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CONSCIOUS AWARENESS OF FACIAL STIMULI AS A FUNCTION OF ATTENTIONAL, TIME AND CONTEXTUAL CONSTRAINTS

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ABSTRACT

The present research inquired the functional dissociation, that different independent variables produce, between the two states of conscious awareness, measured by remember and know responses. The experimental work used a divided attention task, and two contextual manipulations, a perceptual one and a conceptual one.

The findings from the divided attention task showed the selective influence on remembering whereas knowing remained unaffected across conditions. Furthermore, the observed dissociation was maintained in varying divided attention tasks, that is, tone counting (Experiment 1 and 2) and story listening (Experiment 3).

The overall findings from the manipulation of context was that study/test compatibility increased only remember responses whereas know and guess responses maintained similar levels of performance. However, the effect of context disappeared under rapid presentation rates, namely 300 and 700msec. This pattern of dissociation between remembering and knowing was preserved in both perceptual manipulations, that is, modification of size in Experiments 4 and 5, and conceptual manipulation, that is, alteration of word cues in Experiments 6 and 7.

The obtained results are discussed in the light of the conceptual/perceptual theory, the distinctiveness/fluency theory, the signal detection theory, and the multiple memory systems theory.

CHAPTER 1

MEMORY AND CONSCIOUS AWARENESS

1.1 General Introduction

The work that follows sets out to investigate the systematic dissociations between the two states of conscious awareness, measured by remember and know responses, in recognition memory. Furthermore, the study seeks out to determine how conceptual and perceptual manipulations produce differential effects on remembering and knowing.

Section 1.1 of this chapter depicts the relation between memory concepts and consciousness by stating Tulving's distinction between noetic, autonoetic and anoetic consciousness (Section 1.1.i), along with the development of the remember/know experimental paradigm (Section 1.1.ii).

Section 1.2 deals with the historical development of consciousness in memory research. Specifically, section 1.2.1 discusses the four major theoretical explanations for dissociations between remembering and knowing: the multiple memory systems account according to which remember and know responses reflect different memory systems (e.g. Tulving, 1985b), the transfer appropriate processing account according to which dissociations between remember and know responses reflect different degrees of processing (e.g. Roediger & McDermott, 1993; Rajaram & Roediger, 1997), the distinctiveness/fluency account according to which remember and know responses are influenced by the distinctive, or fluent attributes, by which the material is processed

(Rajaram, 1996; 1998), and the signal detection theory account which suggests that remembering and knowing reflect different response criteria in a continuum of memory strength (Donaldson, 1996). Section 1.2.2 deals with additional related work that provides further explanations to the dissociations between remembering and knowing, that is, Jacoby's (1991; 1996) process dissociations procedure and Gardiner's (1988; Gardiner & Java, 1990; 1993) integrative view. Section 1.2.3 reviews the empirical evidence reporting remember and know responses according to independent variables that yield dissociations and independent variables showing parallel effects. Section 1.2.4 delineates the relation between remember and know responses and discusses the view of exclusivity (e.g. Gardiner, 1988; Gardiner & Parkin, 1990; Gardiner & Java, 1991), inclusivity (e.g. Joordens & Mericle, 1993) and independence (e.g. Jacoby, Yonelinas & Jennings, 1997).

Finally, section 1.3 deals with the current research interests, with section 1.3.1 dealing with the main aims of the thesis in relation to the theoretical explanations, and with section 1.3.2 describing the experimental chapters.

1.1.i Consciousness and Corresponding Memory Concepts

Memory research, from the days of William James (1890) and Herman Ebbinghaus (1885), emphasised the important role of consciousness in retention. It was James who first attempted to give a psychological definition to consciousness. He defined it as personal, selective, purposive, continuous and constantly changing (James, 1890, Vol.1). In his own words he wrote, "consciousness, then, does not appear to itself chopped up in bits . . . it flows. A 'river' or a 'stream' are the metaphors by which it is most naturally described" (1890, Vol.1, p.239).

Nearly a century later, Tulving (1983, 1985a, 1985b) dealt with the concept of consciousness, which he defined as "our capacity to contemplate the universe and to apprehend the infinity of space and time, and our knowledge that we can do so" (Tulving, 1995b, p. 1). Tulving's contribution to the study of consciousness has been the introduction of the concepts of autonoetic, noetic and anoetic consciousness in an attempt to accommodate three memory systems (1983; 1985a). He assumed that each system is associated with a different kind of consciousness. Specifically, autonoetic consciousness, that is, self knowing, is related to self awareness through time. The following quote has been taken from Tulving's (1985a) article and describes clearly his conception of autonoetic consciousness. It "allows an individual to become aware of his or her own identity and existence in subjective time that extends from the past through the present to the future. It provides the familiar phenomenal flavour of recollective experience characterised by 'pastness' and subjective veridicality. It can be impaired or lost without impairment or loss of other forms of consciousness" (Tulving, 1985a, p.388). Tulving maintains that noetic (knowing) consciousness is associated with our general knowledge of the world we live in, in a more abstract way. He argues in the following quote, taken from the same source, that "the object of noetic consciousness is the organism's knowledge of its world" (Tulving, 1985a, p.388). Finally, anoetic (nonknowing) consciousness allows us to be aware only of our immediate surrounding and makes us react to an immediate situation. It "refers to an organism's capability to sense and to react to external and internal stimulation, including complex stimulus patterns" (Tulving, 1985a, p.388).

Tulving's (1983; 1985a) conceptualisation of consciousness is not arbitrary but is related to already existing conceptualisations of memory. Specifically, autonoetic consciousness relies upon the episodic system, noetic consciousness is controlled by the semantic system, and anoetic is associated with the procedural system.

The development of an experimental paradigm for studying consciousness was suggested by Tulving (1985b), in which remembering and knowing was defined and tested as different levels of conscious awareness. Accordingly, remember and know responses were subjective reports of autonoetic and noetic consciousness respectively, which in turn characterised the episodic and semantic memory systems. In fact, the author clearly indicated the distinction between remembering and knowing by arguing that

". . . even when a person does not remember an event, she may know something about it" (1985b, p.6).

Tulving's initial writings on the topic turned out to be extremely stimulating and yielded a series of empirical papers that provided modifications of his view of memory. Researchers such as Roediger (e.g. Rajaram & Roediger, 1997), Gardiner (e.g. Gardiner, Ramponi, & Richardson-Klavehn, 1999) and Jacoby (e.g. Jacoby, Yonelinas, & Jennings, 1997) carried out interesting extensions of his experiments. Their data led to alternative theoretical models of the underlying mechanisms of memory.

In conclusion, it seems that nowadays we have a clearer view of the parameters that may influence the relation between memory and consciousness despite the fact that research on the matter has generated a number of controversies.

1.1.ii Remembering and Knowing Distinction

Endel Tulving (1985b) demonstrated the use of remembering and knowing as reports of autonoetic and noetic consciousness, respectively. In his illustrative experiment, he presented participants with lists of pair words which were tested for free recall, cued recall and recognition. After participants recalled, or recognised an item, they were also asked to provide for each item a remember or a know judgement. Results showed that remembering was greater for recognition than cued recall, and greater for cued recall than free recall. Interestingly enough, however, remembering declined over an 8'day retention interval whereas knowing did not.

It is worth noting that prior to Tulving, Mandler (1980) made the distinction between two different components of recognition, that is, elaboration and integration. According to Mandler, elaboration depends on conceptual analysis and the item's internal features, and is associated with conscious experience of recollection, whereas integration depends on a perceptual and sensory analysis of the presented items and is associated with feelings of familiarity.

Both Tulving's (1985a) and Mandler's (1980) theoretical arguments point to the existence of two distinct states of awareness depending on the memory experience. This distinction is experienced in everyday life either in memories that are remembered consciously, meaning specific place and situation, or in memories that produce a feeling of familiarity, meaning knowing something without remembering places or situations.

Following Tulving's original research, Gardiner and his colleagues extended the ideas put forth by previous writers. He carried out a series of experiments in which subjects were instructed to make a distinction between remembering and knowing based on the following classifications. According to Gardiner (1988, p.311) remembering was defined as "the ability to become consciously aware again of some aspect or aspects of what happened or what was experienced at the time the word was presented (e.g. aspects of the physical appearance of the word, or something that happened in the room, or what one was thinking or doing at that time)". Similarly, knowing was defined as "the recognition that the word was in the booklet but the inability to recollect consciously anything about its actual occurrence, or what happened, or what was experienced at the time of its occurrence" (Gardiner, 1988, p.311). From the above definitions it appears that participants were required to distinguish between their mental experiences and not to report them in full, which differs from classical introspection.

The main goal of the remember/know paradigm was to measure individual experiences and mental events that contributed to memory performance, under controlled conditions. For this reason, different experimental manipulations and different subject populations have been used producing systematic and functional dissociations between remember and know responses (e.g. Gardiner & Java, 1990; Gregg & Gardiner, 1994; Gardiner, Ramponi, & Richardson-Klavehn, 1999). Different theoretical models emerged to explain these dissociations between remembering and knowing, and in turn to explain the basic mechanisms underlying memory and consciousness.

Subsequent empirical demonstrations by Gardiner and his associates (e.g. Gardiner, Kaminska, Dixon, & Java, 1996a) indicated that false alarm rates in some experimental manipulations were relatively high (e.g. Gregg & Gardiner, 1994). Initially, these differences were attributed to different variables, for example response bias (Strack & Forster, 1995). However, Gardiner and his associates assumed that the large differences between corrected and uncorrected data (e.g. Rajaram, 1990; Gregg & Gardiner, 1994) were attributed to the fact that participants may have included guessing along with know responses, despite the specific instructions that discouraged guessing (see Gardiner, Java, & Richardson-Klavehn, 1996, for a review). This assumption initiated a series of experimental manipulations in which a third state of awareness was introduced, that is, guess responses. Guessing was instructed as follows: "there will also be times when you do not remember a theme, nor does it seem familiar, but you might want to guess that it was one of the themes you heard earlier" (Gardiner, Kaminska, Dixon, & Java, 1996a, p.369).

Evidence from studies that reported guesses showed that guessing was used as a default response category that involved other judgmental strategies for selection. Specifically, Gardiner, Ramponi, and Richardson-Klavehn (1998) reported transcripts of participants' explanations upon their responses. They found that guessing was associated to personal thoughts of the participants which were not related to the studied items, for example, "it was a guess" (p. 8), or "I lived by the sea all my life, so I was not sure whether I have encountered that word here or whether it is to do with home" (p. 22). Results from those studies yielded important findings. Firstly, guess responses do not have discriminative power, that is, they lack the ability to separate targets from lures. Secondly, guess responses show below chance performance that might be attributed to greater response opportunity with new than with old items. And thirdly, guess responses were affected by manipulations of response bias and response opportunity (see Gardiner, Ramponi & Richardson-Klavehn, 1998, p. 2, for review).

However, the advantage of guess responses is not that clear since we are getting different results across laboratory settings (e.g. Gardiner, Java, & Richardson-Klavehn, 1996b), and naturalistic ones (Conway, Gardiner, Perfect, Anderson, & Cohen, 1997). Conway et al. tested psychology students in a multiple choice test following lecture, and laboratory research, courses. Their answers were accompanied by one of the following states of awareness: remembering, knowing, familiarity and guessing. Results showed that students who scored high on the test, gave more correct guess answers, indicating that guessing is partly dependent on conscious aspects of memory. In these tests, the answers to the multiple questions are not equally probable, a priori, and so students can use partial knowledge they may have about the topic to discount the less probable answers. This would explain why their guesses are sometimes correct. In contrast, findings in the laboratory studies indicated that guess responses lack any conscious memory of studied items (e.g. Gardiner, Kaminska, Dixon, & Java, 1996a).

At this point it seems worthwhile to point out that guessing has not been adequately explained by different theoretical accounts (e.g. Tulving, 1985b; Rajaram & Roediger, 1997; Rajaram, 1998; Donaldson, 1996). The only usefulness most theorists emphasise is that guessing purifies know responses and allows the interpretation of knowing without this confounding (e.g. Gardiner, Richardson-Klavehn & Ramponi, 1997).

1.2. Historical Development of Consciousness of Memory Research

1.2.1 Theoretical Accounts

A number of theoretical accounts have been proposed to explain the different effects that the two states of awareness exhibit. In this section we will discuss the four most influential ones, along with some other related proposals.

1.2.1.i Tulving's Systems Account

Tulving's contribution to the understanding of the organisation of memory started in 1972 when he first introduced the terms episodic and semantic memory to explain the retention of personal experiences and general knowledge information. In 1985, Tulving published his proposal on multiple memory systems, in which he related consciousness with memory, and the experiential measures of memory were introduced. Finally, to account for differences between implicit and explicit memory tests, conceptual and perceptual memory tasks and differences between amnesic and normal individuals, Tulving (1985a; 1995) suggested the existence of five different memory systems. Those systems are: procedural memory, perceptual representation memory, semantic memory, working memory and episodic memory. According to Tulving (1995) the relation between these memory systems is process-specific depending on the process involved, that is, encoding, storage, or retrieval processes. Specifically, information is encoded serially, then it is stored in a parallel way, and finally it is retrieved independently.

According to Tulving, the procedural system represents our skilled behavioural and cognitive action performance. It is described as a vast, mainly unexplored memory system responsible for motor and cognitive skills, simple conditioning and simple associative learning. These skills are mainly acquired by gradual learning and are performed automatically, without the use of cognitive operations. Thus, according to Tulving, the procedural memory "enables organisms to retain learned connections between stimuli and responses, including those involving complex stimulus patterns and response chains, and to respond adaptively to the environment" (Tulving, 1985a, p.387).

Evidence of the lack of cognitive operations in procedural memory system comes from dissociations between the procedural system and other systems. Cohen and Squire (1980) found that amnesic patients could learn to read words through a mirror at a normal rate, even though they could not recollect those words. Thus, the authors demonstrated that skill learning, which is an operation of the procedural memory system, could occur independently of episodic and semantic memory systems. Similarly, other researchers have presented dissociations between the procedural memory system and other systems for both amnesic patients (e.g. Shimanura, 1986; Tulving & Schacter, 1990) and normal participants (Schwartz & Hastroudi, 1991).

The perceptual representation system (PRS) is responsible for the ability of object identification. It is hypothesised to contain three subsystems, that is, visual and auditory word forms, and structural descriptions of objects and faces. In other words, the perceptual representation system is responsible for identifying words, objects and faces. Specifically, it has been defined as "the perceptual encounter with an object on one occasion primes or facilitates the perception of the same or a similar object on a subsequent occasion" (Tulving, 1995, p.5). The perceptual representation system is one step before semantic memory and is involved in the non-conscious priming effects found in perceptual implicit memory tests.

Evidence for the contribution of the perceptual representation system is provided from dissociations that different variables produce between perceptual implicit and explicit tests. Specifically, those variables include amnesia (e.g. Graf, Squire, & Mandler, 1984; Squire, Shimanura, & Graf, 1987; Tulving, Hayman, & MacDonald, 1991), levels of processing (e.g. Jacoby & Dallas, 1981; Graf & Mandler, 1984; Hayman & Jacoby, 1989), generation effect (e.g. Gardiner, 1988; Java, 1994), modality (e.g. Roediger & Blaxton, 1987a; Roediger & MacDermott, 1993) and retention interval (e.g. Jacoby & Dallas, 1981; Tulving, Schacter, & Stark, 1982).

Semantic memory is thought to contain a person's factual knowledge about the world. It represents a person's cognitive operations without immediate perceptions. It involves the use of two subsystems, that is, spatial and relational subsystems. The semantic memory is responsible for abstract thoughts beyond the reach of the perceptual system. Tulving suggested that the semantic system has the "capability of internally representing states of the world that are not perceptually present" (Tulving, 1985a, p.387).

Primary memory or working memory contains incoming information that is retained for a brief period of time. Information is registered through visual and auditory paths which are considered subsystems of the primary memory. The primary memory system has links with the long-term memory systems, so that information can be retained for longer periods of time. Evidence for the existence of the working memory system is provided through dissociations with the other memory systems.

Finally, episodic memory refers to personally experienced events. Through episodic memory, humans are consciously aware of their past which they can consciously recollect. Tulving thought of episodic memory as the system that allowed the "acquisition and retention of knowledge about personal experienced events and their temporal relations in subjective time and the ability to mentally 'travel back' in time" (1985a, p.387).

Evidence for the existence of both episodic and semantic memory is provided by studies employing recognition tests, which are hypothesised to facilitate episodic memory, and word-fragment completion tests, which are hypothesised to facilitate semantic memory (e.g. Tulving, Schacter, & Stark, 1982).

However, there is some debate as to whether semantic and episodic memory are separate systems. Squire and associates (e.g. Squire, 1994; Knowlton and Squire, 1995) suggested that episodic and semantic memory are two forms of declarative memory. Instead of five memory systems, they distinguished between declarative (knowing what) and non declarative memory (knowing how). Declarative memory refers to facts and events whereas non declarative memory refers to skills and habits, priming, classical conditioning and nonassociative learning. In contrast, Schacter and Tulving (1994) showed that the episodic and semantic systems are different since they rely on different brain structures. Specifically, semantic memory depends on medial-temporal regions whereas episodic memory depends more on right prefrontal-cortical areas. Moreover, Tulving and associates provided evidence showing that amnesic patients can acquire new semantic information without being able to recollect personal experiences of the past (e.g. Tulving, Hayman, & MacDonald, 1991; Hayman, MacDonald, & Tulving, 1993).

In relation to the remember/know paradigm, Tulving's contribution is quite clear. Remembering relies on episodic memory system since it allows the conscious recollection of past experiences. There is converging evidence from different variables depicting this point (e.g. Gardiner, 1988; Gardiner & Parkin, 1990; Gardiner & Java, 1990; Gardiner, Gawlik, & Richardson-Klavehn, 1994) (see section 1.2.3).

In contrast, according to Tulving, knowing depends upon the semantic memory system according to which past events are retrieved in the absence of recollective experience. However, empirical evidence suggests that know responses seem to be affected from different memory systems depending on the experimental manipulation. Specifically, knowing may reflect semantic memory system (e.g. Gardiner & Java, 1990), or it may depend on perceptual representation system without containing associative or semantic information (e.g. Gardiner & Java, 1990; Gardiner & Parkin, 1990). This conclusion was derived from Gardiner and Java's study that found increased rates of know responses in nonwords that have no semantic representation.

In conclusion, empirical evidence suggests that remembering relates only to episodic memory system whereas knowing corresponds to the semantic memory system.

1.2.1.ii Roediger's Transfer Appropriate Processing Account

An alternative theoretical framework underlining the basic mechanisms of encoding, storage and retrieval has been offered by a more process oriented view. The most influential theoretical consideration has been the transfer appropriate principle which states "that performance on memory tests benefits to the extent that cognitive operations at test recapitulate (or overlap) those engaged during initial learning" (Roediger, 1990, p.1049).

The basic principles of transfer appropriate were initially introduced by Kolers and Roediger (1984). They provided evidence suggesting that recognition is enhanced by the similarity of encoding and retrieval operations (e.g. Kolers, 1978). The evidence was based on a number of experiments conducted to measure benefits across study and test. Tasks varied from reading rotated text to reciting an alphabet in the bilinguals´ second language. It was found in all experiments that the more similar studying and test conditions were, the greater the transfer. This idea was extended by Kolers and Roediger (1984) who formulated the assumption of transfer appropriate processing. Put in their own words, ". . . effects of experiences depend upon the procedures used to realise them . . ., and that particular experiences train skills selectively" (p. 436).

Roediger and his colleagues (e.g. Roediger, Weldon, & Challis, 1989; Blaxton, 1989; Rajaram, Srinivas, &

Roediger, 1998) continued the transfer appropriate explanation and provided a series of subsequent experimental manipulations as evidence. Accordingly, study episodes involve a combination of data-driven, that is, perceptual, or bottom-up processing, and conceptually-driven, or top-down processing. Dissociations between implicit and explicit memory tasks have been attributed to differences between the underlying conceptual mechanisms of explicit tests and the perceptual ones encompassed in implicit tests. Specifically, explicit tests, which rely upon the semantic attributes of the material, need an overlap in encoding and retrieval at the semantic level (e.g. Blaxton, 1989; Srinivas & Roediger, 1990; Rajaram, Srinivas, & Roediger, 1998). In contrast, implicit tests rely upon the perceptual attributes of the material, and require an overlap in encoding and retrieval at the perceptual level (e.g., Blaxton, 1989).

However, Roediger, Srinivas and Weldon (1989) have modified this distinction arguing that "there is no necessary correlation between explicit memory tests and conceptually-driven processing, or between implicit memory tests and data-driven processing" (p.69). In other words, explicit memory tests might be influenced by perceptual operations, whereas implicit memory tests might be influenced by conceptual operations. In support of this qualification, Blaxton (1989) investigated generation effects on implicit and explicit tasks, both conceptual and perceptual in nature. She found that generated items increased performance on implicit and explicit conceptual tasks (answering general knowledge questions, free recall and semantic cued recall), whereas studied items increased performance on implicit and explicit perceptual tasks (word fragment completion and recall using graphemic cues).

An important criticism of the transfer appropriate processing theory is that it does not adequately explain how amnesic patients who have impaired explicit memory, demonstrate intact performance on perceptually and conceptually based priming.

With specific reference to the remember/know paradigm, the transfer appropriate account relates remember responses to conceptual processing and know responses to data-driven or perceptual processing. Experimental evidence illustrates similar dissociations underlining remember/know responses, implicit/explicit memory tests, and conceptual/perceptual tasks. Therefore, the processing account can accommodate to the explanation of the functional dissociations between remembering and knowing.

Rajaram (1993, Exp. 1) investigated the effects of rhyme and semantic associates in a recognition memory test measured by remember and know responses. Findings showed that participants gave more know responses to rhyme associates rather than semantic associates, thus supporting the hypothesis that know responses depend on perceptual factors.

Still, another example is offered by Gardiner & Java (1990, Exp. 2) who manipulated words versus nonwords at study and at test. The authors found that nonwords elicited more know responses to studied nonwords than to studied words, whereas studied words elicited more remember responses than studied nonwords. Findings were taken as evidence that encoding of nonwords relies more on the perceptual analysis of the material, since no conceptual processing is available for these items, resulting in increased rates of know responses. In contrast, words rely entirely on the conceptual analysis of the material, resulting in more remember responses.

Two illustrative examples were provided, showing how the processing account relates remembering with conceptual manipulations and knowing with perceptual ones. The transfer appropriate processing seems to be a feasible theoretical account in explaining the functional dissociations between remembering and knowing, which is based on memory processes and not on memory systems.

1.2.1.iii Rajaram's Distinctiveness\Fluency Hypothesis

Following Roediger's processing account (e.g. Roediger, 1990), another process-oriented hypothesis was outlined by Rajaram (1996). She proposed the distinctiveness/fluency framework in an attempt to predict and explain how different experimental manipulations affect subjective experiences at retrieval. She argued that, on the one hand, the distinctive attributes of the material, conceptual or perceptual in nature, might lead to the experience of remembering at retrieval. On the other hand, she suggested that knowing is enhanced by the fluency with which presented items are processed, resulting either from conceptual or perceptual factors.

The difference between the two processing views, the conceptual/perceptual framework and the distinctiveness/fluency framework, is illustrated in the following diagrams:

Conceptual/Perceptual Framework

Remember	Know
Conceptual	Perceptual

Distinctiveness/Fluency Framework

	Remember	Know
Conceptual	Distinctive	Fluency
Perceptual	Distinctive	Fluency

Thus, the conceptual/perceptual distinction argues that conceptual variables influence remembering and perceptual variables influence knowing. In contrast, the distinctiveness/fluency distinction maintains a more orthogonal relationship between the states of awareness and the processing view. Accordingly, remember responses depend on the distinctiveness of processing, either conceptual or perceptual, whereas know responses depend on processing fluency, again either conceptual or perceptual. The distinctiveness/fluency framework is supported best if a conceptual or perceptual variable influences both remembering and knowing depending on the distinctiveness of processing or on the fluency of processing.

Prior empirical evidence has indicated that remember judgements might be selectively influenced by conceptual conditions (see Gardiner & Java, 1993 for review). However, when Rajaram (1996) employed a perceptual manipulation, namely a picture recognition task (Experiment 1), size changes in pictorial material (Experiment 2), and changes in pictorial orientation (Experiment 3), superior performance of pictorial recognition memory as measured by remember responses was found. Her results across the three experiments confirmed the assumption that distinctiveness of processing, either conceptual or perceptual, facilitated elaboration and heighten recollection. Specifically, in Experiment 1 the perceptual effect of size congruency occurred only in remember responses. A limitation of Rajaram' s study was that she didn't manipulated fluency of processing, either conceptual or perceptual in nature. Moreover, it must be taken into consideration that the reported findings of Rajaram may have been influenced by the instructions she gave to the participants. In fact, she emphasised the perceptual aspects of the materials by indicating to participants to make the following associations: "aspects of the physical appearance of the picture, . . .or something about its appearance" (Rajaram, 1996, p.373). Rajaram commented on that point as well, suggesting that instructions might have influenced the rate of remember responses.

Additional support for the distinctiveness/fluency framework was provided by another study of Rajaram (1998). She tested the effect of distinctive attributes at the time of retrieval in two experiments. Experiment 1 manipulated the conceptual processing of homographs that were encoded either in their dominant (money-BANK) or their nondominant (river-BANK) meanings. Experiment 2 manipulated the perceptual processing of orthographically distinctive (subpoena) or orthographically common (sailboat) words. Results revealed higher proportions of remember responses for both distinctive conceptual (i.e. dominant interpretation of homographs) and perceptual attributes (i.e. orthographically distinctive words) of the material over nondistinctive conceptual (i.e. nondominant interpretation homographs) and perceptual processing (i.e. orthographically common words). The findings demonstrated that what truly affects the experience of remembering is the encoding of the item's distinctive attributes and not the selective influence of conceptual factors.

A question, however, that naturally rises from this experiment is that an experimental task which emphasises the use of perceptual factors does not preclude the use of conceptual ones. In other words, when participants are presented with orthographically distinctive words, they might engage in both conceptual encoding, as well as perceptual encoding. One may argue that orthographically unique words require further elaboration and conceptual processing, much as low frequency words do (e.g. Gardiner & Java, 1990) or generated words (e.g. Gardiner, 1988).

So far, Rajaram (1996; 1998) provided evidence for a conceptual and perceptual influence on remember responses. Support for the perceptual fluency by which know responses are affected, comes from a variety of empirical findings and experimental manipulations in literature (e.g. Gardiner & Java, 1990; Rajaram, 1993; Gardiner, Java, & Richardson-Klavehn, 1996; Gregg & Gardiner, 1994). However, additional research is needed in order to determine the extent to which conceptual factors play a crucial role in knowing.

Along these lines of thought, Mantyla (1997) provided evidence in support of the conceptual fluency of the experience of familiarity (see Mantyla, 1997 for review). The rationale for his experiments was to examine whether the encoding of distinctive facial characteristics, as compared to a more global encoding of faces, would facilitate recollection. He manipulated the processing of facial features in three experiments. Participants were required to encode the faces either according to their similarities, that is relate each face to four student-type categories, or according to their differences by rating each face in terms of distinctive characteristics. The former manipulation allowed the use of perceptual operations which increased remembering. By contrast, the latter manipulation, allowed participants to engage in conceptual operations which increased knowing. It should be noted that this pattern of results is not consistent with previous assumptions (e.g. Gardiner & Parkin, 1990) that remember responses depend on conceptual processing and know responses on perceptual processing. He interpreted his puzzling findings as providing evidence in support of the systems account but against the processing account.

Thus, the evidence presented so far (Rajaram, 1996; 1998; Mantyla, 1997) concerning Rajaram´s theoretical distinctiveness\fluency notion is weak. An important criticism of it is that Rajaram assumed that the material used in her experiments was distinctive and perceptual in nature. However, one may argue that both pictorial stimuli (size differences & left-right orientation) and verbal material (orthographically distinctive or common words) require conceptual processing since they need further effort to be encoded.

1.2.1.iv Donaldson's Signal Detection Account

Finally the fourth theoretical view, which challenges the ones mentioned above, has been proposed by Donaldson (Donaldson, 1996; see too, Hirshman & Master, 1997; Inoue & Bellezza, 1998; Hirshman, 1998). It has been derived from the signal-detection theory and has many similarities with the classical signal detection model of recognition memory. This model suggests that memory is a continuum of information, where a response criterion (C), set by the participant, separates old from new items. In addition, a second response criterion (RC) is placed, which divides the old items between remember and know responses. According to Donaldson (1996), remember and know judgements reflect a unitary trace strength model in which remembering represents a stronger trace, while knowing represents a weaker one. In other words, remembering reflects a conservative response criterion, whereas knowing reflects a lenient response criterion.

