides an alternative retrieval pathway for memory. It seems clear, however, that the role of a transform is to necessitate extra retrieval effort. As in the successful Erdelyi and Stein study with part-form test items, the transformation of items moves the recognition test away from the automatic ease of identity matching. In addition, the greatest hypermnesic effect, as noted, appears to be contributed by the recall-first group. Thus, the recall tests in this experiment can be seen as priming retrieval effort in the explicit recognition task.

A trend is discernible: Whether with the use of paraphrases, part-forms, or subliminal items, an active retrieval process is required in order to produce recognition hypermnesia.

*Theoretical Models Of The Differences Between Recall and Recognition*

*Historical roots.* Any distinction between recognition and recall, whether as a task of verbal discrimination or as a function of memory, takes as its historical starting point the observation that tasks of recognition are usually, under the standardized conditions in which they were examined, easier than that of recall. This stable finding of the relative ease of recognition was established by a number of early investigators (McDougall 1904, Hollingworth 1913), though every-day experience was and continues to be a reference point. Theories about the nature of recognition start by explaining this observable difference, yet also attempt to explain the intuitive sense that while the two may be separable in performance, in form and function they may, in some important aspects, be inextricably linked.

Robert Woodworth (1921) called recognition of "objects seen, heard, touched, etc., the most rudimentary form of memory" while simultaneously noting that knowing that a fact recalled is what "we formerly committed to memory.....is part of the larger question of how we recognize." (p. 357) Thus, the conundrum surfaced early in research on the process of recognition: Was recognition qualitatively different than recall, or do the two involve essentially the same psychological process?

*Threshold theory.* The concept of a shared process underlying both recognition and recall held sway for the first half of this century, and it was MacDougall (1904) who gave the earliest expression to this viewpoint in what became known as the threshold theory of recognition. Simply stated, this viewpoint holds that recognition is simply an easier task because item presentations during an experiment increase the subject's familiarity with that item. A low degree of familiarity (lower threshold) is sufficient for later recognition of that item; it takes a greater degree of familiarity to recall an item. This theory fit in neatly with the classical S-R school that came to predominate the early part of the century. In this theoretical framework, single-item recognition learning involves a single process: associative learning. Contextual clues function as the stimulus units that hook up with the items themselves as response units. Thus, there is no qualitative difference between recognition and recall learning. If one replaces "familiarity" with "associative strength", it is easy to see how MacDougall's conception of the recognition-recall distinction came to be a dominant part of S-R theory.

*Dual Process Theory.* Dissenters opposed to a single process underlying both recognition and recall were also part of the early verbal learning scene. Müller in 1913 (cited by Kintsch, 1970) formulated the two-stage or dual process theory, distinguishing between a retrieval mechanism

which makes memory traces accessible for recall and a decision mechanism that enables the subject to judge the appropriateness of whatever traces are retrieved covertly. Historically, Müller's conception is a restatement of William James' (1890/1948) metaphoric description of how a successful memory search is conducted--the rummaging through the attic that is memory, for a desired but misplaced item:

In short, we make a search in our memory for a forgotten idea, just as we rummage our house for a lost object. In both cases we visit what seems to us the probable *neighborhood* of that which we miss. We turn over the things under which, or within which, or alongside of which, it may possibly be; and if it lies near them, it soon comes to view. (p. 290)

In modern terminology, this brand of dual process theory postulates that recall requires a search retrieval process that is not present in recognition.

*More Recent Schools of Thought: The Role of Retrieval.*

Until the 1960's, recognition tests were primarily used as a measurement tool in tasks of verbal discrimination and associative learning. Recognition was, for the most part, viewed merely in its role as the servant of the recall process, and in this context was virtually synonymous with the end-stage, decision step of recall. After a search has been made and items retrieved from memory during a recall task, one must recognize the correct (or target) item in

order to discriminate it from incorrect or false memories. If recall involves a detailed search and examination of memorial contents prior to a recognition decision, then recognition itself is seen as an essentially perceptual affair, its work involving a matching process (either of global or specific features) and a decision based on the match. If recall is reflective, then recognition is reflexive, automatic and, relative to recall, simple in execution.

The speed and ease of recognition is easily explained within this framework: The match and decision are considered to be essentially the same step. It was assumed that all cognitive processes involved in recognition were subsumed in the recall process, and variables that effected recognition would similarly effect recall, but not the reverse.

Clouding the picture is the fact that in certain instances, recognition is more difficult than recall. Using nonsense syllables as items to be remembered, for example, can result in a failure to recognize as "old" items that have been correctly recalled, as can the number of choices and the discriminability of those choices (Kintsch, 1970; Tulving, 1983). What was (and to a large extent still is) often overlooked, is that although recognition may appear to be easier than recall, it may not always be an easy task. The seemingly automatic nature of recognition may be tied

not merely to the task's requirements but to the task itself. Recognizers are not, after all, always certain in the correctness of their response. Further, though the recognition task may not require an initial search for an item, it may require what may be termed a verifying search (Mandler, 1967). As psychologists began to ask more questions about underlying processes and move away from purely associative theories of stimuli, clues, and context, the important assumption that recall and recognition of items differed only in terms of threshold values came under closer scrutiny. The function of retrieval became the focus: How are items brought out from their storage place in memory?

In Mandler's view (1969), the subjects in a recognition task are involved in a two-step process: first a tentative decision to recognize (or reject); then, a "quasi-retrieval" to decide whether their decision was correct. This verification stage is subject to a check of the item in memory, and as in recall, categorization and organization in storage is an aid. This process is particularly important in low-confidence identifications, where categorization can specifically affect the final decision to recognize or not. Here, a recognition match is an answer to the question of whether the presented item fits the correct address, rather than its strength of familiarity. Matching involves retrieval, which in turn necessitates the checking for the

presence of the item in a particular place, particular category or location. Presentation of a complete stimulus is akin to having a full identification complete with zip code; partial cues point the way to location and slow down the process. Once again, there is a return to earlier theories of recognition, and the echoes of William James' attic are again relevant.

In reporting the results of a series of experiments designed to test both the effects of organization and semantic similarity on tasks of recall and recognition, Mandler finds evidence to support his assertion that organization is integral for recognition. Previous experiments had demonstrated that the number of categories in organized lists of words presented as study items to subjects determined the number of words recalled by those subjects. To extend this finding to recognition, groups of subjects were presented with word lists, and asked to categorize the words into anywhere from two to seven categories (by placing word cards into bins). Subjects were then given a recall task, followed by a recognition test. They were tested in a second session (recall and then recognition) with the time interval from the first session varied with each of three experimental groups. The recognition test was of an old/new design, and the type of filler items on the test varied for each group. One group had random fillers, and their second recognition task was

two weeks after the first. Another experimental group had synonyms for fillers, with their second session also coming two weeks after the first. The third experimental group had similar (confusing) distractors, but their second session came five weeks after the first.

In analyzing the recall results, Mandler notes that this experiment provided a replication of previous findings that there is a stable relationship between the number of categories and the amount of material recalled. In the present experiment, each additional category added about five words to recall, and the relationship persisted, though to a smaller degree, over the two week period between first and second test. The effect of categorization on recognition is present, though smaller than that found in recall. Interestingly, this relationship is more pronounced after a two week delay.

Mandler replicated these results, and further investigated the effect of both delay and categorization in a second experiment. The recognition sheet for one group (the delay plus categorization) was designed so that in addition to both old and new words, the seven categories used in the sorting task were also given. These appeared as the headings of the columns under which the subjects were to place those words that they identified as old. The groups that received this delayed and categorized recognition test

performed significantly better (hits = .90, false alarms = .26) than those who either had an immediate test (hit rate = .81, false alarm = .22) or a delayed test without re-categorization (hits = .83, false alarms = .24).

These results reinforce the idea that retrieval may be part of the task of recognition, though its operation may not be easily observable unless the recognition involved is not easy or automatic. The more pronounced effect of the organization variable on a delayed recognition task, when memory has been weakened, and decisions not so certain, lends empirical evidence to Mandler's concept of retrieval as a checking system for recognitions of lowered confidence. This finding refutes Kintsch's argument that organization "can have no effect on recognition, since organization facilitates retrieval and only recall involves retrieval" (Kintsch, 1968). Instead, retrieval is part of the recognition task, and is an aid to its correct execution, a finding congruent with observations about recall.

Tulving (1983) asserts that his theory has more in common with Kintsch than Mandler, but on examination it appears that his "synergistic ecphoric theory" combines features of both. In his model, organization and retrieval cues are but two variables that are fused into one cohesive framework that envisions both recognition and recall as different shades in the one continuous spectrum that is memory. Tulving's conception is one of integration and

junction (synergy). Any memory performance relies on both retrieval information and stored trace information because this is exactly what a memory is composed of: a bundle of information that is both a trace and its attendant location cues. It is the conversion of this information to an activated state (ecphory) that determines memory performance.

Recognition and recall differ not in process therefore, but in the type of conversion required. Rather than passing a psychophysical threshold, successful recall or recognition necessitates overcoming a conversion threshold: Is the ensemble of trace information and cues rich enough to meet the demands of the given task? Recall and recognition require different types of conversion. A recall task demands ecophoric information of "higher quality ('more' of it)" than recognition, because recognition is essentially a familiarity judgement based on external activating cues. Although it may appear that Tulving has simply retooled strength theory, he distinguishes his theory from it: Strength theory is based only on the memory trace, and the ecphory model is concerned with the junction of trace information and retrieval information.

Recall and recognition are separable then, not in the type of processes underlying each, but the starting point for the activation and subsequent location of a memory item. A typical recognition task presents as a test item a copy of

the original stimulus; to the extent that this copy cue provides an identity match in features, context, or address, recognition will be successful. Recall relies on internally-generated retrieval cues in response to an external stimulus to activate the necessary information. If recognition and recall are on opposite ends of a continuum, then cued recall is somewhere in between with externally-generated cues providing a context for the location of the meeting point trace and retrieval information.

Tulving separates his theory from dual process theory in proposing a single process for both recognition and recall, with the success of either reliant upon the passing of a conversion threshold. He is also uncomfortable with dual step models such as Mandler's, even though this model gives retrieval an essential role. Tulving feels that the delineation of two steps in the one process implies a separation between retrieval information and stored information that is unnecessary. Although Tulving's model for recognition is based on a single process and single stage, separating his concept from that of Kintsch, he still finds some common ground. Tulving notes that both he and Kintsch propose pattern matching as the mechanism for recognition.

Erdelyi has articulated another variant of the two-stage theory of recognition based on the evidence in his study on recognition hypermnesia (1981). In recognition as

in recall, according to Erdelyi and Stein, the retrieval component is an essential aspect of the task and as such, can be manipulated with a resultant observable increment in memory. In recognition, items are first retrieved and then subject to a decision as to whether this retrieval is correct. The timing of the retrieval step (as well as its extensiveness) can be tied to the demands of the test.

In recent discussions reviewing the Mandler and Erdelyi views, Erdelyi and I have concluded that a more useful delineation is that there are two types of processing (rather than stages) during recognition. Use of the term "stage" unnecessarily limits the retrieval and identification decision to a particular order or sequence. Subjective experience suggests that the order of these processes is a function of the type of stimulus that is to be recognized. In the Erdelyi and Stein (1981) study, for example, the presentation of a part-form (either caption or picture) necessitates retrieval as the first process. When the stimulus is a simple word (as in the Mandler studies), familiarity is the initial connection, followed by retrieval. Therefore, retrieval may occur throughout the recognition process: early on, when finding targets; towards the end as a confirmation of decision; or threaded throughout the task as needed. Thus, both Mandler and Erdelyi share the same two-process view of recognition, including retrieval as an essential component.

In easy recognition tasks, such as those where the test stimulus is the same as the original stimulus, the retrieval is fast and essentially automatic because the retrieval cue gives full information on the memory address. It quickly reaches the asymptote under these parameters and therefore hypermnesia is not typically observable. When the retrieval component in a recognition test is made more time-consuming or more difficult (in the experiment by Erdelyi and Stein, accomplished by presenting a part of the original stimulus) this step is necessarily less automatic, and less precise. Thus, as in recall tests, there can be an improvement during successive trials because there is more opportunity for additional expenditure of retrieval-recognition effort, with possible increased success.

Recognition and recall therefore both involve two processes according to Erdelyi (Erdelyi and Stein, 1981; Erdelyi, 1984). Models based on neural computing and the autoassociative properties of memory, integrate this concept of a shared process into a general model of recollection. In these models, partial stimuli act as entry points into memory structures that are self-organized and plastic in nature. A partial cue, rather than a whole stimulus is given at test; it is the "key" that initiates a search and match to a previously stored pattern (Kohonen, 1990). Figure I.4 is a demonstration of this associative recollection. Image a represents one sample (of 500)

Figure I.4

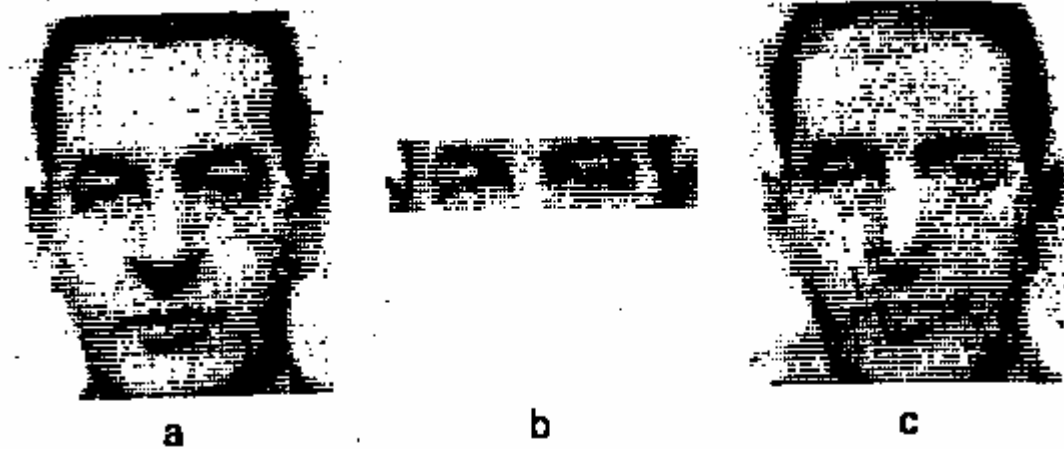


Figure I.4. Demonstration of associative memory in a distributed network. Image a is the stored image; Image b is the input pattern; Image c is the match made by the computer. From "Notes on Neural Computing and Associative Memory" by T. Kohonen, 1990, in J. McGaugh, N. Weinberger, and G. Lynch (Eds.), *Brain Organization and Memory: Cells, Systems, and Circuits*, p. 336.

photographic images that were used as input patterns and that form the computer's "memory bank" of faces. Figure b is the key pattern used for excitation; it is the test stimulus, from which the computer is asked to recollect or remember. Figure c is the recollection, or correct match generated by the computer.

This computer model shows the ability of a network to retrieve a previously stored pattern if the initial activation is a part of it. Is the programmed network recalling or recognizing? This neural network recollects on the basis of a retrieval cue that is a partial copy cue; though the author calls this autoassociative recall, the active pattern matching makes this a process of recognition. In order to locate, partial activation cues are necessary; once retrieved, an image is generated. Correct regeneration or recognition is dependent on the initial activating cue -- if it is too weak, there will be no retrieval and no recognition.

The mechanism of this neural network and its application of partial cues parallels the use of cartoons that were broken into their constituent parts at test in the Erdelyi and Stein experiment (1981). Hypermnnesia resulted from the use of parts of configured cartoons, which provided a strong activating link. The unconfigured cues were unsuccessful because they were, in effect, weak ineffectual cues. Neural network models demonstrate the importance of

retrieval cues in recognition and may help to remove the boundaries between recall and recognition.

*Implications for research*

Hypermnnesia is an effect observed historically in recall, but not in recognition. Recent findings however, suggest that hypermnnesia may indeed be possible in a task of recognition--to the extent that the recall component is accentuated in the recognition task.

Successful attempts at producing recognition hypermnnesia have resulted from designs that cause retrieval or search processes to play an important role. When study stimuli have been transformed or truncated at test, retrieval is made an active part of the recognition task, as it must necessarily be in recall. When retrieval takes work and time, the automatic and routinely accurate task of recognition is transformed into a less precise action that may need time or repeated effort in order to succeed. The use of paraphrases and part-stimuli have spotlighted the role of the retrieval process and brought it to the foreground.

The speed with which retrieval takes place in the standard act of recognition, when the item presented is identical to the item to be recognized, has led to the conclusion that retrieval and recognition are fused into one function. The unifying thread to these successful experiments is that they show that it is incorrect to assume

that retrieval plays no role in recognition, or that it is synonymous with the process itself.

The dissertation takes this core idea as its starting point. Emphasizing the role of retrieval in hypermnesia and understanding that the traditional design of the recognition task precludes much retrieval effort, each experiment was conducted using a non-standard approach. The first three experiments use a simple format transformation from study to test: pictures were tested by their word identifiers and analogously, words by pictorial representations. Experiments 1 and 2 were suggesting an interesting pattern of hypermnesia, which however, Experiment 3 failed to replicate. Either the first two studies produced "significant" effects that were unreliable or a procedural error (see p. 85) led to the non-replication. Experiments 1, 2, and 3, although they did not as a group produce any breakthrough, are included because they elaborated a simple transformation procedure which might lead to a straightforward method of producing recognition hypermnesia in the laboratory which, actually, Kazén and Solis-Macías have recently used to try to produce recognition hypermnesia (see pp. 29 - 32). In Experiments 1, 2, and 3, though the stimuli are of a similar design, the recognition testing is unaided -- not preceded by recall testing as in the Kazén and Solis-Macías studies. Experiments 4 - 8, using cartoons as stimuli (pictures with captions) in the manner of Erdelyi

and Stein (1981), take a different approach to non-standard recognition testing, and as a group produce credible evidence of recognition hypermnesia.

Experiment 1: Pictures and Words as Stimuli,  
Words as Tests

Experiment 1 was an attempt to produce recognition hypermnesia with the use of stimuli typically probed in recall hypermnesia studies (lists of words and pictures). The ceiling problem and the retrieval issue were approached in the following two ways. First, a longer than usual delay was introduced between study and test phase. Second, there was a transformation of the pictorial stimuli to their word identifiers in the test phase, making the recognition for these items more difficult. The format switch also added a degree of retrieval effort by necessitating a more active search by the subjects for the stimuli in their original pictorial form.

The availability of high school students for use as the subjects of this experiment permitted a greater delay between study and test than might ordinarily be practical. Though the delay was introduced as a manipulation to mitigate the ceiling problem in recognition, it also allowed for an examination of whether recall hypermnesia can be produced after a lengthy delay between presentation and test. The design of the experiment, therefore, called for one group of subjects to perform a recall task during the delayed phase, rather than the recognition task. In this

way, if recognition hypermnesia was not produced, it could still be ascertained whether this particular subject population, in conjunction with the lapse of a very long interval between presentation and test, could produce recall hypermnesia.