The revised signal detection model (Donaldson, 1996) makes two important predictions. The first one argues that "bias-free estimates of memory should produce equivalent values whether calculated on the overall hit-rate and false alarm-rate data or only on the remember data" (p. 524). The second prediction states that "memory based on knowing will not be independent of the yes/no criterion" (p.525), and thus expects the existence of "a positive correlation between the placement of the yes/no criterion and the amount of know responses" (p.525). Furthermore, Donaldson suggested the use of A′ estimates, following the assumption that A′ is less affected by response criteria. He argued that A′ can vary between 0.5 and 1.0. The formula given is

$$A' = .5 + (H-FA)(1+H-FA)/4H(1-FA).$$

In cases where lure rates exceed target rates, the formula is slightly altered

$$A' = .5 - (H-FA)(1+H-FA)/4H(1-FA).$$

Donaldson (1996) provided empirical evidence in support of the above rationale and performed a meta-analysis on data derived from 17 studies. Additionally, he conducted a simple experiment to test the predictions of the signal detection model. In the experiment, participants were asked to read and memorise a list of 100 words, which they had to recognise in a subsequent recognition memory test. The Yes/No recognition response criterion was manipulated to be liberal by asking participants to report confidence ratings for each item they thought was old.

A comparison between the experiment and previous studies in the literature, provided evidence in support of the theory's most important predictions which are the following: First, A′ estimates of memory are similar, whether derived from overall performance of hit and false alarm rates, or only from remember hit and false alarm rates. And second, there is a positive correlation between the yes/no recognition criterion and know rates.

However, there are some limitations of the signal detection model. Specifically, the model's most fundamental prediction cannot be met when the experimental manipulation produces very small values of remember responses (e.g. Gregg & Gardiner, 1994). Consequently, Donaldson's alternative view requires further testing in order to decide whether it can possibly accommodate remember know data.

Following Donaldson, Hirshman and Master (1997) used the signal detection model to explain the functional dissociations that exist in the remember - know literature. The authors argued that shifts in RC criterion produce different proportions of remember and know responses. Thus, there is a "trade off" between remembering and knowing, that is, depending on the criteria placement, remember rates can be large and know responses can be small, or vice versa. Furthermore, for a single-process model to account for experimental results that show opposite effects between remembering and knowing, the theory assumes that shifts in C and RC criteria placement can explain this patterns of dissociations (see Hirshman & Master, 1997, for review).

Still, Hirshman and Henzler (1998) tested whether different variables would affect criteria placement and consequently would influence remember and know rates. In the experiment the authors manipulated test instructions and presentation rate at study. Specifically, half of the participants were informed that 30% of the test items were study items, and the other half of the participants were informed that 70% of the test items were study items. However, in both cases, 50% of the test items were study items. It was expected that this manipulation would produce similar effects on remember and know responses. The presentation rate of study items was set on 2sec. and 700msec. Results showed that test instructions produced changes in criteria placement affecting both remember and know responses in a parallel manner. This finding fully supported the predictions of the signal detection model of memory since criterion placement affected both remember and know responses.

Innoue & Belleza (1998), tested the model's main predictions in two experiments. Experiment 1 was a replication of Donaldson (1996) initial study with the difference that the ratings of test items followed the remember/know judgements and not the other way around. Experiment 2 manipulated same versus different context of words across study and test by presenting unrelated word pairs during study with the first word being the context word and the second word being the target word. During testing each target word was accompanied by either the same or a different context word. The authors hypothesised that if the dual-memory models were valid, only remember responses would be affected by contextual information. In contrast, if the detection model was valid, A' values would be the same for both recognition and remember responses, regardless of test context. Overall findings argued in favour of the signal detection model, showing that A' estimates had similar value for both recognition and remember responses. However, compared with the same context, the different context reduced performance for both recognition and remember criteria.

Finally, Hicks and Marsh (1999) employed two different presentation rates of study items, a short one (1-sec) and a long one (4.5sec) under three different recognition judgements, that is, an old-new judgement, an old-new recognition in which old items were further judged as remember-know items, and a simultaneous remember-know-new recognition judgement. The first two conditions provided similar findings. However, results from the third condition differed in respect that the participants employed a more liberal response criterion as evidenced by the low B''_D criteria in comparison to the other conditions. It seems that the R-K-N alternative requires more effort. As the authors argued "the more difficult the task, the more leniently placed is the criterion in order to avoid missing a weaker signal" (p.122).

Contrary to Donaldson (1996), Gardiner and Gregg (1997) in their article refuted the signal detection theory. They presented evidence from various experiments and showed that knowing represents another source of memory and not just a lenient response criterion (see Gardiner & Conway; Gregg & Gardiner, 1994; Gardiner, Richardson-Klavehn & Ramponi, 1997). Specifically, the authors used experimental conditions that lead to little or no remembering. To this end, Gregg and Gardiner (1994, Exp. 2) designed an experimental condition that discouraged remembering. Specifically, participants were presented with a list of words at a very rapid presentation rate and varied the modality between study and test with a visual format at study and both visual and auditory formats at test. Re-analysis of data according to the signal detection theory showed that A′ estimates of overall hit and false alarm rates were significantly greater than A′ estimates of remember hit and false alarm rates. The present findings provided evidence against the single process models. It seems that under conditions of very small remember rates, the signal detection model cannot be applied to distinguish between the two states of conscious awareness.

1.2.2 Related Theoretical Developments

The previous section covered the four major theoretical accounts that contribute to the understanding of the conscious awareness research. However, there is additional related work, which tries to provide further explanations to current empirical findings. This section will discuss these related proposals, that is Jacoby's process dissociation procedure, and Gardiner's integrative view.

1.2.2.i Jacoby's Process Dissociation Procedure

Jacoby and his colleagues (e.g. Jacoby, 1991; 1996; Jacoby, Yonelinas, & Jennings, 1997) utilise the process dissociation procedure to define and explain the relation between memory processes. According to this account, dissociations between explicit and implicit tests of memory rely on consciously controlled and automatic influences, respectively. They proposed that conscious recollection and judgements of familiarity are two alternative responses in recognition memory. The former is hypothesised to depend more on controlled, effortful and intentional processes, whereas the latter is faster, needs less effort, and intention, that is, judgements of familiarity are more automatic. Furthermore, the relation underlining recollection and familiarity processes is assumed to be that of independence.

Jacoby (1991) has introduced a method to separate recollection from automatic influences of memory and has tried to investigate "automatic influences in the context of conscious - controlled process" (Jacoby, Yonelinas & Jennings, 1997, p.4) by comparing recognition performance between inclusion and exclusion tests. Specifically, participants study two different sets of words, one presented visually and the other presented auditorily. Under inclusion condition, participants are instructed to include items from both sets, that is, auditory and visual words, whereas under exclusion condition, participants are instructed to include items from one set, and not the other, that is, visual, but not auditory. Estimates of both recollection (R) and familiarity (F), under inclusion conditions are equated to $I= R+F-RF$, whereas under exclusion conditions are expressed as $E=(1-R)F$. Furthermore, Jacoby assumed that the difference in performance between hits in the inclusion test, and false alarms in the exclusion test, provide a valid estimate of the magnitude of conscious influences, that is $R = I-E$. In contrast, mistakes in the exclusion condition represent familiarity processes, which is equal to $F = E/(1-R)$.

With specific reference to the remember/know paradigm, Jacoby, Yonelinas, and Jennings (1997) proposed the Independence Remember/Know model according to which remember and know responses must be corrected for independence. In particular, the model assumes that remember responses provide a valid estimate of recollection. In contrast, know responses are an underestimation of familiarity because according to the independence model some recollection is accompanied by familiarity. Consequently, knowing must be corrected for independence to provide an accurate estimate of familiarity, that is, F = K/1-R.

Jacoby and his colleagues showed evidence in support of their model. In particular, Jacoby et al. (1997) employed cross modality transfer (Experiment 4) and size congruency (Experiment 5) to demonstrate the independence assumption between remember and know responses. Findings showed that changes in modality between study and test decreased remember responses, whereas know responses remained unaffected. However, estimating the results according to the independence model, the picture changed dramatically, showing a parallel increase of both recollection and familiarity processes for read than heard items. Similarly, altering the size of shapes between study and test (Jacoby et al., 1997; Yonelinas & Jacoby, 1995) showed a parallel increase of both recollection and familiarity processes, but a decrease of know responses in the congruent condition.

The most important criticism of the independence remember/know model is that Jacoby has equated the functions of recollection and familiarity with those of remembering and knowing. However, these constructs differ significantly in their definitions. Specifically, recollection requires consciously controlled retrieval of "critical 'diagnostic' attributes" that discriminate between old and new items, or between the different lists (i.e. read and heard) (Gardiner, Ramponi, & Richardson-Klavehn, 1998, p.11). In contrast, remembering is associated with any recollective experience which can occur with or without intention. Similarly, familiarity differs from knowing in terms of its operation, since the former is hypothesised to contain "irrelevant" recollection, whereas the latter probably excludes any recollective experience.

Furthermore, another point against the application of the process dissociation procedure to recognition memory is that recollection and familiarity are influenced by conscious and unconscious processes (e.g. Jacoby, 1991), whereas remembering and knowing are two measures of conscious awareness (e.g. Gardiner & Java, 1990). How, then, can Jacoby and associates link familiarity to knowing since the former depends on unconscious influences and the latter depends on conscious influences?

1.2.2.ii Gardiner's Integrative Account

Another fundamental theoretical view has been the one offered by Gardiner and his associates (Gardiner, 1988; Gardiner & Java, 1990, 1993; Gardiner & Parkin, 1990). They proposed a theoretical framework that combined Tulving's memory systems theory with a processing account, according to which remember responses are based on the episodic memory system that employs elaborative or conceptually driven processing, while know responses are based on the procedural memory system that, in turn, employs data - driven processing, or a "traceless" awareness of familiarity arising in a perceptual representation system. Thus, Gardiner and associates introduced a number of variables that showed that remember and know responses exhibit the same functional dissociations as conceptual explicit memory tasks and perceptual implicit memory tasks. Such manipulations include levels of processing and generating versus reading (Gardiner, 1988), retention interval (Gardiner, 1988; Gardiner & Java, 1991), and divided versus full attention (Gardiner & Parkin, 1990; Parkin, Gardiner, & Rosser, 1995).

Further evidence for this integrative account is provided by Gregg and Gardiner' s study (1994) that manipulated a highly perceptually orienting task, designed to minimise recognition performance as depicted by remember responses. Results supported the idea that know responses were particularly sensitive to perceptual factors. The authors argued in favour of a conceptual/perceptual distinction which influences remembering/knowing respectively.

Furthermore, as was described in a previous section, Rajaram (1993) suggested a processing account in which, remembering and knowing depend on conceptual and perceptual influences, respectively. These different accounts are based on the observation that different variables affect remember/know judgements, or conceptual/perceptual manipulations in different ways. Rajaram's findings suggested that levels of processing (Experiment 1) and picture superiority effect (Experiment 2) tap conceptual processing, meaning increased performance of remember responses, whereas masked repetition priming increased perceptual fluency, which increased performance of know responses (see section 1.2.1.ii, for details).

1.2.3 Current Empirical Evidence

Tulving' s (1985b) article initiated a series of experiments aiming to further investigate and understand consciousness as depicted by remember and know responses, and more recently by guess responses as well. Various experimental manipulations have been investigated, such as levels of processing (Gardiner, 1988; Rajaram, 1993; Gardiner, Java, & Richardson-Klavehn, 1996) and generation effect (Gardiner, 1988; Rajaram, 1993), low versus high frequency words, and words versus to nonwords (Gardiner & Java, 1990), massed versus spaced repetition (Parkin & Russo, 1993), elaborative versus maintenance rehearsal (Gardiner, Gawlik, & Richardson-Klavehn 1994), musical excerpts (Java, Kaminska, & Gardiner, 1995; Gardiner, Kaminska, Dixon, & Java, 1996; Gardiner & Radomski, 1998), number of study trials (Gardiner et al., 1996), dividing attention to both verbal material (Gardiner & Parkin, 1990), and facial material (Gardiner, Parkin, & Rosser, 1995), test modality and rapid presentation rate (Gregg & Gardiner, 1994), relational compared to distinctive processing of face recognition (Mantyla, 1997), short compared to long response delay (Gardiner, Ramponi, & Richardson-Klavehn, 1999), changes in size and orientation of pictures across study and test (Rajaram, 1996), orthographically distinctive compared to common words (Rajaram, 1998), and finally, psychopharmacological treatment (Curran, Gardiner, Java, & Allen (1993). These different experimental manipulations produced functional dissociations between remember and know responses, which can be viewed in the light of two separate components, those that yield dissociations and those that show parallel effects (i.e. Gardiner, Ramponi, & Richardson-Klavehn, 1999). In other words there are independent variables that produce dissociations influencing remember responses only, or know responses only, or both remember and know responses similarly, or differently.

1.2.3.i Independent Variables Yielding Dissociation

The first type of dissociations influencing remembering but not knowing, pertains to variables that entail conceptual and elaborative processing. First, Gardiner (1988) investigated the functional relationship between remembering and knowing by requiring participants to recognise a list of words. Experiment 1 manipulated different levels of processing requiring phonemic or semantic encoding. He found higher proportions of remember responses for the semantically encoded words, which were processed for meaning, over phonetically encoded words, which were processed for surface level information. Similarly, Experiment 2 investigated encoding conditions by asking participants either to generate or read a list of words, which were then tested either after 1h or after 1-week retention interval. The results showed an increased performance of remember responses for the generated items compared to the read items. This effect was maintained even after 1 week's interval. The overall findings supported the dual process theory of recognition which assumes that recognition memory entails two different processes, that is data-driven and conceptual-driven processes (Roediger, 1990), or two different encoding components (Mandler, 1980), such as elaboration and integration of stimulus information. Accordingly, remember responses increased under study conditions requiring conceptual encoding.

Gardiner's (1988) research was followed by Rajaram (1993) who manipulated levels of processing in a study, and obtained increased performance in remembering, but not in knowing. Experiment 1 was a replication of Gardiner' levels of processing condition, namely semantic associates versus rhyme words, with the addition of modality of presentation, namely visual versus auditory. The recognition test was presented visually. Her findings replicated Gardiner's data since semantic encoding affected only remember responses, whereas modality manipulation did not show any advantage for either remember or know responses.

Gardiner and Java (Experiment 1, 1990) tried to provide evidence in support of the dual-component hypothesis, that is, the hypothesis that remember and know responses reflect qualitatively distinct elements of recognition memory. In contrast, they argued against the trace strength hypothesis that supports a unitary dimension of memory. In one experiment, they employed low- versus high-frequency words in a 24h retention interval. If the dual-component hypothesis were valid, know responses were expected to increase by the low-frequency words showing that knowing can be systematically influenced by experimental manipulations. It was found that low - frequency words increased only remembering performance, leaving knowing unaffected. Findings failed to support the authors´ original hypothesis since know responses did not increase by the increased familiarity or perceptual fluency of low frequency words, as the dual-component hypothesis predicted. However, the hypothesis was further explored in the article. A subsequent discussion on this issue will be in place in the following pages of this manuscript.

In a subsequent study, Gardiner, Gawlik and Richardson-Klavehn (1994) found another variable affecting remembering and not knowing, that is, elaborative compared to maintenance rehearsal. They employed a directed - forgetting paradigm according to which each word was followed by a cue, designating that the word was either to be forgotten, or to be learnt. However, the important manipulation was the short and long delay presentation between the study word and the cue, which varied the amount of maintenance and elaborative rehearsal. Specifically, it was assumed that the longer cue delay would allow the occurrence of maintenance rehearsal since it increases the interval between the study word and the cue. In contrast, it was expected that the short cue delay would give more time after the cue to elaborately rehearse the study item. Accordingly, the hypothesis tested was two fold: first, remembering would be increased in the short cue delay that allowed the elaborative rehearsal of the study word, whereas knowing would be increased in the long cue delay that allowed the maintenance rehearsal of the study word. Second, the directed-forgetting paradigm would affect only remember responses, with increased performance to the learn rather than the forget cue-designation. Results fully supported the hypothesis. Findings showed that the learn/forget designation influenced only remembering, leaving knowing unaffected. Furthermore, short cue delay increased remember responses under the learn cue items, whereas long cue delay increased know responses, regardless of learn or forget designation.

Moreover, Java, Kaminska and Gardiner (1995) investigated the replicability and generality of remember/know dissociations in nonverbal domains. They introduced musical themes, that is, famous and obscure classical excerpts. A superior recognition performance was expected for remember responses following famous classical themes, probably because they were easier to encode in elaborative and associative manner. In contrast, the performance of know responses was uncertain since the materials were used for the first time. The authors suggested that increased rates of know responses might be expected following obscure musical themes since they reflected more perceptual processing. Two experiments were conducted testing this hypothesis and revealed an increase of remember responses while know responses remained unaffected. It seems that the participants' pre-experimental experience of famous classical themes facilitated elaborative, attentional encoding. Contrary to that, obscure classical themes lacked pre-experimental hearing and were based on the encoding of perceptual features. The important conclusion of the study was that it replicated previous empirical evidence concerning functional dissociations between remember and know responses with nonverbal material.

Gardiner and Parkin (1990) showed that divided attention at study impaired word recognition accompanied by remember responses. In particular, two levels of divided attention versus full attention were manipulated. Participants were required to recognise a list of words either under a full attention condition, or under a divided attention condition. The divided attention task comprised of a tone monitoring task, one varying between 6 and 9 sec and the other between 3 and 4.5 sec. The findings revealed that divided attention produced a progressive decline in performance reflected by remember responses while know responses remained constant across conditions. As such, they supported the hypothesis that remember responses reflected conceptual processing in an episodic memory system whereas know responses reflected perceptual processing in a semantic memory system.

In addition to the conceptual/perceptual distinction that influences remember/know responses respectively, the authors characterised the relation between these two states as being mutually exclusive. Exclusivity assumes that recognition memory can be accompanied by only one of the two components each time. That is, the two components have no relation with one another and the one component does not influence the other. As such, this relation explains the existence of a large number of variables, including divided attention, that influence remember responses without affecting know responses. This type of relation between remember and know responses is further discussed in detail in the following section (see Section 1.2.4).

The selective influence on remember responses was similarly obtained by Parkin, Gardiner and Rosser's (Experiment 1, 1995) study. They introduced facial stimuli in the inquiry of conscious awareness in order to investigate the ecological validity and replicability of the functional dissociations that have previously appeared in verbal and musical material. The experiment manipulated divided versus full attention (same as Gardiner & Parkin, 1990). The main difference from Gardiner and Parkin's research was the employment of the faster interval between tones, that is between 3 and 4.5 seconds and not between 6 and 9 seconds. Results replicated and extended prior evidence in the verbal domain. Specifically, divided attention clearly decreased remember responses while know responses remained insensitive to this manipulation. It seems that remembering relies more on controlled conditions, whereas knowing is dependent on automatic processes. Furthermore, the rehearsal perspective (e.g. Gardiner, Gawlik, & Richardson-Klavehn, 1994) is consistent with the present evidence. Specifically, remember responses depend on elaborative rehearsal, as in the case of full attention, whereas know responses depend on maintenance rehearsal, as in the case of divided attention.

In addition, Gardiner, Java, and Richardson-Klavehn (1996) investigated the influence of levels of processing on awareness in yes/no and two alternative forced-choice recognition tests. The levels of processing manipulation (Experiment 1 and 2) included a semantic task, which required participants to produce a meaningful associate of the study word, compared to a graphemic task which required participants to produce letters that did not appear in the study word. Experiment 3 employed a generating versus reading manipulation with words being generated from a semantic context and with words being read in the absence of context. For all experiments subjects were allowed to report guess responses as well. Results revealed an influence on remember and not know responses for both levels of processing and generating versus reading, and both yes/no and two alternative forced-choice recognition. Specifically, in all three experiments, knowing remained unaffected by the factors that produced large effects on remembering. In addition, it was guessing, not knowing that was inversely related to remembering. It must be noted that guess responses showed no discriminative power, in that guess responses to targets did not exceed guess responses to lures.

Finally, other evidence that shows a selective influence on remember responses comes from psychopharmacological treatment. Curran, Gardiner, Java, and Allen (1993) provided pharmacological evidence for impaired recognition performance with the use of lorazepam. Participants were asked to recognise a list of words previously studied, 1h after, 3h after and 5h after the administration of the lorazepam drug. Findings showed that the drug impaired remember responses while leaving know responses relatively unchanged. Interestingly enough, it was remember and not know responses that were related to levels of arousal/sedation during study, whereas levels of knowing were held constant whether sedation was measured by psychophysiological, motor or mood tasks. These results support previous findings suggesting that remembering and knowing are based on contextual and associative information, or on perceptual and semantic information, respectively.

Now, there are few variables that have been found to affect know but not remember responses, especially the ones that engage in perceptual processing. An example of their impact has been offered by Rajaram (1993, Experiment 3). She increased perceptual processing of study items by masked priming. Specifically, test items were immediately preceded by rapid exposure of another item, either the identical word or an unrelated word. The repeated display of the target item was supposed to enhance the perceptual fluency with which the test items were processed (see same Section for details). Accordingly, this manipulation affected only know responses since it was a perceptually induced factor and showed that perceptual processing influences know, but not remember responses.

As was described in a previous section, Gregg and Gardiner (1994) (see also Gardiner & Gregg, 1997) examined the effect of perceptual factors on know responses by testing mode correspondence between study and test (see section 1.2.2.ii). Experiment 1 employed levels of processing, that is, shallow versus deep processing, and different modality presentation, that is, visual versus auditory. The findings showed an advantage of know responses for the same mode across study and test, though not significant, while remember responses exhibited a small advantage for different mode. Experiment 2 employed the same mode correspondence effect with the addition of a highly perceptual orienting task, namely a perceptual-fast condition versus a memory-slow condition. This manipulation was employed to maximise perceptual fluency and discourage any conceptual encoding. The data revealed a clear advantage of know responses following a highly perceptual influence in the same mode state. These experiments clearly showed that recognition memory as measured by know responses was especially susceptible to perceptual factors and not conceptual ones.

In addition, Gardiner, Gawlik, and Richardson-Klavehn (1994) (see this section for details) showed that lengthening the duration of maintenance rehearsal in a direct-forgetting paradigm increased knowing, but not remembering. Specifically, the long delay condition between the target and the forget/learn cue allowed more time for maintenance rehearsal of the item, which was assumed to influence knowing, but not remembering. The long delay seemed to increase maintenance rehearsal of all target items, regardless of learn or forget designation.

However, there is another small number of variables that influenced remember and know responses in opposite ways. Specifically, variables that increased know responses and decreased remember ones. For example, Gardiner and Java (1990, Experiment 2) used words versus nonwords to investigate the hypothesis that nonword recognition is enhanced by perceptual fluency. It was assumed that nonwords lack meaning for elaborate processing, thus depend more on perceptual fluency. The findings demonstrated that nonwords, when compared with words, increased knowing and decreased remembering, confirming the initial perceptual fluency hypothesis.

Furthermore, Parkin and Russo (1993) presented participants with words which were repeated either immediately (lag0) or after six intervening items (lag6). The results showed that the spaced compared to immediate repetition of words had opposite effects on remember and know responses. Specifically, spaced repetition increased remembering while reducing knowing.

Similarly, Parkin, Gardiner, and Rosser (1995, Experiment 2) replicated Parkin and Russo's study, but with facial material. Findings revealed the same pattern of results with massed repetition increasing know responses and decreasing remember responses.

Thus, it seems that in both studies (Parkin & Rosser; Parkin, Gardiner, & Rosser), massed repetition facilitated familiarity without inducing elaborative encoding, necessary for conscious recollection.

Still, Mantyla (1997) (study that was mentioned in Section 1.2.1.iii) investigated relational and distinctive processing by employing differences versus similarities manipulations in three experiments of face recognition. The reported findings revealed an increased performance of know responses following relational processing, whereas the opposite was true for remember responses. Thus, the experimenter concluded that recognition memory does entail two distinct components of recollection, but these dissociations do not always reflect conceptual and perceptual processing differences. It seems that the distinctive attributes of the material, perceptual in nature, was the important manipulation that influenced remembering.

1.2.3.ii Independent Variables Showing Parallel Effects

In the present section we will outline those variables that show parallel effects on remember and know responses.

For example, Gardiner, Kaminska, Dixon & Java (1996b) followed up Java, Kaminska and Dixon's (1995) study and employed musical excerpts in an attempt to further clarify the distinction between remembering and knowing. They manipulated study trials and the participants' report of guess responses. Their materials consisted of Polish folk songs and classical melodies. A recognition memory test revealed that study trials with Polish melodies had an increasing effect on both remember and know responses whereas repetition of classical melodies increased only remember responses. Guessing was found to be inversely related to both remembering and knowing. As far as the findings on classical melodies were concerned, the investigators suggested that prior familiarity of the stimulus domain as a whole, played a significant part in the increase of remember responses.

Furthermore, Gardiner and Radomski (1998) extended previous evidence on musical themes concerning classical compared to obscure musical pieces (Java, Kaminska, & Gardiner, 1995) and classical themes compared to Polish folk songs (Gardiner, Kaminska, Dixon, & Java, 1996). The authors used Polish and English folk songs heard by both Polish and English people. This manipulation revealed an increased performance of know responses only for those folksongs that were from the cultural background unfamiliar to both English and Polish subjects. Furthermore, an increased performance of both remember and know responses was revealed with the addition of study trials, when the folk songs were not in the prior experience of the subject. This parallel effect of repeated study trials on remember and know responses replicated previous findings since the materials lacked pre-experimental representations and supported the view that these subjective states were functionally independent.

Finally, Gardiner, Ramponi and Richardson-Klavehn (1999) replicated Toth's (1996) study to investigate the effects of response deadline to subjective reports of remembering and knowing. Specifically, Gardiner et al. employed levels of processing and generation effects in conjunction with two response deadlines, a short one, 500msec., and a long one, 1500msec. It was hypothesised that the short response deadline would not allow sufficient time for a controlled recollection, thus decision would be largely based on automatic processes. In contrast, the long response deadline would permit the necessary controlled processes for a recognition decision. Accordingly, only remember responses would benefit from the longer response deadline, in both generating, and deeper level of processing, conditions. However, findings showed that both remember and know responses increased with the longer compared with shorter response deadline, implying that know responses, as well as remember responses, depend on controlled processes.

From the literature reviewed thus far, we may conclude that different variables affect conscious recollection and feelings of familiarity in different ways, thus creating systematic functional dissociations between them. The major conclusion that can be derived is that remember and know responses reflect qualitatively distinct components of memory.

1.2.4 Relational Controversy: Exclusivity or Independence?

The relation between remember and know judgements has been interpreted as one of exclusivity, or one of independence.

Participants in the remember/know paradigm are asked to classify an item as a remember one, when it is accompanied by a clear recollection of its prior occurrence, whereas items that failed to elicit a conscious recollection are given a know response. Therefore, it is assumed that the two states of awareness were mutually exclusive.

The way that instructions are given obligate participants to make a mutually exclusive response. The exclusivity assumption seems logical enough with respect to the states of awareness, since one cannot experience conscious recollection, and feelings of familiarity in the absence of conscious recollection, simultaneously.

Moreover, Gardiner and Parkin (1990) suggested that the processes underlying the two states of awareness might also be exclusive. This was on the basis of showing that divided attention during study decreased remembering and left knowing unaffected (see Section 1.2.3 for details).

However, one may think that the exclusivity assumption is a rather simple way to explain the relation between the processes assumed to underlie remember/know judgements. Thus, another possible relation is independence which states that recollection and familiarity are fully independent processes. Specifically, recollection process can exist with, or without, familiarity process. This view differs from the exclusivity assumption which argues that the processes underlying the two states, remembering and knowing, cannot co-exist.

For the remember/know paradigm, the independence model suggested the Independence Remember/Know Procedure (IRK) (Jacoby, Yonelinas, & Jennings, 1997). According to this model, remember responses reflect an accurate estimate of the recollection process (R). This point is strengthened by the low probability of remember responses in false alarm rates. In contrast, know responses do not provide an accurate estimate of familiarity (F), but instead, reflect familiarity in the absence of recollection (F(1-R)). Jacoby et al. argued that there are a number of items that are both familiar and recollected and those items will make participants to produce a remember response even though the items are also familiar. Estimates of the familiarity process are therefore calculated as follows: $F=K/(1-R)$.

A basic difference between exclusivity and independence applies to know responses. The exclusivity assumption sees knowing as a complete estimate of familiarity, whereas the independence assumption needs to divide the proportion of know responses by 1-R to derive the complete estimate of familiarity.

In a number of studies in which familiarity estimates, derived from the independence remember/know model, were directly compared to remember/know data, there were several inconsistencies (Richardson-Klavehn, Gardiner, & Java, 1996, Table 3.14). Specifically, in studies where the independent variable influenced only remembering, such as divided attention, familiarity estimates showed similar results to recollection (Gardiner & Parkin, 1990). In studies where knowing was affected, such as same versus different masked test prime (Rajaram, 1993) and study-test modality (Gregg & Gardiner, 1994), familiarity estimates magnified the effect of the manipulation. Finally, in non-words compared to words familiarity estimates lead to the same conclusion as "uncorrected" know responses (Gardiner & Java, 1990).