#### *Method*

*Subjects.* Two classes of high school students enrolled in a health careers class at Ft. Hamilton High School (Brooklyn, New York) were the subjects of this study. Special permission was asked and received from all relevant parties involved: administrators, students and their parents (or guardians) were informed of the relevant facts of the study and then asked for consent to participate. There were 53 students present for the initial phase of this study; a total of 40 students participated in both the initial and the delayed portions of the experiment (17 in the recall group, 23 in the recognition group).

*Materials.* In the study phase, 80 slides were presented to the subjects at the timed rate of 5 seconds each. Forty of these slides were simply-drawn pictures (cup, flower, sun...), while the remaining forty were words (see Appendix A). In constructing the list of items for the (delayed) recognition task, 20 pictures and 20 words from the study phase were chosen randomly, 40 distractor (new) items added, to comprise an 80 item test list in word format. The order of the appearance of these items on the

list was chosen randomly with the constraint that no more than 3 old or new items appeared consecutively (see Table 1.1, p. 50).

*Design and Procedure.* Both classes were treated identically in the initial phase of the study. Subjects were told that they were going to see a series of slides and that they would be asked to recall them after presentation. They were informed that some of the slides would be pictures and some would be words, but that in either case they should try and make a mental image of each as they were presented (see Appendix B for verbatim instructions). After exposure to the stimuli, each subject received a sheet with 50 blank numbered lines and was asked to recall all that they could. In addition, they were asked to fill in any remaining blanks with non-repeating guesses, drawing a line to distinguish between their recall and their guesses, but marking a check next to any guess that they wished to identify as something they thought they remembered. This forced recall procedure has been used effectively by Erdelyi (1970; Erdelyi and Becker, 1974; Erdelyi and Kleinbard, 1978) in controlling for response bias in tasks of this nature. The recall trial lasted 7-8 minutes, with a warning given to the subjects when 2 minutes remained. At the end the subjects were thanked, with no mention of further testing.

The second phase of the experiment occurred, unannounced, after a delay of 44 days. One class was

randomly assigned to perform the recall task, the other, recognition. Only those students who had been present at the initial phase were tested, and absentees from this delayed phase had no further part in the study. After a brief introduction reminding the students that they had participated in a memory task several weeks earlier, the students were given instructions as to their present task. The *recall group* was given instructions similar to the initial recall task (see Appendix C). They were again asked to fill in all the blank lines; however, because of a lack of success in following the forced recall procedure (a difficulty considered more fully in the discussion section that follows), each recall form had 40, rather than 50, blank lines. There were 3 successive recall trials: After completing the first, the recall form was collected, the subjects asked to sit quietly for a few minutes and not to discuss the experiment. After approximately 2-3 minutes, fresh recall sheets were distributed and the subjects were asked to try again, to recall as much as they could and to fill in all the blanks. This was repeated for the third recall trial, except that they were now informed that this was their last test. Each recall trial lasted 7-8 minutes, with a two minute warning during each.

The *recognition group* was told that they would not be asked simply to remember the items that they had seen before, but that they would be given a list of words, and

next to each they would indicate whether or not they remembered seeing each item. They were informed that half the items were those they had seen, and half were not, and that though the slides had contained either pictures or words, now they would see only words. In addition, they would be rating each answer to indicate how sure they were of their response. This would be done by circling a number on a scale printed next to each item on the list (see Table 1.1). To clarify this procedure, a practice sheet was distributed, containing four items (2 old, 2 new; none used on the recognition task; see Appendix D). The class practiced as a group, reading the instructions describing the rating scale together, and then going through the four items aloud. The spelling out of the meanings of the numbers on the rating scale and the setting aside of a practice period was felt to be a necessary accommodation to this particular group of novice subjects. It lasted until all apparently understood the procedure, both the rating scale and the transformation of pictures seen at the study phase into identifiers at test (see Appendix E for verbatim instructions).

Each student then received a recognition form; the order of items on each individual student's sheet was different (within each column of 40 items) in order to minimize temptations to check a neighbor's work. Each student received the same numbered form on each of the 3

Table 1.1

## Experiment 1: Recognition Response Sheet

**S-26**

**NAME** \_\_\_\_\_ **AGE** \_\_\_\_\_ **DATE** \_\_\_\_\_

**DIRECTIONS:** After you read each word, circle the number on the scale that best shows your thoughts. The ratings range from 0 ("I definitely DON'T remember seeing it"), to 1 ("I probably didn't see it") to 2 ("I probably did see it") to 3 ("I definitely DID see it")

0.....1.....2.....3  
 NO!      No      Yes      YES!  
 [DEFINITELY NO] [PROBABLY NO] [PROBABLY YES] [DEFINITELY YES]

ICE CREAM CONE	0...1...2...3	SEA SHELL	0...1...2...3
BAT	0...1...2...3	FRYING PAN	0...1...2...3
BELL	0...1...2...3	FLOWER	0...1...2...3
SYRINGE	0...1...2...3	ROLLING PIN	0...1...2...3
BOTTLE	0...1...2...3	BELT	0...1...2...3
HORSE	0...1...2...3	BONE	0...1...2...3
CHAIN	0...1...2...3	LEAF	0...1...2...3
FEATHER	0...1...2...3	GUN	0...1...2...3
PENCIL	0...1...2...3	TRUMPET	0...1...2...3
FAN	0...1...2...3	DOMINO	0...1...2...3
ROLLER SKATES	0...1...2...3	TWEEZERS	0...1...2...3
CRUTCH	0...1...2...3	GLASS	0...1...2...3
WHEEL	0...1...2...3	PIG	0...1...2...3
TEEFEE	0...1...2...3	CORN	0...1...2...3
TREE	0...1...2...3	TELEVISION	0...1...2...3
ENVELOPE	0...1...2...3	CAT	0...1...2...3
FEAR	0...1...2...3	BIRD	0...1...2...3
PINEAPPLE	0...1...2...3	SEAL	0...1...2...3
HOOK	0...1...2...3	BASKET	0...1...2...3
FIGGY BANK	0...1...2...3	CANE	0...1...2...3
DOG	0...1...2...3	OCTOPUS	0...1...2...3
BUG	0...1...2...3	BUCKET	0...1...2...3
BOOK	0...1...2...3	COMB	0...1...2...3
AX	0...1...2...3	BRUSH	0...1...2...3
ARROW	0...1...2...3	HAMMER	0...1...2...3
PAPER CLIP	0...1...2...3	FAUCET	0...1...2...3
SNAIL	0...1...2...3	FUNNEL	0...1...2...3
SKATES	0...1...2...3	NET	0...1...2...3
ALLIGATOR	0...1...2...3	PURSE	0...1...2...3
SNAKE	0...1...2...3	FLAG	0...1...2...3
MOON	0...1...2...3	FISH	0...1...2...3
DICE	0...1...2...3	TABLE	0...1...2...3
HANGER	0...1...2...3	SOCK	0...1...2...3
BUTTERFLY	0...1...2...3	EYE	0...1...2...3
PLIERS	0...1...2...3	GUITAR	0...1...2...3
IRON	0...1...2...3	ACE	0...1...2...3
HAT	0...1...2...3	SWORD	0...1...2...3
TENT	0...1...2...3	SAILBOAT	0...1...2...3
CAR	0...1...2...3	BANANA	0...1...2...3
SHORTS	0...1...2...3	CIGAR	0...1...2...3

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successive recognition trials. A fresh recognition sheet was distributed at the beginning of each trial to each student and all completed forms were collected at the end of a trial. As with the recall group, the subjects were asked to sit quietly for 2-3 minutes between trials, and then asked to try again. This was repeated for the third trial, with the exception that the subjects were informed that this would be their last try. Each recognition trial lasted approximately 7 minutes.

#### *Results and Discussion*

The initial recall task at the end of the study phase provided a reason to the subjects for the presentation of the stimuli. Also, because the two groups would not undertake the same type of test in the delayed phase it allowed for a measure of whether there were any detectable differences between these two groups on a memory task. The mean number of items correctly recalled (hits) on the immediate test were, respectively, 29.6 for the delayed recognition group and 27.6 for the delayed recall group. No significant difference between the two groups was found,  $t(51)=1.131$ , *ns*. (See Table 1.2)

As can be seen in Table 1.3, the *recall group*, after a delay of 44 days, produced hypermnesia ( $R1 = 16.06$ ,  $R2 = 17.82$ ,  $R3 = 18.59$ ). There was a significant difference between the first recall trial ( $R1$ ) and the third recall trial ( $R3$ ), the third trial producing, on average, 2.53 more

Table 1.2  
Experiment 1

Results of Immediate Recall

	<u>Recall-Delayed Recognition Group</u> (N=30)					<u>Recall-Delayed Recall Group</u> (N=23)				
	<u>Hits</u>			<u>F</u>	<u>H+F</u>	<u>Hits</u>			<u>F</u>	<u>H+F</u>
	<u>P</u>	<u>W</u>	<u>P+W</u>			<u>P</u>	<u>W</u>	<u>P+W</u>		
S-1	10	13	23	10	33	15	13	28	4	32
S-2	16	14	30	1	31	15	13	28	7	35
S-3	19	11	30	11	41	13	15	28	1	29
S-4	16	13	29	1	30	12	11	23	1	24
S-5	14	9	23	10	33	19	16	35	1	36
S-6	18	13	31	1	32	12	10	22	24	46
S-7	13	16	29	4	33	13	8	21	0	21
S-8	16	17	33	8	41	19	15	34	1	35
S-9	10	11	21	3	24	19	20	39	0	39
S-10	22	10	32	2	34	13	13	26	1	27
S-11	24	16	40	2	42	20	23	43	1	44
S-12	20	15	35	3	38	7	10	17	1	18
S-13	18	15	33	15	48	14	6	20	3	23
S-14	18	14	32	0	32	10	11	21	0	21
S-15	16	12	28	2	30	11	11	22	1	23
S-16	17	17	34	6	40	14	15	29	12	41
S-17	24	15	39	1	40	20	16	36	0	36
S-18	13	7	20	8	28	--	--	--	--	--
S-19	19	13	32	1	33	--	--	--	--	--
S-20	13	17	30	9	39	--	--	--	--	--
S-21	16	22	38	0	38	--	--	--	--	--
S-22	20	20	40	0	40	--	--	--	--	--
S-23	16	14	30	0	30	--	--	--	--	--
S-24	15	17	32	2	34	--	--	--	--	--
*S*	11	5	16	5	21	15	15	30	0	30
*S*	11	9	20	7	27	13	14	27	2	29
*S*	14	10	24	2	26	13	11	24	1	25
*S*	10	15	25	16	41	11	9	20	6	26
*S*	16	13	29	15	44	19	14	33	2	35
*S*	14	16	30	10	40	16	13	29	2	31
	<u>Hits</u>			<u>F</u>	<u>H+F</u>	<u>Hits</u>			<u>F</u>	<u>H+F</u>
	<u>P</u>	<u>W</u>	<u>P+W</u>			<u>P</u>	<u>W</u>	<u>P+W</u>		
$\bar{x} =$	16.0	14.6	<b>29.6</b>	5.2	34.8	14.5	13.1	<b>27.6</b>	3.1	30.7

\*S\* = Subjects who did not attend the (later) delayed phase

Table 1.3

## Experiment 1

Repeated Recall after a delay of 44 days

<b>R1</b>			<b>R2</b>			<b>R3</b>								
<u>Hits</u>			<u>F</u>	<u>H+F</u>	<u>Hits</u>			<u>F</u>	<u>H+F</u>	<u>Hits</u>			<u>F</u>	<u>H+F</u>
<u>P</u>	<u>W</u>	<u>P+W</u>			<u>P</u>	<u>W</u>	<u>P+W</u>			<u>P</u>	<u>W</u>	<u>P+W</u>		
8	7	15	4	19	10	10	20	6	26	9	11	20	9	29
9	7	16	24	40	8	8	16	24	40	9	10	19	21	40
6	5	11	3	14	8	9	17	5	22	8	8	16	6	22
10	11	21	19	40	8	9	17	23	40	7	6	13	27	40
7	9	16	4	20	6	12	18	8	26	12	12	24	10	34
4	7	11	29	40	4	8	12	28	40	6	8	14	26	40
7	5	12	10	22	7	5	12	18	30	5	4	9	31	40
11	9	20	11	31	13	13	26	14	40	10	12	22	18	40
8	9	17	13	30	12	8	20	33	13	15	7	22	13	35
9	8	17	5	22	10	11	21	4	25	11	11	22	5	27
13	9	22	18	40	9	12	21	19	40	12	11	23	28	51
11	6	17	15	32	10	12	22	18	40	11	11	22	18	40
9	12	21	18	39	9	12	21	18	39	10	11	21	18	39
6	8	14	3	17	7	7	14	10	24	12	9	21	19	40
10	7	17	5	22	9	11	20	10	30	9	15	24	10	34
6	8	14	23	37	5	8	13	21	34	5	7	12	28	40
5	7	12	2	14	5	8	13	2	15	6	6	12	4	16

---

Summary:  $\bar{X}$

<b>R1</b>			<b>R2</b>			<b>R3</b>								
<u>Hits</u>			<u>F</u>	<u>H+F</u>	<u>Hits</u>			<u>F</u>	<u>H+F</u>	<u>Hits</u>			<u>F</u>	<u>H+F</u>
<u>P</u>	<u>W</u>	<u>P+W</u>			<u>P</u>	<u>W</u>	<u>P+W</u>			<u>P</u>	<u>W</u>	<u>P+W</u>		
8.2	7.9	<b>16.1</b>	12.1	28.2	8.2	9.6	<b>17.8</b>	14.2	32.0	9.2	9.4	<b>18.6</b>	17.1	35.7

---

correct responses. An analysis of variance (recall trials x stimulus type) yielded a significant effect for trials,  $F(2, 32) = 4.88, p < .05$ , but not for stimulus type,  $F(1, 16) = .87$  or their interaction,  $F(2, 32) = 2.32$ . However, this result is tempered by the fact that what was designed as a forced recall procedure, in practice, became a free recall task. On both the initial and delayed recall tasks, the subjects, as a whole, did not follow the forced recall instructions. Despite repeated reminders, they would not, or could not, fill in all the blank lines presented to them. Whether this was because they did not understand the instructions, or that what seemed like a call for indiscriminate guesses went against all that they were taught about test-taking in school is unclear. What is apparent is that any possible response bias has not been controlled, for as the hit rate went up from  $R1$  to  $R3$ , so did the average number of responses (an increase of 7.5 items).

Although Roediger and Payne (1985) suggested that response bias is not really a problem in these type of tasks, Erdelyi, Finks and Feigin-Pfau (1989) found that guessing can lead to spurious performance increments over trials. In Experiment 4A of their 1989 study, Erdelyi et al., found that (with the same stimuli as used here) the guessing factor was approximately 4%. This value may be used to compute a corrected hit rate for each subject in the

present experiment (see Table 1.4). Any incremental difference in hits between  $R1$  and  $R3$  is therefore calculated on the basis of the change from  $R1 \rightarrow R3$  - the guessing factor. Because there was no significant main effect for stimulus type in the analysis using the uncorrected scores, an analysis of variance on the corrected hits (i.e., total of pictures + words) was undertaken with trials as the sole factor. This proved to be significant:  $F(2, 30) = 3.971$ ,  $p < .05$ . Therefore, when the correction is made for guessing, the recall group did produce hypermnesia, after a long lapse between study and test.

Recognition hypermnesia, on the other hand, was not obtained for either picture or word stimuli, as can be seen in the average  $d'$  scores for each recognition trial, shown in Tables 1.5 and 1.6. Sensitivity remained low throughout, and did not increase over subsequent recognition trials. An examination of the data patterns showed that most subjects evidence a poor use of all the points of the rating scale; the "certain" choice points (definitely yes or no; "3" or "0" respectively) were used most often. As a result, an analysis of variance (recognition trial x stimulus type) was undertaken using the "3" rating as the sensitivity measure of each subject. This showed no main effects for either trials,  $F(2, 44) = .8296$ , or stimulus,  $F(1, 22)$  or their interaction  $F(2, 44) = .3972$ .

Table 1.4

## Experiment 1

Repeated Recall after Delay, Corrected for Response Bias

<u>TOTAL RESPONSES (P+W)</u>					<u>CORRECTION FACTOR</u>	
<u>R1</u>	<u>R2</u>	<u>(R2-R1)</u>	<u>R3</u>	<u>(R3-R1)</u>	<u>R2 (R2-R1 X 4%)</u>	<u>R3 (R3-R1 X 4%)</u>
19	26	(7)	29	(10)	.28	.40
40	40	(0)	40	(0)	--	--
14	22	(8)	22	(8)	.32	.32
40	40	(0)	40	(0)	--	--
20	26	(6)	34	(14)	.24	.56
40	40	(0)	40	(0)	--	--
22	30	(8)	40	(18)	.32	.72
31	40	(9)	40	(9)	.36	.36
30	33	(3)	35	(5)	.12	.20
22	25	(3)	27	(5)	.12	.20
40	40	(0)	51	(11)	--	.44
32	40	(8)	40	(8)	.32	.32
39	39	(0)	39	(0)	--	--
17	24	(7)	40	(23)	.28	.92
22	30	(8)	34	(12)	.32	.48
37	34	(+3)	40	(3)	+.12	.12
14	15	(1)	16	(2)	.04	.08

CORRECTED HITS (P+W)

<u>R1</u> <u>(UNCHANGED)</u>	<u>R2</u> <u>(P+W) - (CORRECTION FACTOR)</u>	<u>R3</u> <u>(P+W) - (CORRECTION FACTOR)</u>
15	19.72	19.60
16	16.00	19.00
11	16.68	15.68
21	17.00	13.00
16	17.76	23.44
11	12.00	14.00
12	11.68	8.28
20	25.64	21.64
17	19.88	21.80
17	20.88	21.80
22	21.00	22.56
17	21.68	21.68
21	21.00	21.00
14	13.72	20.08
17	19.68	23.52
14	13.12	11.88
12	12.96	11.92
$\bar{x} =$ <b><u>16.06</u></b>	<b><u>17.67</u></b>	<b><u>18.29</u></b>

Table 1.5

## Experiment 1

## Pictures and Words as Stimuli

Repeated Recognition level ( $d'$ ) for Words After a Short Delay**WORD (STUDY) STIMULI**

Rg1			Rg2			Rg3			
$d'$			$d'$			$d'$			
Rating 3	Rating 2	Rating 1	Rating 3	Rating 2	Rating 1	Rating 3	Rating 2	Rating 1	
1.23	0.97	1.33	1.28	1.23	1.16	1.35	0.99	1.10	
0.38	0.15	-0.14	0.00	-0.19	-0.36	-0.06	0.97	0.00	
0.32	0.91	0.53	0.40	0.06	0.15	0.93	0.28	0.35	
0.31	-0.45	0.68	-0.25	0.61	0.32	0.51	0.72	0.32	
0.52	0.34	0.19	0.44	0.44	0.44	0.39	0.00	-0.07	
0.27	0.17	-0.60	0.45	0.58	0.92	0.45	0.52	1.03	
0.55	0.32	0.68	0.40	0.32	0.25	0.52	0.42	0.61	
0.72	0.77	0.49	0.63	0.57	0.65	0.93	0.99	0.58	
0.51	0.07	--	0.53	0.68	--	0.51	0.32	--	
0.71	0.65	0.83	0.65	0.34	0.43	0.71	0.52	0.44	
0.59	0.78	0.90	0.78	0.84	0.78	0.65	0.77	1.03	
0.29	0.05	0.32	0.08	-0.06	0.58	0.36	0.07	0.27	
1.20	0.84	1.53	0.85	1.54	1.51	0.46	0.97	1.96	
1.18	1.06	0.32	1.39	0.92	--	1.64	1.36	--	
1.03	0.71	0.51	1.03	0.71	0.76	0.77	0.65	1.10	
0.32	0.32	0.61	-0.15	0.31	0.21	0.59	0.67	-0.16	
0.55	1.10	1.28	0.78	0.78	1.16	0.90	0.44	0.40	
0.61	0.78	-0.16	0.77	0.43	0.81	0.77	0.31	0.32	
1.03	0.87	0.76	0.64	0.57	0.30	0.76	0.84	0.58	
0.92	1.64	--	0.37	1.03	--	0.21	0.68	--	
0.81	0.78	0.65	1.10	0.86	1.16	0.67	0.78	1.03	
1.31	1.14	0.84	1.16	0.86	0.71	1.28	1.32	1.06	
0.78	0.57	0.77	1.14	0.84	0.80	1.06	0.77	0.84	
$\bar{x}$	<b>0.70</b>	<b>0.63</b>	<b>0.59</b>	<b>0.63</b>	<b>0.62</b>	<b>0.64</b>	<b>0.71</b>	<b>0.67</b>	<b>0.64</b>

Table 1.6

## Experiment 1

## Pictures and Words as Stimuli

Repeated Recognition Level ( $d'$ ) for Words After a Short Delay**PICTURE (STUDY) STIMULI**

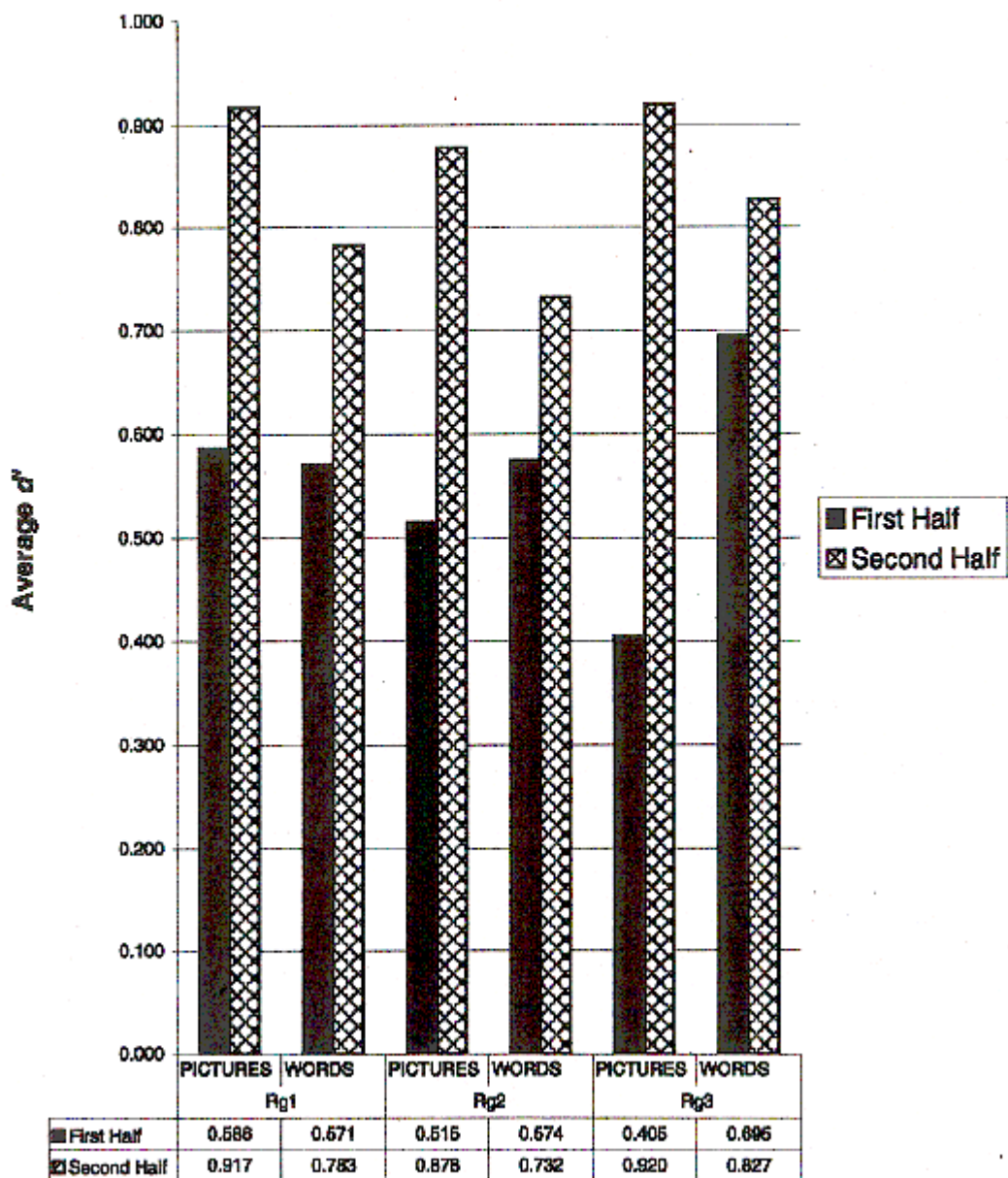
Rg1			Rg2			Rg3			
$d'$			$d'$			$d'$			
Rating 3	Rating 2	Rating 1	Rating 3	Rating 2	Rating 1	Rating 3	Rating 2	Rating 1	
0.77	0.46	0.36	0.69	0.71	0.97	0.55	0.41	0.32	
0.78	1.12	0.81	0.67	0.61	0.32	0.90	1.29	0.00	
0.70	1.16	0.53	1.05	0.65	0.51	1.06	0.70	0.67	
0.90	0.07	0.00	0.19	0.78	0.32	0.00	0.40	0.32	
1.03	0.79	0.80	0.57	0.57	0.57	0.64	0.39	0.58	
0.00	0.00	0.00	0.31	1.19	0.92	0.31	0.96	1.03	
0.67	0.90	0.68	0.27	0.45	0.00	0.52	0.59	0.25	
0.51	0.88	0.45	0.50	0.57	0.14	0.67	0.84	0.07	
0.91	1.33	--	1.04	1.29	--	1.29	1.44	--	
0.71	0.85	0.58	0.80	0.95	0.87	0.57	0.96	0.68	
1.10	1.54	0.90	1.29	1.60	1.71	1.04	1.67	1.03	
0.26	0.67	1.29	0.08	-0.32	0.39	0.36	0.07	0.27	
1.35	1.04	1.12	0.85	1.29	0.83	1.52	0.97	0.90	
0.57	1.06	0.32	0.59	0.24	--	0.44	0.18	--	
0.61	0.71	1.21	0.90	0.71	0.51	0.77	0.78	1.34	
0.59	0.57	0.25	0.78	1.03	0.52	0.59	0.67	0.52	
0.68	0.78	1.04	0.78	0.64	0.55	0.77	0.31	0.26	
0.76	0.64	-0.40	0.77	0.86	0.13	0.77	0.57	0.32	
0.26	0.70	0.32	0.26	0.42	-0.06	0.42	0.81	0.19	
0.40	0.36	--	0.50	0.71	--	0.34	0.36	--	
1.06	1.54	1.26	1.23	0.86	1.16	0.80	1.54	1.03	
1.31	0.63	0.70	1.03	0.99	1.43	1.16	1.19	0.93	
0.52	0.57	0.45	0.63	0.58	0.38	0.67	0.64	0.57	
$\bar{x}$	<b>0.72</b>	<b>0.80</b>	<b>0.60</b>	<b>0.69</b>	<b>0.76</b>	<b>0.61</b>	<b>0.70</b>	<b>0.77</b>	<b>0.56</b>

That recall hypermnesia was produced after such a long delay, is in itself noteworthy, since this has not been previously demonstrated. This experiment then, is a replication of the Payne and Roediger's finding that recognition hypermnesia does not occur with stimuli that produce recall hypermnesia. Since it did not fully attempt to duplicate the conditions that produced recognition hypermnesia in the Erdelyi and Stein experiment, it does not disconfirm their results, and so leaves the door open to further exploration of inter-test recognition hypermnesia.

To detect any possibility of intra-test hypermnesia a further analysis of the results was undertaken which compared, for each subject, the second block of each recognition test with the first. Each block contained 40 trials. Figure 1.1 shows the results of this second half vs first half analysis. There is a tendency towards an increase in sensitivity in the second half for both pictures and words, though an analysis of variance delineated these trends more clearly. A trial x block analysis for pictures proved significant for blocks,  $F(1, 20) = 13.038$ ,  $p < .01$ , although the same analysis for words-only was not significant,  $F(1, 20) = 1.075$ ). Since this analysis had not been planned at the outset, the apparently superior performance on Block 2 could simply be explained as an inadvertent result of the stimuli on the second half of the test being somehow more memorable. However, because the

Figure 1.1

**Experiment 1**  
**Analysis of Average  $d'$  Contrasting**  
**First Half (40 Items) and Second Half (40 Items)**



order of the stimuli had been chosen randomly, this seems unlikely. Thus, this analysis confirmed the existence of intra-test hypermnesia as found in the Merikle and Reingold (1991) study, though interestingly, not with the stimuli he used (words). In the present case, only the pictures demonstrated this effect, leading to more questions about the conditions under which either type of hypermnesia can be induced.

Experiment 2: Pure Lists of Pictures or Words,  
Tested with Words after a Short Delay

The low sensitivity evidenced by the subjects in Experiment 1 was unexpected; the effort to mitigate the ceiling effect problem was apparently too successful. Experiment 2 was designed to specifically address this aspect of the results. The delay between exposure and test may have been so long that recognition memory was dampened to a greater degree than was necessary. Coupled with the transformation of picture stimuli into word identifiers at the test phase, the extra retrieval effort involved may have made the task more difficult than originally assumed. The study of a mixed series of picture and word stimuli also may have added still another difficult dimension to this task. At test, the subject's task was not really to simply rate the "oldness" or "newness" of items but to decide whether the word on the test sheet was one of the following: a reproduction of a word item previously studied; a transformation of a picture stimulus into its word identifier; or neither of these, but an entirely new item.

In the present experiment therefore, several modifications were made. The three recognition tests were given immediately after the study phase. The subjects were in two groups, each presented with a study series composed

of either solely pictures or words. The recognition test sheet remained the same (i.e., a list of words or word identifiers), with the slight modification of each quarter of the list (20 items) having an equal number of old and new stimuli. This change was made in order to facilitate a clear check on intra-test hypermnesia.

#### *Method*

*Subjects.* Brooklyn College graduate students in psychology were used as the subjects in this experiment. A total of nine students were available and participated in the experiment; five comprised the picture-study experimental group, while four subjects made up the words-only group.

*Materials.* The materials used were the same as in Experiment 1, with the difference that, as previously noted, the study phase was not a mixed list of pictures and words, but either a presentation of 80 slides of simply drawn pictures or of words (again at a timed rate of 5 seconds each). The recognition test sheet had the same format and design as in Experiment 1 and was the same for both experimental groups. The only modification (again, as noted in the introduction) was that the entire response sheet was balanced so that there was an equal number of old and new items in each quarter (20 items).

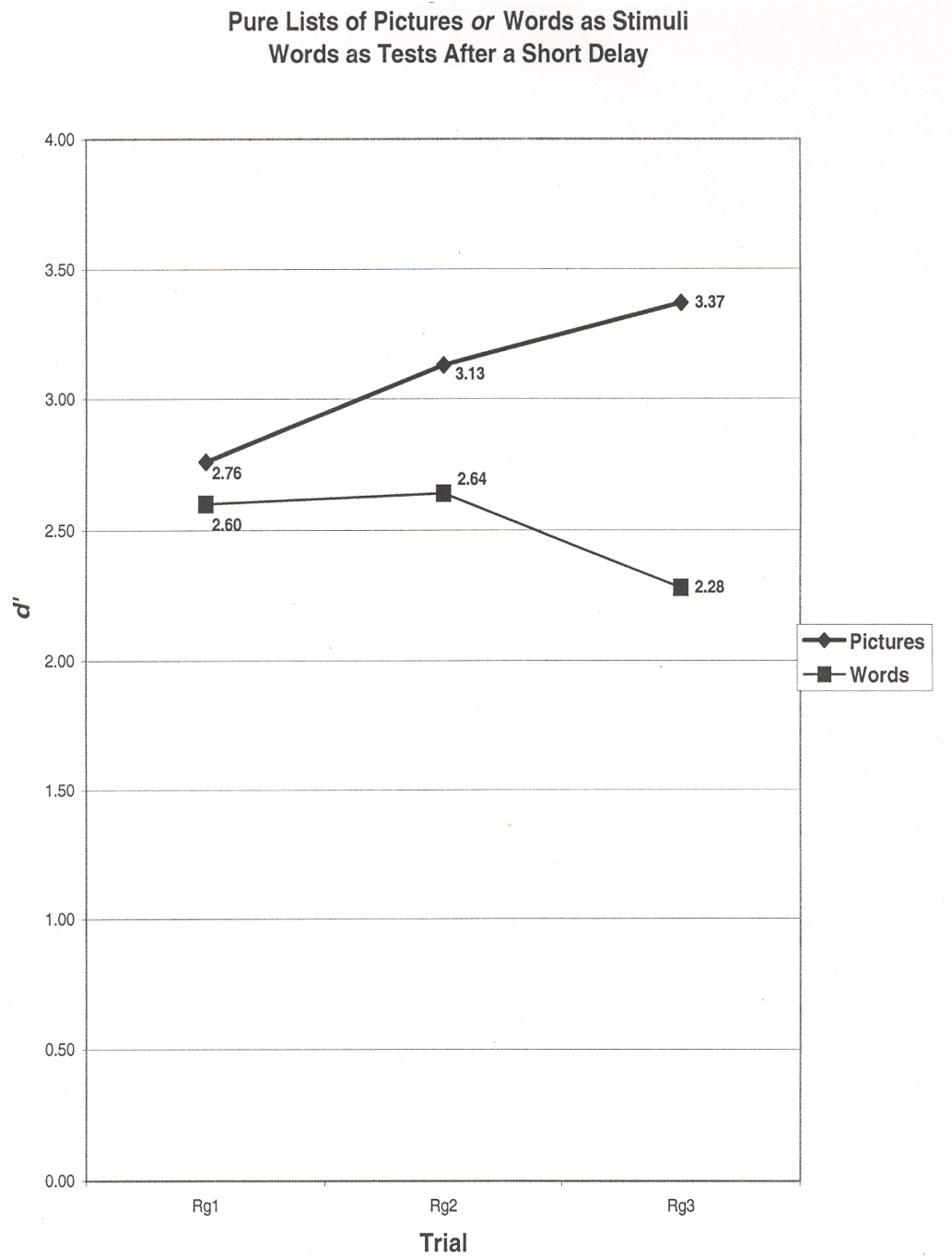
*Design and Procedure.* Both groups were treated alike throughout the study; the instructions and procedures for

both were essentially the same as in the delayed recognition phase of Experiment 1. After exposure to the 80 slides during the study phase each subject was given a recognition sheet; a discussion of the use of the rating scale prior to its use occurred but there was no practice sheet as with the high school students. In the case of the picture-study group, there was an additional notation of the fact that the answer sheet contained only the word identifiers of items they had seen (for example, the word "PIPE" in place of the sketch of a pipe). There were three successive recognition trials, with a only brief interlude of two to three minutes between each. Each trial was prefaced by a reminder to use the entire rating scale as needed and to try one's best to recognize the items from the study phase.

#### *Results and Discussion*

As can be seen from Figure 2.1, the picture-study group showed a significant increase in  $d'$  over successive trials, while the word-study group did not. An analysis of variance (recognition trials x stimulus type) on the "3" rating as the sensitivity measure yielded a significant effect for the interaction between trials and stimulus,  $F(2, 14) = 8.75$ ,  $p < .01$ , but not for trials,  $F(2, 18) = 2.41$  or stimulus,  $F(1, 7) = .601$ . The same analysis of variance on the average  $d'$  scores for each subject (based not just on the "3" rating but on each of the criterion points, "1", "2", and "3" generated by the 4-point rating system) yielded a

Figure 2.1



significant effect for the interaction between trials and stimulus,  $F(2, 14) = 3.73, p = .05$ . Using the picture-study data only, a one-way analysis of variance with repeated measures on the rating "3" scores for each subject yielded a significant  $F(2, 8)$  of 18.79,  $p = .001$ .

This positive outcome for picture recognition is the first inter-test hypermnesia resulting from the use of traditional recognition stimuli (lists of words or pictures) as study items and immediate recognition tests. Key to this production of hypermnesia is the use of a non-standard recognition test -- the picture stimuli have been transformed at test to their word referents. Additionally, and even more unexpectedly, this recognition hypermnesia occurred in conjunction with high  $d'$  (see Table 2.1).

Viewed together with the intra-test hypermnesia found in Experiment 1, intriguing clues to the different sides of recognition memory may be emerging. In Experiment 1, at levels of low  $d'$ , pictures evidenced intra-test hypermnesia. In the present experiment, at levels of high  $d'$ , there was no intra-test hypermnesia: a second block vs. first block, as well as an even finer quarter by quarter analysis, revealed no significant difference with this within-trial measure for either the picture or word-study groups (though there was a significant difference during the second recognition trial in the picture-study group). For the first recognition trial (Rg1), the mean for the first block

Table 2.1

## Experiment 2

Pure Lists of Pictures or Words as Stimuli  
 Words as Tests After a Short Delay

**PICTURE (STUDY) STIMULI**

Rg1				Rg2			Rg3		
$d'$				$d'$			$d'$		
	Rating 3	Rating 2	Rating 1	Rating 3	Rating 2	Rating 1	Rating 3	Rating 2	Rating 1
S-1	2.08	2.36	1.67	2.38	1.68	1.25	2.65	2	1.48
S-2	3.94	4.21	4.21	4.65	3.98	3.98	4.65	3.98	3.98
S-3	1.6	1.17	0.89	1.7	1.14	0.63	2.4	0.92	0.7
S-4	2.65	3.16	2.22	3.1	3.1	2.97	3.17	2.58	2.73
S-5	3.53	3.42	2.91	3.8	2.97	2.9	3.97	3.07	2.85
$\bar{x}$	<b>2.76</b>	<b>2.86</b>	<b>2.38</b>	<b>3.13</b>	<b>2.57</b>	<b>2.12</b>	<b>3.37</b>	<b>2.51</b>	<b>2.12</b>

**WORD (STUDY) STIMULI**

Rg1				Rg2			Rg3		
$d'$				$d'$			$d'$		
	Rating 3	Rating 2	Rating 1	Rating 3	Rating 2	Rating 1	Rating 3	Rating 2	Rating 1
S-1	3.01	2.28	1.8	2.85	2.67	1.03	2.41	2.32	1.59
S-2	0.76	1.25	0.64	1.49	0.7	0.7	0.37	0.29	0.59
S-3	2.66	2.85	1.04	2.53	2.85	1.65	2.66	2.52	1.17
S-4	3.97	3.97	3.97	3.7	3.7	3.7	3.7	3.7	3.7
$\bar{x}$	<b>2.60</b>	<b>2.59</b>	<b>1.86</b>	<b>2.64</b>	<b>2.48</b>	<b>1.77</b>	<b>2.28</b>	<b>2.21</b>	<b>1.61</b>

was 2.62 and for the second block, 2.72; for Rg2, the mean for the first block was 2.53 and for the second block, 2.78; for Rg3, the mean for the first block was 2.82 and for the second block, 2.83 (Table 2.2). Thus, these two experiments reveal a kind of opposition, or perhaps more correctly, a complementary effect: at low  $d'$ , intra-test hypermnesia may evidence itself (as it did Experiments 2A and 2B of the 1988 Merikle and Reingold study), but at high  $d'$ , inter-test hypermnesia can occur.