Similarly, an experiment by Jacoby et al. (1997), demonstrated how findings change when results are re-computed according to the independence assumption. Participants either heard or read a list of words. During testing, they were instructed to use the presented fragments as cues to complete words. After the completion of each fragment, participants had to indicate whether they remembered or knew it was a new word. The employment of the cross modality transfer (visual study - visual test compared with auditory study - visual test) seemed to influence only remember responses, while know responses remained constant. However, when results were corrected for independence, both recollection and familiarity influences increased under the visual-visual conditions compared with auditory-visual conditions.

Finally, Jacoby et al. (1997) discussed one more piece of evidence in favour of the independence model. This was from different studies using the same independent variables. One such example was the levels of processing effect (Gardiner, 1988; Rajaram, 1993). Gardiner (1988) found that levels of processing increased remembering and held knowing constant. In contrast, Rajaram (1993), by employing the same variable, found an increase in remembering and a decrease in knowing. According to the independence model, this difference in results could be attributed to the fact that remember responses reflect both recollection and familiarity. On the other hand, Gardiner, Java and Richardson-Klavehn (1996) showed that large effects on remember responses might not always produce opposite effects on know responses.

However, Gardiner, Ramponi, and Richardson-Klavehn (1999) employed short and long response deadlines in levels of processing and generation effects. As was described in the previous section, results revealed a parallel increase in both remember and know responses at the longer response deadline, which implied that knowing did not reflect an automatic familiarity process (see Section 1.2.3 for details). This conclusion was maintained even with estimates of the independence remember-know model, that is, dividing the proportion of know responses by one minus the proportion of remember responses (Jacoby et al., 1997; see also Gardiner et al., 1999).

In conclusion, it seems not possible to fully resolve this controversy at present time. Indeed, it may be that in some situations the underlying relationship is exclusive, and in other situations the underlying relationship is independence. The importance of the underlying relations between remember and know responses has been the subject of extensive discussion in the literature which is the reason that it is discussed here. Accordingly, the present thesis covered the issue even though it is not the focus of the present experimental research and so is not discussed further.

1.3 Goals of the Thesis

The previous section discussed the major theoretical accounts, along with related empirical evidence, and tried to explain the role that consciousness plays in memory processes, particularly as measured by remember and know responses. Furthermore, it has become apparent that each one of the theoretical models, namely the systems account, the conceptual/perceptual account, the distinctiveness/ fluency account and the signal detection account, can provide an explanation of dissociations that have been found between remembering and knowing. The reported experimental findings do not provide overwhelming support for any one of these theoretical models.

Consequently, the main goal of the thesis is to relate the obtained findings to the conceptual/perceptual processing account, the distinctiveness/fluency framework and the signal detection theory. The multiple memory systems account is also considered throughout the experiments, but less often and with less details. Specifically, the present research employed a number of conceptual and perceptual manipulations to examine which of the two processing views, that is, the conceptual/ perceptual and the distinctiveness/fluency, provide a better explanation for the remember/know paradigm. Thus, the thesis examines the impact study and test conditions may have on remember, know and guess responses, when perceptual and conceptual congruency between study and test, attentional requirements during study, as well as the presentation rates are manipulated. Furthermore, most of the experimental data in the present study are analysed to test the predictions of the signal detection model.

1.3.1 An Introduction to the Experimental Chapters

Thus far, the present thesis has covered the theoretical accounts concerning the subjective states of awareness measured by recollective and familiar components of explicit memory (Section 1.2.1 and 1.2.2), as well as the theoretical evidence that investigated these processes (Section 1.2.3). By doing this historical development of the experiential approach to memory, we set the foundations to our experimental research, base our hypothesis, and subsequently, explain our empirical evidence.

The experimental chapters that follow are based on the experiential procedure and the dissociations that different variables, namely divided attention, context effects and rate of presentation during study, produce on remember, know and guess responses.

The first experimental chapter, Chapter 2, covers three experiments which deal with divided attention effects on recollective experience with the use of facial stimuli. Experiment 1 used a tone monitoring task simultaneously presented with a list of faces while subsequent performance was measured by remember and know judgements. Experiment 2 replicated Experiment 1 but with the inclusion of guessing as well. The robustness of the phenomenon was investigated in Experiment 3 by using a meaningful task of divided attention.

Specifically, the purpose of Experiment 1 was to replicate the work of Parkin, Gardiner and Rosser (1995) in a facial recognition task. These authors repeated the study of Gardiner & Parkin (1990) to test the controlled and automatic processes that underlie remember and know responses (see section 1.2.i). As such, the initial concern of Experiment 1 was to test the generality of dividing attention in a different laboratory setting and with a different subject population. Furthermore, it was expected that the divided attention condition would decrease performance of the remember responses whereas know responses would remain unaffected across full and divided attention conditions.

Experiment 2 used the same manipulation of divided attention but this time participants were allowed to report a third mode of consciousness, namely guessing, in addition to remember and know judgements. Guess responses have shown to be dissociated from remembering and knowing in different ways and the inclusion of guessing has indicated a differentiation in performance (see Gardiner, Kaminska, Dixon, & Java, 1996; Gardiner, Java, & Richardson-Klavehn, 1996; Gardiner, Richardson-Klavehn, & Ramponi, 1997; Gardiner, Ramponi, & Richardson-Klavehn, 1999; see too Section 1.1.ii). Thus, Experiment 2 employed for the first time guess judgements in a divided attention condition. It was predicted that guessing would be inversely related either to remembering (Gardiner, Java, & Richardson-Klavehn, 1996), or inversely related to both remembering and knowing (Gardiner, Kaminska, Dixon, & Java, 1996).

The third and final experiment of Chapter 2 employed once again a divided attention having participants listen to meaningful stories, instead of meaningless tone counting. This condition required highly conceptual processing, since the encoding of stories relied on effort. This manipulation has never been employed in a study concerning either divided attention or subjective recognition performance. It was hypothesised that story listening and face encoding demand similar resources, namely elaborative processing. Thus, there might be an even greater decrease in remember rates (Experiment 2).

The second experimental chapter, Chapter 3, covers work on two experiments which vary the contextual information appearing across study and test. The two experiments described in this chapter, used faces with varying size across study and test, that is, congruent and incongruent stimuli. In addition Experiment 5 employed a very brief time of presentation, specifically 300msec and 700msec per item. A recognition test was employed for all experiments that tested subjective states of conscious awareness measured by remember, know and guess judgements.

Specifically, Experiment 4 was based on the study of Rajaram (Experiment 2, 1996, see section 1.2.1.iii) who employed picture recognition in different or same size across study and test. The present experiment replicated this procedure but with the use of facial stimuli instead, in an attempt to investigate the distinctiveness/fluency framework and extend the basic assumptions of the framework. It was predicted that same context would boost performance in general and more specifically in remember responses, whereas know responses would remain constant across conditions.

The purpose of Experiment 5 was to test whether the manipulation of context would affect know responses if remembering was stripped away. As such, a similar procedure was employed as in Experiment 4 with the addition of a highly perceptual task which concerned the rapid presentation rate of 300msec. versus 700msec. This manipulation was first employed in the study of Gregg and Gardiner (1994) who found a large mode correspondence effect on know responses under rapid rates of presentation. Similarly, it was expected that if remembering was stripped away with rapid presentation rates then the effect of size congruency could occur in know responses, like the effect of same modality in Gregg and Gardiner's study.

The work discussed in the final experimental chapter, Chapter 4, extends the findings of the earlier experiments in the present thesis in two ways. First, it tests the strength of contextual influences on subjective states of awareness, and second it further explores the conceptual and perceptual attributes of remember and know responses. Thus, Experiment 6 showed words with faces by presenting simultaneously facial stimuli with a descriptive adjective which either remained constant or changed across study and test conditions. Furthermore, Experiment 6 employed two different presentation times, 5sec versus 700msec. Under the slow rate, it was expected to find context effects only in remember responses, supporting the conceptual/perceptual distinction. In contrast, under the fast rate, which lacks conceptual or distinctive processing, a great decrease of remember responses was expected. In addition, it was hypothesised that if remembering was stripped away under the fast presentation time then context effects might occur in knowing.

Similarly, Experiment 7 extends the findings of Experiment 6 by presenting the same study list three consecutive times. Following Experiment 6, in Experiment 7 the effect of context was expected to occur only in remember responses under the slow rate. However, under the fast rate, remembering was not expected to decrease since participants would experience the study list three times, thus, providing the necessary time for the conceptual encoding of the material. Consequently, under the rapid rate, know responses would not have the opportunity to show context effects.

Finally, Experiment 8 was designed to investigate whether or not know response rates are higher for words than they appeared to be for faces, in the previous experiments (Experiment 6 and 7). As such, Experiment 8 employed the same procedure as in Experiment 6 but subjects were tested only on the words. It was expected to find an increased performance in know responses for the fast rate than the slow rate, same as Gregg and Gardiner' s study (Experiment 2, 1994, see also section 1.2.2.i).

In summary, the three experimental chapters dealt with measures of conscious awareness and how these measures are affected by conceptual and perceptual manipulations. Chapter 2 covered work on divided attention conditions with Experiment 1 and 2 using a tone monitoring task and Experiment 3 using meaningful stories that needed conceptual processing. Chapter 3 discussed the effect of context involving size changes across study and test in two experiments. Experiment 4 compared performance on congruent and incongruent facial stimuli while Experiment 5 added two rapid presentation rates, 300 and 700msec. respectively. The final experimental chapter investigated verbal contextual information, conceptual in nature.

CHAPTER 2

DIVIDED ATTENTION AND LEVEL OF CONSCIOUSNESS

2.1 Introduction

The aim of the present chapter is to replicate and extend previous work dealing with divided attention (Parkin, Gardiner, & Rosser, Experiment 1, 1995), and further explore the relation between memory performance and consciousness. Thus, the three experiments discussed in this chapter examined recognition memory measured by remember, know and guess responses using facial stimuli.

Specifically, Experiment 1 manipulated levels of attention, by employing focused versus divided attention conditions, in a face recognition task. Following Parkin, Gardiner and Rosser (Experiment 1, 1995; see also Gardiner & Parkin, 1990), it was predicted that divided attention would decrease remember responses but would leave know responses unaffected.

Similarly, Experiment 2 manipulated levels of attention with the addition of guess responses, whereas Experiment 3 investigated the levels of attention variable included in a meaningful context.

2.2 Experiment 1

Experiment 1 was a replication of the Parkin, Gardiner, and Rosser (Experiment 1, 1995) study which manipulated levels of attention task and found that divided attention reduced remember responses, whereas know responses remained unaffected. The main reasons for doing Experiment 1 were first, to investigate further the functional dissociations between remember and know responses in recognition memory; and second, to check the replicability of Parkin et al.'s results with our set of materials and our subject population. The latter was considered necessary since it was the first experiment conducted with a different population and in a different setting.

In the present experiment, university students were exposed to a list of unfamiliar faces under conditions of either focused or divided attention. An important difference between this experiment and Parkin et al. study (Experiment 1) was the manipulation of attention. Specifically, in the divided attention condition, participants were instructed to observe a list of faces and simultaneously monitor tones of various pitches. In the focused attention condition, participants were presented with the same list of faces and heard the same tones, but they were instructed not to pay attention to the auditory task. This manipulation, being that both groups heard tones, makes the effect of attention stronger since it is based only on instructions. This was a major departure from the Parkin et al. study (Experiment 1) in which the tones were omitted under the focused attention task. All subjects were then given a recognition memory test in which they had to record whether the recognised faces were remembered or known. Remembering was defined as the kind of awareness characterised by recollective experience, while knowing was characterised by feelings of familiarity in the absence of recollective experience.

The divided attention was predicted to affect only recollective experience, having a decrease in remember responses, while feelings of familiarity were expected to be unaffected. The above prediction was derived from the pattern of results obtained with both verbal material (Gardiner & Parkin, 1990) as well with facial stimuli (Parkin, Gardiner & Rosser, Experiment 1, 1995). The decrease in remembering can be explained in terms of Tulving and Schacter's (1990) argument which states that conscious recollection relies on an episodic memory system, whereas feelings of familiarity depends upon the semantic memory system (e.g. Tulving & Schacter, 1990).

Other researchers, including Jacoby, Yonelinas and Jennings (1997) have offered a different account for the above findings. According to the attributional view of memory, remember responses rely more on intentional processes and require conscious attentional modes, which are lacking in the case of divided attention, while know responses rely more on automatic processes, which are not influenced by the tone monitoring task.

Therefore, following Parkin et al. (1995), it was expected that divided attention would significantly reduce remembering, while knowing would remain unaffected in both divided and focused conditions.

Method

Participants. The participants were 60 full - time undergraduate students at The American College of Greece, 18 to 20 years of age. They were randomly allocated to each of the conditions. They participated voluntarily, upon personal request, without pay. They were tested in a memory laboratory setting individually, or in small groups of two or three students.

Design and Materials. The present experimental design entailed one independent variable, namely attention with two levels, that is either monitoring tones or just listening to them. The manipulation took place in a between-subjects design.

A sample of 140 black and white photographs was selected originally by the experimenter from the College's 1994 yearbook. Each person was photographed in a head - and - shoulder view against the same neutral background. Individuals with unusual characteristics such as beards, moustaches or eyeglasses were excluded. A total of 72 faces was selected by two judges. This material was used during study and test. The photographs were presented in a PC monitor screen (14 inch) and were processed through the Corel5 Software Package in order to be presented automatically, one at a time.

The pictures of faces were randomly divided into two sets of 36, thus comprising List A and List B. For half of the participants in each condition, List A served as the study items pool and List B the lure items pool, while for the other half of the participants the reversed was used. The recognition test list comprised of 18 items from List A and 18 from List B randomly ordered. This manipulation of the test list items allowed the maintenance of the list length to be the same across study and test trials. Thus, the amount of total time spent during the encoding and retrieval opportunities was kept the same. By doing so, we deviated slightly from the original Parkin et al. (1995) list length and kept it the same across study and test conditions. The assumption underlying this modification was that when participants are presented with either half of the targets in the test list, or all of the targets with an equal number of lures, responses across remember and know judgements are not affected. Four combinations of study and test lists were required to achieve complete counterbalancing.

Procedure. The participants were tested in small groups of one to three individuals. They were required to read and sign a consent form that briefly provided information about the nature of the experiment, and stressed their voluntary participation and their option to leave at any time they wished to do so. Next, participants were instructed that they were to memorise a series of faces, either male or female. Each face was shown for 8 seconds following the presentation rate that was used by Gardiner et al. (1995) Experiment 1.

Each group of participants was randomly assigned to the divided and focused attention groups. In the divided group participants were presented with a list of photographs and were asked to monitor individual tones of either low, medium, or high pitch. Subjects were told to count one of the three tones and report the total number of them at the end of the study list. Subjects were able to follow the instructions since their performance was at or close to 100%. The tones were recorded on the PC and their sequence was randomly determined. The presentation rate for the tones was quasi - random in that the time elapsing between any two successive tones varied randomly between a minimum and maximum time constant which was between 3 and 4,5 seconds (see Parkin, Gardiner, & Rosser, 1995, for details). In the focused attention group participants experienced the exact same conditions as in the divided attention task but were instructed to ignore the tones and focus their attention only to the presentation of faces.

Following the Parkin et al. (1995) procedure, there was a 10 - minute retention interval during which participants were required to perform a distractor task that would divert their attention from the recollection of the studied material to something irrelevant. The distractor task was selected from a weekly magazine and was a "find the differences" quiz in which participants had to find 20 differences between two complicated pictures. Subsequently, they were given a recognition test. They were told that another series of faces would be presented on the computer screen, some of which were shown on the study list and some that were new. Each face appeared for 8 seconds during which time subjects were to decide whether they had seen it before, by making Y/N judgement on the answer sheet that was provided. The answer sheet for the recognition test was a single sheet of paper with numbers from 1 to 36 next to which participants had to circle their answer.

Furthermore, participants were asked to distinguish between remember and know judgements. Following earlier practices in the remember/know literature (e.g. Rajaram, 1993; Gardiner, 1988), remembering involved awareness of some aspect, or aspects, of what had happened, or what was experienced at the time the face was presented (e.g. aspects of the physical appearance of the face, or of something that happened in the room, or of what one was thinking or doing at the time). In contrast, knowing was used when participants recognised the face as having been presented in the study list along with evoking familiarity, but with no ability to consciously recollect anything about its prior occurrence, or what happened, or what was experienced at the time of its occurrence. At the end of the experiment the participants were orally debriefed about the nature of the experiment.

Results

The principal results for hits and false alarms are shown in Figure 2.1, demonstrating the proportion of remember and know responses as a function of study condition, and the proportion of the corresponding false alarm data. The level of significance was set at $p<.05$. Three One Way Analyses of Variance (ANOVA) were performed on the hit scores. Specifically, the overall mean face recognition memory was significantly better for the focused attention condition (.71) than for the divided attention group (.50), [$F(1,58)=8.74$, $\underline{MSe}=84.81$, $\underline{p}<.01$]. Higher proportions of remember responses were also obtained for faces presented in the focused condition (.46) compared to faces presented in the divided attention task (.34), [$F(1,58)=8.6$, $\underline{MSe}=72.6$, $\underline{p}<.01$]. Know judgements remained constant across both conditions with a mean proportion of .25 in both cases, [$F(1,58)=.0028$, $\underline{MSe}=.01$, $\underline{p}>.05$]. Similarly, for the false alarm rates two One - Way Analyses of Variance (ANOVA) were performed which revealed no significant results with a response probability for remembering of .06 in the divided attention and .04 in the focused condition. Knowing remained again unaffected, with .11 for the focused group and .10 for the divided attention group (see Table 2.1).

Another Two Way Analysis of Variance (ANOVA) was carried out for both remember and know hit rates in order to investigate the interaction between the level of attention and the reported subjective response. The manipulated factors were level of attention (focused versus divided) as a between-subjects variable, and type of response (remember versus know) as a within-subjects variable. As such, hit rates revealed a significant effect of attention [$F(1,58)=8.57$, $MSe=37.41$, $p<.01$], as well as for type of response (remembering and knowing) [$F(1,58)=22.07$, $MSe=221.41$, $p<.0001$], whereas the interaction between the two variables did not reach the level of significance [$F(1,58)=3.51$, $MSe=35.21$, $p>.05$]. As for the false alarm rates, a second Two Way Analysis of Variance was performed, having the same factors, namely level of attention and type of response. The analysis revealed only a significant effect for type of response with more knowing than remembering [$F(1,58)=16.34$, $MSe=31.01$, $p<.0001$].

Three separate One Way Analyses of Variance (ANOVA) of the data were performed using this time corrected scores (false alarms subtracted from hits). Table 2.1 showed the mean proportion of the difference for overall performance, remember and know responses. For overall recognition, the pattern of results was similar to that observed for the uncorrected scores such that faces presented in the focused condition (.56) were significantly higher, compared to the condition where faces were presented in divided attention

Experiment 1

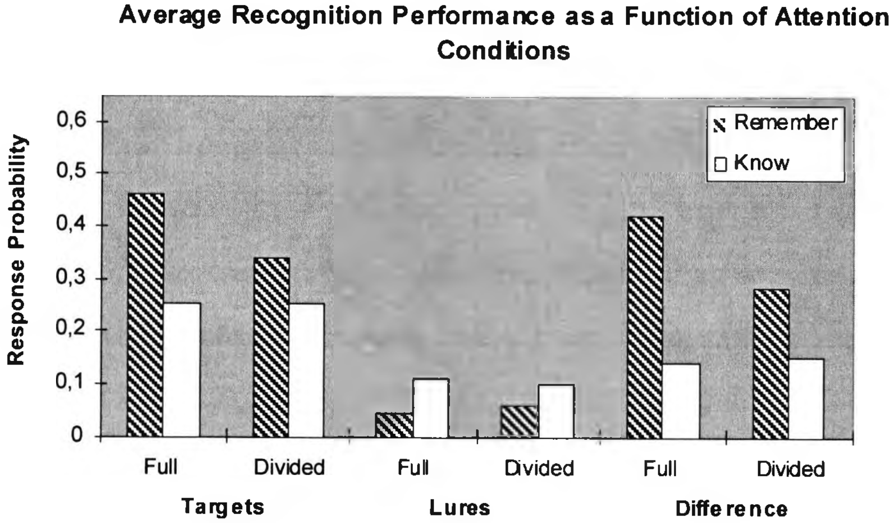

Figure 2.1

Experiment 1

Mean Proportion of Remember and Know Responses as a Function of Attention Involving Bip Sounds

	Hits		False Alarms		Difference	
	Full	Divided	Full	Divided	Full	Divided
Remember	.46	.34	.04	.06	.42	.28
Know	.25	.25	.11	.10	.14	.15

Table 2.1

(.43), [$F(1,58)=6.62$, MSe=91.26, $p<.05$]. Similarly, remember judgements were significantly better for the focused task (.42) than for the divided attention task (.28), [$F(1,58)=10.74$, MSe=96.26, $p<.01$]. Finally, knowing remained constant across conditions having a .14 rate for the focused condition and a .15 for the divided attention condition [$F(1,58)=.009$, MSe=.06, $p>.05$].

These results replicate the empirical findings of previous studies on facial stimuli (Parkin, Gardiner and Rosser, 1995) as well as on verbal material (Gardiner and Parkin, 1990) and showed that a divided attention task may decrease performance on remembering, while it may not influence knowing responses.

Discussion

The results of Experiment 1 showed for hit rates an increase of remember responses for the focused condition over the divided attention task, whereas know responses remained unaffected by the manipulation of attention. False alarm rates revealed a trend for more errors on remembering in the divided attention condition over the focused one but were nonsignificant, whereas knowing false alarm rates were approximately the same. Similarly, the analysis of corrected scores followed the exact same pattern of results for hits or false alarms showing that only remember responses can be influenced by the level of attention, which suggests that recollection is identified with controlled processes whereas familiarity with automatic processes.

As such, the results reported are in agreement with previously published findings in other laboratories (e.g. Gardiner & Parkin, 1990; Parkin, Gardiner & Rosser, Experiment 1, 1995) despite the fact that we used another set of materials and another subject population (Greek student population). The only discrepancy between the present findings and those obtained in the Parkin, Gardiner and Rosser' (1995) study is in the false alarm rates for remember responses. Specifically, in the present experiment divided attention produced errors in the remember responses, but failed to reach significance. This finding was expected because the selection of the materials lacked any distinctive characteristics and when distinctiveness is lost, it is plausible that faces form similar schematic representation and thus yield poorer remembering.

In conclusion, it appears that remember responses were fully dependent upon the attentional demands placed on the study material during initial exposure. In contrast, know responses perhaps require minimal conscious attention during encoding and probably depend upon automatic processes rather than effortful encoding.

The following experiment was designed to extend the previous evidence by allowing participants to report guesses as well. Experiment 2 followed exactly the same procedure with the addition of guess responses in order to examine the impact of remember and know responses on guessing.

2.3 EXPERIMENT 2

In the previous experiment we demonstrated how divided attention dissociates remember from know responses. Participants were specifically instructed not to guess, but to report either their recollective experience, or their feelings of familiarity. It has been reported in the literature, however, that participants are guessing even when they are not allowed to do so and that their guesses are included in the know response (e.g. Gardiner, Java, & Richardson-Klavehn, 1996). It has been argued, therefore that guess responses might be inversely related to remember responses (Gardiner, Kaminska, Dixon & Java, 1996; Gardiner, Java & Richardson-Klavehn, 1996) (see Section 1.1.ii, for details).

In the light of the aforementioned interpretation of earlier findings, the main purpose of the present experiment was to replicate and extend Experiment 1 with the addition of guess responses. Again, it was expected that divided attention would decrease remember responses whereas know responses would remain constant across focused and divided attention conditions. As for guessing, it was expected to remove any possible confounding between guess and know responses. Replicating previous reported findings, (Gardiner, Java & Richardson-Klavehn, 1996; Gardiner, Kaminska et al., 1996) guessing might also be inversely related to remember responses.

Method

Participants. Sixty - four undergraduate students of the American College of Greece participated either on a voluntary basis or for course credit. All participants were Greek-English bilinguals, both males and females with varying ages of 18-24. They were all tested in a memory laboratory setting individually, or in groups of two, and were randomly assigned to each of the two experimental conditions.

Design and Materials. The experiment entailed a divided attention and a focused attention condition in a between-subjects manipulation.

The materials used were the same as those in Experiment 1. Eight more faces were added to the original pool of faces to serve as buffer items. Two of them were placed at the beginning of the study list in order to control for primacy effects and another two were placed at the end of the list in order to minimise recency effects. The remaining four served as practice items and were given to the participants in order to familiarise them with the procedure. Two study lists were created, having 36 target items each and four buffers, which were used as alternates for targets and lures, this way achieving complete counterbalancing. In this experiment the recognition test consisted of a test list that contained all the target items, that is a total of 36 pictures, and an additional 36 lures.

Procedure. The procedure was a replication of the one followed in Experiment 1. Participants were presented with a list of faces under an 8 seconds presentation rate. The stimuli were accompanied by tones of low, medium and high pitch played randomly at 3- to 4.5 seconds intervals. The retention interval for this experiment was approximately 3 minutes, whereas in Experiment 1 the retention interval was 10 minutes. The reason for this modification was to ensure that the participant's interest was maintained, now that the test list was double in size and the fact that age of the test items would be affected by list length. This modification was implemented following a small pilot experiment which showed that the cutting down of the retention interval while increasing list length on the test list did not affect differently remember and know responses.

The memory test required participants to indicate which of the test items were on the study list and which ones were not. Specifically, participants had to report if their subjective experience was expressed by a remember, know or guess response (see Experiment 1, p. 86-87, for definitions). Apart from explaining to participants the characteristics of remembering and knowing judgements, guessing was also recorded for experiences that were not accompanied by either feelings of recollection, or feelings of familiarity, but might have been from the study list. Specifically, the difference between know and guess responses was explained to the participants as follows:

"When recognising faces there will be instances when we see someone on television and we think (i.e. we guess) we might have seen that person before and instances where we recognise someone on television and we are sure (i.e. we know) that person before, but we cannot remember when or where we saw that person before" (e.g. Gardiner, Java, & Richardson-Klavehn, 1996).

Results

Figure 2.2 presents the mean proportion of targets and lures for remember, know and guess judgements with respect to level of attention. False alarm rates for full attention were .06 for remembering, .06 for knowing and .12 for guessing whereas for the divided attention task the average scores were .06, .07 and .13, respectively (see Table 2.2). For hit rates, an One Way Analysis of Variance (ANOVA) showed a significant decrease in overall performance as depicted by divided attention (.63) compared to focused attention (.75), [$F(1,62)=5.30$, $MSe=.14$, $p<.05$]. A second One Way Analysis of Variance (ANOVA) depicted the same pattern of results for remember responses with a noticeable decrease of .32 for the divided attention over .47 in the focused attention condition, [$F(1,62)=12.80$, $MSe=.33$, $p<.001$]. In contrast, know and guess responses remained unaffected by the manipulation of attention, with [$F(1,62)=.38$, $MSe=.004$, $p>.05$] and [$F(1,62)=2.71$, $MSe=.011$, $p>.05$] respectively.

A second analysis was judged necessary and a Two Way Analysis of Variance (ANOVA) was performed that included remember, know and guess judgements as an independent variable. The statistical model implemented was a attention (2) x response (3) mixed factorial design with attention (focused versus divided) being the between-subjects variable and type of response (remember, know and guess) being a within-subjects variable. Hit rates revealed a significant effect of level of attention [$F(1,61)=4.59$, $MSe=.04$, $p<.05$], and type of response [$F(2,122)=82.74$, $MSe=1.26$, $p<.0001$]. The interaction between these two variables was significant as well [$F(2,122)=7.98$, $MSe=.12$, $p<.01$]. In contrast, a separate analysis, of the false alarm rates in 2x3 ANOVA arrangement on the attention and type of response variables demonstrated a significant effect only for type of response [$F(2,124)=18.88$, $MSe=.08$, $p<.0001$].

Summing up, the findings on hit rates clearly showed that divided attention affects performance measured by remember responses whereas know and guess responses remained unaffected by this manipulation.

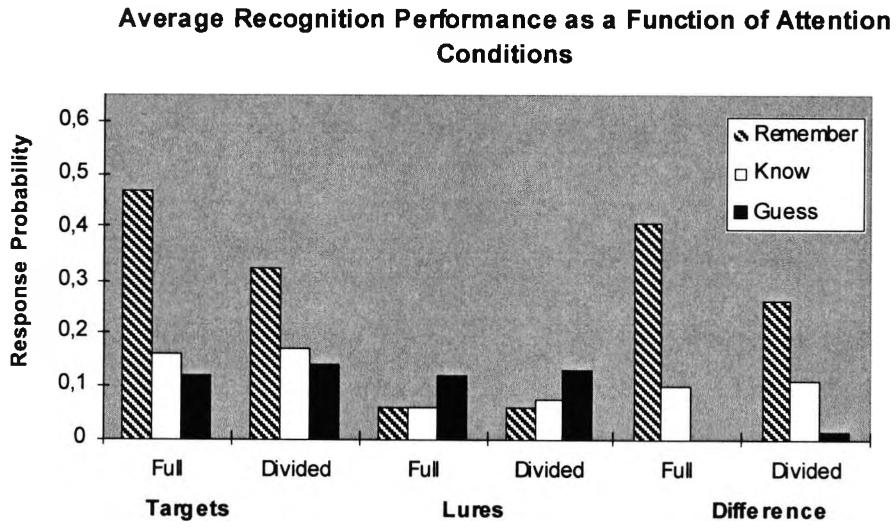
Average Recognition Performance as a Function of Attention Conditions
Response Probability
0,6
0,5
0,4
0,3
0,2
0,1
0
Remember
Know
Guess
Full
Divided
Full
Divided
Full
Divided
Targets
Lures
Difference

Figure 2.2

Experiment 2

Mean Proportion of Remember, Know and Guess Responses as a Function of Attention Involving Bip Sounds

	Hits		False Alarms		Difference	
	Full	Divided	Full	Divided	Full	Divided
Remember	.47	.32	.06	.06	.41	.26
Know	.16	.17	.06	.07	.10	.17
Guess	.12	.14	.12	.13	.00	.01

Table 2.2

However, findings on false alarm rates indicated that full and divided attention yield no difference in error judgements across remember, know and guess responses.

To investigate the performance of guess responses in relation to know responses, a further One Way Analysis of Variance comparing hit to false alarm rates on know responses indicated that there were significantly more hits over false alarm rates in both focused [$F(1,62)=15.23$, $MSe=.13$, $p<.001$] and divided condition [$F(1,62)=22.26$, $MSe=.0013$, $p<.001$]. A second analysis examined the guess responses and revealed no difference between hit over false alarm rates in both focused [$F(1,62)=.0003$, $MSe=.00$, $p>.05$] and divided attention conditions [$F(1,62)=22.26$, $MSe=.198$, $p>.05$], suggesting that guessing cannot discriminate between targets and lures.

A separate 2x3 Analysis of Variance (ANOVA), having the same factors, for the corrected scores confirmed the above results and revealed a significant effect of attention [$F(1,62)=4.39$, $MSe=.07$, $p<.05$] and of response type [$F(2,124)=108.8$, $MSe=1.86$, $p<.0001$], as well as the interaction between attention and response type [$F(2,124)=7.83$, $MSe=.13$, $p<.01$]. Mean proportion for the corrected scores are shown in Table 2.2.

Discussion

These findings revealed an effect of divided attention on remember responses for hit rates, whereas know and guess responses remained constant across conditions. This pattern of results was strengthened by the results of corrected scores analysis as well. Thus, Experiment 2 confirmed the findings of Experiment 1, as well as evidence provided by Gardiner and his colleagues (Gardiner & Parkin, 1990; Parkin, Gardiner & Rosser, 1995).

A comparison of the data in Experiments 1 and 2 reveal that both remember and know responses were affected in the same way insofar as effects of attention are concerned. Specifically, a closer examination of Tables 2.1 and 2.2 suggests that divided attention greatly reduced remembering but had little influence on knowing. The only discrepancy in results between Experiment 1 and 2 is the percentages of know and guess responses. Specifically, the overall percentage of know responses dropped significantly with the addition of guess responses (.50 in Experiment 1 to .33 in Experiment 2, by adding know responses in the focused and divided attention in Tables 1.1 and 1.2, respectively) which shows that when subjects are not allowed to guess, they use know responses as an alternate for guesses. Thus, the inclusion of guess responses is critical insofar as it removes any contributions that otherwise would be assigned to know responses (Gardiner, Java, & Richardson-Klavehn, 1996).

Furthermore, know and guess responses seem to be similarly affected by the manipulation of attention. However, the comparison of know and guess responses for hit and false alarms showed, first, that guessing is distinct from knowing, and second, that guessing shows no memory. Moreover, an analysis of the corrected scores clearly illustrated the above point. Guess responses showed no 'discriminative power' between studied and unstudied faces. This important difference between know and guess responses has been demonstrated in previous studies (Gardiner, Java, & Richardson-Klavehn, 1996a; Gardiner, Kaminska, Dixon, & Java, 1996b; Gardiner, Richardson-Klavehn, & Ramponi, 1997) as well, showing that awareness of guessing is distinct from knowing. The discussion of guess responses is continued in the General Discussion section, after the presentation of Experiment 3.

The Experiment that follows further explores the effect of level of attention with the use of a different attentional task to check the robustness of the divided attention effect.

2.4 EXPERIMENT 3

Experiment 2 showed that the condition focused versus divided attention had a differential effect on recognition memory as depicted by remember, know and guess judgements. Furthermore, it was shown that the inclusion of guessing had less effect on the proportions of remember than know responses.

The purpose of Experiment 3 is to further explore the effects of attention on conscious recognition. So far in Experiments 1 and 2, the divided attention task involved tone counting, a meaningless behavioral condition which seemingly disrupted the participants' encoding processes. Experiment 3 employed a much more conceptual divided attention task in an attempt to generalise the effect of divided attention. Specifically, participants were presented with meaningful distractors which may require the formulation of an additional representation in semantic memory, beside the one formed by the facial stimuli.

The procedure was exactly the same as in Experiment 2 with the only difference being that instead of hearing tones, subjects heard stories. Half the participants were instructed to pay attention to both stories and faces, and the other half were instructed to ignore the stories and focus their attention on the faces. This instructional manipulation of the divided attention task, that is both groups heard stories, was similarly employed in the present experiment to make the effect of divided attention stronger. It was hypothesised that remember responses would be affected by this manipulation, thus decreasing in the divided attention task, whereas knowing and guessing would remain constant across conditions (e.g. Gardiner & Parkin, 1990; Parkin, Gardiner, & Rosser, 1995).

Method

Participants. Sixty-four students volunteered from the same population and were allocated arbitrarily to one of the two experimental conditions. They were tested individually, or in groups of two, under similar testing conditions and in the same laboratory setting.

Design and Materials. The same independent variable as in Experiment 1 and 2 was employed, that is, focused versus divided attention and it was manipulated between subjects.

The materials used for the study lists, as well for the recognition tests were identical to those used in Experiment 2. Furthermore, during the divided attention task, participants heard seven neutral stories of various unrelated topics, without any emotional overtone, simultaneously with the presentation of the study faces. The stories had been recorded in a professional recording studio, by a professional female English native speaker. During the recognition test participants were presented only with the faces.

Procedure. At the beginning of the experimental session participants received intentional instructions similar to the ones obtained in previous experiments. The participants were randomly assigned either to the divided or focused attention condition. In the former condition, participants were asked to pay attention to the stories because they were asked to complete a multiple-choice comprehension test immediately after study. This test was given in order to ensure that the participants paid attention to the stories. In the latter condition, participants were instructed to ignore the stories and focus their attention on the faces. Thus, stories in this latter condition were treated as background noise, as tones did in Experiments 1 and 2. The duration of the stories in both full and divided attention lasted exactly the same time as the presentation of faces, that is 10.6 minutes. Subsequently, the divided attention group received the multiple-choice comprehension questions that were followed by a 'find - the - differences' perceptual task spending approximately 3 minutes on the above. The focused attention group spent more time on the same 'find - the - differences' perceptual task, thus, spending an equal amount of time prior to receiving the memory test. The memory test procedure was identical to the one used in Experiment 2. Definitions of remember, know, and guess responses were given at the beginning of the session, following previous instructions (see Gardiner, 1988).

Results

The average correct performance of the comprehensive test for the divided attention group was approximately .62. This percentage implies that participants followed instructions and were attending the stories as well as the faces. The principal results for hit and false alarm rates are depicted in Figure 2.3, which shows the mean proportion of remember, know and guess responses as a function of level of attention. False alarm rates fell within the ranges reported in Experiment 2 for both focused (remember .07, know .07, and guess .13) and divided attention (remember .11, know .11 and guess .17) (see Table 2.3). Four separate One Way Analyses of Variance (ANOVA) for hit rates revealed a significant effect for the overall performance with focused attention (.82) significantly higher than divided attention (.70), [$F(1,62)=9.63$, $MSe=289$, $p<.01$]. A similar effect was demonstrated for remember responses with increased performance on focused (.57) compared to divided attention (.40), [$F(1,62)=10.64$, $MSe=606.39$, $p<.01$]. As for know responses, they were maintained constant across focused and divided attention with .13 in both conditions [$F(1,62)=.001$, $MSe=.01$, $p>.05$]. Similarly, guess responses failed to reach the level of significance with .12 in the focused condition and .17 in the divided attention condition [$F(1,62)=3.71$, $MSe=60.06$, $p>.05$]. False alarm rates showed more errors in remember responses on divided (.11) compared to focused attention condition (.07), [$F(1,62)=4.73$, $MSe=43.89$, $p<.05$]. Overall false recognition performance reached the level of significance as well with .13 and .17 rates for focused and divided attention respectively, [F(1,62)=5.38, MSe=324, p<.05]. To investigate how guess responses were affected, an Analysis of Variance was performed comparing hits over false alarms which failed to reach significance for both focused [F(1,62)=.425, MSe=5.06, p>.05] and divided attention conditions [F(1,62)=.025, MSe=.56, p>.05], revealing that guess responses did not distinguish between targets and lures. Furthermore, a closer look to know responses showed that know hit rates were close to false alarm rates (Table 2.3). Accordingly, two One - Way Analyses of Variance were performed comparing hits over false alarm know performance. Specifically, the focused condition revealed a significant effect for hit (.13) over false alarm rates (.07), [F(1,62)=6.9, MSe=74,39, p<.01]. In contrast, the divided attention condition failed to reach the level of significance [F(1,62)=.788, MSe=11,39, p>.05], revealing that know responses show very little memory.

A second analysis was performed that included response (3) x attention (2) mixed factorial design with response (remember, know and guess) treated as a within-subjects manipulation, and attention (focused versus divided) as a between-subjects manipulation. Data revealed a significant effect of level of attention [F(1,62)=6.10, MSe=.03, p<.05], and of subjective responses [F(2,124)=174.66, MSe=3.53, p<.01], as well as the interaction between them [F(2,124)=3.68, MSe=.07, p<.05]. The reported statistical findings suggested that divided attention greatly affected recognition performance yielding a decline for remember responses while know and guess responses remained unaffected.

To investigate further the effect of attention in recognition memory, a separate Analysis of Variance (ANOVA) of the corrected scores was performed. Table 2.3 illustrates the corrected data as depicted by remember, know and guess responses. Results yielded a significant main effect of level of attention [$F(1,62)=19.87$, $MSe=487.46$, $p<.0001$] and response type [$F(2,124)=113.62$, $MSe=3970.01$, $p<.0001$]. Similarly, the interaction was significant [$F(2,124)=8.42$, $MSe=294.31$, $p<.0001$]. The corrected scores fully supported the uncorrected data producing similar results. It is obvious that the effect of divided attention was maintained even when the divided attention task has meaningful, conceptual attributes.

Experiment 3

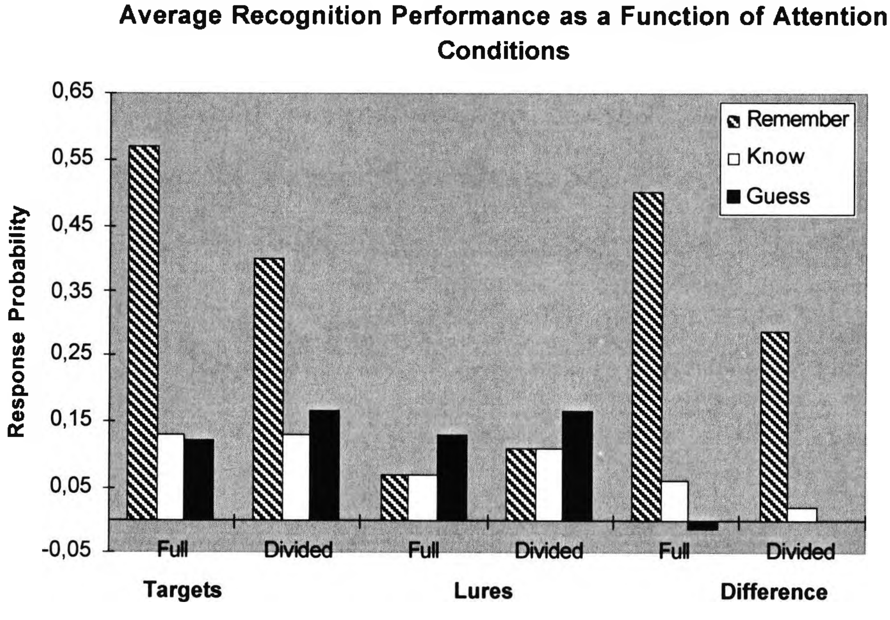

Figure 2.3

Experiment 3

Mean Proportion of Remember, Know and Guess Responses as a Function of Attention Involving Listening to Stories

	Hits		False Alarms		Difference	
	Full	Divided	Full	Divided	Full	Divided
Remember	.57	.40	.07	.11	.50	.29
Know	.13	.13	.07	.11	.06	.02
Guess	.12	.17	.13	.17	-.01	.00

Table 2.3

Discussion

The results obtained in Experiment 3 were compatible to those derived in Experiment 2, showing the robust effectiveness of the divided attention tasks, mainly on remembering. It appears that dividing attentional mechanisms between the visual encoding of faces and the auditory encoding of stories, greatly affected remember responses without affecting know responses. However, there is a discrepancy in the present findings, that is know hit rates are close to know false alarm rates.

A possible explanation for the above findings is that seeing faces while listening to meaningful vignettes involves the activation of semantic memory processes. Speculatively, such processes allow the further memory storage of facial features, along with accompanying story related details. In other words, memory storage most likely is influenced by story related encoding characteristics, a process which is mostly conceptual in nature. Thus, this conceptual dimension of the materials affects know responses which suffer greatly, especially under the divided attention condition (Table 2.3).

Furthermore, according to the IRK model even low levels of know responses may "reflect" the familiarity process (Yonelinas & Jacoby, 1996). Re-analysing results of the Experiment showed that familiarity decreased from .30 to .21 for focused to divided attention conditions. According to those estimates, the familiarity process is also affected by divided attention demands. Therefore, all three experiments showed effects of divided attention on estimates of familiarity process.

Guess responses were again proven nondistinguishable between studied and unstudied items (see Table 2.3). Furthermore, guessing showed to be inversely related to remember responses supporting previous findings (Gardiner, Java, Richardson-Klavehn, 1996). As such, in the divided attention condition, in which remember responses declined, guess responses showed a small increase in performance, though that increase failed to exhibit a significant effect.

It is worth noting that the manipulation of attention, that is, both groups heard the stories, made the effect of attention more impressive since participants were based only on the instructions given (i.e. to attend, not to attend). This manipulation contrasts with previous studies in which only the divided attention group heard the distractors (e.g. Gardiner & Parkin, 1990; Parkin, Gardiner, & Rosser, 1995).

In conclusion, the above results have shown that the effect of divided attention is a valid manipulation for obtaining dissociation in facial recognition judgements. In fact, attentional manipulation can have an impact on remembering regardless of the study materials used (see also Parkin, Gardiner & Rosser, 1995).

2.5 General Discussion

Experiment 1 tested the replicability in the facial domain of previously found results on verbal tasks. Levels of attention were manipulated at study, divided versus focused condition, and the instructions to decide upon the two distinct states of awareness, namely remember and know responses, showed that divided attention affects only remember responses while know responses remained constant.

Thus, Experiment 1 has replicated the study of Parkin, Gardiner and Rosser (1995) and extended the work of Gardiner and Parkin (1990) which dealt with verbal material. Moreover, it examined the functional dissociations between remember and know judgements and showed that level of attention was a variable that affects conscious recollection but not feelings of familiarity. An important departure from previous studies dealing with attention (e.g. Parkin et al.) was that both groups heard the tones. This manipulation made the effect of attention stronger since it was based on instructions, that is, to attend or to ignore the tones.

Experiment 2 compared focused versus divided attention task with the inclusion of guess responses as a third state of conscious awareness. It was a replication of Experiment 1 but this time participants were allowed to report guess responses when they did not experience either feelings of recollection or feelings of familiarity. Accordingly, the purpose of Experiment 2 was to investigate the way that remember and know responses would influence guess responses. Findings confirmed previous literature concerning guess responses (e.g. Gardiner & Conway, 1999) and showed that guesses reflect contributions that otherwise would be made to know responses. This has been demonstrated by the decrease of know performance with the inclusion of guessing in comparing Experiment 1 with Experiment 2 (Tables 2.1 and 2.2). Aside from the inclusion of guess responses, Experiment 2 differed from Experiment 1 in the test list length. Specifically, the recognition test in Experiment 2 consisted of all target items with an additional number of lures (see page 95 for more details). However, despite these differences, divided attention condition affected only remember responses without affecting know responses.

Thus, to investigate further the effect of divided attention, Experiment 3 was conducted, but this time the demands were altered since the task required more conceptual than perceptual processing. Narration of stories were heard simultaneously with the presentation of faces. As in the previous experiments the effect of attention was instructional since both groups heard stories. Findings followed the same pattern of results as in Experiment 1 and 2, with divided attention affecting only remember responses, whereas know and guess responses remained constant.

The novel aspects of the experiments can be summarised in three important points. First, the attentional manipulation was instructional in that both groups heard bips or stories. This manipulation made the effect of attention more impressive. Second, the inclusion of guess responses was employed for the first time in divided attention conditions (Experiments 2 & 3). And third, Experiment 3 manipulated a more conceptual in nature divided attention condition to further explore the robustness of the phenomenon (Experiment 3).

The main conclusions from the experiments might be summarised in the following points. First, divided attention tasks affected greatly only remember responses. This effect was maintained through different attentional manipulations, that is, perceptual or conceptual. However, in the conceptual story encoding task (Experiment 3) remember responses had an overall increase in performance in comparison to the perceptual tone counting task (Experiment 2). This increase suggests that remember responses were less affected by the conceptual than by the perceptual task. This outcome might be attributed to the fact that the conceptual task is less difficult. In contrast, know responses, remained constant across divided and focused attention conditions, but the overall performance decreased under the conceptual task in relation to the perceptual task. Second, another finding though less significant is related to guess responses. Specifically, guess responses showed no memory and no 'discriminative power' between old and new items, they exhibited a small 'negative discriminability' effect, though nonsignificant (Experiment 2) and last, findings revealed a small trend that guess responses are inversely related to remember responses.

Another possible theoretical interpretation is based on a combination of Tulving's (1983, 1985) memory systems and Roediger's conceptual and perceptual processes (Gardiner & Java, 1993). According to these theoretical accounts, remember responses are dependent on conceptual and attentional factors in an episodic memory system, whereas know responses are dependent on perceptual and automatic factors in a semantic memory system (see Gardiner & Java, 1993).

Related to the transfer appropriate processing account, it seems that remembering is facilitated by the conceptual, elaborative processing in the focused attention condition since it permits full attention to broadly and deeply analyse the features of the stimuli. In contrast, divided attention task reduced remember responses since it lacked the necessary attentional conditions for conceptual processing to occur. This argument is further strengthened by the increased overall performance of remember responses under the conceptual story encoding conditions in Experiment 3, in comparison to the tone counting task in Experiment 2, which may indicate that the story task was less difficult. On the other hand, knowing seems to rely on perceptual processing which requires effortlessly encoding. Accordingly, know responses remained unaffected by the attentional manipulation. However, know responses had a decrease in overall performance in the conceptual story encoding task in comparison to the tone counting condition since it permitted mostly conceptual and not perceptual encoding.

Regarding the goals of the thesis, the present set of experiments showed that divided attention reduced remembering since it lacked the necessary attentional conditions for conceptual processing, whereas knowing remained unaffected since it relies on perceptual processing which is more automatic in nature.

The following chapter further investigates the functional dissociations between the two states of awareness by employing a contextual manipulation as an additional variable, that is, preserving or altering the study stimuli across study and test.

CHAPTER 3

CONTEXT EFFECTS, PERCEPTUAL INFLUENCES AND LEVELS OF CONSCIOUS AWARENESS

3.1 Introduction

This chapter describes two experiments examining the effect of context in recognition memory tests. The two experiments reported used a context manipulation, which involved presentation of same versus different size faces between study and test. The experimental manipulation focused on perceptual features because it involved preserving, or altering the facial representation formulated across study and test. Rajaram (1996, Experiment 2) examined the effects of size changes in pictorial stimuli on recognition and remember judgements. She found an increased performance of remember responses following the same size condition across study and test. Rajaram interpreted her findings by proposing the distinctiveness/fluency framework. Specifically, she claimed that remember judgements were created by the analysis of the distinctive attributes of stimuli, either conceptual or perceptual in nature. In contrast, know judgements were enhanced by the fluency with which presented items were processed, again, either stemming from conceptual or perceptual factors. However, Rajaram's study did not provide direct evidence in support of fluency.

An alternative suggestion has been offered by Gregg and Gardiner (Experiment 2, 1994) who investigated the influence of a highly perceptual task, namely the rapid presentation rate of study lists, on remember and know responses. They found a mode correspondence effect on know responses, following the highly perceptual task (p. 142) and argued, as Rajaram (1993) had proposed, that remembering is influenced by conceptual factors and knowing is influenced by perceptual ones (see Section 1.2.2.ii), an assumption that spoke in support of the conceptual /perceptual distinction. Accordingly, this chapter employs rapid presentation rates, in addition to the context manipulation, following Gregg and Gardiner' s procedure.

Under the slow rate condition, the Experiment was expected to replicate Rajaram's findings and hence provide further evidence in support of the distinctiveness/fluency framework, but against the conceptual/perceptual distinction. In contrast, under the fast rate conditions, the conceptual/perceptual distinction suggests that context effect should occur only in know responses, since the fast rate makes distinctive encoding difficult and allows mostly the perceptual encoding of the material. Similarly, for the same reasons the distinctiveness/fluency framework predicts that the context effect might be obtained in know responses.

An important detail of the present experiments is the inclusion of guess responses. In both Rajaram 's (1996) and Gregg and Gardiner's (1994) studies guess responses were omitted. However, the inclusion of guessing was judged necessary to remove any possible confounding from know responses.

In this set of experiments the predictions of Donaldson's (1996) signal detection theory are going to be tested. The reason for introducing Donaldson's model in this chapter, and not in the previous one, is the use of rapid presentation rate employed on the present experiments. This manipulation facilitates the testing of the model's most important prediction since the manipulation is not only expected to decrease remembering but to increase knowing as well. This is more likely to lead to differences in bias-free estimates of memory when derived from overall hit and false alarm rates or and from remember hit and false alarm rates (Gardiner & Gregg, 1997; see also Section 1.2.1.iv). Donaldson assumes that the two states of awareness represent a continuum of trace strength with remembering reflecting a stricter criterion and know responses being the lenient criterion. Donaldson's suggestions have been rejected by Gardiner and Gregg (1997) who provided evidence disconfirming the detection model (Section 1.2.1.iv).

The aim of Experiment 4 was to replicate Rajaram's (1996, Experiment 2) findings, using facial stimuli instead of pictorial. Thus, an attempt was made to test two opposing theoretical hypotheses, that is the conceptual/perceptual distinction (Rajaram, 1993; Gregg & Gardiner, 1994), and the distinctiveness/fluency one (Rajaram, 1996; 1998) by manipulating the perceptual factor of size changes across study and test. If this perceptual manipulation affects only know responses, then this would support the conceptual/perceptual distinction according to which perceptual manipulation should only affect know responses. If remember and know responses were both affected by this perceptual manipulation, then this would support the distinctiveness/fluency framework according to which the two states of awareness are orthogonal to the distinction between conceptual/perceptual processes.

Similarly, Experiment 5 varied the congruency across study and test. The main difference between Experiments 4 and 5 is the presentation rate employed, which was set in 300msec versus 700msec. This idea was taken from Gregg and Gardiner's study (Experiment 2, 1994) who manipulated study-test modalities in a highly perceptual orienting task and used either 2sec. or 300msec. presentation rates during study. The aims of Experiment 5 were first, to replicate the Gregg and Gardiner result for faces, rather than words, and so provide a further test of the A' predictions, and second, to see if the effect of study-test congruency predicted in remembering reappears in knowing, when remembering is reduced.

3.2 EXPERIMENT 4

Experiment 4 examined the way perceptual manipulations, namely different size of faces across study and test, would affect participants making remember, know and guess responses. Participants were presented with faces either in a congruent context, that is small size at study and test and large size at study and test, or in a incongruent context condition, that is small-size at study, large-size at test, or large-size at study, small-size at test. In order to make sure that participants followed that study task, they were instructed to look carefully at each face and check whether any of them had freckles. In addition they were told to keep a tally of faces with freckles and report the number of them at the end of the study list. However, none of the faces had any freckles.

The rationale of the present experiment was based on the general conclusion derived from the literature (e.g. Rajaram & Roediger, 1997) suggesting that conscious recollection is selectively influenced by conceptual conditions, whereas feelings of familiarity by perceptual conditions. Of course, it worth noting that Rajaram (1996; 1998) has maintained an opposing view suggesting that conscious recollection is affected by the item's distinctive attributes, whether conceptual or perceptual in nature. As such, the present experiment investigated the distinctiveness/fluency framework and the assumption that stimuli, perceptual in nature will influence conscious recollection. If the distinctiveness/fluency framework

(Rajaram, 1996; 1998) was valid, then remembering would be affected by the perceptual manipulation, namely size changes across study and test. In contrast, if the conceptual/perceptual distinction (Rajaram, 1993; Gregg & Gardiner, 1994) was valid, then only know responses would be influenced by this manipulation.

Furthermore, in this experiment Donaldson's (1996) signal detection model view in analysing remember and know responses is tested (see Section 1.2.1.iv). In other words, if Donaldson's predictions were correct then A' estimates of remember hit and false alarm rates should be similar with estimates of overall hit and false alarm rates.

Method

Participants. Thirty-two participants were recruited for the experiment. All of them were full-time students at the American College of Greece, being at freshman or sophomore levels with an age of 18 to 24 years. They were tested in a memory laboratory setting individually, or in small groups of two.

Design and Materials. Participants were allocated to the condition of context, congruent versus incongruent, in a within-subjects manipulation.

A modified version of materials, used in previous experiments was loaded on the computer. Again, 96 black and white photographs of unfamiliar faces, taken from the 1994 yearbook of the American College of Greece were selected from a total pool of 300 pictures and were presented through a 14inch PC monitor screen. The photographs were processed through Corel Draw 5.0 slides show runtime player package and were presented to the subject, one picture at a time. Following the materials selection criteria used in Experiment 1, faces represented in a head - and - shoulder view against the same neutral background while individuals with unusual characteristics such as beards, moustaches or eyeglasses were excluded based on the ratings of a group of judges. Four judges, two females and two males, between the ages of 20 to 25 years, carried out the selection. The faces were prepared in small and large versions with a ratio of 1:2. Each study list consisted of 48 faces, 24 small ones and 24 large ones, presented randomly with respect to size and sex.

Two study lists were created and half the participants studied one set of 48 faces and the other half the other set of 48 faces. The memory test comprised of 96 faces, 48 items from the study list intermixed with the 48 unstudied faces. In the test list half of the studied faces were presented in the same size at study and test (large at study and test or small at study and test) and the other half were different in size across study and test (large at study - small at test, or small at study - large at test).

Thus, eight combinations of study and test lists were created in order to achieve complete counterbalancing.

Procedure. Participants received both oral and written instructions at the beginning of each session and they were required to sign a consent form. Faces for study and test lists were presented for 5 sec each via a computer screen and subjects were seated at a 1-meter viewing distance. During the study phase participants were instructed to look at each of the faces carefully. They were told that some of the faces had freckles and they had to count the number of faces that had freckles and report it at the end of the sequence. This task was to ensure that participants were following the study list. They were also informed of the subsequent memory test but without specific details.

During a subsequent 5-min retention interval participants were required to perform a "find the differences" quiz, which served as a distractor task. Immediately after, they were presented with the recognition test and were instructed to ignore the size of the faces while making the recognition judgements. They had to decide whether they had seen each face before, and if so, make an indication in the answer sheet provided. Furthermore, they were asked to make a distinction between remember, know and guess responses, which was explained to them in full detail and with adequate examples. As in the previous Experiments, a remember response was defined as a state during which a face evoked some immediate association or any other memory for that item at the time it was presented. In contrast, a know response was accompanied by no recollection of its prior occurrence. Guess judgements were added in order to have a clearer picture of the know performance. Thus, participants reported guess responses whether the face elicited neither the experience of remembering nor of knowing but, nevertheless, seemed to have occurred in the study list.

Results

The statistical analysis was based on comparisons between congruent, that is, stimuli presented small at study - small at test or large at study - large at test, and incongruent, that is small at study - large at test or large at study - small at test, stimuli across study and test. The proportion of correct responses for overall performance, remember, know and guess responses as well as the proportion of lures are depicted in Table 3.1. From the proportion of lures that subjects incorrectly chose as targets (.13), remember judgements were .02, know judgements were .03 and guess ones were .08. These data are compatible with the earlier empirical findings and are comparable to Rajaram's (1996; Experiment 2) findings. Note, however, that Rajaram did not include guess responses in her experiment.