In Experiment 1, the lengthy delay between study of a mixed list of picture and word stimuli and test, coupled with the transformation of some stimuli (pictures) into word identifiers at the delayed test, resulted (presumably) in an extra retrieval effort which fostered the presence of intra-test hypermnesia. The very low sensitivity at the delayed test indicated that perhaps the combination of both a delay and a transformation exerted too strong a dampening effect. The transformations may have made an already difficult task (because of time-dampened memory) into one that was insurmountably confusing over the course of three trials: Thus the hypermnesia occurred only within the short duration of one trial.

Experiment 2 focused on the transformation of the stimuli as a sole factor involved in making the retrieval a non-trivial activity for the subject, during a task of immediate, rather than delayed recognition. This resulted

Table 2.2

## Experiment 2

PICTURES: d' BLOCK-BY-BLOCK ANALYSIS (RATING "3" ONLY)

<u>Rq1</u>				<u>Rq2</u>				<u>Rq3</u>			
<u>Block</u>											
<u>1/4</u>	<u>2/4</u>	<u>3/4</u>	<u>4/4</u>	<u>1/4</u>	<u>2/4</u>	<u>3/4</u>	<u>4/4</u>	<u>1/4</u>	<u>2/4</u>	<u>3/4</u>	<u>4/4</u>
2.49	1.28	2.56	2.12	2.42	1.28	2.17	2.48	2.49	1.65	3.29	2.12
2.08	1.37	.59	2.49	1.90	.84	.80	1.90	1.90	1.90	1.12	1.90
3.29	2.93	2.93	2.93	3.29	3.29	3.29	3.29	3.29	3.29	3.29	3.29
1.81	2.49	2.12	2.93	1.81	2.93	2.49	2.49	2.17	2.93	2.48	2.49
2.93	2.93	3.29	2.93	3.29	2.49	3.29	2.93	3.29	2.93	3.29	2.93
$\bar{X} = 2.52$	$2.20$	$2.30$	$2.68$	$2.54$	$2.17$	$2.41$	$2.62$	$2.63$	$2.54$	$2.69$	$2.55$
<u>1/2</u>		<u>2/2</u>		<u>1/2</u>		<u>2/2</u>		<u>1/2</u>		<u>2/2</u>	
2.03		2.32		1.98		2.32		2.03		2.43	
1.67		1.54		1.41		1.63		2.13		1.76	
3.70		3.53		3.70		3.70		3.70		3.70	
2.41		2.68		2.41		2.72		2.72		2.72	
3.29		3.53		3.16		3.53		3.57		3.53	
$\bar{X} = 2.62$		$2.72$		$2.53$		$2.78$		$2.82$		$2.83$	

DIFFERENCES: 2/2 -1/2 (within each trial)

<u>Rq1</u>	<u>Rq2</u>	<u>Rq3</u>
.288	.342	.397
-.130	.220	-.370
-.169	.000	.000
.276	.318	.000
.236	.363	.000
Difference= .100 (ns)	.249 p<.05	.005 (ns)

in inter-test hypermnesia with accompanying high  $d'$ , though interestingly not as perfect or near-perfect as might be expected. The likely reason for this non-ceiling effect is that the transformation of picture stimuli into their word identifiers at test added the needed difficulty to this immediate task, lowering  $d'$  enough to allow for the increase in memory to occur.

In this second experiment, study and test were close in time; the transformations worked to both dampen the memory and to engage the attention of the subject in working to re-clarify it. The subject must take an active role through the initiation of a non-automatic retrieval process resulting in the observed inter-test hypermnesia. Therefore, at high  $d'$ , the relatively simple act of transforming the original stimuli may provide just enough activity to lock into the retrieval process that results in inter-test hypermnesia.

A more prosaic factor needs to be mentioned, however. Experiment 2 used graduate student volunteers while Experiment 1 used high school students. Just possibly, therefore, some of the outcome differences arose from the subject differences.

Experiment 3: Pictures Tested with Words,  
Words Tested with Pictures

In Experiment 2, two experimental groups were involved, studying not a mixed list as in Experiment 1, but either a presentation of just words or just pictures. The group that studied pictures had a recognition task of transformed stimuli, i.e., word identifiers. The present experiment extended the transformation to the word-study group also: at test, in a task parallel to the picture-study group, their recognition task was comprised of pictures of the words that had been presented during the study phase. In addition, this experiment picked up the threads of Experiment 1, including a delayed recognition test as well. Experiment 3, therefore was designed to test the hypotheses concerning both intra- and inter-test recognition hypernesia and to clarify the role of three variables in this process: the type of stimuli studied, transformation at test, and delay of test.

*Method*

*Subjects.* Two classes of high school students enrolled in a health careers class at Ft. Hamilton High School (Brooklyn, New York) were the subjects of this study (as noted earlier, all necessary and requisite consent was obtained from all parties involved). A total of 38 students

participated in the initial phase (immediate recognition) of this study: 18 in the word-study group and 20 in the picture-study group. Of these, 20 were present for the delayed test: 11 of the word-study group and 9 (with an additional 5) of the picture-study group.

*Materials.* The materials used in the study phase were the same as in Experiment 2 -- a presentation of 80 slides of simply drawn pictures or of words at a timed rate of 5 seconds each. The recognition sheet for the picture-study group was the same as used in Experiment 2, a list of word identifiers mixed with an equal number of word distractors (80 in all: 40 identifiers, 40 distractors). The identifiers and distractors were evenly and randomly distributed on the sheet so that 20 identifiers appeared in each half. (See Table 3.1) The word-study group was given a test designed in parallel, consisting of simply drawn pictures of the words studied, mixed with picture distractors. (See Table 3.2) One other modification was made as far as the make-up of the recognition sheet. In order to insure that if intra-test hypermnesia did occur it was not as result of the positioning on the items on the recognition task sheet, two versions of each type of test (word or picture transforms) were made. The second of each type had the columns of items reversed: what had been the first block of 40 items on one was now the second block on

Table 3.1

## Experiment 3: Balanced Recognition Response Sheet

NAME*		DATE*	
<p><b>DIRECTIONS:</b> After you read each word, circle the number on the scale that best shows your thoughts. The ratings range from 0 ("I definitely DON'T remember seeing it"), to 1 ("I probably didn't see it") to 2 ("I probably did see it") to 3 ("I definitely DID see it")</p>			
<p style="text-align: center;">0.....1.....2.....3</p> <p style="text-align: center;">NO!            No            Yes            YES!</p> <p style="text-align: center;">[DEFINITELY NO] [PROBABLY NO] [PROBABLY YES] [DEFINITELY YES]</p>			
HOOK	0...1...2...3	BASKET	0...1...2...3
PIGGY BANK	0...1...2...3	CANE	0...1...2...3
DOG	0...1...2...3	OCTOPUS	0...1...2...3
BUG	0...1...2...3	BUCKET	0...1...2...3
BOOK	0...1...2...3	COMB	0...1...2...3
TENT	0...1...2...3	BRUSH	0...1...2...3
ARROW	0...1...2...3	HAMMER	0...1...2...3
PAPER CLIP	0...1...2...3	FAUCET	0...1...2...3
SNAIL	0...1...2...3	FUNNEL	0...1...2...3
BANANA	0...1...2...3	NET	0...1...2...3
SKATES	0...1...2...3	PURSE	0...1...2...3
SNAKE	0...1...2...3	FLAG	0...1...2...3
MOON	0...1...2...3	SEA SHELL	0...1...2...3
DICE	0...1...2...3	HELICOPTER	0...1...2...3
HANGER	0...1...2...3	SOCK	0...1...2...3
BUTTERFLY	0...1...2...3	EYE	0...1...2...3
ENVELOPE	0...1...2...3	CAT	0...1...2...3
PLIERS	0...1...2...3	BIRD	0...1...2...3
PEAR	0...1...2...3	PIG	0...1...2...3
WHEEL	0...1...2...3	GUITAR	0...1...2...3
TEEPPE	0...1...2...3	TONGS	0...1...2...3
TREE	0...1...2...3	SEAL	0...1...2...3
IRON	0...1...2...3	CORN	0...1...2...3
BAT	0...1...2...3	TELEVISION	0...1...2...3
AX	0...1...2...3	ACE	0...1...2...3
CAR	0...1...2...3	SWORD	0...1...2...3
SHORTS	0...1...2...3	SAILBOAT	0...1...2...3
ICE CREAM CONE	0...1...2...3	ALLIGATOR	0...1...2...3
RAT	0...1...2...3	CIGAR	0...1...2...3
BELL	0...1...2...3	FISH	0...1...2...3
SYRINGE	0...1...2...3	LIGHT BULB	0...1...2...3
BOTTLE	0...1...2...3	FLOWER	0...1...2...3
HORSE	0...1...2...3	ROLLING PIN	0...1...2...3
CHAIN	0...1...2...3	BELT	0...1...2...3
FEATHER	0...1...2...3	BONE	0...1...2...3
PENCIL	0...1...2...3	LEAF	0...1...2...3
TABLE	0...1...2...3	GUN	0...1...2...3
FAN	0...1...2...3	TRUMPET	0...1...2...3
CRUTCH	0...1...2...3	DOMINO	0...1...2...3
PINEAPPLE	0...1...2...3	TWEEZERS	0...1...2...3

\*reduced in size for reproduction

Table 3.2

Experiment 3: Balanced Recognition Response Sheet

Name \_\_\_\_\_ Date \_\_\_\_\_

Directions: After you look at each picture, circle the number on the scale below it that best shows your thoughts. The ratings range from 0 ("I definitely DON'T remember seeing it"), to 1 ("I probably didn't see it") to 2 ("I probably did see it") to 3 ("I definitely DID see it").

0.....1.....2.....3							
NO!	No	Yes	YES!				
(DEFINITELY NO)	(PROBABLY NO)	(PROBABLY YES)	(DEFINITELY YES)				
							
							
							
							
							
							
							
							
							
							

\*reduced in size for reproduction

the other (see Tables 3.3A and 3.3B for examples of each type with their reversals). In each experimental group, half of the subjects (or as close as possible) would receive each of the two orders of test items.

*Design and Procedure.* There were two experimental groups: a words-only study group and a pictures-only study group. Both groups received an immediate recognition test on the complementary transformed stimuli: The word-study group received a recognition task comprised of picture transformations, while the picture-study group received a recognition task made of the word identifiers of the pictures that had been studied (as in the previous experiment). As in the immediate tests of Experiment 2, and following a typical inter-test hypermnesia protocol, the subjects were given three recognition tests in a row, immediately following the presentation of the stimuli (Rg1) and with a brief interlude between each successive test of 2-3 minutes. Additionally, as in Experiment 1, these same subjects were tested again, unannounced, at a delay of approximately six weeks. The delayed recognition task followed the same protocol as the immediate test: three successive tests on transformed stimuli.

#### *Results and Discussion*

As can be seen by the summary Tables 3.4A and 3.4B, this experiment failed to replicate either the finding of inter-test hypermnesia on transformed stimuli on an

Table 3.3A

## Recognition Response Sheet with Reversed Columns

NAME**		DATE**	
<p><b>DIRECTIONS:</b> After you read each word, circle the number on the scale that best shows your thoughts. The ratings range from 0 ("I definitely DON'T remember seeing it") to 1 ("I probably didn't see it") to 2 ("I probably did see it") to 3 ("I definitely DID see it")</p>			
		0.....1.....2.....3	
		NOI      No      Yes      YES:	
		(DEFINITELY NO) (PROBABLY NO) (PROBABLY YES) (DEFINITELY YES)	
BUCKET	0...1...2...3	BUG	0...1...2...3
COMB	0...1...2...3	BOOK	0...1...2...3
BRUSH	0...1...2...3	TEXT	0...1...2...3
HAMMER	0...1...2...3	ARROW	0...1...2...3
FAUCET	0...1...2...3	PAPER CLIP	0...1...2...3
FUNNEL	0...1...2...3	SNAIL	0...1...2...3
NET	0...1...2...3	BANANA	0...1...2...3
PURSE	0...1...2...3	SKATES	0...1...2...3
FLAG	0...1...2...3	SNAKE	0...1...2...3
SEA SHELL	0...1...2...3	MOON	0...1...2...3
HELICOPTER	0...1...2...3	DICE	0...1...2...3
SOCK	0...1...2...3	HANGER	0...1...2...3
EYE	0...1...2...3	BUTTERFLY	0...1...2...3
CAT	0...1...2...3	ENVELOPE	0...1...2...3
BIRD	0...1...2...3	PLIERS	0...1...2...3
FIG	0...1...2...3	PEAR	0...1...2...3
GIUITAR	0...1...2...3	WHEEL	0...1...2...3
TONGS	0...1...2...3	TREEPEE	0...1...2...3
SEAL	0...1...2...3	TREE	0...1...2...3
CORN	0...1...2...3	IRON	0...1...2...3
TELEVISION	0...1...2...3	BAT	0...1...2...3
ACE	0...1...2...3	AX	0...1...2...3
SWORD	0...1...2...3	CAR	0...1...2...3
SAILEDAY	0...1...2...3	SHORTS	0...1...2...3
ALLIGATOR	0...1...2...3	ICE CREAM CONE	0...1...2...3
CIGAR	0...1...2...3	BAT	0...1...2...3
FISH	0...1...2...3	BELL	0...1...2...3
LIGHT BULB	0...1...2...3	SYRINGE	0...1...2...3
FLOWER	0...1...2...3	BOTTLE	0...1...2...3
ROLLING PIN	0...1...2...3	HOSE	0...1...2...3
BELT	0...1...2...3	CHAIN	0...1...2...3
BONE	0...1...2...3	FEATHER	0...1...2...3
LEAF	0...1...2...3	PENCIL	0...1...2...3
GUN	0...1...2...3	TABLE	0...1...2...3
TRUMPET	0...1...2...3	FAN	0...1...2...3
DOMINO	0...1...2...3	CRUTCH	0...1...2...3
TWEEZERS	0...1...2...3	PINEAPPLE	0...1...2...3
BASKET	0...1...2...3	HOOK	0...1...2...3
CANE	0...1...2...3	PIGGY BANK	0...1...2...3
OCTOPUS	0...1...2...3	DOG	0...1...2...3

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Table 3.3B

Recognition Response Sheet with Reversed Columns

NAME\*\* \_\_\_\_\_ DATE\*\* \_\_\_\_\_

**DIRECTIONS:** After you read each word, circle the number on the scale that best shows your thoughts. The ratings range from 0 ("I definitely DON'T remember seeing it"), to 1 ("I probably didn't see it") to 2 ("I probably did see it") to 3 ("I definitely DID see it")

0.....1.....2.....3  
 NO! NO YES YES!  
 DEFINITELY NO PROBABLY NO PROBABLY YES DEFINITELY YES

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Table 3.4A

Summary: Experiment 3Pictures Tested with Words, Words Tested with PicturesAverage d'


---

<u>Group 1. A. Immediate Rg: Word Study/Test on Picture Complements</u>			
(N)	<u>Rq1</u>	<u>Rq2</u>	Rq3
(10)	<b>2.01</b>	<b>1.92</b>	<b>1.90</b>
(*8)	<b>2.15</b>	<b>2.18</b>	<b>2.26</b>
*with blocks reversed			
(18) Total	<b>2.07</b>	<b>2.04</b>	<b>2.06</b>
<u>B. Delayed Rg: Test, Words</u>			
(11)	.62	.04	.34

---

<u>Group 2. A. Immediate Rg: Picture Study/Test on Word Identifiers</u>			
(N)	<u>Rq1</u>	<u>Rq2</u>	<u>Rq3</u>
(13)	<b>2.56</b>	<b>2.72</b>	<b>2.27</b>
(*7)	<b>3.09</b>	<b>2.74</b>	<b>2.32</b>
*with blocks reversed			
(20) Total	<b>2.75</b>	<b>2.72</b>	<b>2.23</b>
<u>B. Delayed Rg: Test, Pictures</u>			
(9)	<b>.81</b>	<b>.81</b>	<b>.80</b>
<u>Subjects who completed only 2 immediate Rg tests:</u>			
(5)	<b>.74</b>	<b>.67</b>	<b>.78</b>

---

Table 3.4b

EXPERIMENT 3Block Analysis Summary: First Half (40 Items) vs Second Half (40 Items)Average d' (rating "3" only)-----  
1a. Immediate Rg: Word Study/Test on Picture Complements

N=10	<u>Rg1</u>		<u>Rg2</u>		<u>Rg3</u>	
	Block 1	Block 2	Block 1	Block 2	Block 1	Block 2
	<b>1.83</b>	<b>1.93</b>	<b>1.87</b>	<b>1.86</b>	<b>1.73</b>	<b>2.05</b>
N=8*	Block 2	Block 1	Block 2	Block 1	Block 2	Block 1
	<b>2.04</b>	<b>2.08</b>	<b>2.03</b>	<b>2.04</b>	<b>2.07</b>	<b>2.13</b>
<i>*the test sheets had reversed blocks</i>						
Total						
N=18	<b>1.95</b>	<b>2.03</b>	<b>1.94</b>	<b>1.94</b>	<b>2.00</b>	<b>2.09</b>

## 1b. Immediate Rg: Picture Study/Test on Word Identifiers

N=13	<u>Rg1</u>		<u>Rg2</u>		<u>Rg3**</u>	
	Block 1	Block 2	Block 1	Block 2	Block 1	Block 2
	<b>2.43</b>	<b>2.47</b>	<b>2.58</b>	<b>2.65</b>	<b>2.04</b>	<b>2.37</b>
N=7*	Block 2	Block 1	Block 2	Block 1	Block 2	Block 1
	<b>2.96</b>	<b>2.89</b>	<b>2.70</b>	<b>2.67</b>	<b>2.25</b>	<b>2.44</b>
<i>*the test sheets had reversed blocks</i>					<i>**delay of 72hrs</i>	
Total						
N=20	<b>2.61</b>	<b>2.62</b>	<b>2.62</b>	<b>2.66</b>	<b>2.11</b>	<b>2.40</b>

## 2a. Delayed Rg: Study:Words/Immediate Rg:Pictures/Delayed Rg Test:Words

N=11	<u>Rg1</u>		<u>Rg2</u>		<u>Rg3</u>	
	Block 1	Block 2	Block 1	Block 2	Block 1	Block 2
	<b>.79</b>	<b>.49</b>	<b>.06</b>	<b>.18</b>	<b>.25</b>	<b>.42</b>

## 2b. Delayed Rg: Study:Pictures/Immediate Rg:Words/Delayed Rg Test:Pictures

N=9	<u>Rg1</u>		<u>Rg2</u>		<u>Rg3</u>	
	Block 1	Block 2	Block 1	Block 2	Block 1	Block 2
	<b>.73</b>	<b>.91</b>	<b>.82</b>	<b>.71</b>	<b>.80</b>	<b>.72</b>
Subjects who did not complete the (3) immediate Rg tests:						
N=5	<b>.65</b>	<b>.84</b>	<b>.53</b>	<b>.76</b>	<b>.65</b>	<b>.89</b>

-----

immediate task of recognition or intra-test hypermnesia on a delayed task of recognition. The reversal of blocks shows that one particular ordering of stimuli, not necessarily in a specific serial order but in a block of 40 items, did apparently result in a slightly higher  $d'$ , whether in an immediate or delayed task. Though there was no inter-test hypermnesia, this finding raises the possibility that the block hypermnesia effect may be a testing effect rather than a memory effect. The  $d'$  on the delayed task was extremely low, perhaps so low that inter-test hypermnesia was subject to a "basement" effect. This could be the result of an (inadvertent) procedural error that occurred in the administration of the delayed test.

The delayed test was not a repeat of the immediate recognition task on transformed items that had been undertaken by each subject. Instead, each group took what amounted to a standard recognition test of copy cues: the word-study group completed a delayed test of words and distractors; the picture-study group took the picture recognition test. So, for example, the word group studied a list of words, had an immediate recognition test on pictorial transforms, and then on the delayed test went back to the original (untransformed) words that they had studied. This may have so dampened an already faint memory that it led to more confusion than recognition. There is some

support for this theory when one examines the data for the 5 subjects separated in the delayed picture-study group (refer to Table 3.4B, part 2b). These subjects, for various reasons, had completed the study portion of the initial phase but had declined to participate in the three tasks of immediate recognition. There seems to be a tendency for an increase in  $d'$  between blocks of all three of the delayed tests for these subjects. Thus for these subjects, intra-test hypermnesia seems to be a possibility.

In summary, the results of Experiments 1, 2, and 3 provided a mixed message concerning recognition hypermnesia. All used simple words and pictures as stimuli and attempted to address the issue of a ceiling effect as well as explore the necessity of increased retrieval effort in producing recognition hypermnesia. In Experiment 1, where there was a long delay between study and test, recognition hypermnesia occurred within the span of a single test, with increased memory measured by a split-half analysis. However, this intra-test hypermnesia was not found in the subsequent experiments.

Experiment 2 began to narrow the focus to the transformation of study items at test. In Experiment 1, all subjects studied a mixed list of words and pictures and were tested on words and the word identifiers (of the studied pictures). In Experiment 2 there were two experimental groups; each study list was made completely of either

pictures or words. The picture study group of Experiment 2 did produce recognition hypermnesia, however it was a very small group of graduate students who participated. With this initial success, Experiment 3 moved to complete the transformation of studied items. Subjects again were divided into two experimental groups studying a list of words or pictures. There were two complementary tests in Experiment 3 made of either word identifiers (for the picture study group) or drawn pictures (for the word study group). Hypermnesia was not found in either condition, leading to more questions than answers.

The initial findings of intra-test hypermnesia in Experiment 1 and multi-trial hypermnesia in Experiment 2 may simply be unreliable. However, it could also be that the graduate students used as subjects took the task more seriously than either the high school students of Experiment 1 or the undergraduate pool of Experiment 3. Experiment error in Experiment 3 has been noted earlier; yet still, there was no clear-cut trend throughout. Perhaps the common and familiar items used as stimuli in these early experiments may simply engender confusion over a sequence of repeated tests. The procession of familiar items can easily join the large pool of known items whose time source of study is unclear; these simple items may recede into the mix of the already well-used and easily accessible words and figures of every day experience.

Each promising lead had evaporated. It seemed that a different approach was warranted.

The next set of experiments (Experiments 4 - 8) looked back to Erdelyi and Stein (1981) as a starting point. In its positive results, the Erdelyi and Stein study provided a road map for inducing hypermnesia through retrieval effort. Moreover, the stimuli for the study were complex cartoon items composed of both pictorial and verbal material. The necessity for retrieval effort at test could therefore be explored through several venues, as a greater variety of transforms, part-forms, and paraphrases could be designed.

## Experiments 4 - 8: Cartoons as Stimuli

The Erdelyi and Stein study was a successful attempt at inducing recognition hypermnesia employing unusual stimuli that are rich in both pictorial and semantic detail. As complex material, these cartoons provide a deep platform for retrieval. The set of experiments that follow sought both to replicate the Erdelyi and Stein recognition hypermnesia findings and to vary the experimental conditions in an attempt to widen the settings under which recognition memory can increase. Each of these experiments therefore has, as the essence of its design, a unique transformation of the cartoon stimuli studied at test.

Experiment 4, which used part-forms as recognition stimuli (a quadrant of the original whole picture), is the lone failure of the group. Experiment 5 is a successful replication of the Erdelyi and Stein study where multiple recognition tests on the picture components of the cartoons produced hypermnesia. Experiments 6 through 8 all produced significant results, each expanding the definition, application, and the design of the transformation. In Experiment 6, subjects were tested on verbal paraphrases: a written description of the picture portion of the studied cartoon. Experiment 7, the latent content condition, used test stimuli that summarized (in words) the gist of each cartoon. Experiment 8 combined the successful test features

of Experiments 6 and 7: Each test item now comprised (a) the verbal paraphrases of the picture in each cartoon and (b) the cartoon's latent content. As a group, Experiments 5 - 8 demonstrate that the recasting of complex stimuli from study to test can be the key to triggering the necessary work of memory leading to recognition hypermnesia.

#### Experiment 4: Picture-Fragment Condition

The Erdelyi and Stein stimulus set consists of cartoons with captions taken from a variety of sources such as magazines, newspapers, and joke books. In this experimental condition, the *picture-fragment condition*, test items were designed as part-forms of the studied stimuli (the complete funny/configured cartoon; for an example see Figure 4.1, p. 93). Subjects were tested on a fragment of the original picture portion of the cartoon. At test, this fraction-of-the-whole presentation could reduce the automaticity in the recognition process. The subjects would have to generate mentally the missing portion of the cartoon and complete it before a recognition decision could be made (in those cases where the fragment by itself is not recognized).

##### *Method*

*Subjects.* Brooklyn College students enrolled in an introductory psychology class were used as the subjects. A total of twenty-five students participated in the experiment.

*Materials.* The complete stimulus set consisted of 140 cartoons presented to the subjects in a looseleaf binder. A single complete cartoon was printed on each page, ordered alphabetically in the binder by the last word of each cartoon's caption. The test set was comprised of a total of

40 items. Twenty were old items taken from the studied cartoons. Each had been assigned a stimulus order number and were chosen as a subset according to a random numbers table. The remaining 20 distractors (new items) originated from previously unseen cartoons of the same type and source as the stimulus set. All forty items (old plus new) were placed in a random order in the binder, with the restriction that no more than three old items could appear together.

In order to produce these test items, intended to be picture fragments, the upper left quadrant of the picture portion of the cartoon was designated as the section to be judged by each subject at test. However, if this quarter-part did not appear to contain enough pictorial information to be useful in recognition, an exception was made, and a larger section of the cartoon (two quadrants) was used. Figure 4.1 gives an example of a study stimulus and its corresponding picture fragment (test) counterpart. Each picture fragment appeared alone on a page; the complete test set of 40 was presented in a randomly ordered sequence in a looseleaf binder.

*Design and Procedure.* At the beginning of the experiment all the subjects were told that they were participating in a study that required them to remember a large number of cartoons (see Appendix F for complete verbatim instructions). The subjects were asked to study

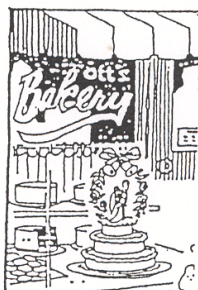
Figure 4.1

**Experiment 4: Examples of Study and Test Stimuli**



"Yeah... but after the cake was gone, you'd still be MARRIED."

**Figure 4a: Example of Original (study) stimulus**



**Figure 4a: Example of Picture Fragment (test) stimulus**

each cartoon carefully as they would be tested on the materials later. After being shown the looseleaf binder that they would receive, it was explained that in order to insure a set study time for each item the group would proceed together through the set of cartoons at a timed rate of 15 seconds for each item. It was further explained to the subjects that they were to study each cartoon in sequence and not to go ahead or back to any one item. They were to wait for the signal to begin, and likewise wait for the call to proceed to the next item. Subjects were tested in batches that ranged from two to five. Once the full set of 140 cartoons was viewed (which took about 35 minutes), the binder was collected.

The subjects were then told that they would now be tested on a subset of the cartoons they had just studied. They were informed that half of the test items were actually those that they had seen and half were not. Further, the items they would now be asked about were not in their original presentation form. In order to clarify this modification at test each subject was given an example of a complete cartoon and its picture fraction counterpart. Figure 4.2 demonstrates what each participant received.

Finally, each subject was shown the recognition answer sheet, comprised of numbers corresponding to items in the test binder and an accompanying rating scale next to each number (zero through three: Definitely No, Probably No,

Figure 4.2

**Experiment 4: Practice Example Given to Subjects**

**IF YOU STUDIED THIS.....**



"Yeah... but after the cake was gone, you'd still be MARRIED."

**NOW YOU WILL SEE THIS:**



Probably Yes, Definitely Yes; see Appendix G). The use of this rating scale, with three points articulating recognition confidence was discussed. The subjects were told to rate each test item in order and were not permitted to review previous pages in the binder. Subjects were given 10 minutes to rate the 40 test items, but were allowed a 2 minute grace period if needed. Once they were done, the test binders were collected as were the rating protocols.

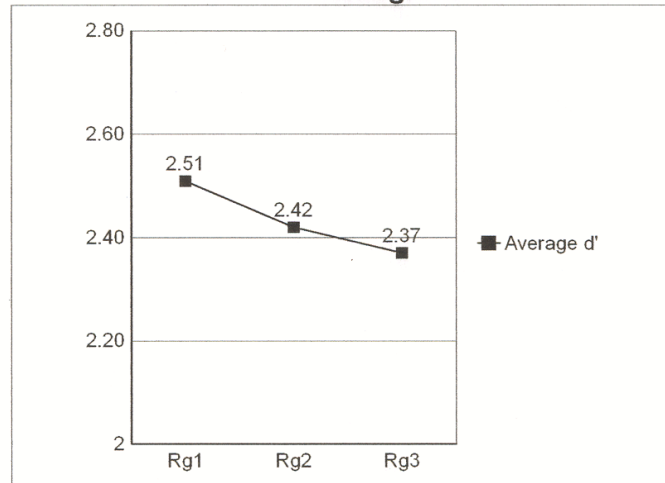
After a 5 minute break, a second recognition test (Rg2) was administered, identical to the first (Rg1). The participants were instructed to try again to remember as well as they could, and to think back to the original group of cartoons that they had studied. This was followed by a third and final recognition test (Rg3), also identical to the previous two tests.

#### *Results and Discussion*

As can be seen in Table 4.1, this condition produced an amnesic trend rather than hypermnesia. A one-way analysis of variance with repeated measures was performed on the average  $d'$  scores for each subject. It yielded a non-significant amnesic trend,  $F(2, 48) = 1.94, p = .154$ . An additional statistic was produced by generating individual ROC curves and calculating the area under the curve for each subject. When subjected to an analysis of variance these area scores produced a significant downward trend:  $F(2, 48) = 7.40, p = .002$ .

Table 4.1

**Experiment 4: Picture Fraction Condition  
d' Over Three Recognition Trials**



	<b>Rg1</b>	<b>Rg2</b>	<b>Rg3</b>
<b>Average d'</b>	<b>Average d'</b>	<b>Average d'</b>	<b>Average d'</b>
	2.19	1.58	1.41
	2.77	2.65	2.69
	2.16	2.00	1.59
	2.32	2.27	1.92
	1.98	2.14	1.82
	3.94	3.09	2.90
	1.04	0.88	0.91
	2.00	2.15	2.37
	1.65	1.31	1.21
	3.45	3.38	3.33
	3.20	2.58	2.46
	3.43	3.70	3.70
	1.82	1.79	1.64
	3.01	2.40	2.28
	1.82	1.77	1.68
	2.17	2.11	1.83
	2.22	2.30	2.15
	3.14	3.08	3.25
	3.06	3.29	3.29
	1.95	1.98	2.03
	3.21	3.17	3.53
	2.92	3.12	3.00
	2.52	2.42	2.67
	2.09	2.85	3.29
	2.70	2.43	2.41
$\bar{x}$	2.51	2.42	2.37

All the cartoons, whatever their source, are essentially black and white line drawings of similar style. Therefore, when reduced to a fragment they may become hardly-meaningful black lines on a page, each very similar to the next, particularly when presented again and again. The negative findings are actually in line with previous probes (Erdelyi and Stein, 1981) showing that degrading the stimuli mechanically either at presentation or test--by faster presentation rates, more difficult distractors, fractional tests from pseudo (nonsense) cartoons, for example--all fail to produce hypermnesia.

### Experiment 5: Picture-Only Condition

With such mixed findings so far, Experiment 5 sought to replicate the positive outcome of the Erdelyi and Stein (1981) study. The stimuli in the Erdelyi and Stein experiment were of two types: configured (funny) cartoons and non-configured pseudo-cartoons created by mismatching cartoon pictures and captions. Subjects studied either configured or non-configured stimuli and were then tested on the pictures or the captions of these cartoons. Thus, there were four independent test conditions: pictures/funny; pictures/non-funny; captions/funny; captions/non-funny. It was only the picture/funny test condition that resulted in hypermnnesia and it is therefore this experimental variant that is repeated here in the *picture-only condition*.

#### *Method*

*Subjects.* Twenty-five Brooklyn College students enrolled in an introductory psychology class were used as the subjects.

*Materials.* The study portion of this condition was identical to that of Experiment 4 with 140 cartoons presented in a looseleaf binder. Also identical was the subset of 40 cartoons (20 stimuli plus 20 distractors) used to construct the test items for this condition. In this, the *picture-only condition*, the test stimuli were made of

the whole picture portion of each cartoon, again presented singly on a each page. Figure 5.1 shows an example of both the study and test stimulus.

*Design and Procedure.* The procedure was the same as in the prior experiment, with the exception of the modification of both explanation and example, as necessary, to suit this condition and these constructed stimuli. The subjects again studied the 140 cartoon stimulus set at a timed rate of 15 seconds each. Prior to test the subjects were shown an example of a typical study stimulus and the corresponding picture portion that would comprise a test item for this condition. Three recognition tests were given in succession, with a 5-minute break between each test.

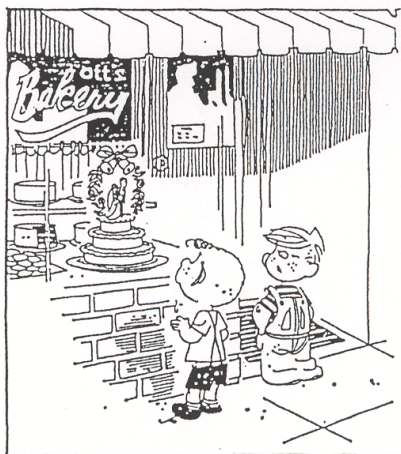
#### *Results and Discussion*

This experiment is the first successful replication of the Erdelyi and Stein (1981) study. A one-way analysis of variance with repeated measures on the average  $d'$  scores for each subject yielded a significant  $F(2, 48)$  of 3.22,  $p = .049$ . Table 5.1 shows the positive trend of the average  $d'$  scores over the course of repeated testing.

Table 5.2 shows the average  $d'$  for each recognition trial (Rg1, Rg2, Rg3) as well as the area statistic for each. The area analysis showed an incremental trend, but proved to be not significant. The average  $d'$  measure and  $P(A)$  correlate well (.98, see Appendix H). However, the

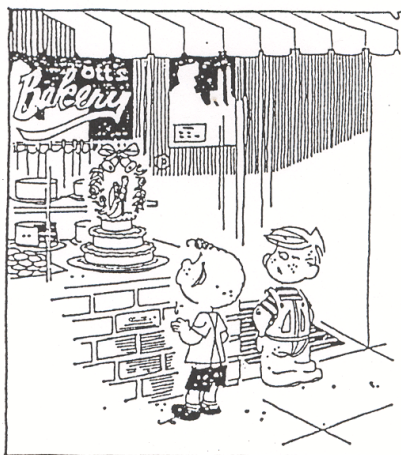
Figure 5.1

**Experiment 5: Examples of Study and Test Stimuli**



"Yeah... but after the cake was gone, you'd still be MARRIED."