Figure 3.1 summarised the mean proportion of targets and lures as a function of study conditions. As such, overall recognition revealed a significant effect of context condition. In particular, a One Way Analysis of Variance (ANOVA), comparing congruent versus incongruent items, for overall facial recognition memory revealed a significant effect for congruent faces (.71) than for incongruent ones (.56), [$F(1,62) = 12.23$, MSe = .43, $p<.001$]. The effect of size was analysed separately for remember, know and guess responses. Remember judgements showed the same pattern of results as in overall recognition and were significantly higher in the same context condition (.46) than the different context (.31), [$F(1,62)=9.81$, MSe=.33, $p<.001$]. However, know responses did not meet the significance level [$F(1,62)=.24$, MSe=.002, $p>.05$] and remained relatively unchanged across the context conditions with same size across study and test (.16) compared to different size across study and test (.15). Finally, guess judgements were also unaffected by the condition of same versus different context [$F(1,62)=.878$, MSe=.0008, $p>.05$], with congruent condition (.11) compared to incongruent one (.12).

A second analysis of the data was carried out that derived A′ estimates from the data which are summarised in Table 3.1. A 2x2 Analysis of Variance (ANOVA) was performed with one factor being context (congruent versus incongruent) and the other being performance (remember hit and false alarm rates versus remember plus know hit and false alarm rates) all in a within subjects manipulation. The analysis did not include guess responses because they

Experiment 4

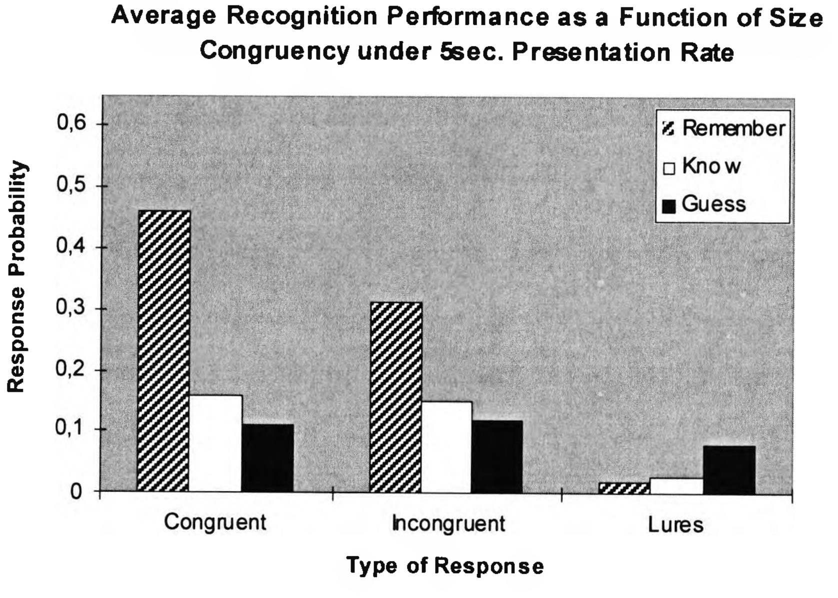

Figure 3.1

Experiment 4

Mean Proportion of Targets, Lures and A′ Estimates as a Function of Size Congruency under 5sec. Presentation Rate

	Targets			A′ Estimates	
	Same	Different	Lures	Same	Different
Remember	.46	.31	.02	.84	.80
Know	.16	.15	.03	.85	.81
Guess	.11	.12	.08	.85	.80

Table 3.1

were too low to change the overall picture of results. The effect of context was significant for overall A′ estimates, [$F(1,31)=12.781$, $MSe=.06$, $p<.001$], but not for individual congruent (remember .84, remember plus know responses .85) or incongruent conditions (remember .80, remember plus know responses .81), [$F(1,31)=2.78$, $MSe=.01$, $p>.05$]. These findings suggest that bias-free estimates of memory were similar whether derived from remember hit and false alarm rates or from remember plus know hit and false alarm rates. As these results show, Donaldson's (1996) model is supported by the present experiment.

Discussion

The findings showed an increased level of remember responses in the congruent condition whereas know and guess responses maintained the same rates across conditions. This outcome is inconsistent with the notion that remember responses were selectively sensitive only to conceptual manipulations (e.g. Gardiner, 1988). As such, results confirmed the distinctiveness/fluency hypothesis according to which remember responses are influenced by the distinctive attributes of the stimuli whether conceptual or perceptual in nature. This conclusion, along its implication, is considered in the General Discussion section after the presentation of the next experiment.

As for know responses, they remained constant, consistent with Rajaram's hypothesis. Knowing is influenced by the fluency with which the to-be-recognised information was processed. Since the design of the Experiment deals with distinctiveness, know responses remained unaffected.

Similarly, guess responses replicated previous findings because they did not show any discriminative power (Gardiner, Java & Richardson-Klavehn, 1996; Gardiner, Richardson-Klavehn & Ramponi, 1997; Gardiner & Gregg, 1997).

Finally, a re-analysis of data for A′ estimates showed an effect of context and fully replicated the theory's most important prediction. That is, bias-free estimates of memory were equivalent whether derived from overall recognition hit and false alarm rates or from remember hit and false alarm rates. This effect can be explained since the experiment's remember responses exceeded by far know responses and the test involved comparisons between remember and remember plus know responses. In experimental designs where know responses exceed remember ones, the outcome of A′ estimates is quite different (Gardiner & Gregg, 1997).

Experiment 5 that follows employed same compared to different size of faces across study and test by introducing faces in a rapid succession, that is 300msec versus 700msec. The task was employed in order to see if, with little or no remembering, congruency effect might occur in know responses. Furthermore, this manipulation would answer the questions raised on Experiment 4. First, rapid presentation rate is beyond any doubt a highly perceptual task that reduces the opportunity for conceptual processing, and second, since know responses are expected to be the majority of responses, then bias-free estimates of memory measured by remember plus know hit and false alarm rates may be expected to be higher than remember hit and false alarm rates.

3.3 Experiment 5

Experiment 4 was designed to replicate Rajaram' s (1996, Experiment 2) finding that same size pictures at study and test lead to more remember responses than different size pictures, but with same versus different size faces. Findings revealed that the perceptual manipulation of size congruency increased remember responses without affecting knowing. The purpose of Experiment 5 was to investigate whether greatly reducing remember responses would produce a congruency effect in know responses. For that reason, a highly perceptual task was used by introducing faces at study in a rapid succession, namely 300msec versus 700msec, same as Gregg's and Gardiner's (1994) study in their Experiment 2. If know responses were affected by the manipulation of context, then the conceptual/perceptual distinction would be supported under the assumption that knowing is particularly sensitive to perceptual conditions. Similarly, that finding would also be consistent with the distinctive/fluency framework, because the effect of context would be occurring in know responses under conditions that reduce the distinctiveness needed to support remembering, and so lead to greater reliance upon perceptual fluency.

Furthermore, the assumptions of the signal detection model would be investigated. Specifically, Gardiner and Gregg (1997), following the statistical rationale used by Gregg and Gardiner (1994), found that A' estimates were significantly higher when derived from remember plus know responses than when derived only from remember responses. Moreover, Gardiner and Gregg pointed out that there are studies in which A′ estimates of remember plus know responses would exceed the ones derived from remember responses, if recognition is associated with unusually high proportions of know responses. Since the Experiment is a replication of Gregg and Gardiner's study, an increase is expected on A′ estimates derived from overall recognition over A′ estimates derived only from remember responses.

Method

Participants. Forty-eight undergraduates from the American College of Greece were recruited and participated on a volunteer, or fulfillment for credit, basis. They were tested individually in the same memory laboratory setting as in Experiment 4.

Materials, Design and Procedure. The experimental procedure and materials were the same as in Experiment 4. The design differed only with respect to presentation rate. Two different presentation rates of the study list were introduced, that is 300msec versus 700msec, in a between subjects manipulation. An equal number of subjects were randomly allocated to the 300 or 700msec, set automatically by the computer. The task of counting the faces that had freckles was maintained. The presentation rate of the recognition test was 5sec., as in Experiment 4, to allow participants to decide upon their answer.

Results and Discussion

The proportion of targets and lures are displayed in Figure 3.2.a and 3.2.b. In particular, for the presentation rate of 300msec, the proportion of false alarms was .27 with .06 being remember judgements, .09 being know judgements and .12 being guesses (Table 3.2.a). For hit rates, three One Way Analyses of Variance (ANOVA) were performed which failed to reach significance for congruent against incongruent stimuli for all types of response, that is remember [$F(1,46)=.43$, $MSe=1.02$, $p>.05$], know [$F(1,46)=.46$, $MSe=3.52$, $p>.05$] and guess responses [$F(1,46)=.98$, $MSe=6.75$, $p>.05$].

For the presentation rate of 700msec, the statistical analysis followed the same pattern of results as in 300msec. Specifically, false alarm rates showed a decrease (.15), with remember responses at .03, know responses at .06 and guesses at .06. The average performance levels across response types are demonstrated in Table 3.2.b. For hit rates, the three One Way Analyses of Variance (ANOVA) which compared congruent versus incongruent rates on remember [$F(1,46)=.03$, $MSe=.08$, $p>.05$], know [$F(1,46)=.85$, $MSe=7.52$, $p>.05$], and guess responses [$F(1,62)=2.60$, $MSe=7.52$, $p>.05$] did not reach significance.

Furthermore, in order to compare the two rapid presentation rates, that is 300msec and 700msec, comparable statistical analysis was undertaken. Thus, a 2x3x2 ANOVA for hit responses was performed with the factors of context (congruent versus incongruent) and type of response (remember versus know versus guess), being within - subjects, presentation rate (300msec versus 700msec), being between - subjects. The results revealed a significant main effect for type of response [F(2,92)=54.3, MSe=271.36, p<.001] and an interaction between response type and presentation rate [F(2,92)=8.12, MSe=40.59, p>.05], showing that remember, know and guess responses are affected differently by the rapid presentation rates. The effects of context [F(1,46)=2.34, MSe=12.5, p>.05] and presentation rate [F(1,62)=1.85, MSe=13.35, p>.05] failed to reach the level of significance.

Three separate 2 x 2 Analyses of Variance (ANOVA) were performed with context (congruent versus incongruent) being within-subjects, and presentation rate (300msec versus 700msec) being between-subjects, for each response type. This comparison was carried out to investigate how presentation rate influenced remember, know and guess responses. Specifically, remember responses failed to reach significance for both presentation rate [F(1,46)=3.65, MSe=11.34, p>.05] and context effect [F(1,46)=.57, MSe=.84, p>.05], and for the interaction between them [F(1,46)=.18, MSe=.26, p>.05]. In contrast, know responses revealed a significant effect for the presentation rate [F(1,46)=7.94, Mse=60.17, p<.01], showing an increase of know responses from 300 to 700msec, whereas context effects [F(1,46)=1.22, MSe=10.67, p>.05] and the interaction between presentation rate and context effects

[F(1,46)=.04, MSe=.38, p>.05] failed to approach significance. Finally, guess responses revealed a significant main effect for congruent against incongruent stimuli [F(1,46)=.042, Mse=14.26, p<.05], whereas presentation rate [F(1,46)=3.53, MSe=23.01, p>.05] and the interaction between congruence and presentation rate failed to reach the level of significance (see Appendix A).

The A′ estimates were calculated for this experiment as well, and replicated the ANOVA uncorrected data. Tables 3.2.a and 3.2.b demonstrate the mean proportion of A′ estimates for remember, remember plus know and remember plus know plus guess hit and false alarm rates for both 300 and 700msec. For the 300msec a 2x2 Analysis of Variance (ANOVA) was performed with response type (remember versus remember plus know) and context (congruent versus incongruent), being within subjects variables, and revealed that contextual information did not influence either remembering or knowing in this rapid presentation condition [F(1,23)=.29, MSe=.01, p>.05]. On the other hand, A′ estimates for individual subjects had a significant main effect for both congruent (remember .55 and remember plus know .62) and incongruent condition (remember .53 and remember plus know .60), [F(1,23)=4.43, MSe=.13, p<.05], suggesting that A′ estimates were significantly higher when derived from remember plus know hit and false alarm rates than when derived from remember hit and false alarm rates (Table 3.2.a).

Similarly, for 700msec a 2x2 Analysis of Variance (ANOVA) showed no evidence of context effect [$F(1,23)=.60$, $\underline{MSe}=.01$, $\underline{p}>.05$]. But individual subject data showed a significant effect of remember plus know hit and false alarm rates over remember hit and false alarm rates, [$F(1,23)=11.04$, $\underline{MSe}=.16$, $\underline{p}<.01$], refuting once more the signal detection theory's (Table 3.2.b) main assumption, that is, remember and know responses reflect different decision criteria on a continuum of memory and not performance derived from different memory systems or processes.

For comparisons between A' estimates of 300 and 700msec, a 2x2x2 Analysis of Variance (ANOVA) was carried out with type of response (remember versus remember plus know hit and false alarm rates) and context (same versus different), being the within subjects variable, presentation rate (300msec versus 700msec), being the between subjects variable. The effect of context was eliminated in both 300 and 700msec [$F(1,23)=.04$, $\underline{MSe}=9.18$, $\underline{p}>.05$], whereas presentation rate reached the level of

Experiment 5

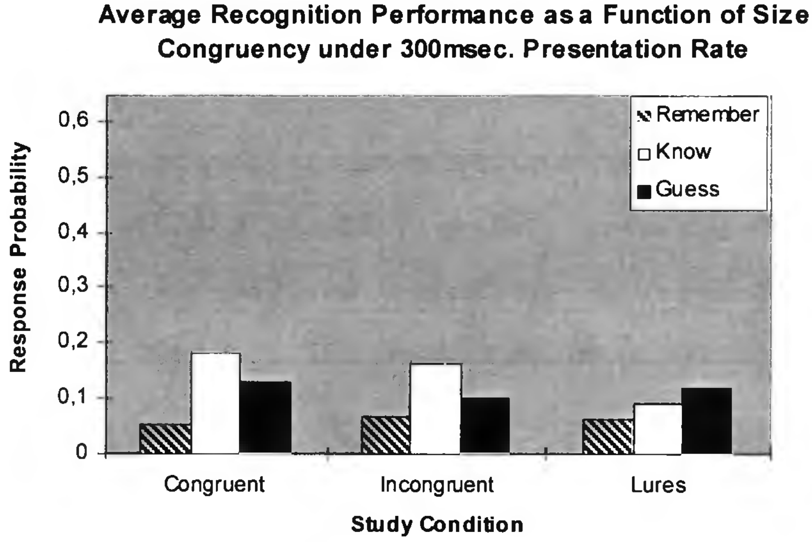

Figure 3.2.a

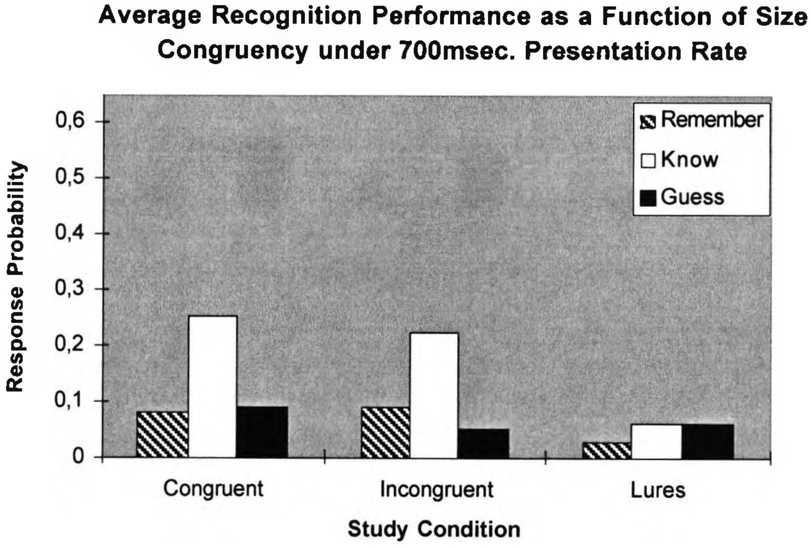

Figure 3.2.b

Experiment 5

Mean Proportion of Targets, Lures and A′ Estimates as a Function of Size Congruency under 300msec. Presentation Rate

	Targets			A′ Estimates	
	Same	Different	Lures	Same	Different
Remember	.05	.07	.06	.55	.53
Know	.18	.16	.09	.62	.60
Guess	.13	.10	.12	.61	.57

Table 3.2.a

Mean Proportion of Targets, Lures and A′ estimates as a Function of Size Congruency under 700msec. Presentation Rate

	Targets			A′ Estimates	
	Same	Different	Lures	Same	Different
Remember	.08	.09	.03	.66	.67
Know	.25	.22	.06	.74	.74
Guess	.09	.05	.06	.74	.71

Table 3.2.b

significance [$F(1,46)=30.78$, $MSe=1.30$, $p<.001$]. Similarly, A′ estimates for individual subjects revealed a significant effect of remember plus know, hit and false alarm rates, over remember, hit and false alarm rates [$F(1,46)=12.024$, $MSe=.306$, $p<.01$], for both presentation rates. The present results argue against Donaldson's (1996) signal detection theory and support Gardiner and Gregg's (1997) conclusion which states that know responses reflect a distinct memory trace and not a more lenient response criterion.

Furthermore, comparing these findings to the ones of Gregg and Gardiner (Experiment 2, 1994), it is obvious that facial stimuli may yield similar findings to those obtained with visual presentation of verbal material. The highly perceptual task greatly decreased remember responses as in Gregg and Gardiner's experiment. The only unexpected finding was the relatively low rate of know responses in comparison to Gregg and Gardiner's (1994) experiment. Furthermore, know responses showed no sign of congruency effect, even though remember responses were stripped away. This finding might be attributed to the inclusion of guess judgments as well, which were omitted in Gregg and Gardiner's manipulation. As for guess responses, they indicate that they differ from know responses (Gardiner, Kaminska, Dixon, & Java, 1996; Gardiner, Java, & Richardson-Klavehn, 1996; Gardiner, Richardson-Klavehn, & Ramponi, 1997), in accordance to previous empirical findings.

These findings provide no support of either the conceptual/perceptual distinction, or the distinctiveness/fluency framework, since know responses failed to show congruency effects. Specifically, it seems that under conditions that make distinctive encoding difficult and foster perceptual fluency, know responses are not affected.

Another important finding is the parallel increase of both remember and know responses from the 300 to the 700msec (see Tables 3.2.a and 3.2.b.). However, it must be taken under consideration that only know responses showed a significant increase, whereas remember responses failed to reach the significance level. Still, remember responses showed a trend for a parallel increase between the two presentation rates. This effect has been previously demonstrated in two other empirical studies, using completely different experimental manipulations. First, Gardiner, Kaminska, Dixon, and Java (1996b) manipulated three versus one study trials with highly unfamiliar music. They argued that the parallel increase of both remember and know responses provided support that that two states of awareness are functionally independent. And second, Gardiner, Ramponi and Richardson-Klavehn's study (1998) employed long versus short response-signal delay. In our experiment, it appears that an increase in presentation time, from 300 to 700msec, allows participants to further process the information, both conceptually and perceptually.

3.4 General Discussion

Two experiments were performed investigating the impact of perceptual processing on remembering and knowing in recognition memory. Specifically, the effects of varying contextual information between study and test lists, and rapid presentation rates during study, were employed to investigate the conceptual/perceptual distinction on states of conscious awareness in recognition memory. Also, the obtained data was calculated according to the A′ estimates in order to investigate the assumptions of the signal detection model.

Experiment 4 replicated Rajaram's study (1996) and showed an increase in remember responses when context remained constant. Rajaram argued that the distinctive attributes of the material make information memorable and as a result boost recollective experience. She proposed that by altering the size of the picture during test, the picture becomes less distinct and as such less memorable. The findings of Experiment 4 provide evidence in support of her suggestions. Specifically, remember responses were affected by contextual manipulations, whereas know responses were not affected.

Experiment 5 was designed first to replicate Gregg and Gardiner procedure in facial stimuli, second, to investigate further the predictions of A′ estimates, and third, to see if the effect of study-test congruency predicted in remembering reappears in knowing, when remembering is stripped away. Findings revealed a great decrease in remember responses, replicating Gregg and Gardiner results for faces, rather than words. However, this highly perceptual manipulation of rapid presentation rates failed to show the expected congruency effect in know responses. These findings provided no evidence in support of either the conceptual/perceptual distinction or the distinctiveness/fluency framework.

Furthermore, Experiments 4 and 5 were based on several assumptions following Rajaram's (1996) study. First, it was assumed that only perceptual aspects of the material were triggered by size changes and not conceptual ones. Still, another assumption made was that the material was distinctive, but Rajaram offered no clear argument about this. However, in a subsequent study Rajaram (1998) defined distinctiveness as the 'differences among items, or the salience of the items that make them stand out from among the background items' (Rajaram, 1998, p. 72). According to the above definition, pictures that were maintained the same size 'stand out' compared to pictures that were varied in size. Thus, Experiment 4 seemed to support the distinctiveness/fluency framework and the fact that perceptual factors influence remember responses, as long as they are distinctive in nature.

On the contrary, Experiment 5 does not fully support Gregg and Gardiner's (1994) argument which claims that under "a highly perceptual orienting task in which conceptual, elaborative processing was minimal, a mode correspondence effect occurs in know responses" (p.142). Accordingly, in Experiment 5, it was expected that under the highly perceptual task size congruency effect would occur in know responses. However, this prediction was not supported by the present findings. Perhaps this discrepancy could be attributed to a number of differences among their main experiment and our Experiments. Specifically, Gregg and Gardiner presented subjects with words, whereas we presented our participants with faces. Furthermore, Gregg and Gardiner's experiment did not include guess responses, whereas ours did. This difference encompasses a slightly different way for the participants decision making process and of course, the assumptions made about the analysis of attributes.

Finally, in testing the predictions of the signal detection model (Donaldson, 1996), A′ estimates of Experiment 4 were similar whether derived from remember responses or from remember plus know hit and false alarm rates. However, there are some cases in which estimates of memory strength are reduced when derived from remember responses alone rather than from overall hit and false alarm rates (e.g. Gregg & Gardiner, 1994), such as Experiment 5 A′ estimates of memory (Table 3.2.a.and 3.2.b). These cases include manipulations where participants make fewer remember responses, like the rapid presentation times in Experiment 5. In conclusion, findings oppose Donaldson's interpretation and argue in support of Gardiner and Gregg (1997) conclusion that knowing reflects a distinct memory trace and not a more lenient response criterion.

The following chapter further investigates congruency effects in remember, know and guess responses by employing a more conceptual than perceptual task, that is, varying descriptive words between presentation and test conditions.

CHAPTER 4

CONTEXT EFFECTS, CONCEPTUAL INFLUENCES AND LEVELS OF CONSCIOUS AWARENESS

4.1 Introduction

The previous chapter manipulated contextual information by changing size of facial stimuli across study and test and it investigated the effect of context on recollective experience. At the same time, it used a highly perceptual task, which involved the presentation of faces at study in a rapid succession. Overall results revealed a significant effect of context for the slow presentation rate, which was eliminated under the rapid presentation rate, whereas that manipulation produced essentially no remembering at all. It became obvious that remember responses were not affected by the highly perceptual attributes of the material in Experiment 5. In addition, know responses did not show congruency effects when remembering was stripped away in Experiment 5. These findings did not support the perceptual/conceptual distinction since knowing was not affected by the highly perceptual manipulation.

Continuing the inquiry, this chapter describes three experiments that manipulated contextual information once more by pairing verbal information with the facial task.

The three experiments described used the same face recognition task with a different contextual manipulation, which involved pairing the pictures of faces with a descriptive word, an adjective that was either maintained, or changed during recognition. The purpose of this manipulation was to further explore the conceptual/

perceptual distinction (Gregg & Gardiner, 1994) and the distinctiveness/fluency hypothesis (Rajaram, 1996; 1998). As such, faces comprised the perceptual component of the material whereas words comprised the conceptual one.

The aim of Experiment 6 was to further explore the predictions of the conceptual/perceptual distinction and the distinctiveness/fluency framework concerning the conceptual and perceptual attributes of remember and know responses. Thus, verbal material was used for the effect of context, which is conceptual in nature. Faces were paired with descriptive adjectives (i.e. small, smart, tall) that were either maintained or altered across study and test. The adjectives were high frequency, common words that assigned a description to the face. Furthermore, the study stimuli, that is, both faces and words, were introduced under two presentation rates, 5 sec versus 700msec. It was predicted that under the 5 sec presentation rate, remember but not know responses would be influenced by congruency effects, thus, supporting the conceptual/ perceptual distinction. This is because it is assumed that the 5sec. presentation rate allows ample time for more elaborative conceptual processing. In contrast, under the 700msec. it is assumed that there is much less opportunity for conceptual processing and consequently remember responses would be largely eliminated. As a result, the congruency effect might occur in know responses. This would support the distinctiveness/fluency framework because it would show that conceptual congruency can influence knowing when recognition has to be based largely on fluency.

In Experiment 7 the study list was presented three consecutive times with the same variables as in the previous experiment. Context was manipulated by providing same, or different words across study and test under 5sec or 700msec. presentation rates. It was predicted that the three study trials would increase the number of know responses, especially for the 700msec, thus solving the floor effects found in Experiment 6. Consequently, under the fast rate condition know responses were expected to show congruency effects, supporting the distinctiveness/ fluency framework. In contrast, if know responses fail to show congruency effect, findings will support the conceptual/perceptual distinction, since know responses will not be influenced by conceptual factors. Furthermore, it was expected that remember responses would eventually produce similar end results for both presentation rates. In other words, it was expected that under the 700msec. presentation rate, remember performance would be similar to the 5sec. presentation because participants would have the opportunity to improve their performance over trials. This gradual benefit may be accomplished through the additional processing that participants engage in from trial to trial. Moreover, it was predicted that remember responses would show congruency effects in the slow rate, supporting both processing accounts (that is, the conceptual/perceptual distinction and the distinctiveness/fluency framework).

Experiment 8 was conducted first, to investigate further the low rates of know responses found in Experiments 6 and 7, and second, to test whether know rates would increase more for words than they did for faces. It was predicted that know responses would be higher in the rapid rate than in the slow rate (Gregg & Gardiner, 1994). For that reason participants experienced the same study list under the two different presentation rates but were tested only on the words, not on the faces.

Finally, in the previous chapter, A′ estimates of data showed that the signal detection model is valid under specific conditions. That is, bias free estimates of memory are equivalent whether derived from overall hit and false alarm rates or only from remember responses, only when experimental manipulations give more remember than know responses. In cases where know responses are more than remember ones, A′ estimates calculated on overall recognition are greater than those calculated only on remember responses, such in the rapid presentation manipulation. Similarly, A′ estimates would be calculated in the present chapter to investigate whether results will remain the same by changing the context (instead of altering the pictorial size, changing descriptive words) (see Gardiner & Gregg, 1997). Specifically, under the 5sec. presentation it is expected that A′ estimates from overall hit and false alarm estimates would have similar values as A′ estimates from remember hit and false alarm rates, since remembering would have predominate rates. In contrast, under the 700msec. presentation it is expected that A′ estimates from overall hit and false alarm rates would be significantly higher than A′ estimates from remember hit and false alarm rates, since remembering would be reduced.

4.2 Experiment 6

Experiment 6 was conducted to investigate the theoretical assumptions of the two juxtaposing theories stated in the previous chapter, the one being the distinctiveness/fluency framework (Rajaram, 1996; 1998) and the second being the conceptual/perceptual distinction (Gregg & Gardiner, 1994). The distinctiveness/fluency framework suggests that remember judgements are influenced by both conceptual and perceptual factors. Specifically, Rajaram argued that remember judgements are created by the analysis of distinctive attributes, conceptual or perceptual in nature of the items presented, whereas know judgements are enhanced by the fluency with which presented items are processed, either from conceptual or perceptual factors, too. In contrast, the conceptual/perceptual distinction argues that remember responses are selectively influenced by conceptual processing, whereas know responses by perceptual processing (Rajaram, 1993; Gregg & Gardiner, 1994). Thus, pictures of faces were paired with one descriptive word, an adjective, which was either maintained or altered across study and test (i.e. smart, small, tall). Furthermore, two different presentation rates of the study list were employed, that is a rapid succession of 700msec., or a normal presentation rate of 5sec.

Under the 5sec. presentation rate it was expected to find congruency effects in remembering not in knowing, since remember responses would be greatly facilitated by the conceptual and distinctive attributes of the word accompanying the face. Accordingly, this finding would be consistent with both conceptual/perceptual distinction and distinctiveness/fluency framework. In contrast, under the 700msec. presentation rate both process views, that is the conceptual/perceptual distinction and the distinctiveness/fluency framework, lead to the expectation of greatly reduced remember responses since the fast rate would reduce the opportunity for conceptual and distinctive encoding. Consequently, the question is whether context effect will occur in know responses. If it does, then the distinctiveness/fluency framework will be supported since know as well as remember responses will be influenced by conceptual processing. If it does not, findings will be more consistent with the conceptual/perceptual distinction.