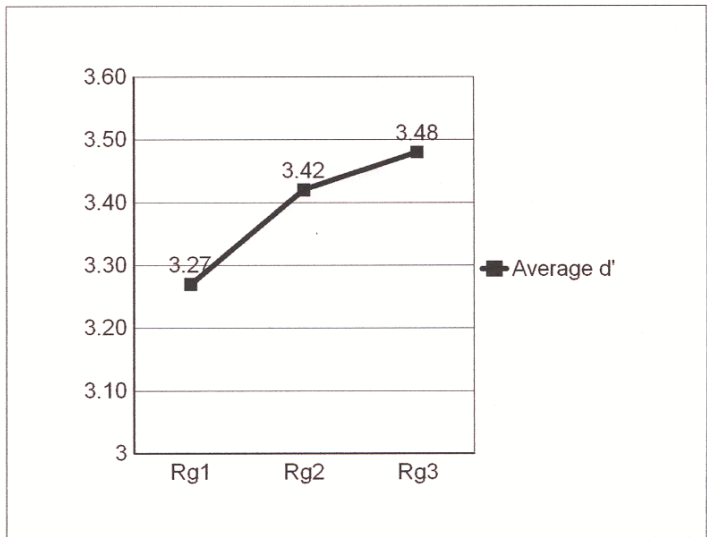
**Figure 5a: Example of Original (study) stimulus**



**Figure 5b: Example of Picture Only (test) stimulus**

Table 5.1

**Experiment 5: Picture-Only Condition  
d' Over Three Recognition Trials**



<b>Rg1</b>	<b>Rg2</b>	<b>Rg3</b>
<i>Average d'</i>	<i>Average d'</i>	<i>Average d'</i>
2.31	2.38	2.68
3.00	3.21	3.32
3.74	3.94	3.94
3.94	3.94	3.94
3.64	3.56	3.45
3.86	3.34	3.74
0.47	2.50	2.50
3.74	3.58	3.94
3.94	3.94	3.94
1.41	2.40	2.46
2.99	3.34	3.34
3.94	3.94	3.94
3.78	3.94	3.94
3.78	3.94	3.94
3.94	3.94	3.94
3.94	3.94	3.94
3.25	3.29	3.59
3.16	3.16	3.16
3.54	3.17	3.17
3.13	3.12	3.00
3.94	3.94	3.94
2.99	2.45	2.30
3.51	3.94	3.94
3.23	3.59	3.86
2.70	3.01	3.16
$\bar{x}$ 3.27	3.42	3.48

Table 5.2

## Experiment 5: Picture-Only Condition

Average  $d'$  and AreaAverage  $d'$ 

<b>Rg1</b>	<b>Rg2</b>	<b>Rg3</b>
2.31	2.38	2.68
3.00	3.21	3.32
3.74	3.94	3.94
3.94	3.94	3.94
3.64	3.56	3.45
3.86	3.34	3.74
0.47	2.50	2.50
3.74	3.58	3.94
3.94	3.94	3.94
1.41	2.40	2.46
2.99	3.34	3.34
3.94	3.94	3.94
3.78	3.94	3.94
3.78	3.94	3.94
3.94	3.94	3.94
3.94	3.94	3.94
3.25	3.29	3.59
3.16	3.16	3.16
3.54	3.17	3.17
3.13	3.12	3.00
3.94	3.94	3.94
2.99	2.45	2.30
3.51	3.94	3.94
3.23	3.59	3.86
2.70	3.01	3.16

## Area

<b>Rg1</b>	<b>Rg2</b>	<b>Rg3</b>
0.929	0.940	0.940
0.967	0.995	0.995
1.000	1.000	1.000
1.000	1.000	1.000
0.999	0.950	0.950
1.000	1.000	1.000
0.614	0.910	0.910
1.000	1.000	1.000
1.000	1.000	1.000
0.965	0.995	0.995
0.760	0.913	0.913
1.000	1.000	1.000
1.000	1.000	1.000
1.000	1.000	1.000
1.000	1.000	1.000
0.974	0.999	0.999
0.950	0.950	0.950
1.000	0.975	0.975
0.972	0.950	0.950
1.000	1.000	1.000
0.990	0.923	0.923
1.000	1.000	1.000
1.000	1.000	1.000
0.923	0.950	0.950

$\bar{x}$	<b>3.27</b>	<b>3.42</b>	<b>3.48</b>	$\bar{x}$	<b>0.962</b>	<b>0.978</b>	<b>0.978</b>
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method by which the  $P(A)$  is calculated may make it less suitable for use in the analysis of this type of memory task.

When a subject discriminates with perfect accuracy,  $d'$  is calculated with a correction term in order to avoid the infinite  $d'$  that precise performance implies (MacMillan and Creelman, 1991). The necessity of using a correction term becomes especially telling in conditions where subjects are extreme in their use of points on the rating scale, or are confident in their choices so that there are many data cells with zero as an entry. The individual ROC curves and the area under these curves, however, is calculated without a correction term. The computer program (SPSS, version 11.5) plots 100% correct but ignores zero points when calculating the  $P(A)$ .

Also, because any zero points are invisible to statistical procedures and in graph production when SPSS computes and produces an ROC curve, a subject with perfect recognition and one with a little uncertainty are treated alike, resulting in identical area scores. The area statistic therefore misses the sometimes subtle and slight changes that appear over the course of repeated testing for these items that are highly memorable. The ceiling effect discussed at the outset needed to be addressed in the design of recognition experiments seeking a resultant memory increase. It may be equally important that the statistics

employed in analysis be sensitive to the problem of high accuracy by subjects as well.

The *picture-only condition* in particular, points out the difficulty of using the area statistic when recognition levels are at or close to ceiling and the ability of the subjects to recognize studied items is quite high. With many subjects expressing solid confidence in their choices the problem of not including zero points looms large. More than a few subjects scored 100% hits and 0% false alarms, and therefore the computed area scores do not accurately reflect the performance of the individual subjects. Combined together for group analysis the trend appears to get diluted and the small increment available for improved recognition is dissipated. The design of the experiment surmounted the ceiling issue; this particular statistic is not as effective in addressing it.

The 1981 study by Erdelyi and Stein was one of a handful to tackle recognition as a memory process with similar parameters to recall. In demonstrating successful hypermnesia, Erdelyi and Stein removed recognition from its status as a reflexive task; recognition could now be seen as more than the end-step in the recall process or merely a simple task from a fundamentally different memory domain. In replicating the Erdelyi and Stein finding, additional

weight is given to the two-process model of recognition memory, highlighting retrieval as a key step in recognition, as it is in recall.

### Experiment 6: Verbal-Paraphrase Condition

Experiment 5 replicated the Erdelyi and Stein (1981) recognition hypermnesia effect. In so doing, it seemed to reaffirm the retrieval component in recognition and to underscore the crucial point that there must be active and prolonged retrieval if hypermnesia is to occur. In Experiment 6, the retrieval process is taken beyond Experiment 5 through a design that further extends the notion of transformed stimuli. Taking a cue from English, et al., (1934, 1939), the subjects are presented with verbal paraphrases. Each test item is a veridical written description of the picture portion of each cartoon. The graphic has been translated to the verbal, forming a complement to the *picture-only condition*.

#### *Method*

*Subjects.* Twenty-five Brooklyn College students enrolled in an introductory psychology class were used as the subjects.

*Materials.* The materials were the same as in the prior experiments. A verbal paraphrase was made by succinctly describing the main elements and key details of the picture part of each cartoon. Figure 6.1 shows an example of these stimuli.

Figure 6.1

**Experiment 6: Examples of Study and Test Stimuli**

"Yeah... but after the cake was gone, you'd still be MARRIED."

**Figure 6a: Example of Original (study) stimulus**

Dennis the Menace says something to his friend who is looking at a wedding cake in a bakery window.

**Figure 6b: Example of Verbal Paraphrase (test) stimulus**

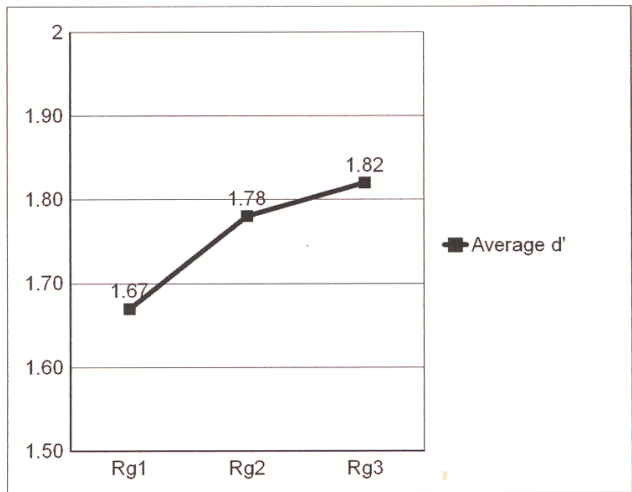
*Design and Procedure.* The procedure followed was in essence, identical to the prior experiments, with modification in explanation and example as necessary.

*Results and Discussion*

A one-way analysis of variance with repeated measures on the average  $d'$  for each subject shows significant hypermnesia,  $F(2, 48) = 3.70$ ,  $p = .03$  (see Table 6.1). The paraphrase tactic proposed by English, et al., (1934) now seems validated without the earlier noted methodological pitfalls. The area measure shows an upward trend, though it is not significant.

Table 6.1

**Experiment 6: Verbal Paraphrase Condition  
d' Over Three Recognition Trials**



	<b>Rg1</b>	<b>Rg2</b>	<b>Rg3</b>
<b>Average d'</b>	<b>Average d'</b>	<b>Average d'</b>	<b>Average d'</b>
	1.32	1.27	1.62
	1.61	1.62	1.96
	2.09	2.17	2.19
	2.21	2.46	2.49
	2.00	1.69	2.17
	1.40	1.75	1.77
	1.52	1.17	1.40
	1.45	1.00	0.86
	2.94	2.93	2.93
	1.96	2.28	2.00
	2.26	2.56	2.33
	1.76	1.97	1.90
	1.51	1.77	1.99
	2.35	2.36	2.60
	1.24	1.15	1.07
	2.32	2.54	2.67
	1.95	1.87	1.96
	1.98	1.94	1.86
	1.77	2.38	2.29
	1.10	1.88	2.01
	1.18	1.69	1.59
	1.29	1.43	1.64
	1.64	1.81	1.50
	0.94	0.65	0.50
	0.04	0.28	0.12
$\bar{x}$	1.67	1.78	1.82

### Experiment 7: Latent-Content Condition

In both Experiment 5 (pictures only) and Experiment 6 (verbal paraphrase), subjects were tested on part-forms of the original studied stimuli. In Experiment 6, the switch of format from graphic to verbal added an additional degree of transformation. The verbal paraphrases separated content from depiction by translating only the visual elements of each cartoon. In this, the *latent-content condition*, the cartoon is transformed in its entirety.

The present study pushed reconstructive retrieval to a new limit: the gist or latent content of a cartoon, not any straight copy or paraphrase served as test items. What is captured in words in a latent content item is the meaning of the cartoon -- its humor, commentary, or pungent observation intact. These extractions can be viewed as summary paraphrases. Latent content, by definition, is not instantaneously discernible by the reader of a cartoon. All the pieces, both script and image, must be put together in order to discern the humorous or satirical purpose of the presented item. In rendering the latent content, the whole cartoon must be processed, absorbed, reduced to its essence and then recapitulated. This produces an abstract from which recognition can proceed.

*Method*

*Subjects.* Twenty-five Brooklyn College students enrolled in an introductory psychology class were used as the subjects.

*Materials.* The materials were the same as in the prior experiments. Each latent content stimulus is a rendition of the underlying meaning of each cartoon, a special type of summary item that is a recapitulation of purpose and humor. In the writing of these items, care was taken not to include any specific words from the caption of the cartoon. The only exceptions made were for proper name identifiers (for example "Dennis the Menace"). Figure 7.1 gives an example of these items.

*Design and Procedure.* The procedure followed was, again, identical to the prior experiments with changes in instructions and examples as required.

*Results and Discussion*

As can be seen in Table 7.1, the latent content stimuli produced highly significant hypermnesia. The one-way analysis of variance with repeated measures on the average  $d'$  scores produced an  $F(2, 48)$  of 15.06,  $p = .0002$ . The area statistic showed, in this case, a significant upward trend in this condition as well:  $F(2, 48) = 13.32$ ,  $p = .0004$  (see Table 7.2). In this condition there is full use of the rating scale by the subjects and few cells with zero as an entry.

Figure 7.1

**Experiment 7: Examples of Original and Test Stimuli**

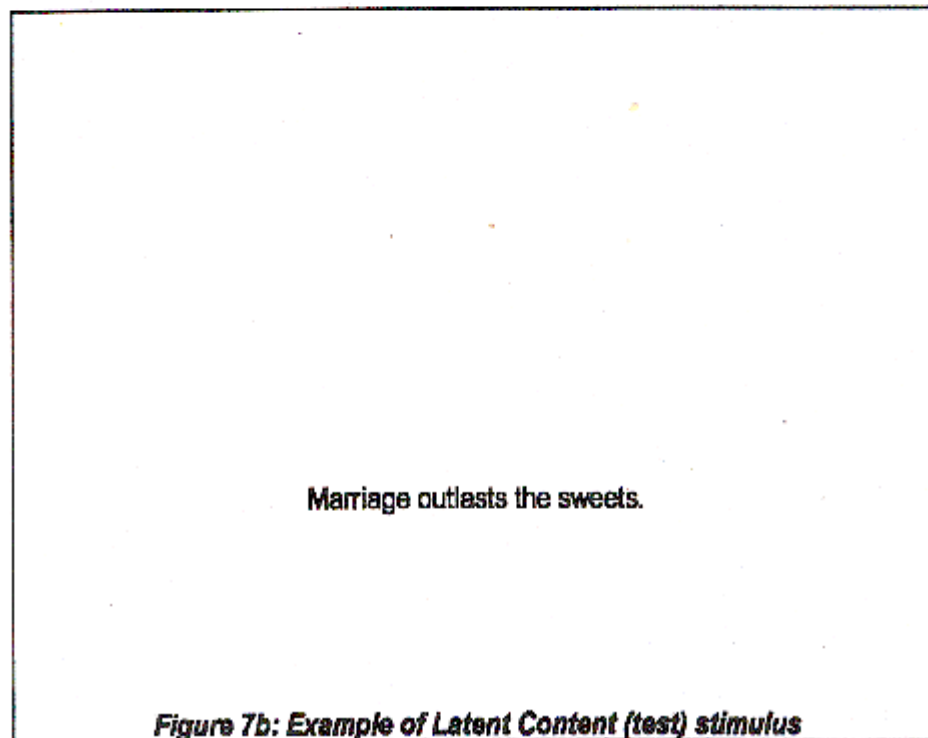
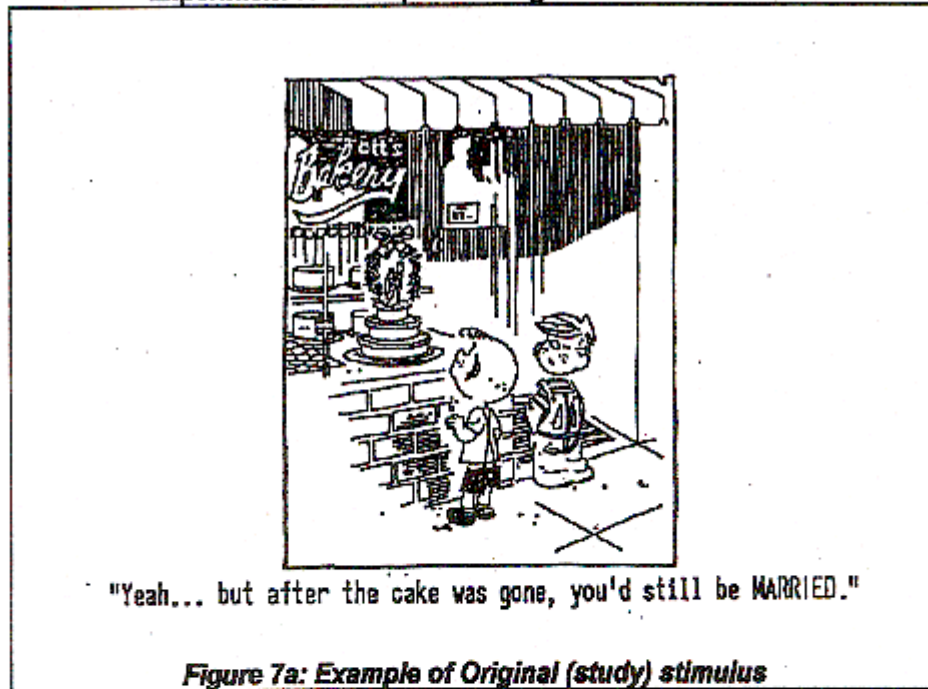
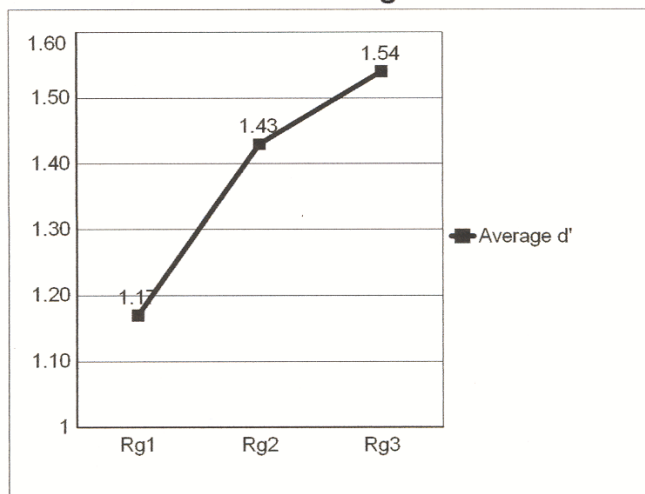


Table 7.1

**Experiment 7: Latent-Content Condition  
d' Over Three Recognition Trials**



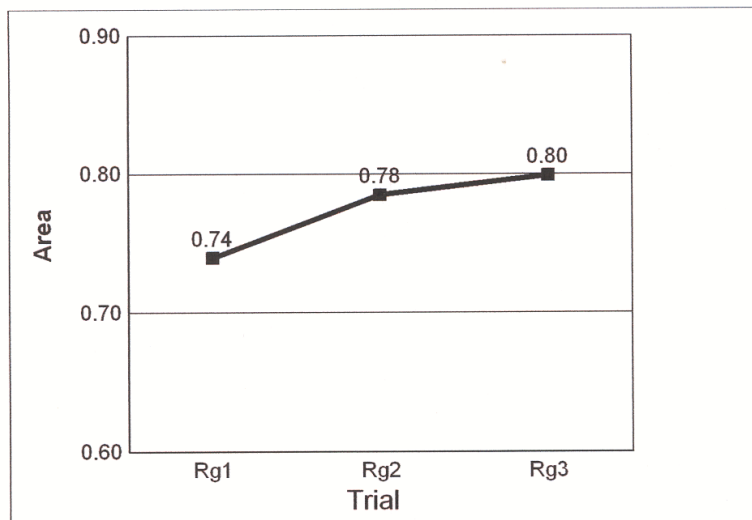
	<b>Rg1</b>	<b>Rg2</b>	<b>Rg3</b>
<b>Average d'</b>	<b>Average d'</b>	<b>Average d'</b>	<b>Average d'</b>
	2.08	2.51	2.43
	0.54	0.92	0.93
	1.98	2.24	2.07
	0.86	1.27	1.64
	1.15	1.85	1.78
	1.98	1.67	2.26
	0.50	0.92	0.92
	2.00	1.92	1.98
	1.03	1.01	0.78
	0.69	0.61	0.92
	1.01	0.69	1.12
	0.22	0.95	0.82
	0.49	0.68	0.47
	2.80	2.42	2.61
	1.61	1.90	2.12
	1.39	1.68	2.10
	1.37	1.58	1.47
	2.08	1.92	2.05
	1.96	2.79	2.79
	1.29	2.44	2.61
	0.10	0.82	0.40
	0.40	0.44	0.53
	0.97	1.24	1.42
	0.30	0.48	0.85
	0.43	0.70	1.32
$\bar{x}$	<b>1.17</b>	<b>1.43</b>	<b>1.54</b>

Table 7.2

**Experiment 7: Latent Content Condition with Area**

Rg1	Rg2	Rg3
Area	Area	Area
0.930	0.955	0.945
0.665	0.770	0.764
0.851	0.871	0.850
0.717	0.805	0.783
0.778	0.868	0.818
0.886	0.836	0.894
0.574	0.698	0.718
0.869	0.865	0.870
0.703	0.745	0.688
0.686	0.683	0.742
0.749	0.695	0.781
0.564	0.710	0.696
0.631	0.720	0.650
0.952	0.895	0.920
0.807	0.849	0.824
0.803	0.850	0.915
0.813	0.836	0.863
0.894	0.904	0.923
0.894	0.865	0.960
0.768	0.894	0.900
0.533	0.700	0.636
0.593	0.580	0.609
0.765	0.806	0.780
0.494	0.571	0.710
0.579	0.650	0.736
Rg1	Rg2	Rg3
0.740	0.785	0.799

x



Several degrees removed from the original stimuli, latent content items must force the participant into extended effort and multiple stages of retrieval paths in the act of remembering. The low levels of  $d'$  attest to this and the highly significant results demonstrate as well that when the task demands purposeful and explicit retrieval, hypermnesia will result.