Finally, trace strength of memory will be investigated (Donaldson, 1996). Under the 5sec, where remember responses are expected to maintain high levels of performance, A′ estimates are expected to produce equivalent values whether derived from overall recognition or from remember responses. On the other hand, under the 700msec. presentation rate, where remember responses are expected to decrease dramatically then A′ estimates derived from overall recognition are expected to be greater than those derived from remember responses.

Method

Participants. Thirty-two college students from the American College of Greece volunteered to participate. All participants were Greek native speakers with English as a second language and were freshmen, or sophomores, between the ages of 18 and 24. Volunteers were randomly assigned to the conditions, that is 24 to each presentation rate and were tested in groups of two in a memory laboratory setting.

Design. A 2x2 factorial design, with contextual similarity across study and test (same versus different), being the within subjects manipulation, and with presentation rate of the study list (5sec. versus 700msec.), being the between subjects variable.

Materials. For the experiment a total of 104 common black and white pictures were used from the yearbook of the American College of Greece (Academic year 1994). The material was the same as in the previous chapters with the addition of eight new pictures for the practice and buffer items. Each person was photographed in a head-and-shoulder view against the same neutral background, while individuals with unusual characteristics such as beards, moustaches, eyeglasses or jewellery were excluded. The faces were characterized as typical ones based on the ratings of a group of judges. Four judges, two females and two males between the ages of 20 to 25, selected from a pack of 20 pictures the additional 8 photographs according to the aforementioned limitations. They were two study lists consisting of 48 pictures each. Four buffer items were included, two at the end of each list to avoid primacy and recency effects. Each face was paired with one word, a descriptive adjective (i.e. tall, small, smart), which appeared in lower case, bold letters, 'Times new roman' font, sized 72. Words were ordinary, common adjectives, familiar to the population, having word length of four to six letters long. They were selected by two judges according to the above selection criteria.

The memory test was comprised of 96 faces, 48 items from the study list (targets) intermixed with 48 unstudied pictures (lures). In the test list half of the studied pictures were presented with the same descriptive word as in the study and the other half with a different word across study and test. Eight combinations of study and test lists were created to achieve complete counterbalancing of study - test conditions, lure - target selection and slow - fast presentation rate. All faces were presented in a PC monitor screen 14 inch. Photographs of the faces were scanned and processed through the Powerpoint MSOffice software package which set the presentation times and the size of faces and fonts of the words.

Procedure. Participants were tested in groups of two. At the beginning of the experimental session they were required to read and sign the consent form and they received both oral and written instructions in both Greek and English for better understanding of the procedure. Participants were further familiarised with the procedure with four practice items before the beginning of the study list. Pictures for the study lists were presented either for 5 sec or 700msec each through a computer screen, depending on the experimental condition, whereas pictures for the test list were presented only for 5 sec.

During the study phase, participants were instructed to look each picture carefully and at the same time read the word presented underneath. There was a 3-min retention interval during which participants were required to perform a 'find the differences' quiz that would distract their attention from the recollection of the studied material. Immediately after, they were presented with the recognition test and they were instructed to read the word underneath the face when they were making the recognition judgements, which were made for the face and not the word. Participants were unaware of the context manipulation. They had 5sec. to decide whether they had seen the face before and if so to indicate it in the answer sheet provided. After each individual Yes response, participants were asked to make remember, know and guess judgements, which were explained to them in full detail and with adequate examples. The instructions concerning the recollective judgements were based on the definitions from previous literature (Gardiner, 1988; Rajaram, 1993). Being consistent with the previous literature, a remember response was defined as the state during which a face evoked some immediate association or any other memory for that item at the time it was presented. In contrast, a know response was accompanied by no recollection of its prior occurrence. Finally, subjects were encouraged to report a guess response when the picture elicited neither the experience of remembering nor of knowing but nevertheless it might be from the study list.

Results

The mean proportion of hits and false alarms for remember, know and guess responses as a function of context and presentation rate are displayed in Figure 4.1. Specifically for the 700msec., mean false alarms for remember (.07), know (.10) and guess (.05) responses were similar to those found when the manipulation of context was size and not words (see previous chapter). Similarly, for the presentation rate of 5sec., mean false alarms for remember (.05), know (.08) and guess (.06) responses followed the same picture. A 2x2 Analysis of Variance (ANOVA) was performed for each response type, with one variable between subjects, being presentation rate (5sec. versus 700msec.), and one variable within subjects, being context (congruent versus incongruent). Remember responses revealed a significant effect of context [$F(1,30)=7.33$, $Mse=.05$, $p<.05$], and presentation rate [$F(1,30)=.041$, $Mse=.05$, $p<.05$], whereas the interaction between context and presentation rate [$F(1,30)=3.86$, $Mse=.03$, $p>.05$] failed to reach significance. In contrast, know responses revealed a significant effect of presentation rate [F(1,30)=4.55, Mse=.05, p<.05], whereas context [F(1,30)=.09, Mse=.00, p>.05], and their interaction [F(1,30)=1.00, Mse=.01, p>.05] failed to reach the level of significance. Similarly, guess responses failed to reach the level of significance for context [F(1,30)=2.19, Mse=.00, p>.05], presentation rate [F(1,30)=1.42, Mse=.00, p>.05] and their interaction [F(1,30)=.64, Mse=.00, p>.05]. Furthermore, a closer look to know responses showed that know hit rates were very similar to know false alarm rates under the 5sec presentation rates (Figure 4.1.a). Accordingly, One Way Analysis of Variance comparing hits rates with overall false alarm rates failed to reach significance [F(1,30)=3.96, Mse=24.5, p>.05] revealing that know responses show no memory.

Following Gardiner, Ramponi and Richardson-Klavehn (1999), a second analysis of the data was judged necessary to reveal a clearer picture. Remember, know and guess responses were treated as independent variable and an 3x2x2 Analysis of Variance (ANOVA) was performed with response type (remember, know and guess) and context (congruent versus incongruent), being the within subjects variable, and with presentation rate (700msec. versus 5sec.) being the between subjects variable.

Experiment 6

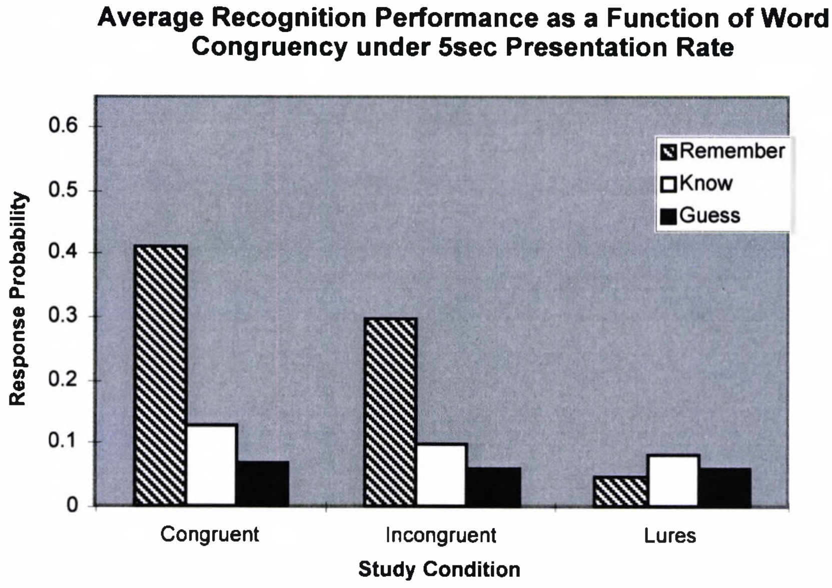

Figure 4.1.a

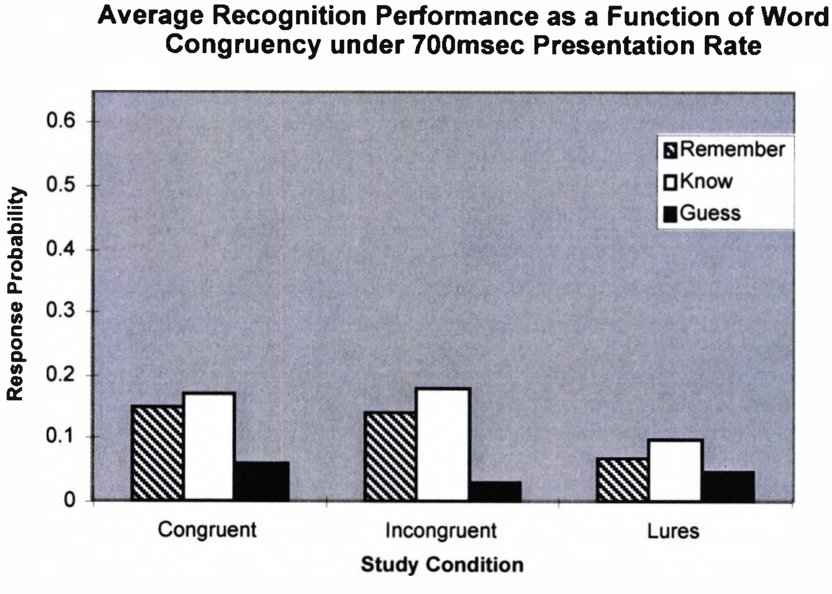

Figure 4.1.b

The results of the ANOVA for the hit rates showed that the main effects of presentation rate [$F(1,30)=22.96$, $MSe=90.75$, $p<.001$], of type of response [$F(2,60)=37.96$, $MSe=357.02$, $p<.001$], as well as that of congruence [$F(1,30)=5.11$, $MSe=20.02$, $p<.05$] were all significant, and so too was the interaction between presentation rate and response type [$F(2,60)=18.99$, $MSe=178.64$, $p<.001$].

The above results demonstrated that decreasing presentation rate from 5 sec. to 700msec. affected performance, especially remember rates (see Figure 4.1.a & 4.1.b). In the same way, ANOVA for the false alarm rates revealed a significant effect only for type of response [$F(2,60)=4.21$, $MSe=32.79$, $p<.05$] whereas presentation rate failed to reach the level of significance. Tables 4.1.a and 4.1.b demonstrate the mean proportions of remember, know and guess rates for both presentation rates.

In order to have comparable data with Chapter 3 concerning context, A' Estimates were calculated as well. Factorial analysis was employed with context (congruent versus incongruent) and performance (R, R+K, R+K+G), being the within subjects variables, and with presentation rate (5sec. versus 700msec.), being the between subjects

Experiment 6

Mean Proportion of Targets, Lures and A′ Estimates as a Function of Word Congruency under 5sec. Presentation Rate

	Targets			A′ Estimates	
	Same	Different	Lures	Same	Different
Remember	.41	.30	.05	.80	.77
Know	.13	.10	.08	.79	.75
Guess	.07	.06	.06	.73	.78

Table 4.1.a

Mean Proportion of Targets, Lures and A′ Estimates as a Function of Word Congruency under 700msec. Presentation Rate

	Targets			A′ Estimates	
	Same	Different	Lures	Same	Different
Remember	.15	.14	.07	.66	.61
Know	.17	.18	.10	.66	.64
Guess	.06	.03	.05	.65	.62

Table 4.1.b

variable. Table 4.1.a and 4.1.b show mean proportion of A′ estimates. Statistical analysis revealed a significant effect of context, [$F(1,30)=4.22$, $\underline{MSe}=.81$, $\underline{p}<.05$], and of presentation rate, [$F(1,30)= 14.83$, $\underline{MSe}=.58$, $\underline{p}<.05$], whereas A′ estimates of individual subjects did not seem to matter whether they were derived from remember hit and false alarm rates, or from remember plus know hit and false alarm rates [$F(1,30)= .15$, $\underline{MSe}=.00$, $\underline{p}>.05$]. Contrary to size changes (see chapter 3), altering a descriptive word across study and test did not affect A′ estimates which remained constant even in the rapid presentation condition. Furthermore, the finding that know responses showed very low hit rates and very similar false alarm rates was reflected in A′ estimates. Specifically, the finding that A′ estimates of memory produced equivalent values whether derived from remember hits and false alarm rates or only from remember hits and false alarm rates provided more evidence that know responses showed no memory.

Results from Experiment 6 clearly revealed that remember responses were influenced by conceptual processes as indicated first, by their congruency effects in the slow rate, and second, by their great decrease in the fast rate. Furthermore, remember responses seemed to be facilitated by the slow rate, which allowed the distinctive encoding of the material. However, the fast rate condition reduced the distinctiveness needed to support remembering. In contrast, know responses showed a small increase under the 700msec. condition. Interestingly enough guess responses remained constant across conditions. Overall, participants made more errors under the rapid presentation rate. Moreover, contextual manipulation did not affect performance under the rapid presentation rate.

Discussion

The current experiment was conducted to further explore the predictions of two opposing theoretical explanations that relate to the above findings, the one being the conceptual/perceptual distinction, and the other being the distinctiveness/fluency hypothesis. The experiment used as contextual information words which are semantic in nature and need elaborative and conceptual processing. At the same time, time of presentation was manipulated, that is 5sec. versus 700msec. presentation rate. It is obvious from the findings (Figure 4.1.a) that remember responses were affected by the contextual information under the 5sec. presentation rate, providing support for both theoretical frameworks, that is the conceptual/perceptual distinction and the distinctiveness/fluency framework. In contrast, know responses did not show congruency effects with the 700msec. presentation rate. It seems that the conceptual manipulation of altering words did not affect knowing, supporting the conceptual/perceptual distinction. Furthermore, rapid presentation rate greatly decreased remembering, a prediction that both processing views (conceptual/ perceptual and distinctiveness/fluency) support since fast rate reduces the opportunity for conceptual and distinctive encoding.

At this point, the reader must note that know performance under slow presentation rates, that is 5 seconds, yields similar levels of dissociation for remember and know judgements when stimulus-test item congruence is manipulated by size of pictures and accompanying word cues. In other words, it appears that the type and level of congruence between study and test materials, namely picture-size and picture-word manipulations, produce similar levels of performance under slow presentation rates, across Experiments 4 and 6 (Figures 3.1 and 4.1.a). However, there is a minor difference in patterns of performance across Experiments 5 and 6 (Figures 3.2.b and 4.1.b), where picture-size and picture-word manipulations are given under extremely fast presentation rates. Specifically, remember responses remain low, whereas know responses remain low as well, but quite higher under the picture-size manipulation compared to the picture-word manipulation. It is likely, then, that know responses suffer more under the study-test contextual congruence manipulations involving the combination of perceptual and semantic processing. In fact, keeping the same, or modifying, the word cues accompanying the face stimuli leaves know responses low and unaffected. Interestingly enough, know responses receive some benefit when face stimuli undergo a completely perceptual manipulation during testing. Thus, when encoding, storage, and retrieval operations across study and test conditions involve perceptual processing, then know responses benefit more.

Finally, the re-analysis of data of A′ estimates showed that bias-free estimates of memory were similar whether derived from remember hit and false alarm rates or from overall recognition hit and false alarm rates. This finding was expected under the 5sec. presentation rate where remember responses were quite higher than know responses. In contrast, under the 700msec. presentation rate, one would normally expect overall recognition estimations to be significantly greater than remembering estimations. However, the present results demonstrated that under the semantic face-word manipulation of context, the levels of knowing remained quite low compared to the face-size manipulation. When know responses are very low it is inevitable that A′ estimates for individual subjects produced similar rates of remember and overall recognition estimates. Unfortunately, the low level of knowing also compromises conclusions about the failure to find effects of congruency in those responses.

4.3 Experiment 7

The aim of Experiment 7 was, first, to further test the robustness of the predictions of the conceptual/ perceptual distinction; and second to compare Experiment 7 with Experiment 6 where only one study trial was employed. Experiment 7 presented the study list three consecutive times. Furthermore, two different presentation rates were employed, that is 5sec. and 700msec. Gardiner, Kaminska, Dixon and Java (1996b) employed three study trials as well and reported a parallel increase in remember and know responses for the first time. However, guessing was found to be inversely related to remembering (Gardiner, et al., 1996). Their materials consisted of Polish folk songs and classical melodies. They found that additional study trials with unfamiliar Polish melodies had an increasing effect on recognition memory as depicted by both remember and know responses. Repetition of classical melodies, however, increased only remember responses which suggested that prior familiarity of the stimulus domain as a whole, played a significant part in the increases observed in remember responses.

Accordingly, in the present experiment it was predicted that the repeated presentations of the study list would increase the number of know responses (as well as remember responses), especially for the 700msec. rate. Thus, it was expected to overcome the floor effects of know responses, found in Experiment 6. Furthermore, it was expected to find context effect in remembering but not knowing under the 5sec. presentation rate, supporting both the conceptual/perceptual distinction and the distinctiveness/fluency framework. However, the low level of remember responses at 700msec. were expected to increase too, since after the three successive study trials, even the rapid presentation rate would allow the conceptual and distinctive encoding of the material. Furthermore, under the fast rates, know responses were expected to show congruency effects if the distinctiveness/fluency framework is valid and knowing can also be influenced by conceptual fluency. In contrast, if know responses failed to show congruency effects, then findings would be consistent with the conceptual/perceptual distinction since know responses will not be influenced by conceptual factors. As for guessing, it was expected to remain unaffected by the increased number of study trials as in the study of Gardiner, Kaminska, Dixon, and Java (1996).

Method

Participants. Experiment 7 recruited 32 subjects who participated voluntarily and were randomly assigned to the experimental conditions. Some of the subjects participated as a fulfilment of course credits. They were undergraduate students in the American College of Greece (Deree), between the range of 18-24 years, preferably freshmen and sophomores. They were tested in groups of two, in the same laboratory setting, as in previous experiments.

Design and Materials. The study used a 2x2 mixed factorial design, with Context, congruent versus incongruent, being the within subjects variable, and presentation rate, 5sec and 700msec, being the between subjects variable.

The same 104 pictures were used in order to construct two study lists, with 48 items each, the recognition test and the practice items. Faces were paired with words, descriptive adjectives and these pairs were presented in a PC monitor screen. Again eight combinations of study and test items were created for complete counterbalancing.

Procedure. The experiment once again followed the same procedure, consisting of three phases, study, retention interval and memory test. The procedure during the retention interval and the test phase was identical to that in the previous experiment. The only difference in the study phase was that participants were informed that the study list would be presented three times in a sequence before the introduction of the recognition test. Faces were randomly reordered for each study trial. Presentation rate of the study pairs, faces with words, was 700msec for the one condition, leading to a total presentation time of 2.1sec, per face and 5 sec for the other, having a total presentation time of 15sec. per face, whereas presentation rate of each test pairs remained constant across conditions, that is 5 sec. Definitions of remember, know and guess responses remained identical to that in Experiment 6.

Results

The mean proportions of remember, know and guess responses for targets and lures are displayed in Figures 4.2.a and 4.2.b. The proportions of false alarms for the 700msec, (remembering .08, knowing .14, and guessing .21) and 5sec (remembering .13, knowing .09, and guessing .17) presentation rate were higher than those reported in the literature. A 2x2 Analysis of Variance (ANOVA) was performed for each response type, with one variable between subjects, being presentation rate (5sec. versus 700msec.), and one variable within subjects, being context (congruent versus incongruent). Remember responses revealed a significant effect of context [$F(1,30)=5.54$, $Mse=56.25$, $p<.05$], whereas presentation rate [$F(1,30)=.82$, $Mse=39.06$, $p>.05$] and the interaction between context and presentation rate [$F(1,30)=.01$, $Mse=.06$, $p>.05$] failed to reach significance. In contrast, know responses did not reveal a significant effect either for context [$F(1,30)=.00$, $Mse=.00$, $p>.05$], or presentation rate [$F(1,30)=1.15$, $Mse=14.6$, $p>.05$], or their interaction [$F(1,30)=.02$, $Mse=.06$, $p>.05$]. Similarly, guess responses failed to reach the level of significance for context [$F(1,30)=1.27$, $Mse=3.52$, $p>.05$], presentation rate [$F(1,30)=2.97$, $Mse=17.02$, $p>.05$] and their interaction [$F(1,30)=3.52$, $Mse=9.77$, $p>.05$].

Furthermore, know responses showed very similar hit and false alarm rates under both 5sec. and 700msec. presentation rates (Table 4.2.a and 4.2.b). Accordingly, two One Way Analyses of Variance comparing know hits with overall know false alarm rates failed to reach significance for both slow [$F(1,30)=.972$, $\underline{Mse}=.0078$, $\underline{p}>.05$] and rapid [$F(1,30)=.2522$, $\underline{Mse}=.0030$, $\underline{p}>.05$] presentation rates, revealing that know responses show no memory.

A second analysis of the data that included remember, know and guess responses as an independent variable was undertaken. Specifically, a 3x2x2 Analysis of Variance (ANOVA) was performed with response type (remember, know and guess) and context (congruent versus incongruent), being the within subjects variable, and with presentation rate (700msec. versus 5sec.) being the between subjects variable. The results of the ANOVA for the hit rates revealed significant main effects for response type [$F(2,60)=98.53$, $\underline{MSe}=2635.4$, $\underline{p}<.0001$], but not for context [$F(1,30)=4.01$, $\underline{Mse}=10.55$, $\underline{p}>.05$] and for presentation rate [$F(1,30)=.10$, $\underline{Mse}=.88$, $\underline{p}>.05$]. The only interaction that showed a significant effect was the one between context and response type [$F(2,60)=3.66$, $\underline{MSe}=24.61$, $\underline{p}<.05$], whereas presentation rate by context [$F(1,30)=1.67$, $\underline{Mse}=4.38$, $\underline{p}>.05$], presentation rate by response type [$F(2,60)=1.29$, $\underline{Mse}=34.63$, $\underline{p}>.05$], presentation rate by context by response type [$F(2,60)=.41$, $\underline{Mse}=2.76$, $\underline{p}>.05$] failed to reach significance. These results suggest that with additional presentation of the study list, the effects of presentation rate and context disappear. Similarly, the ANOVA for the false alarm rate revealed a significant effect only for type of response [F(2,60)=4.57, MSe=158.38, p<.05].

A 2 x 2 x 2 Analysis of Variance (ANOVA) was performed for the A′ estimates of memory, with one variable between subjects, being presentation rate (5sec. vs. 700msec.), and two variables within subjects, being context (congruent vs. incongruent) and performance (remember vs. remember + know). The calculated data for the three study trials did not reveal a significant effect either for individual estimates [F(1,30)=.48, MSe=.00, p>.05], or presentation rate [F(1,30)=.64, MSe=.06, p>.05], or context [F(1,30)=.78, MSe=.01, p>.05]. Tables 4.2.a and 4.2.b show the A′ mean proportions.

In order to compare the one study presentation in Experiment 6 to the three study presentations in Experiment 7, a second Analysis of Variance was undertaken that used the data from both experiments. Specifically, three separate 2 x 2 x 2 Analyses of Variance were performed for each of the three kinds of response, with two variables between subjects, being presentation rate (5sec. vs. 700msec.) and study trials (one vs. three), and one variable within subjects, being context (congruent vs. incongruent). For hit rates, the trials effect was significant for remember [F(1,60)=68.79, MSe=2000.28, p<.0001] as well as guess [F(1,60)=9.82, MSe=37.20, p<.01] but not for know responses [F(1,60)=.12, Mse=1.12, p>.05].

Furthermore, the effect of presentation rate affected both remember [$F(1,60)=12.08$, $\underline{MSe}=351.12$, $\underline{p}<.01$] and know responses [$F(1,60)=4.45$, $\underline{MSe}=42.78$, $\underline{p}<.05$] but not guess responses [$F(1,30)=.91$, $\underline{Mse}=3.45$, $\underline{p}>.05$]. Finally, congruence effect facilitated only remember responses [$F(1,60)=11.61$, $\underline{MSe}=81.28$, $\underline{p}<.01$], but not know [$F(1,60)=.08$, $\underline{Mse}=.28$, $\underline{p}>.05$], or guess responses [$F(1,60)=.04$, $\underline{Mse}=.07$, $\underline{p}>.05$]. For false alarm rates, presentation rate met the significant level only for know responses [$F(1,60)=4.08$, $\underline{MSe}=54.39$, $\underline{p}<.05$] whereas the trials effect was significant only for guesses [$F(1,60)=28.71$, $\underline{MSe}=669.52$, $\underline{p}<.01$]. Generally, it seems that the additional study trials increased performance measured by remember responses whereas know and guess responses remained unaffected for both presentation rates. Especially for the 700msec, remember responses increased dramatically, almost reaching the 5sec performance.

Experiment 7

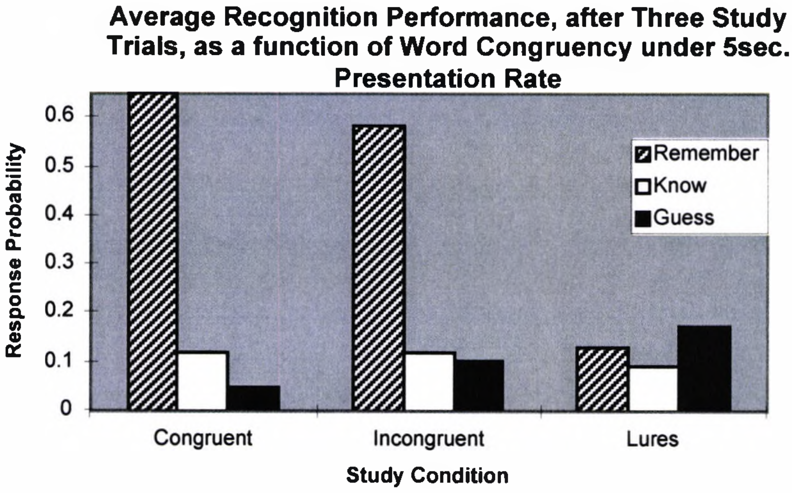

Figure 4.2.a

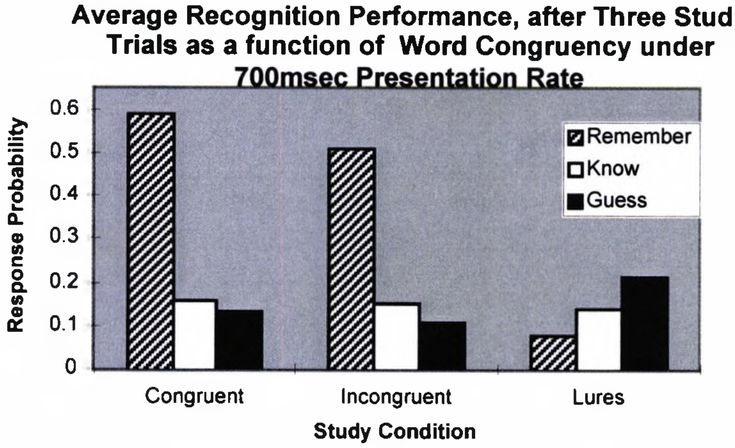

Figure 4.2.b

Experiment 7

Mean Proportion of Targets, Lures and A′ Estimates, after Three Study Trials, as a Function of Word Congruency under 5sec. Presentation Rate

	Targets			A′ Estimates	
	Same	Different	Lures	Same	Different
Remember	.65	.58	.13	.78	.79
Know	.12	.12	.09	.79	.78
Guess	.05	.10	.17	.76	.76

Table 4.2.a

Mean Proportion of Targets, Lures and A′ Estimates, after Three Study Trials, as Function of Word Congruency under 700msec. Presentation Rate

	Targets			A′ Estimates	
	Same	Different	Lures	Same	Different
Remember	.59	.51	.08	.85	.82
Know	.16	.15	.14	.84	.80
Guess	.13	.11	.21	.82	.75

Table 4.2.b

In comparing the results of Experiment 7 with the results of Experiment 6, remember responses were greatly facilitated by the addition of trials, especially for the rapid presentation times. Furthermore, these results demonstrated that facial stimuli have a prior schematic representation in semantic memory since know responses remained unaffected by that manipulation, same as classical melodies in Gardiner, Kaminska, Dixon, & Java's (1996b) study.

Discussion

The major finding of Experiment 7 was that only remember responses showed congruency effects, whereas know responses were not affected by study-test congruency. Furthermore, with the addition of trials overall performance and specifically remember responses at 700msec almost reached the same levels as 5sec. Trials offered the additional necessary time for conceptual, elaborative processing whereas know responses remained constant across conditions. Moreover, the present results provided further evidence for the assumptions made by Gardiner, Kaminska, Dixon and Java (1996b) that found a parallel increase in performance measured by remember and know responses only to those materials that were unfamiliar to the subjects, that is Polish folk songs and not classical melodies in which only remember responses were facilitated by the three consecutive presentation of the study list. In the same way, compared with Experiment 6, Experiment 7 showed that when the materials have a schematic representation in semantic memory, as in the case with facial stimulus, only remember responses are increased. Finally, guess responses are inversely related to remember responses (Gardiner, Kaminska, Dixon and Java, 1996).

Furthermore, as it was mentioned previously, results showed congruency effects only in remember responses supporting fully the original hypothesis. Specifically, it was argued that both presentation rates would allow the conceptual and distinctive encoding of the material, since the study list was presented three consecutive times. Consequently, this outcome supports both the conceptual/perceptual distinction and the distinctiveness/fluency framework. In contrast, know responses failed to show context effects for two main reasons. First, remembering was not stripped away under the 700msec. rate, leaving no room to know responses to show context effects. And second, know responses showed very little memory, a fact that limits the interpretation. Thus, the effect of context might not have occurred in know responses because of the floor effects.

Finally, in testing the predictions of the signal detection model (Donaldson, 1996), A′ estimates of memory were similar whether derived only from remember rates or from remember plus know hit and false alarm rates. This finding was expected since the effect of trials produced very high rates of remember responses in both slow and fast presentation rates. However, this outcome must be treated with caution because of the floor effects in know responses.

In conclusion, the main points concerning the present findings are first, evidence showed that only remember responses were affected by conceptual processing, and second, the replicability of the results was confirmed with additional study trials, using different materials, that is, facial stimuli instead of musical themes.

The next experiment tests whether or not the know response rate is higher for the words than it turned out to be for the faces, in Experiments 6 and 7. Consequently, participants were presented with faces and words under two presentation rates, 700msec and 5sec, but they were tested only on the words.

4.4 Experiment 8

Experiments 6 and 7 failed to show congruency effects in know responses, even when remembering was reduced. A possible explanation of that finding was the low rates of know responses, which might have limited the interpretation. In other words, congruency effects might not have occurred in knowing because of the floor effects. Accordingly, the purpose for conducting Experiment 8 was to investigate whether know responses would show higher rates in words than it turned out to have for faces, in the previous experiments. It was expected to find more know responses for the fast rate than in the slow rate, same as Gregg & Gardiner study (1994). Specifically, participants were presented with pairs of faces and words but were tested only on words. They were instructed to look at the faces and simultaneously read the word underneath, same as Experiment 6.

Method

Participants. Participants were 32 students from the same population and were allocated arbitrarily to one of the presentation rate conditions. They were freshmen or sophomore students between the age of 18 and 24 as in the previous experiments and they were tested in groups of two in the same laboratory setting.

Design and Materials. Presentation rate of the study list was again manipulated at two levels, 700msec and 5 sec, in a between subjects design. Accuracy of recognition memory and remember, know and guess response frequencies were measured in a recognition memory test.

A total of 104 faces and another 104 words, same as previous experiments, were used. Words appeared in lower case, bold letters, 'Times new roman' font, sized 72, and they were presented simultaneously underneath the faces during study phase. During the memory test, the words appeared without the faces, having the same font but with 96 font size. There were two study lists consisting of 48 faces and words each, with the addition of four buffer items. The memory test was comprised of 96 words, 48 from the study list intermixed with 48 unstudied words. Four combinations of study and test lists were created to achieve complete counterbalancing.

Procedure. In many respects, the procedure of the experiment was similar to Experiment 6. The difference was entailed in the memory test in which participants were tested on their memory for adjectives accompanying the faces. The instructions were identical to the previous experiments, the only difference being that participants were not informed that the recognition test would be on words, and not on faces. During study they were instructed to pay attention to both faces and words. Again definitions of remember, know and guess were explained in full detail, taken from previous literature.

Results and Discussion

The principal results are summarised in Figure 4.3, which exhibit the mean proportion of hit and false alarm rates as a function of presentation rate. Three separate One Way Analyses of Variance (ANOVA) showed that participants gave a significantly higher proportion of correct remember responses with the 5sec rate (.51) than with the 700msec rate(.32), [F(1,30)=6.42, MSe=684.5, p<.05]. For know responses, the reversed difference, that is, with the 700msec presentation rate (.23) compared with the 5sec presentation rate (.16), was not statistically significant [F(1,30)=1.56, Mse=132.03, p>05]. Finally, participants made significantly more guess responses with the 700msec rate (.25) than with the 5sec rate (.16), [F(1,30)=4.33, MSE=132.03, p<.05].

A second statistical analysis was undertaken in order to test whether or not know responses have higher rates for words, than they had for faces in Experiments 6 and 7. Specifically, a 2x2 Analysis of Variance was performed for know responses, with item type being the within subjects variable, that is targets versus lures, and presentation rate being the between subjects variable, that is 5sec. versus 700msec. The results of the ANOVA revealed a significant main effect of response type [F(1,30)=10.11, Mse=236.39, p<.01], but not for presentation rate [F(1,30)=2.16, Mse=112.89, p>.05], or for the interaction

Experiment 8

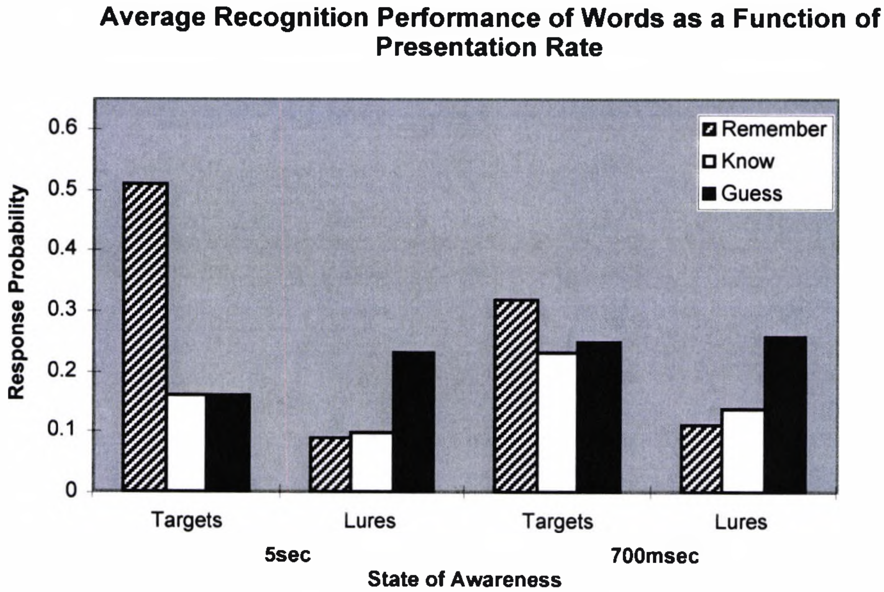

Figure 4.3

Mean Proportion of Word Recognition of Targets and Lures as a Function of Presentation Rate.

	5sec			700msec		
	Targets	Lures	A′	Targets	Lures	A′
Remember	.51	.09	.83	.32	.11	.72
Know	.16	.10	.84	.23	.14	.73
Guess	.16	.23	.76	.25	.26	.73

Table 4.3

between presentation rate and response, [$F(1,30)=.49$, $Mse=11.39$, $p>.05$].

Furthermore, a 2x2 Analysis of Variance (ANOVA) was performed for the A′ estimates of memory, with one variable between subjects, being presentation rate (5sec. vs. 700msec.), and one variable within subjects, being performance (remember vs. remember + know). The data revealed only a significant effect of presentation rate [$F(1,30)=12.43$, $Mse=.17$, $p<.01$], whereas individual estimates failed to reach significance [$F(1,30)=1.14$, $Mse=.00$, $p>.05$]. Table 4.3 show the A′ mean proportions, again for R, R+K, and R+K+G.

Findings in Experiment 8 revealed higher rates of know responses for word recognition than it did for facial recognition, in the previous experiments. However, know responses failed to increase more in the fast rate than the slow rate. Thus, the Experiment did not replicate Gregg and Gardiner (1994) result, which showed more know responses in the perceptual-fast condition, which did not allow conceptual, elaborative processing. This discrepancy in the results might be attributed to the fact that participants were not aware that the recognition test would be on the words and not on the faces.

Finally, in testing the predictions of the signal detection model, Experiment 8 replicated the obtained results in facial recognition (Experiment 6) in verbal recognition. Specifically, A′ estimates of memory were similar whether derived only from remember rates or from remember plus know hit and false alarm rates. This finding was expected since remember responses were either very high, as in the 5sec. rate, or very similar to know responses, as in the 700msec. rate.

4.5 General Discussion

Three experiments were conducted to test the hypothesis that the experience of remembering depends on conceptual factors whereas the experience of knowing depends on perceptual ones. Two theories were investigated, first Rajaram's (1996; 1998) distinctiveness/fluency framework and second Gregg and Gardiner's (1994) conceptual/perceptual distinction. According to the first, remember responses depend upon the processing of the distinctive attributes of the stimuli, perceptual or conceptual in nature whereas according to the latter, remember responses are influenced only by conceptual manipulations.

Results of Experiment 6 showed significantly higher proportions of remember responses to items presented under 5 sec than under 700msec, whereas know responses remain constant across different presentation rates. Moreover, remember responses were significantly higher for congruent items than incongruent ones whereas know responses failed to show congruency effects.

The findings from Experiment 7, in relation to Experiment 6, revealed significantly higher proportions of remember responses with the addition of trials, for both presentation rates, and for both congruent and incongruent items, whereas the effect of trials did not affect the proportions of know responses. Furthermore, remember responses showed once more congruency effects whereas know responses remained unaffected by the manipulation of context.

Finally, Experiment 8 showed increased know rates in verbal recognition, a condition that was lacking in the previous experiments. Participants were tested on words in an attempt to investigate whether know responses would show increase performance in verbal material compared to the facial material, in experiments 6 and 7. Furthermore, Experiment 8 tried to replicate Gregg and Gardiner's study in which know responses were increased more with the brief presentation rate compared with the slow presentation rate. Findings from Experiment 8 partly confirmed the hypothesis. Specifically, indeed know responses showed increased rates of performance, avoiding the floor effects obtained in Experiments 6 and 7, but failed to increase more with the brief compared with the slow presentation rate.

Taken together, these results illustrate that remembering is influenced only by variables that allow conceptual and elaborative processing, like congruency effects and slow presentation rates. Similarly, additional study trials allow more time for the elaborative, attentional processing to occur. These findings provide support for the conceptual/perceptual distinction proposed to understand the nature of recollective experience (Rajaram, 1993; Gregg & Gardiner, 1994). Specifically, according to this distinction, remember responses reflect episodic memory that depends on conceptual and attentional factors (see Gardiner & Java, 1993a; 1993b). Thus, as it has already been mentioned, the use of verbal material for the effect of context reflects conceptual processing. Consequently, remembering is greatly facilitated by this manipulation, showing congruency effects only in the slow rate, which provide the necessary time for the conceptual encoding. However, these findings are equally consistent with the distinctiveness/fluency framework since the slow rates allow the distinctiveness of processing to take place, facilitating remember responses. In contrast, know responses, which rely more on perceptual processing, could not benefit from the face-word manipulation, which is conceptual in nature, even in the fast rate. On the other hand, this evidence fails to support the distinctiveness/fluency framework (Rajaram, 1996) since know responses failed to show congruency effects even under the fast rates where remembering was greatly decreased.

Finally, Experiments 6, 7 and 8, in testing the predictions of the signal detection model, showed that bias-free estimates of memory have equivalent values whether derived from remember responses or from remember plus know hit and false alarm rates. This outcome was expected since remember rates were either very high (Experiment 7), or very low, but relatively similar to know responses (Experiment 6 and 8). It seems that when know responses are very low and not different from false alarm rates then the predictions of the signal detection theory are supported because adding know responses to remember responses makes no difference. Unfortunately, once again the low levels of know responses compromises the conclusion about the lack of any congruence effect on knowing.

CHAPTER 5

CONCLUDING DISCUSSION

5.1 Introduction

The overall discussion is divided into five sections. Section 5.2 restates the critical points and the basic aims of the thesis, whereas Section 5.3 summarises the experimental results. The following section, Section 5.4, examines the experimental results with respect to the four major theoretical theories, the conceptual/perceptual distinction, the distinctiveness/fluency framework, the signal detection theory and the multiple memory systems theory (see Section 1.2.1). Section 5.5 discusses future developments and identifies the areas of study that would benefit from the present research. Finally, Section 5.6 states the conclusions of the thesis.

5.2 Aims of the Thesis

The main aims of the thesis can be summarised into four arguments. First, it was important to replicate and extend previous experimental findings in the recent consciousness paradigm that has found systematic dissociations between remembering and knowing (see Section 1.2.3). In the case of the present thesis, the replication and generalisation of findings was particularly important because the materials employed, namely facial stimuli (Appendix B), differed from those used in most prior empirical studies (i.e. verbal stimuli).

The second objective was to employ variables that either facilitated or produced parallel effects in remembering and knowing. Specifically, the experimental chapters investigated the effects of the divided attention, context manipulations, and different presentation rates within the remember-know paradigm. The use of divided attention conditions examined the effects of effortful encoding and automatic processing in recognition (Parkin, Gardiner, & Rosser, 1995). In contrast, the manipulation of contextual information explored the effects of conceptual and perceptual processes in the remember-know distinction (Rajaram, 1996). Similarly, slow and rapid presentation rates investigated further the use of conceptual and perceptual processing (Gregg & Gardiner, 1994).

The third aim of the present thesis was to critically examine previous empirical findings in the remember/know paradigm and test the generality of their predictions in relation to the current experimental manipulations and results.

The fourth aim was to thoroughly examine which of the four theoretical views accommodate and explain the processes underlying remembering and knowing in our experimental manipulations. Findings were discussed in relation to the conceptual/perceptual processing account (Rajaram & Roediger, 1997, Section 1.2.1.ii), the distinctiveness/fluency framework (Rajaram, 1996; 1998, Section 1.2.1.iii) and the signal detection model (Donaldson, 1996; Section 1.2.1.iv). The systems account (Tulving, 1983; 1985; Section 1.2.1.i) was discussed more in Chapter 1 and less throughout the experimental chapters. The advantages and disadvantages of each theoretical account were investigated and associated to the current research.

However, the overall conclusion from the explanations derived from the four dominant theoretical accounts indicates that no theory is clear and parsimonious enough to answer some fundamental questions derived from the present findings. This point will be further discussed following the summary of the empirical findings.

5.3 Summary of Experimental Results

All experimental chapters, that is Chapters 2, 3 and 4, manipulated facial instead of verbal stimuli in an attempt to extend the generality of previous findings in our set of materials. In other words, an attempt was made to identify independent variables that produce dissociations when facial stimuli are being used.

In Chapter 2, three experiments explored divided attention effects in recognition memory, as measured by remember, know and guess responses. In Experiment 1 divided attention was manipulated in a perceptual tone monitoring task. The divided attention manipulation was instructional in that both focused and divided attention groups heard the tones with different instructions (attend, or not attend). Remember responses were selectively influenced by the divided attention condition over the focused attention condition, whereas know responses remained constant across conditions.

Experiment 2 was a replication of Experiment 1 with the addition of guess responses. The inclusion of guessing did not affect the dissociation between remembering and knowing obtained in Experiment 1, under similar divided attention conditions. Specifically, remembering was influenced by the divided attention condition, while on the contrary, knowing remained unaffected from the manipulation of attention. Similarly, guessing demonstrated the same levels of responses across the divided and focused attention tasks. Moreover, guess responses were similar for targets and lures.

Furthermore, Experiment 3 manipulated a conceptual attention task, that is, participants hearing stories instead of tones. Again, the manipulation of attention was instructional with both groups hearing the stories with different instructions (attend, or not attend). The findings were similar to the ones obtained in Experiment 2, with increased remember rates in the focused condition and similar know and guess rates across the divided and focused attention conditions. At this point, it is worth noting that knowing was higher in Experiment 2 than in Experiment 3 regardless of the attention task conditions. It seems that the manipulation of attention in Experiment 3, that is, hearing stories instead of tones, allowed the conceptual processing of the material. Consequently, know responses in Experiment 3 showed lower rates than in Experiment 2, since they relied more on perceptual processes.

In Chapter 3, Experiments 4 and 5 examined the effect of size congruency of facial stimuli across study and test conditions. In addition, Experiment 5 explored further the effect of rapid presentation rates, that is, 300msec. versus 700msec., that were manipulated during study. Different size at test reduced remembering, whereas knowing remained constant across conditions. Interestingly enough, when rapid presentation rate was manipulated (Experiment

5), the effect of context disappeared from remember but did not appear in know responses. Moreover, under the rapid presentation rate, know responses showed an increase regardless of size congruence. Finally, guess responses remained approximately the same, regardless of either context, or presentation rate.

In Chapter 4, Experiments 6-8, extended the findings of Chapter 3, by examining context effects in a different experimental framework. Specifically, context was manipulated by either preserving, or altering, a descriptive word accompanying each face across study and test. Experiment 6 employed two presentation rates, 700msec. versus 5sec., whereas Experiment 7 employed the same presentation rates as in Experiment 6 with the addition of three study trials. Experiment 8 was designed to explore the low rates of know responses exhibited in Experiments 6 and 7. Specifically, Experiment 8 investigated whether know responses would show higher rates for words than they had for faces, in previous experiments. For that reason, participants were presented with both faces and words, but were tested only on the words.

The findings can be summarised as follows: First, in Experiment 6, remembering showed congruency effects in the slow rate, whereas knowing and guessing remained unaffected. In contrast, during the faster presentation rate conditions, remember responses were greatly decreased, whereas know responses were increased. However, both remembering and knowing failed to show congruency effects in the fast rate. In Experiment 7, with the addition of three study trials, both presentation rates showed an increased performance of remember responses, leaving knowing unaffected. Furthermore, remember responses replicated the congruency effect in the slow rate, whereas in the fast rate both remember and know responses again failed to show congruency effects. Experiment 8 demonstrated an increased performance of know responses for words than it did for faces in Experiment 6 and 7. However, knowing failed to show higher rates to the fast over the slow presentation rate. In conclusion, therefore, remembering increased under congruent context conditions, during slow presentation rates, whereas knowing failed to show congruency effects, even though remembering decreased, during faster rate conditions.

Overall, Chapters 2-4 manipulated divided attention, context effect, presentation rate and trials. Some of the above variables produced dissociations between remember and know responses. Specifically, the manipulation of divided attention during encoding (Experiments 1, 2, & 3), and the change of study context during retrieval (Experiments 4 & 6), decreased remembering while leaving knowing constant. In contrast, repeating the study list three consecutive times (Experiment 7), increased remembering while again knowing remained unaffected.

5.4 An Evaluation of the Experimental Results in Relation to Four Main Theoretical Explanations.

5.4.1 Conceptual/perceptual processing account

The conceptual/perceptual distinction maintains that remember responses are dependent on conceptual factors, whereas know responses rely more on perceptual processing. Most of the conducted experiments attempted to address this distinction by manipulating conceptual or perceptual orienting tasks. Specifically, Experiments 4, 5, 6, and 7 manipulated the similarity between study and test items. In these experiments participants were presented with half of the stimuli modified in various ways. These modifications of the original stimuli were either perceptual, as in Experiments 4,and 5, or semantic/conceptual in nature, as in Experiments 6 and 7. Experiments 6 and 7 argued in support of the conceptual/perceptual distinction for two main reasons. First, remember responses were influenced by the word congruency which activated the conceptual aspects of the material. Second, in the fast rates, the conceptual effect of context failed to appear in know responses. However, findings do not always support of the conceptual/perceptual distinction. Specifically, the patterns of responses found in the case of word congruence between stimuli at study and at test, in Experiments 6 and 7, is similar to that produced by size changes in Experiment 4. In other words, it seems that remembering shows congruency effect even when the manipulated variable (that is alterations of size) allows perceptual processing. Furthermore, in the fast rate, know responses did not show congruency effects, even though remembering was greatly reduced. Thus, knowing failed to show the expected selective influence to perceptual factors. It is worth noting that under study time constraints, such as rapid presentation rates, the typically observed congruency effect in remembering did not occur. Consequently, the conceptual/perceptual distinction may partly accommodate the observed levels of performance. It seems that remembering always benefits from congruent study and test conditions, either conceptual or perceptual in nature, whereas knowing remains nearly unaffected by the similarity between study and test conditions.

Finally, in Experiments 1, 2, and 3, the findings suggest that divided attention influences conceptual processing. In other words, dividing attention between the visual encoding of the facial stimuli and the auditory task (i.e. tones or stories) interferes with normal memory processes resulting in reduced memory performance. Consequently, remembering suffers since it relies more on conceptual processing which requires full attention to occur.

5.4.2 Distinctiveness/Fluency Account

The distinctiveness/fluency account maintains that remembering benefits from the perceptual, or conceptual, processing of the distinctive attributes of stimuli. In contrast, knowing relies upon the perceptual or conceptual processing of the fluent characteristics of stimuli.

The reported experiments showed that under slow presentation rates, namely 5 sec., remember responses were affected by the distinctive attributes of congruent/incongruent manipulation which require either perceptual, as in Experiment 4, or conceptual processing, as in Experiments 6 and 7. However, under rapid presentation rates, that is 300 or 700msec., remember responses largely disappeared. In other words, when a highly perceptual task was employed, remembering was extinguished. This outcome implied that the distinctive attributes of the material may not have been activated when size, or word cues accompanying faces, were maintained the same across study and test. Another plausible explanation might be, that participants encoded facial stimuli conceptually, as well as perceptually under the 5sec. presentation rates. This was clearly shown in Experiments 4 and 6, where remembering was affected by the manipulation of size and accompanying word characteristics. Thus, one may note that the same patterns of performance were found across a number of experimental manipulations that involved size, or word cues congruence across study/test conditions. Moreover, in Experiments 6 and 7, know responses failed to show conceptual effects of context when remembering was reduced. Thus, know responses were not affected by the context manipulation that required conceptual processing.

Based on the above observations, it may be concluded that the distinctiveness/fluency hypothesis cannot easily accommodate the present empirical findings. It is worth noting that the facial stimuli used in the described series of experiments were selected according to average typical characteristics, lacking any distinctive attributes.

Furthermore, in Experiments 1, 2 and 3, which involved allocation of attention during study, remember responses were greatly affected by the divided attention task that reduced the opportunity of conceptual processing. One may also argue that divided attention might also reduce the opportunity of distinctive encoding, as the distinctiveness/fluency theory suggested. In other words, remembering benefits more in the focused attention condition that allows the processing of the distinctive attributes of the material. Thus, Rajaram's (1996; 1998) theory can accommodate the findings in the experiments that manipulated attentional demands during study.

In conclusion, the effects of congruency on remembering, with both conceptual and perceptual processing, are consistent with the distinctiveness/fluency framework. However, the absence of similar effects in knowing, following study conditions designed to greatly reduce elaborative, distinctive encoding, fail to support distinctiveness/fluency framework.

5.4.3 Signal Detection Theory

The signal detection theory maintains that remembering and knowing are highly dependent on response criteria. Moreover, the theory assumes that A′ estimates of memory must be similar whether derived from the overall recognition performance of hit and false alarm rates, or from remember hit and false alarm rates. The independent variables that have been mostly examined and yielded dissociations that encompass test instructions, presentation rates, generation effect, divided attention, levels of processing, maintenance and elaborative rehearsal, nonword recognition, and modality effects (see Section 1.2.1.iv, for details).

The existing empirical evidence in the literature provides several findings that disconfirm Donaldson's predictions (see Gardiner & Gregg, 1997, for details). For example, when there are relatively few remember responses A′ estimates do not meet Donaldson's prediction. A number of suggestions have been offered in the past about this limitation of the signal detection theory.

Interestingly enough, the weaknesses of the theory has been discussed by other researchers in the area, and it seems that their argument derives support from the findings of only two of the experiments discussed in the present thesis. Specifically, the obtained dissociations across experiments yield no A′ differences, except for the experiments where remember responses are low compared to know, in Experiment 5, or when both remember and know responses are low, in Experiment 6.

Given the arguments made above, generally it seems that most of the present experiments support Donaldson's model. However, there are cases where the theory can not provide a complete explanation for data as in Experiments 5 and 6. Furthermore, there is a number of empirical findings in the literature that the model cannot accommodate (Gardiner & Gregg, 1994). Thus, even though the theory can partly explain the present data, it needs further clarifications in order to provide a more complete explanation for all conscious awareness findings.

5.4.4 Memory Systems Account

Finally, findings were interpreted in the light of the memory systems account, even though the theory was not directly investigated in the experimental chapters. Specifically, Tulving (1983; 1985) proposed the multiple memory systems theory that encompasses five different memory systems, that is the procedural, semantic, episodic, primary and perceptual representation system (see Section 1.2.1.i for more details). Accordingly, Tulving (1985), argued that remember responses relied more on the episodic memory system whereas know responses relied more on the semantic memory system.

Consequently, the systems theory can encompass the findings of Experiments 4, 5, 6, and 7 which indicate that remembering requires more elaborate processing and gains facilitation under slow presentation rates. According to Tulving (1985a; 1985b), remembering relies on an episodic memory task that is positively influenced by study time and negatively influenced by rapid presentation rates. Interestingly enough, this observation receives additional support by the fact that the typical remembering loss which appears under fast presentation rates, disappears when repetition of study trials is allowed. Furthermore, the obtained data on knowing indicate that it is a state of awareness that involves perceptual and semantically oriented analyses of features that are independent of study time and context constraints. Thus, one can easily explain why knowing remains unaffected by contextual and study time manipulations.

The divided attention task across Experiments 1, 2, 3 which involved allocating attention between a meaningful and meaningless task, simply encouraged the relative encoding of episodic versus semantic memory characteristics. Again, this evidence provides support for Tulving´s view which attributes episodic characteristics to remembering and semantic-perceptual characteristics to knowing.

5.4.5 Limitations to Conclusions

The present thesis should acknowledge that some of the experimental findings impose limits on the strength of conclusions that can be drawn from them, especially regarding null effects of congruency. In the later experiments, in particular, know responses were subject to floor effects, despite the attempts made to overcome them. Specifically, Experiment 7 employed additional study trials in order to boost the levels of responses, and Experiment 8 examined whether know responses might be higher with the verbal material in an attempt to replicate Gregg and Gardiner's (1994) findings more directly. Unfortunately, the floor effects in knowing persisted; hence the lack of any congruency effect in knowing has to be interpreted with considerable caution.

Similarly, the signal detection theory inevitably is supported by the findings of Experiment 6, 7 and 8 since very small rates of know responses are being added to remember ones. Thus, A′ estimates of memory were similar whether derived from remember plus know hit and false alarm rates, or only from remember hit and false alarm rates. Contrary to these findings, under conditions designed to lead to little or no remembering, as in Gregg and Gardiner's study (1994), know responses were much higher than remember ones. Consequently, the signal detection theory was refuted since A′ estimates of memory for remember plus know hit and false alarm rates were significantly grater than A′ estimates of only remember hit and false alarm rates (Gardiner & Gregg, 1997).

It remains unclear why know responses were at much low levels in some of these experiments. The low levels of knowing might be attributed to the fact that novel faces lack the semantic representations in the semantic memory system compared with words, which already have a semantic representation.

5.5 Proposed Future Research

The reported experiments clearly indicate that there is a need for a more complete theory of conscious awareness. The existing theoretical accounts need to become more precise in terms of determining the underlying cognitive mechanisms involved in producing robust dissociations in remembering and knowing. Both the two processing accounts and the memory systems theory offer sound explanations about the processes underlying remembering and knowing.

However, both theories still need to identify more independent variables that produce robust dissociations. The present data, along with those published in the literature so far, indicate that similar patterns of dissociation may be obtained in experiments that use either the visual or the auditory modalities. However, little systematic research has thoroughly examined the effects in conscious awareness when both modalities, that is, visual and auditory, are presented simultaneously. For example, it would be interesting to present the participants with facial, verbal, or abstract stimuli, accompanied by meaningful and/or meaningless words presented aurally, with the purpose of examining the importance of formulating perceptual or semantic, or both, types of representations during study. By doing so, one would be able to better answer the question of whether dissociations between remembering and knowing depend on maintaining congruence across encoding and retrieval conditions. Also, this type of research may allow us to answer the question of whether when one refers to the memory systems view, one must specify the cognitive operations that take place both during studying and testing. Only when clear answers pertaining to these theoretical considerations are given, will we be able to have a more complete understanding of why and under what conditions remember and know dissociations take place.

5.6 Conclusions

The data reported in the present thesis suggest that remembering is selectively sensitive to most of the experimental manipulations employed in the present research. Indeed the typical dissociation between remembering and knowing facial stimuli was eliminated only under very rapid presentation rates. This outcome suggests that the amount of time provided to the participant during studying becomes a great determinant of the magnitude of subsequent performance levels during testing, especially for remember responses. In other words, remember responses benefit the most under slow presentation rates and with additional study trials that allow more conceptual processing of the material.

The overall picture of the data points to the direction of accepting the conceptual/perceptual account as the most complete theory that can accommodate most findings presented in the previous pages. Thus, it seems that remembering is selectively influenced by conceptual processes whereas knowing depends more on perceptual ones. However, one must not ignore the position taken by the distinctiveness/fluency framework. Even though the present thesis favours the distinction between conceptual and perceptual processing, Rajaram (1996; 1998) has provided considerable evidence suggesting that the relation between the two states of awareness and these two processing dimensions is orthogonal. It seems that the conceptual/perceptual distinction offers too simple a view in explaining the remember/know dissociations. Nevertheless, the present findings imply that the conceptual/perceptual framework still has a useful role to play even though the distinctiveness/fluency framework has superseded it.