These stimuli in particular may make the recognition task more like a recall task, so that the hypermnesia is more pronounced. As in the recall of an intricate story, it is not individual details that are remembered so much as the the gist of the entire item. The specifics gel into a substantive whole which is remembered more readily than individual verbatim aspects. The latent content items are fashioned to require tapping into more recall-like processes, with the concomitant induction of purposeful retrieval. These results demonstrate clearly that when recognition is made to move from a reflexive, mechanical act to one that is deliberate and constructive, hypermnesia will occur as it does in recall. Recognition, therefore, lies squarely in the same memory lane as recall.

## Experiment 8: Verbal Paraphrase combined with Latent Content

In this study, the features of the two previous successful experiments (6 & 7) were combined, in part to replicate the robust recognition hypermnesia obtained and to determine if an even stronger effect could be produced. The verbal paraphrase of the pictorial part of the cartoon *and* the latent content are presented together.

### *Method*

*Subjects.* Twenty-five Brooklyn College students enrolled in an introductory psychology class were used as the subjects.

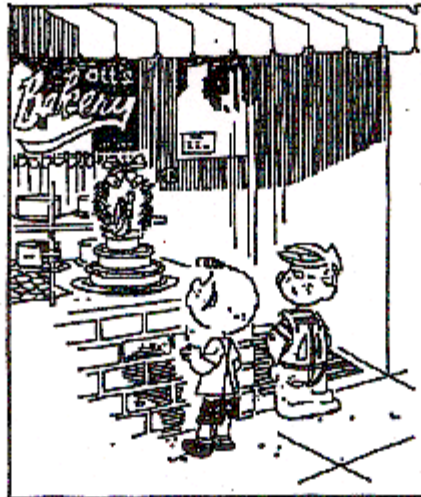
*Materials.* The materials were the same as in the prior two experiments (6 & 7), except combined. Each test item consists of a verbal paraphrase of the picture (as in Experiment 6) and the matching latent content (as in Experiment 7) for a single cartoon. Figure 8.1 gives an example of the stimulus and the recognition test.

*Design and Procedure.* The procedure followed was, once again, the same as in the prior experiments with changes in instructions and examples as required.

### *Results and Discussion*

The results show significant hypermnesia for this condition which paired each verbal paraphrases with its

Figure 8.1

**Experiment 8: Examples of Study and Test Stimuli**

"Yeah... but after the cake was gone, you'd still be MARRIED."

**Figure 8a: Example of Original (study) stimulus****KEY:**

VP. = verbal paraphrase (description of the picture portion of the cartoon)

LC. = latent content (the meaning of the cartoon)

VP. Dennis the Menace says something to his friend who is looking at a wedding cake in a bakery window.

LC. Marriage outlasts the sweets.

**Figure 8b: Example of Verbal Paraphrase and Latent Content (test) stimulus**

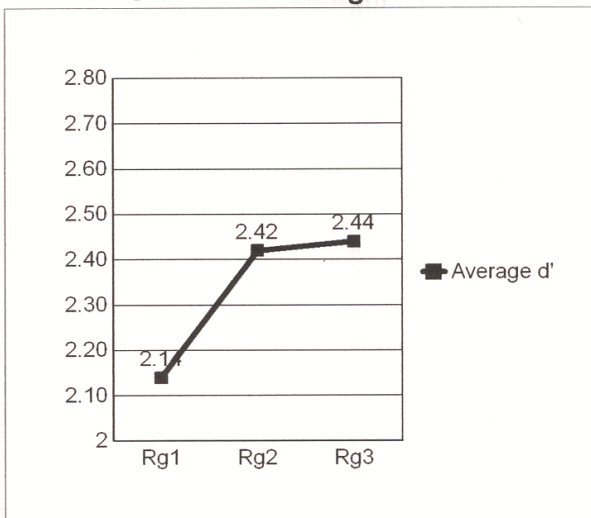
latent content (Table 8.1). A one-way analysis of variance with repeated measures on the average  $d'$  yielded a significant effect,  $F(2, 48) = 5.69$ ,  $p = .006$ . The area statistic showed an upward trend,  $F(2, 48) = 2.71$ ,  $p = .077$ . Thus, the results of Experiments 6 and 7--showing recognition hypermnesia--were replicated. Of additional note is that the phenomenon is stronger than the verbal paraphrase alone, though not quite as robust as the latent content alone. The  $d'$  levels in this investigation showed that the subjects performed at a higher rate of success than found with either the verbal paraphrases or latent content alone (Figure 8.2).

In summary, Experiments 5 - 8, as a set, demonstrated that the further away the recognition test is from identity-matching, the greater the hypermnesic effect that can be produced (Table 9.1). These findings significantly bolster the argument for a two-process model of recognition and provide extensive evidence that retrieval effort is the key ingredient in producing hypermnesia.

Experiment 5 (*pictures-only condition*) used a part-form in a non-standard test of recognition that required the subjects to initiate a kind of completion task before a recognition decision could be made. The apparently extended retrieval effort required for the task resulted in hypermnesia, the first successful reproduction of the Erdelyi and Stein (1981) design. Experiments 6, 7, and 8

Table 8.1

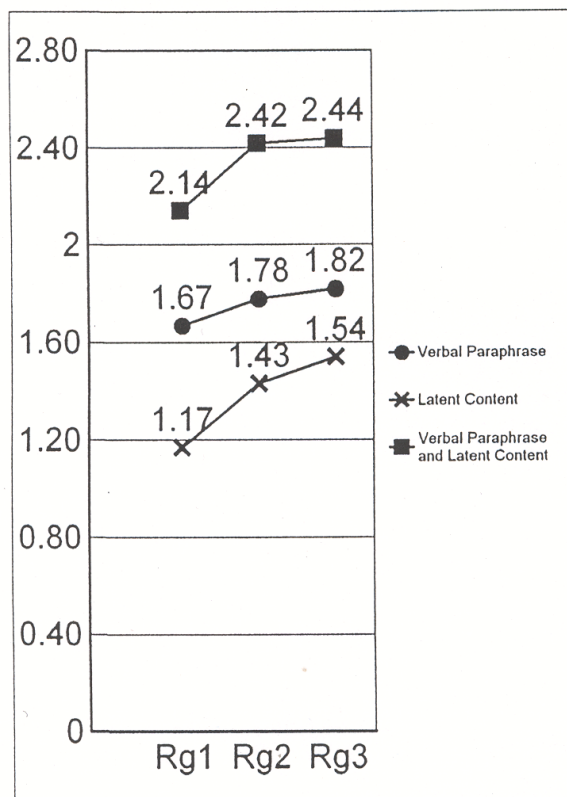
**Experiment 8: Verbal Paraphrase and Latent Content  
d' Over Three Recognition Trials**



	<b>Rg1</b>	<b>Rg2</b>	<b>Rg3</b>
<b>Average d'</b>	<b>3.16</b>	<b>3.53</b>	<b>3.53</b>
	2.22	2.31	2.49
	2.25	2.68	2.68
	1.72	1.44	1.79
	2.68	2.57	2.57
	1.77	1.58	1.80
	0.42	0.97	1.03
	1.96	1.96	2.07
	1.60	2.07	1.12
	1.55	1.75	1.95
	3.86	3.86	3.94
	2.74	2.78	2.96
	2.54	2.90	2.97
	2.93	3.16	2.68
	1.29	2.28	2.32
	1.55	2.97	3.17
	2.78	3.08	3.08
	1.98	1.80	2.44
	2.35	2.33	1.46
	2.24	2.85	2.93
	1.93	1.88	1.77
	3.12	3.00	2.95
	0.56	2.28	2.46
	1.48	2.05	2.33
	2.72	2.29	2.48
<b>x̄</b>	<b>2.14</b>	<b>2.42</b>	<b>2.44</b>

Figure 8.2

**Comparison of Average  $d'$  for Three Conditions**  
**Verbal Paraphrase (Experiment 6), Latent Content (Experiment 7) and**  
**Verbal Paraphrase combined with Latent Content (Experiment 8)**



	Rg1	Rg2	Rg3
Verbal Paraphrase	1.67	1.78	1.82
Latent Content	1.17	1.43	1.54
Verbal Paraphrase and Latent Content	2.14	2.42	2.44

Table 9.1

### Summary of Results for Experiments 5, 6, 7, & 8

#### Experiment 5

<b>Pictures Only</b>				
	Rg1	Rg2	Rg3	
Average $d'$	3.27	3.42	3.48	$p = .049$
Area	0.962	0.978	0.978	$p = .262$
Group ROC	0.964	0.978	0.979	

#### Experiment 6

<b>Verbal Paraphrase</b>				
	Rg1	Rg2	Rg3	
Average $d'$	1.67	1.78	1.82	$p = .032$
Area	0.815	0.834	0.836	$p = .141$
Group ROC	0.823	0.842	0.835	

#### Experiment 8

<b>Verbal Paraphrase and Latent Content</b>				
	Rg1	Rg2	Rg3	
Average $d'$	2.14	2.42	2.44	$p = .006$
Area	0.866	0.895	0.891	$p = .077$
Group ROC	0.867	0.896	0.891	

#### Experiment 7

<b>Latent Content</b>				
	Rg1	Rg2	Rg3	
Average $d'$	1.17	1.43	1.54	$p = .00002$
Area	0.740	0.785	0.799	$p = .00004$
Group ROC	0.742	0.796	0.804	

continued on this path, exploring varied and special types of transformations. The verbal paraphrases of Experiment 6 rendered the pictorial content of the cartoon in a written format and therefore were both part-form and transform. This further extended the design of a non-standard test of recognition, and is so doing, may be seen as having extended the required retrieval effort at test as well, resulting in significant hypermnesia.

Experiment 7 (*latent-content condition*) used the most abstracted transform of the study stimuli, produced by a summary of underlying meaning. The results of Experiment 7 demonstrated that a recognition task could be made difficult yet, in retaining (though not re-presenting) the essential features of the original stimulus, retrieval could not only be fruitful but improve with repeated efforts.

Experiment 8 combined, at test, the verbal paraphrase and the latent content of Experiments 6 and 7. Recognition hypermnesia, intermediate in magnitude to those obtained in Experiments 6 and 7 was obtained.

## Summary and General Discussion

This dissertation set out to explore recognition hypermnesia and determine if it could be produced reliably. Informed by the repeated success of recall hypermnesia and the few instances of recognition hypermnesia, a systematic approach was undertaken in the design of these experiments. Experiments 1, 2, and 3 sought to explore hypermnesia using stimuli that are typical in recognition and recall tasks in the laboratory. The test items for these experiments, however, were transforms, such that (depending on the experiment) pictures were tested with their verbal equivalents and words with their picture counterparts.

In Experiment 1, a lengthy delay between study and test, with high school students serving as subjects, was part of the design. In addition, non-standard tests of recognition (those in which tests are not comprised of re-presentations of studied stimuli) were employed. In Experiment 1, a simple stimulus transform was used for testing: Subjects studied a mixed list of pictures and words but were tested on words or the word identifiers of each picture. Recognition hypermnesia was not obtained with these subjects even though they had produced recall hypermnesia on an immediate task. An internal analysis of these data did show the special case of intra-test

hypermnnesia. The block analysis of the first half of each recognition test vs the remaining second half followed the approach introduced by Merikle and Reingold (1991; see pp. 25 - 28). The significant results, however, are tempered by the lack of control over the possible difference in items between first half and second half in the two blocks, as this analysis was not planned before hand.

Experiment 2 tightened the experimental design in separating pictures and words in the study phase. The subjects were assigned to one of two experimental groups studying a pure list comprised solely of words or of pictures. Both groups were tested with words after a short delay. The picture-study group (tested with words) produced significant improvement, demonstrating that hypermnnesia can result using traditional stimuli for study. The key to this result is the transform of stimulus items at test. Although the  $d'$  levels are high, the mere change from image to verbal label made the task effortful enough to limit the confining success typically produced by highly memorable stimuli. No intra-test hypermnnesia was found with either group in Experiment 2, leaving open the question of when and how this may occur.

Interestingly, the increase in retrieval effort resulting from the transformation of items between study and test has been quantified in a recent study on priming effects. Negative priming, defined as a slowed reaction

time, has been found to be of a greater magnitude when the probe of an item (that has been selectively ignored in the prime presentation) is in a different medium (Tipper and Driver, 2000). An increase in reaction time was found with both a word-to-picture and picture-to-word transformation from study to test.

In Experiment 2, pure lists of words or pictures were both tested with words. In Experiment 3 the design was made symmetrical by testing not only the pictures with words but also the words with pictures. These subjects had three short-term recognition tests and a delayed series as well.

Unfortunately this experiment produced neither inter- or intra-test hypermnesia. Thus, the results of Experiments 1, 2 and 3, as a group were problematic. What seemed to be a fruitful approach at first--the transformation of simple words and pictures at test--proved to be unsuccessful in subsequent experiments. A robust phenomenon in recall, recognition hypermnesia was proving to be delicate and ephemeral.

The Erdelyi and Stein study (1981) had produced one of the few clear-cut instances of recognition hypermnesia in the literature; however, it had not been replicated. Experiments 4 through 8 were designed around this study, in an attempt both to reproduce its results as well as to explore a variety of alterations of items at test. The use

of complex stimuli is an important starting point for these experiments.

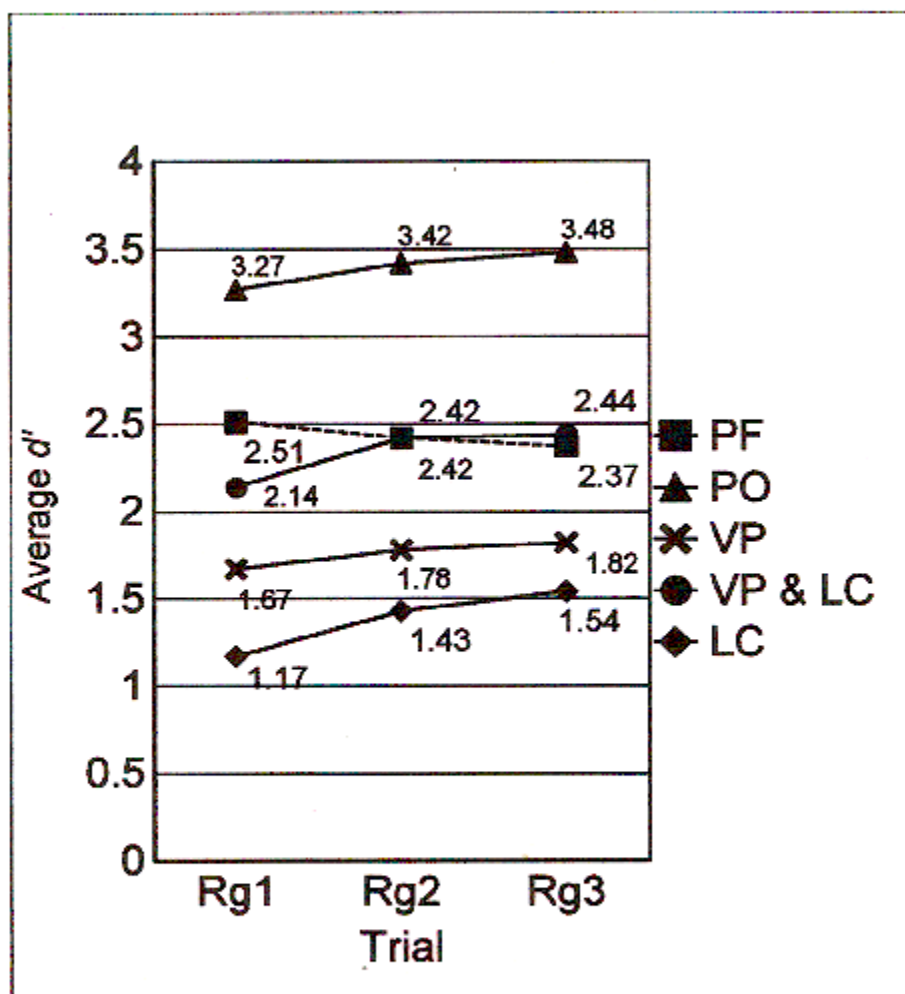
Experiment 5 (*picture-only condition*) replicated the Erdelyi and Stein (1981) findings and in so doing underscored the importance of introducing explicit effort into a recognition task intended to produce memory improvement. Presentation of a truncated stimulus (the picture portion of the cartoon) required mental regeneration of the original full cartoon by the subject.

Experiment 4 (*picture-fragment condition*) cropped the stimulus even further, leaving only a quarter (a quadrant of the picture) for testing. This truncating of the picture for testing went too far, apparently, since no recognition hypermnesia was obtained...the only failure in this series (Experiments 4 - 8; see Figure 9.2). These results lead to the conclusion that there is a delicate balance between too much and too little information that must be achieved when designing stimuli for these kinds of recognition tests. Too much of the original makes the retrieval automatic and easy; too little makes retrieval too difficult and unproductive.

Experiment 6 employed paraphrases of the stimuli, a procedure introduced by English, et al., (1934, 1939) and English and Edwards (1938) as items for recognition testing on studied text material. For the present experiment, verbal paraphrases were produced by rendering the visual elements of the cartoon in written form. These items, which

Figure 9.2

**Summary Graph of Results for Experiments 4 - 8  
d' Over Three Repeated Recognition Tests**



		Rg1	Rg2	Rg3
Picture-Fragment	PF	2.51	2.42	2.37
Picture-Only	PO	3.27	3.42	3.48
Verbal Paraphrase	VP	1.67	1.78	1.82
Verbal Paraphrase & Latent Content	VP & LC	2.14	2.42	2.44
Latent Content	LC	1.17	1.43	1.54

are both part-forms and transforms, produced a greater degree of hypermnesia than the pictures alone (Experiment 5).

Experiment 7 produced the strongest results: highly significant recognition hypermnesia using latent content of the stimuli for testing. These test stimuli are semantemes: the irreducible units of meaning of the cartoon. As such they are both intricate and concise summary items representative of figure, form, and substance. If the verbal paraphrases set a semantic frame for the initiation of retrieval, then the latent content items delve deeper by directing the search to begin from a very abstract base. Latent content items require analysis by the subjects for the presented interpretation and then comparison with the meanings gleaned from the original cartoons. When this search is undertaken, candidate cartoons are regenerated as they are retrieved. It is only then that a decision to recognize or reject can be made.

The latent content stimuli remove any trace of identity matching in the recognition task. The highly significant results were a surprise; in creating these stimuli it seemed that they were so far removed from the original that the task of reconstitution by the subjects would be too difficult (just as the picture fragments were insufficient to produce recognition hypermnesia in Experiment 4). The successful result provides strong evidence that recognition

need not be seen as the automatic arm of memory tasks, an easy exercise in matching features. Experiments 5 and 6 had confirmed both the presence of a retrieval process in recognition and the necessity of retrieval effort for recognition hypermnesia. In instigating retrieval from a deeply transformed access point, the latent content test-stimuli of Experiment 7 produced the strongest recognition hypermnesia.

The joining of verbal paraphrase with latent content in Experiment 8 proved to be a successful combination in producing recognition hypermnesia as well, though it did not produce hypermnesia greater than observed in the latent content (only) tests of Experiment 7.

As a set, Experiments 4 through 8 take a progressively extensive look at the role of retrieval in recognition and hypermnesia. What differs in recall and recognition is the starting point for retrieval. In recognition, there is an examination of an external cue, the retrieval of internal candidates, a correlation and matching of the two, and a concluding decision. In recall, the individual must self-generate items, first locating the domain space, and then engaging in a broad search that must be narrowed before acceptable items can be found. In the typical recognition task, where items are identical to the original, there need be no domain search: Items as presented are checked against those in memory. In the present experiments, in making

recognition tests more like recall for the purpose of inducing hypermnesia, the retrieval space is widened and the retrieval process is made more time-consuming.

The conclusion following from these results is that, to the extent that recognition is not merely viewed as an end point to recall or an automatic process of more perceptual than conceptual bent, hypermnesia can prove to be as robust a phenomenon in recognition as in recall. Retrieval is the problem solver of memory and it has proven to be the solution to the recognition hypermnesia puzzle. It is clear that retrieval occurs in both recognition and recall and that when retrieval is forced out of its hidden status in recognition, hypermnesia will result. In the typical recognition task, that of identity matching, the retrieval step is essentially automatic and therefore not a factor. It is when retrieval plays an active role in recognition that recognition hypermnesia results. This insight leads to the understanding that hypermnesia is a more generalized memory effect than was previously thought and that it can be reliably produced to the extent that retrieval effort is a significant component of the recognition task.

## Future Lines of Research

The experiments reported in this thesis are confined to one laboratory session of about two hours. It would be interesting to expand this experimental time-frame to determine if recognition hypermnesia can be produced over longer intervals (days, weeks, or longer), and if its magnitude increases over time. The stimulus base should also be expanded to include other types of meaningful or "deep" stimuli, e.g., poetry, narrative stories, math problems, and so on. Along these lines, and congruent with a more "real-life" recognition task, photographs of people would be used as study stimuli, with test stimuli involving various transforms, e.g., different clothing, hairstyle, angle of photo, or contextual background.

The possibility of recognition hypermnesia occurring in a forensic setting is especially intriguing. For example, would multiple tests in line-up recognition improve over time? Would recognition of human faces in contrast to every-day objects show differential effects? Also, would children and adults show differences in recognition hypermnesia?

Merikle and Reingold's (1991) findings of recognition hypermnesia for subliminal stimuli should be replicated and extended to a range of liminal exposures. If, in fact, low-grade recognition memory around  $d' = 0$  can both decrease (to

$d' < 0$ ) and then increase (to  $d' > 0$ ) over time, basic ideas in subliminal perception (e.g., "the objective threshold") would need to be discarded or revised, as suggested by Erdelyi (2004a and 2004b).

Clearly, the dissertation has accomplished only a first step: the demonstration of reliable recognition hypermnesia. Now it remains to be seen how strong the effect can be and how it generalizes to a variety of real-life settings. Also of interest is the extent to which recognition hypermnesia requires theoretical reformulation in other areas of psychology, including subliminal perception.

## Appendix A

## Stimulus Set (Experiment 1)

<u>POSITION</u>	<u>ITEM</u>	<u>PICTURE</u> <u>WORD</u>	<u>POSITION</u>	<u>ITEM</u>	<u>PICTURE</u> <u>WORD</u>
1	CUP	(P)	41	KITE	(P)
2	TELEPHONE	(W)	42	ARROW	(W)
3	FUNNEL	(P)	43	IGLOO	(P)
4	STAR	(W)	44	BELT	(P)
5	CHAIR	(W)	45	CAR	(P)
6	DOMINO	(P)	46	SNAKE	(W)
7	MOON	(W)	47	CARROT	(W)
8	NAIL	(W)	48	HEART	(W)
9	BROOM	(W)	49	CANDLE	(W)
10	WATCH	(W)	50	DOG	(P)
11	TABLE	(P)	51	HAND	(P)
12	BAT	(W)	52	AIRPLANE	(W)
13	SUN	(P)	53	TOASTER	(P)
14	FOOTBALL	(P)	54	CAT	(W)
15	SOCK	(P)	55	BOAT	(W)
16	RACKET	(W)	56	PIPE	(P)
17	SHIRT	(P)	57	BOTTLE	(P)
18	BIRD	(W)	58	PITCHER	(P)
19	GLASSES	(W)	59	COMB	(W)
20	BICYCLE	(W)	60	SEAL	(P)
21	KNIFE	(P)	61	FISH	(W)
22	SCISSORS	(P)	62	KEY	(W)
23	LIGHT BULB	(P)	63	ALLIGATOR	(W)
24	FORK	(W)	64	BOOT	(P)
25	GUITAR	(W)	65	PINEAPPLE	(P)
26	FLAG	(W)	66	BOWL	(P)
27	UMBRELLA	(W)	67	CHAIN	(W)
28	WHEEL	(W)	68	BRIEFCASE	(P)
29	NET	(P)	69	PENCIL	(W)
30	PEAR	(W)	70	AX	(W)
31	FLOWER	(P)	71	BELL	(W)
32	LADDER	(P)	72	GUN	(P)
33	HAMMER	(P)	73	PLUG	(W)
34	LAMP	(P)	74	CAGE	(P)
35	TREE	(P)	75	BOOK	(P)
36	TELEVISION	(W)	76	PIG	(W)
37	BALLOON	(W)	77	HANGER	(P)
38	BANANA	(P)	78	SYRINGE	(P)
39	RING	(W)	79	HAT	(W)
40	SAW	(P)	80	LEAF	(P)

## Appendix B

INSTRUCTIONS (EXPERIMENT 1/HIGH SCHOOL STUDENTS)

My name is Mrs. Bergstein - I teach science here - some of you may know me or not. Mrs. Lombardo was nice enough to let me come here to your class today to have you help me out by participating in an experiment. I also do some work and study at Brooklyn College doing some research on learning and memory. We're interested in learning about how different kinds of people learn and remember things. So I'm going to ask you if you'd like to help me out by being part of an experiment. Let me add that this is all voluntary -- if you don't want to do it I'll just ask you to sit quietly and not disturb anyone else who is concentrating. If you do decide to take part though I need you to be very serious about it: follow my instructions and really do what I ask otherwise you can mess up everyone else's work (mine and everyone else who is trying).

Let me tell you what we're going to do before you decide. I'm going to show you a series of slides some of which are just a word and some which are just a picture. Later, I'm going to ask you to remember what you've seen.

Now, anyone who doesn't want to participate? Remember I need you to be very serious about this, if you do decide to join us. No one is going to grade you or mark you on your performance -- we're interested in learning about how different people remember, so however you do is o.k. as long as you try your best and put in a serious effort. And by the way if you decide to participate, but then decide to stop in the middle, that's alright too.

O.K., when we turn down the lights you're going to see a mixed series of words and pictures. Concentrate as you see each one. If it's a picture, try to get it into your head; if it's a word, try to make an image of what it is (represents) in your mind. After we're done I'll ask you to remember as many as you can of the words and pictures you've seen.

*(turn down lights; direct attention to the screen; slides presented at 5 seconds each; after presentation, distribute response sheets with fifty numbered blank lines)*

You can see that each sheet has 50 blank lines. When I tell you to start, write down every item you remember, one word to a line. Whether it was a word or a picture just write down a word: you don't have draw anything therefore. Remember as hard as you can; and even after you're sure you

can't remember any more, try a little more. Now, when you're certain that you can not recall any more, draw a line and continue to fill in the space with guesses until all 50 lines are filled. Make them smart guesses though, good educated guesses. By the way, if as you're doing this you do remember one that you saw, put a little star next to it so I'll know it was something you recalled and not a guess. You must fill in every line then, with no repeats. I'll give you a warning when we're almost out of time.

Before we start, remember I'm just interested in the best you can do -- there are no marks, grades or evaluations tied to this. We're just studying different kinds of people, and I appreciate your putting in a good effort. Thanks!

## Appendix C

Instructions (Experiment 1): Delayed Recall

You may recall that I was here a few weeks ago to show you some slides and ask you to remember what you saw. Well, can you guess why I'm here again now?

That's right, I'm back to see how well you can remember those things now. We're going to do things a little differently though, so let me explain what it is that I'm going to ask you to do.

First, I'll remind you again, that this is not a test, no one is going to check up on you and it has nothing to do with your class mark. But I'll also remind you that this is a serious experiment so I need you to concentrate and do the best you can. I'm going to emphasize the you in this because, again, I'm only interested in how different people learn and remember; it's not important how well you remember in comparison to anyone else. It's not a competition so please, and this is very important, do your own work, don't look at anyone else's paper, even accidentally. After all, if I think I'm checking your memory, but it's really your neighbor's memory, it's really going to mess up my results. So relax, have a little fun seeing how much you remember and don't concern yourself with how anybody else is doing.

Now, what are we going to do today? I'm not going to show you the slides again. I'm going to give you a sheet that has 40 blank lines. When I tell you to start, write down every item you remember, one word to a line. Whether it was a word or a picture just write down a word: you don't have to draw anything therefore. Remember as hard as you can; and even after you're sure you can't remember any more, try a little more. Now, when you're certain that you can not recall any more, draw a line and continue to fill in the space with guesses until all 40 lines are filled. Make them smart guesses though, good educated guesses. By the way, if as you're doing this you do remember one that you saw, put a little star next to it so I'll know it was something you recalled and not a guess. You must fill in every line then, with no repeats. I'll give you a warning when we're almost out of time.

Before we start, remember I'm just interested in the best you can do -- there are no marks, grades or evaluations tied to this. We're just studying different kinds of people, and I appreciate your putting in a good effort. Thanks!

*(give out sheets; give students 7-8 minutes with warning)*

*and a minute or two grace period. remind students not to talk as they have more to do in the experiment)*

Okay, now that you've relaxed a minute I'm going to ask you to try again. Put down everything you can remember, in other words don't just add to what you did the first time. If you remember new items, put them down too. Do the same as before: concentrate remember all you can. When you're sure you've remembered everything, draw a line and fill in those spaces. Make a check next to those that you think you really remember and that are not a guess.

*(repeat a third time)*

## Appendix D

Experiment 1Practice Rating Scale Distributed to Subjects

Directions: After you read each word, circle the number on the scale that best shows your thoughts. The ratings range from 0 ("I definitely DON'T remember seeing it), to 1 ("I probably didn't see it") to 2 ("I probably did see it") to 3 ("I definitely DID see it").

0.....1.....2.....3  
 NO!            No            Yes            YES!  
 [DEFINITELY NO] [PROBABLY NO] [PROBABLY YES] [DEFINITELY YES]

AIRPLANE	0...1...2...3
SCISSORS	0...1...2...3
LADDER	0...1...2...3
RULER	0...1...2...3

## Appendix E

Directions (Experiment 1): Delayed Recognition

You may recall that I was here a few weeks ago to show you some slides and ask you to remember what you saw. Well, can you guess why I'm here again now?

That's right, I'm back to see how well you can remember those things now. We're going to do things a little differently though, so let me explain what it is that I'm going to ask you to do.

First, I'll remind you again, that this is not a test, no one is going to check up on you and it has nothing to do with your class mark. But I'll also remind you that this is a serious experiment so I need you to concentrate and do the best you can. I'm going to emphasize this because, again, I'm only interested in how different people learn and remember; it's not important how well you remember in comparison to anyone else. It's not a competition so please, and this is very important, do your own work, don't look at anyone else's paper, even accidentally. After all, if I think I'm checking your memory, but it's really your neighbor's memory, it's really going to mess up my results. So relax, have a little fun seeing how much you remember and don't concern yourself with how anybody else is doing.

Now, what are we going to do today? I'm not going to show you the slides again. I'm going to give you a piece of paper with a list of words on it, half of which were things you saw last time I was here, and half of which you didn't see. You recall that some of the slides were just words and some were drawings of things, but this time there are no drawings, just words or the names of the pictures you saw. Your job is to tell me which ones you remember seeing and which you don't. But, I'm not just going to ask you simply to tell me yes or no, I'm going to ask you to give me an idea of how sure you are of your answer. How are you going to do that? Next to each word is a rating scale and you are going to circle the rating from 0 to 3 that shows your thoughts. Let me show you.

(Give out example) Look at the scale and let's read the directions. (Read directions) Okay, let's try the first one. Did you see airplane last time? Yes or No? Now how sure are you of your answer? Are you definite that you saw it? Which would you circle? (Try several variations on this, with three examples). Get the hang of it? Any questions?

If everyone's ready, I'll give out the papers now. You'll notice a number on top -- that's because everyone's paper is a little different, so just in case you accidentally happen to look at someone else's paper, it won't really matter. Remember, only your work is important in this

experiment. I will let you know a minute or two before time is up. Work your way through each item -- you must rate each one, so try not to stay on any one too long.

*(give out folders with recognition response sheets; have students work for 7-8 minutes. Give a grace period of a minute or two. collect the folders, reminding the students not to talk, but to relax for a minute because we have more things to do)*

Okay, everyone rested? Now, I'm going to ask you to try the same thing again. Read each item again, and think about it, putting down your feelings. Don't worry about trying to remember the rating you put down last time: if you feel the same way, rate it the same way. But if you've changed your mind that's okay also, you can circle a different rating. Again, do your own work, carefully and deliberately and I'll give you a warning when we're almost done.

## Appendix F

Experiments 4 -8Instructions to Subjects (Study Phase and Test Phase)

This study is concerned with the ability to remember a large number of cartoons.

If you choose to take part, I will give you a booklet containing all 140 of the cartoons and ask you to read through them one by one. After you are done, I will test your memory.

These cartoons come from magazines, newspapers, or book collections. They are generally in the nature of social satire, political, or comic-book type humor. Some of them are slightly off-color, meaning that they have some sexual content. If you are uncomfortable with this, you may choose not to participate, in which case you will get a half-hour credit for the time you have invested in coming here. Your responses to all of the questions will remain confidential. I will not ask you to put your name on any of the response sheets; instead you will be given a code number. Do you want to proceed?

I will now give you a booklet and ask you to read through the cartoons, one by one. Read through each cartoon, paying close attention to each one, as you will be tested on them later. So that we all stay at the same pace, I will tell you when to start and stop for each cartoon, giving you about twenty seconds for each. If you need some more time on any particular cartoon just ask me and I will give you a grace period. *[When all 140 cartoons have been completed, the participants are asked to close the booklet and sit back until further instructions]*

Before we start, I'd like to remind you that your participation is voluntary and also that you may stop at any time during the experiment. If that happens, I will still give you credit for your participation up to that point. Are there any questions?

Memory Test

Now that you have finished studying the cartoons I would like to test your memory of them. I am going to give you another booklet and in this booklet you will find a set of test items containing

- the picture component of the cartoon (just the picture without the caption)
- a section of the cartoon (1/4 or 1/2 of the picture)
- a paraphrase or summary of the picture part of the cartoon
- a written description of the underlying meaning or message of the cartoon

Let me show you an example of the kind of test item that you will be seeing. Do you have any questions?

There will be only forty test items. Half (twenty) actually appeared in the group of cartoons that you studied; the other half did not. I will ask you to indicate whether you recognize each item and also to tell me how confident you are in your answer by rating it on a four point scale. Let me show you the scale and what each point represents.

*[Demonstrate the scale]* Do you understand the rating scale?

Read through each item in your test booklet. Rate each test item in order (first, second...to last). Please don't write in the booklet but do all your ratings on the answer sheet provided. Proceed through each item carefully. Do not go back to any item that you have completed and do not change your ratings. When you are done, you can sit quietly and wait for further instructions. O.K., lets begin.

## Appendix G

Experiments 4 - 8: Recognition Response Sheet

Directions: After you read each word, circle the number on the scale that best shows your thoughts. The ratings range from 0 ("I definitely DON'T remember seeing it), to 1 ("I probably didn't see it") to 2 ("I probably did see it") to 3 ("I definitely DID see it").

0.....1.....2.....3  
**NO!            No            Yes            YES!**  
 [DEFINITELY NO] [PROBABLY NO] [PROBABLY YES] [DEFINITELY YES]

#1) 0...1...2...3	#21) 0...1...2...3
#2) 0...1...2...3	#22) 0...1...2...3
#3) 0...1...2...3	#23) 0...1...2...3
#4) 0...1...2...3	#24) 0...1...2...3
#5) 0...1...2...3	#25) 0...1...2...3
#6) 0...1...2...3	#26) 0...1...2...3
#7) 0...1...2...3	#27) 0...1...2...3
#8) 0...1...2...3	#28) 0...1...2...3
#9) 0...1...2...3	#29) 0...1...2...3
#10) 0...1...2...3	#30) 0...1...2...3
#11) 0...1...2...3	#31) 0...1...2...3
#12) 0...1...2...3	#32) 0...1...2...3
#13) 0...1...2...3	#33) 0...1...2...3
#14) 0...1...2...3	#34) 0...1...2...3
#15) 0...1...2...3	#35) 0...1...2...3
#16) 0...1...2...3	#36) 0...1...2...3
#17) 0...1...2...3	#37) 0...1...2...3
#18) 0...1...2...3	#38) 0...1...2...3
#19) 0...1...2...3	#39) 0...1...2...3
#20) 0...1...2...3	#40) 0...1...2...3

## Appendix H

**Correlation: Average  $d'$  and Area**

		Average $d'$	Area
Verbal Paraphrase	Rg1	1.67	0.823
	Rg2	1.78	0.842
	Rg3	1.82	0.835
Verbal Paraphrase and Latent Content	Rg1	2.14	0.867
	Rg2	2.42	0.896
	Rg3	2.44	0.891
Picture Only	Rg1	3.27	0.964
	Rg2	3.42	0.978
	Rg3	3.48	0.979
Latent Content	Rg1	1.17	0.742
	Rg2	1.43	0.796
	Rg3	1.54	0.804
Picture Fragments	Rg1	2.51	0.928
	Rg2	2.42	0.912
	Rg3	2.54	0.898

Correlation: VP, VPand LC, PO

	Column 1	Column 2
Column 1	1	
Column 2	0.9901577	1

Correlation: All Groups

	Column 1	Column 2
Column 1	1	
Column 2	0.9805354	1

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