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APPENDIX A

Percentage of Targets and Lures as a function of Attention in Experiment 1

Targets				Lures			
Full		Divided		Full		Divided	
Remem	Know	Remem	Know	Remem	Know	Remem	Know
33	38	44	5	5	0	33	16
50	33	38	38	11	16	11	5
38	0	38	22	11	0	11	0
50	27	22	44	16	5	0	27
33	16	72	22	5	16	0	0
44	22	44	22	0	5	0	0
55	22	50	11	5	11	11	0
16	16	61	22	11	22	5	0
38	38	55	16	0	11	27	11
72	27	33	33	0	22	5	22
38	16	72	16	0	0	5	0
66	0	22	22	0	0	0	22
77	5	16	33	5	11	5	33
38	27	11	38	5	16	0	5
27	50	44	11	0	0	11	11
38	33	44	11	5	11	5	11
50	38	0	66	5	16	0	22
55	38	27	0	5	11	0	0
50	16	38	44	5	0	0	11
72	0	27	33	5	38	0	16
38	16	16	11	0	11	5	0
66	27	27	38	0	22	0	5
27	22	38	27	0	5	0	11
50	16	11	27	0	11	0	16
66	11	33	22	0	5	5	5
50	33	33	27	0	5	0	5
33	44	27	11	11	16	11	22
33	44	16	22	5	5	16	16
33	27	27	16	0	11	5	11
44	33	27	33	0	16	0	0

Percentage of Targets and Lures as a Function of Attention in Experiment 2

Targets						Lures					
Full			Divided			Full			Divided		
R	K	G	R	K	G	R	K	G	R	K	G
50	6	16	3	3	8	3	8	22	3	0	0
47	31	8	14	42	8	3	14	11	0	8	8
39	8	22	17	11	30	8	0	20	6	0	19
53	14	19	42	19	22	3	6	24	3	0	19
25	28	22	11	14	17	3	11	17	19	3	20
56	25	11	36	30	14	3	3	3	6	3	8
44	15	19	33	44	11	22	17	28	3	3	27
75	11	11	39	25	25	6	0	5	6	19	25
44	8	8	33	25	8	3	0	3	0	19	3
69	0	17	25	3	5	14	3	25	8	0	0
19	22	11	25	8	0	0	6	16	22	11	0
30	42	3	55	14	14	3	0	30	5	3	14
33	31	17	30	28	22	3	0	8	6	16	22
39	22	8	28	22	25	3	0	8	6	11	8
50	19	17	58	11	11	3	0	14	8	6	22
89	5	3	50	22	3	3	5	3	8	3	19
75	11	8	36	14	17	6	14	8	6	8	14
69	8	11	8	22	28	6	0	8	6	22	14
36	28	14	25	8	11	0	8	8	6	6	16
72	11	6	56	22	8	3	0	0	6	3	8
25	0	11	33	6	14	22	11	11	5	0	3
47	6	3	28	28	14	3	0	3	0	8	11
50	0	11	28	19	11	3	0	0	6	11	11
44	25	0	25	31	19	3	22	3	0	8	19
47	25	14	66	0	6	3	8	8	11	5	6
25	9	19	33	11	17	17	6	16	3	0	8
31	6	16	39	14	16	16	3	11	0	5	14
64	6	8	6	8	22	3	0	08	0	3	22
47	8	14	50	0	5	3	3	11	3	0	3
36	19	6	44	19	17	3	5	11	22	19	17
39	28	8	30	14	14	0	14	22	8	8	22
36	14	11	36	19	17	25	33	8	3	3	16

Percentage of Targets and Lures as a Function of Attention in Experiment 3

Targets						Lures					
Full			Divided			Full			Divided		
R	K	G	R	K	G	R	K	G	R	K	G
83	0	0	27	16	22	3	3	14	14	8	27
72	3	5	0	14	19	11	0	0	0	19	25
55	11	14	36	3	22	5	0	3	8	0	8
52	16	19	36	0	11	5	3	8	30	8	8
36	22	16	19	25	8	8	0	8	33	11	19
88	11	0	86	5	3	3	5	11	33	3	11
77	5	5	36	8	14	11	5	3	5	0	5
55	5	8	50	0	5	8	14	3	0	0	3
50	11	0	64	5	14	0	3	0	5	0	19
36	14	14	30	16	22	8	11	14	11	11	25
27	19	16	0	14	36	19	19	14	0	3	44
27	30	16	16	5	14	22	19	27	3	3	8
52	11	11	61	0	14	0	0	8	8	5	11
36	3	19	36	19	30	3	0	14	5	14	30
61	14	16	47	19	16	3	0	22	8	11	36
41	11	5	16	11	16	16	3	14	30	33	14
91	3	0	27	8	25	5	3	0	11	11	25
52	16	30	11	47	33	30	30	36	5	27	36
50	41	8	19	41	25	5	39	44	11	27	8
38	11	30	50	3	8	5	0	5	22	0	19
36	25	22	44	19	11	3	11	22	16	8	14
61	8	19	55	16	19	8	3	11	5	0	14
50	16	19	27	14	16	0	3	5	8	14	3
52	16	11	61	16	14	3	11	19	8	5	16
75	14	3	44	19	11	3	5	5	5	30	11
50	25	5	36	11	19	11	5	11	3	0	5
77	5	5	61	5	5	11	14	22	5	8	27
69	16	3	61	11	5	3	0	3	8	5	14
77	3	11	80	0	0	3	11	11	16	16	0
83	3	8	58	14	11	0	8	30	5	19	19
61	19	16	86	5	0	3	3	14	19	16	3
52	14	11	0	27	72	3	3	19	22	27	50

Percentage of Targets and Lures as a function of Context in Experiment 4

Targets						Lures		
Congruent			Incongruent					
Remem	Know	Guess	Remem	Know	Guess	Remem	Know	Guess
21	29	12	25	21	4	0	0	4
16	16	16	8	16	12	0	0	10
58	8	8	37	4	12	0	0	0
54	25	0	46	29	0	6	6	2
33	12	21	21	29	33	0	0	2
54	29	0	41	8	29	2	2	4
41	0	12	8	4	16	8	8	2
54	12	0	21	12	0	0	0	8
41	25	25	12	21	25	0	0	0
46	21	12	8	29	25	0	0	0
16	8	16	4	21	16	0	0	6
41	0	21	33	0	8	2	2	0
46	4	33	37	29	8	0	0	10
62	8	21	58	12	21	16	16	16
21	8	12	33	21	0	10	10	16
66	16	8	21	16	8	0	0	4
66	0	0	66	12	0	10	10	10
25	21	4	16	8	8	0	0	2
50	8	8	29	12	21	2	2	6
41	16	4	41	8	4	2	2	8
58	12	8	66	4	25	16	16	27
41	12	12	54	12	0	0	0	6
66	25	4	87	4	0	0	0	6
0	12	12	8	8	16	10	10	2
41	25	4	33	8	4	0	0	0
62	12	0	33	4	8	0	0	2
62	33	4	25	16	0	0	0	0
58	29	8	29	21	0	2	2	4
58	16	0	16	8	0	0	0	0
62	29	0	8	33	4	0	0	0
41	21	0	33	8	0	2	2	0

54	21	4	37	37	4	0	0	8

Percentage of Targets as a function of Context and Presentation Rate in Experiment 5

700msec						300msec					
Congruent			Incongruent			Congruent			Incongruent		
R	K	G	R	K	G	R	K	G	R	K	G
16	16	12	12	25	4	0	25	50	4	8	20
4	12	25	8	29	0	8	16	20	8	4	0
12	33	0	0	20	4	0	4	12	8	0	8
8	4	12	20	54	0	4	8	4	0	8	0
16	20	25	16	25	4	0	16	0	0	0	8
0	46	0	12	25	0	4	4	0	0	12	0
0	20	12	4	20	8	0	20	16	0	29	16
0	16	20	12	20	4	8	33	16	4	29	12
16	46	0	8	12	0	8	25	25	25	20	8
12	29	12	8	12	0	12	33	0	4	20	8
16	50	8	8	25	8	8	33	4	12	20	4
12	46	4	0	25	4	20	8	25	25	4	25
8	0	0	8	29	12	4	4	12	8	4	4
20	33	16	12	20	0	4	12	8	0	8	0
12	16	0	4	25	8	0	0	0	0	20	0
4	8	0	8	20	0	0	12	0	0	8	4
8	16	8	4	16	0	4	8	8	4	12	0
0	46	4	8	12	0	0	29	16	0	20	20
16	25	12	12	16	20	4	12	4	8	54	29
8	12	0	16	37	16	8	16	16	16	25	8
0	42	8	8	12	0	4	25	37	4	12	25
4	29	12	4	12	16	8	33	4	12	25	4
8	12	4	0	16	8	4	33	4	4	20	8
4	25	8	20	12	8	12	25	16	12	12	8

Percentage of Lures as a function of Presentation Rate in Experiment 5

700msec			300msec		
Remember	Know	Guess	Remember	Know	Guess
29	0	42	16	25	42
16	4	0	16	12	46
8	12	4	25	12	8
4	25	12	0	8	4
0	25	20	0	0	12
16	12	0	0	16	16
0	8	16	4	16	12
8	0	16	8	33	25
8	16	8	12	25	29
4	4	4	20	20	20
0	12	8	25	37	12
0	16	12	42	8	37
8	20	8	25	12	16
12	25	12	0	16	0
0	12	8	0	4	25
4	4	0	4	12	16
0	0	12	4	16	20
0	16	0	4	16	20
0	20	16	12	33	29
0	25	0	12	20	29
8	8	4	16	25	37
0	12	12	16	33	16
0	4	8	20	25	25
20	0	42	20	0	66

Percentage of Targets as a function of Context and Presentation Rate in Experiment 6

5sec						700msec					
Congruent			Incongruent			Congruent			Incongruent		
R	K	G	R	K	G	R	K	G	R	K	G
50	12	0	33	8	8	4	16	0	16	12	0
41	20	12	20	8	4	4	29	8	0	46	0
33	12	16	41	12	0	8	12	8	16	20	0
29	25	0	20	12	4	25	16	0	12	25	0
46	4	4	29	12	4	41	0	16	16	0	8
41	12	4	33	16	0	8	16	16	8	29	8
12	8	4	20	0	12	16	25	8	16	12	0
50	16	0	46	16	0	12	16	4	8	16	8
62	8	0	41	4	0	16	20	4	12	12	4
66	20	8	29	4	4	25	4	0	25	20	8
33	0	12	33	0	8	41	8	0	25	4	4
62	16	4	41	0	4	4	29	4	12	16	0
41	20	4	29	8	4	4	25	8	0	41	4
50	25	12	41	16	8	12	20	12	16	25	0
12	4	12	20	25	16	8	12	4	8	0	4
12	0	8	12	20	16	12	16	0	25	8	4

Percentage of Lures as a function of Presentation Rate in Experiment 6

5sec			700msec		
R	K	G	R	K	G
6	6	6	0	6	0
0	12	10	4	29	2
0	8	19	2	15	8
2	8	4	10	16	0
15	15	4	20	2	10
0	0	4	0	8	16
4	6	4	15	19	2
4	20	0	23	8	6
4	4	4	4	10	6
6	10	4	8	15	2
6	4	8	10	8	8
6	4	8	0	16	4
6	6	2	0	8	0
4	10	10	4	6	0
6	6	12	2	0	4
4	6	0	6	4	2

Percentage of Targets as a function of Context, Presentation Rate and Trials in Experiment 7

5sec						700msec					
Congruent			Incongruent			Congruent			Incongruent		
R	K	G	R	K	G	R	K	G	R	K	G
79	16	4	71	12	12	79	0	8	62	0	20
50	8	8	83	4	8	20	20	25	4	8	25
79	16	4	46	37	4	66	12	4	75	12	8
42	33	16	29	4	29	58	25	16	25	25	25
66	25	4	46	20	33	71	8	16	71	0	4
96	4	0	88	12	0	79	8	0	79	8	8
54	25	12	46	20	16	25	46	16	20	46	16
42	8	16	42	12	16	37	16	25	58	0	12
83	4	4	79	0	16	92	0	4	50	29	20
16	8	0	42	4	0	79	4	0	50	4	12
33	4	0	58	0	0	37	25	12	46	25	12
62	12	12	37	16	16	29	37	25	25	25	0
83	12	0	66	25	0	75	8	8	79	8	0
92	4	0	79	4	4	62	8	20	71	12	12
96	0	0	58	0	8	58	25	12	42	20	0
66	4	0	50	8	0	71	8	8	54	25	4

Percentage of Lures as a function of Presentation Rate and Trials in Experiment 7

5sec			700msec		
R	K	G	R	K	G
15	12	25	0	2	10
2	25	6	0	6	23
0	6	44	6	12	23
35	12	19	6	23	46
0	12	39	2	15	29
0	0	0	6	10	23
8	12	48	0	37	23
29	12	15	0	2	19
0	0	25	21	29	33
31	8	0	6	16	12
46	0	2	25	16	23
6	12	6	0	6	16
2	27	19	8	2	19
0	0	4	6	16	29
0	4	15	37	16	2
39	15	4	2	10	6

Percentage of Targets and Lures as a function of Presentation Rate in Experiment 8

Targets						Lures					
5sec			700msec			5sec			700msec		
R	K	G	R	K	G	R	K	G	R	K	G
33	14	31	25	23	27	0	16	25	35	8	29
60	21	12	37	2	10	4	19	50	21	2	21
16	77	6	37	10	35	0	14	39	12	6	19
81	8	8	69	8	12	6	12	23	14	6	8
77	12	6	35	23	27	23	19	27	19	19	10
52	2	19	62	4	12	2	0	12	14	6	8
23	25	23	10	54	35	2	0	4	0	21	64
23	23	23	37	14	16	0	6	2	8	10	23
81	4	4	27	27	23	6	12	23	2	8	25
66	10	6	41	23	16	25	10	16	25	25	21
56	2	23	10	37	39	14	6	33	2	14	37
10	16	50	33	29	23	4	6	46	14	21	2
25	14	23	31	29	16	8	6	19	8	19	33
64	19	12	14	12	33	19	23	23	2	4	35
75	0	0	12	48	23	12	0	14	0	25	16
77	6	12	29	27	43	10	4	14	4	21	60

Table 1: Experiment 1

Summary of One Way Analyses of Variance of Hit Rates for Attention (Full vs. Divided)

Source	df	SS	MS	F	p
Overall Perform.					
Between Groups	1	74.81	84.81	8.74	.0045
Within Groups	58	496.16	8.55		
Total	59	570.98			
Remember					
Between Groups	1	72.60	72.60	8.608	.0048
Within Groups	58	489.13	8.43		
Total	59	561.73			
Know					
Between Groups	1	.01	.01	.0028	.9577
Within Groups	58	340.83	5.86		
Total	59	340.85			

Table 2: Experiment 1

Summary of One Way Analyses of Variance of False Alarm Rates for Attention (Full vs. Divided)

Source	df	SS	MS	F	p
Overall Perform.					
Between Groups	1	.81	.81	.179	.673
Within Groups	58	264.16	4.55		
Total	59	264.98			
Remember					
Between Groups	1	1.67	1.66	1.15	2.87
Within Groups	58	83.73	1.44		
Total	59	85.40			
Know					
Between Groups	1	.15	.15	.05	.815
Within Groups	58	158.43	2.73		
Total	59	158.58			

Table 3: Experiment 1

Summary of Analysis of Variance of Hit Rates for Attention (Full vs. Divided) and Response Type (Remember vs. Know)

Source	df	SS	MS	F	p
Attention	1	37.41	37.41	8.75	.004
Error	58	248.08	4.28		
Response	1	221.41	221.41	22.07	.000
Attent. x Resp.	1	35.21	35.21	3.51	.066
Error	58	581.88	10.03		

Table 4: Experiment 1

Summary of Analysis of Variance of False Alarm Rates for Attention (Full vs. Divided) and Response Type (Remember vs. Know)

Source	df	SS	MS	F	p
Attention	1	.41	.41	.18	.674
Error	58	132.08	2.28		
Response	1	31.01	31.01	16.34	.000
Attent. x Resp.	1	1.41	1.41	.74	.393
Error	58	110.08	1.90		

Table 5: Experiment 1

Summary of Analysis of Variance of Corrected Scores for Attention (Full vs. Divided) and Response Type (Remember vs. Know)

Source	df	SS	MS	F	p
Attention	1	45.63	45.63	6.63	.013
Error	58	399.37	6.89		
Response	1	418.13	418.13	45.74	.000
Attent. x Resp.	1	50.70	50.70	5.55	.022
Error	58	530.17	9.14		

Table 6: Experiment 1

Summary of One Way Analyses of Variance of Corrected Scores (Hit-FA) for Attention (Full vs. Divided)

Source	df	SS	MS	F	p
Overall Perform.					
Between Groups	1	91.26	91.26	6.62	.0126
Within Groups	58	798.73	13.77		
Total	59	890.00			
Remember					
Between Groups	1	96.26	96.26	10.74	.0018
Within Groups	58	519.66	8.95		
Total	59	615.93			
Know					
Between Groups	1	.06	.06	.009	.923
Within Groups	58	409.86	7.06		
Total	59	409.93			

Table 7: Experiment 2

Summary of One Way Analyses of Variance of Hit Rates for Attention (Full vs. Divided)

Source	df	SS	MS	F	p
Overall Perform.					
Between Groups	1	.14	.14	5.30	.024
Within Groups	62	1.74	.03		
Total	63	1.89			
Remember					
Between Groups	1	.33	.33	12.80	.0007
Within Groups	62	1.62	.02		
Total	63	1.95			
Know					
Between Groups	1	.004	.004	.388	.535
Within Groups	62	.713	.011		
Total	63	.717			
Guess					
Between Groups	1	.011	.011	2.713	.104
Within Groups	62	.270	.004		
Total	63	.282			

Table 8: Experiment 2

Summary of One Way Analyses of Variance of False Alarm Rates for Attention (Full vs. Divided)

Source	df	SS	MS	F	p
Overall Perform.					
Between Groups	1	.004	.004	.216	.643
Within Groups	62	1.306	.021		
Total	63	1.311			
Remember					
Between Groups	1	.00	.000	.010	.920
Within Groups	62	.24	.003		
Total	63	.24			
Know					
Between Groups	1	.0003	.0003	.061	.805
Within Groups	62	.309	.005		
Total	63	.310			
Guess					
Between Groups	1	.003	.003	.493	.484
Within Groups	62	.397	.006		
Total	63	.400			

Table 9: Experiment 2

Summary of One Way Analyses of Variance of Know and Guess Responses for Hit vs. False Alarm rates

Source	df	SS	MS	F	p
Overall Know					
Between Groups	1	.32	.322	39.16	.000
Within Groups	125	1.02	.008		
Total	126	1.34			
Full Att. Know					
Between Groups	1	.13	.132	15.23	.0002
Within Groups	62	.53	.008		
Total	63	.67			
Divided Att.Know					
Between Groups	1	.198	.198	22.26	.0000
Within Groups	62	.551	.008		
Total	63	.749			
Overall Guess					
Between Groups	1	.0013	.0013	.230	.631
Within Groups	125	.6802	.0054		
Total	126	.6830			
Full Att. Guess					
Between Groups	1	.000	.000	.0003	.986
Within Groups	62	.311	.005		
Total	63	.311			
Divided At.Guess					
Between Groups	1	.011	.011	1.901	.172
Within Groups	62	.376	.006		
Total	63	.388			

Table 10: Experiment 2

Summary of Analysis of Variance of Hit Rates for Attention (Full vs. Divided) and Response Type (Remember vs. Know vs. Guess)

Source	df	SS	MS	F	p
Attention	1	.04	.04	4.59	.036
Error	61	.56	.01		
Response	2	2.51	1.26	82.74	.000
Attent. x Resp.	2	.24	.12	7.98	.001
Error	122	1.85	.02		

Table 11: Experiment 2

Summary of Analysis of Variance of False Alarm Rates for Attention (Full vs. Divided) and Response Type (Remember vs. Know vs. Guess)

Source	df	SS	MS	F	p
Attention	1	.00	.00	.22	.644
Error	62	.44	.01		
Response	2	.16	.08	18.88	.000
Attent. x Resp.	2	.00	.00	.24	.787
Error	124	.51	.00		

Table 12: Experiment 2

Summary of Analysis of Variance of Corrected Scores for Attention (Full vs. Divided) and Response Type (Remember vs. Know vs. Guess)

Source	df	SS	MS	F	p
Attention	1	.07	.07	4.39	.040
Error	62	.95	.02		
Response	2	3.72	1.86	108.8	.000
Attent. x Resp.	2	.27	.13	7.83	.001
Error	124	2.12	.02		

Table 13: Experiment 3

Summary of One Way Analyses of Variance of Hit Rates for Attention (Full vs. Divided)

Source	df	SS	MS	F	p
Overall Perform.					
Between Groups	1	289.0	289.0	9.629	.0029
Within Groups	62	1860.7	30.0		
Total	63	2149.7			
Remember					
Between Groups	1	606.3	606.39	10.640	.0018
Within Groups	62	3533.2	56.98		
Total	63	4139.6			
Know					
Between Groups	1	.01	.01	.001	.972
Within Groups	62	822.34	13.26		
Total	63	822.35			
Guess					
Between Groups	1	60.0	60.06	3.71	.058
Within Groups	62	1001.6	16.15		
Total	63	1061.7			

Table 14: Experiment 3

Summary of One Way Analyses of Variance of False Alarm Rates for Attention (Full vs. Divided)

Source	df	SS	MS	F	p
Overall Perform.					
Between Groups	1	324.0	324.00	5.378	.0237
Within Groups	62	3734.9	60.24		
Total	63	4058.9			
Remember					
Between Groups	1	43.89	43.89	4.733	.0334
Within Groups	62	574.84	9.27		
Total	63	618.73			
Know					
Between Groups	1	26.26	26.26	2.197	.143
Within Groups	62	741.09	11.95		
Total	63	767.35			
Guess					
Between Groups	1	39.0	39.06	2.236	.1398
Within Groups	62	1082.6	17.46		
Total	63	1121.7			

Table 15: Experiment 3

Summary of One Way Analyses of Variance of Know and Guess Responses for Hit vs. False Alarm rates

Source	df	SS	MS	F	p
Full Att. Know					
Between Groups	1	74.39	74.39	6.90	.0108
Within Groups	62	668.09	10.77		
Total	63	742.48			
Divided Att.Know					
Between Groups	1	11.39	11.39	.788	.3779
Within Groups	62	895.34	14.44		
Total	63	906.73			
Full Att. Guess					
Between Groups	1	5.06	5.062	.425	.5164
Within Groups	62	736.93	11.88		
Total	63	742.00			
Divided At.Guess					
Between Groups	1	.5	.56	.025	.872
Within Groups	62	1347.4	21.73		
Total	63	1348.0			

Table 16: Experiment 3

Summary of Analysis of Variance of Hit Rates for Attention (Full vs. Divided) and Response Type (Remember vs. Know vs. Guess)

Source	df	SS	MS	F	p
Attention	1	.03	.03	6.10	.016
Error	62	.29	.00		
Response	2	7.05	3.53	174.66	.000
Attent. x Resp.	2	.15	.07	3.68	.028
Error	124	2.50	.02		

Table 17: Experiment 3

Summary of Analysis of Variance of False Alarm Rates for Attention (Full vs. Divided) and Response Type (Remember vs. Know vs. Guess)

Source	df	SS	MS	F	p
Attention	1	.00	.00	.01	.904
Error	62	.64	.01		
Response	2	.08	.04	7.59	.001
Attent. x Resp.	2	.01	.00	.62	.538
Error	124	.65	.01		

Table 18: Experiment 3

Summary of Analysis of Variance of Corrected Scores for Attention (Full vs. Divided) and Response Type (Remember vs. Know vs. Guess)

Source	df	SS	MS	F	p
Attention	1	487.4	487.4	19.87	.000
Error	62	1521.9	24.5		
Response	2	7940.0	3970.0	113.6	.000
Attent. x Resp.	2	588.2	294.3	8.4	.000
Error	124	4332.8	34.9		

Table 19: Experiment 4

Summary of One Way Analyses of Variance of Hit Rates for Context (Congruent vs.Incongruent)

Source	df	SS	MS	F	p
Overall Perform.					
Between Groups	1	.43	.430	12.23	.0009
Within Groups	62	2.18	.035		
Total	63	2.61			
Remember					
Between Groups	1	.33	.33	9.81	.0026
Within Groups	62	2.09	.03		
Total	63	2.42			
Know					
Between Groups	1	.002	.002	.24	.6224
Within Groups	62	.570	.009		
Total	63	.573			
Guess					
Between Groups	1	.0008	.0008	.0878	.768
Within Groups	62	.5339	.0086		
Total	63	.5347			

Table 20: Experiment 4

Summary of Analysis of Variance of A′ Estimates for Context (Congruent vs. Incongruent) and Performance (Remember vs. Remember + Know)

Source	df	SS	MS	F	p
Context	1	.06	.06	12.78	.001
Error	31	.15	.00		
Performance	1	.01	.01	2.78	.105
Error	31	.06	.00		
Context x Perf.	1	.00	.00	.09	.771
Error	31	.02	.00		

Table 21: Experiment 5

Summary of One Way Analyses of Variance of Hit Rates for Context (Congruent vs. Incongruent) (300msec)

Source	df	SS	MS	F	p
Remember					
Between Groups	1	1.02	1.02	.43	.5148
Within Groups	46	108.95	2.36		
Total	47	109.97			
Know					
Between Groups	1	3.52	3.52	.46	.4991
Within Groups	46	348.95	7.58		
Total	47	352.47			
Guess					
Between Groups	1	6.75	6.75	.9829	.3267
Within Groups	46	315.91	6.86		
Total	47	322.66			

Table 22: Experiment 5

Summary of One Way Analyses of Variance of Hit Rates for Context (Congruent vs. Incongruent) (700msec)

Source	df	SS	MS	F	p
Remember					
Between Groups	1	.08	.08	.03	.8476
Within Groups	46	102.58	2.23		
Total	47	102.66			
Know					
Between Groups	1	7.52	7.52	.85	.3589
Within Groups	46	402.79	8.75		
Total	47	410.31			
Guess					
Between Groups	1	7.52	7.52	2.60	.1133
Within Groups	46	132.79	2.88		
Total	47	140.31			

Table 23: Experiment 5

Summary of Analysis of Variance of Hit Rates for Presentation Rate (300 vs. 700msec.), Context (Congruent vs. Incongruent) and Response (Remember vs. Know vs. Guess)

Source	df	SS	MS	F	p
Presentat. Rate	1	13.35	13.35	1.85	.180
Error	46	331.64	7.21		
Response Type	2	542.72	271.36	54.30	.000
Pr.Rate x Resp.	2	81.17	40.59	8.12	.001
Error	92	459.78	5.00		
Context	1	12.50	12.50	2.34	.133
Pr.Rate x Cont.	1	.50	.50	.09	.761
Error	46	245.67	5.34		
Resp. x Context	2	13.27	6.64	1.63	.202
Pr.R. x Res. x C	2	.15	.07	.02	.982
Error	92	374.92	4.08		

Table 24: Experiment 5

Summary of Two Way Analyses of Variance of Hit Rates for Context (Congruent vs. Incongruent) and Presentation Rate (300msec. vs. 700msec.)

Source	df	SS	MS	F	p
Remember					
Present. Rate	1	11.34	11.34	3.65	.062
Error	46	143.15	3.11		
Context	1	.84	.84	.57	.455
Pr. Rate x Cont.	1	.26	.26	.18	.678
Error	46	68.40	1.49		
Know					
Present. Rate	1	60.17	60.17	7.94	.007
Error	46	348.79	7.58		
Context	1	10.67	10.67	1.22	.276
Pr. Rate x Cont.	1	.26	.26	.04	.837
Error	46	402.96	8.76		
Guess					
Present. Rate	1	23.01	23.01	3.53	.066
Error	46	299.48	6.51		
Context	1	14.26	14.24	4.40	.042
Pr. Rate x Cont.	1	.01	.01	.00	.955
Error	46	149.23	3.24		

Table 25: Experiment 5

Summary of Analysis of Variance of A′ Estimates for Context (Congruent vs. Incongruent) and Performance (Remember vs. Remember + Know) (300msec)

Source	df	SS	MS	F	p
Context	1	.01	.01	.29	.597
Error	23	.60	.03		
Performance	1	.13	.13	4.43	.046
Error	23	.67	.03		
Context x Perfor	1	.01	.01	.88	.358
Error	23	.29	.01		

Table 26: Experiment 5

Summary of Analysis of Variance of A′ Estimates for Context (Congruent vs. Incongruent) and Performance (Remember vs. Remember + Know) (700msec)

Source	df	SS	MS	F	p
Context	1	.01	.01	.60	.447
Error	23	.42	.02		
Performance	1	.16	.16	11.04	.003
Error	23	.33	.01		
Context x Perfor	1	.00	.00	.39	.536
Error	23	.26	.01		

Table 27: Experiment 5

Summary of Analysis of Variance of A′ Estimates for Presentation Rate (300 vs. 700msec.), Context (Congruent vs. Incongruent) and Performance (Remember vs. Know vs. Guess)

Source	df	SS	MS	F	p
Presentat. Rate	1	1.30	1.30	30.78	.000
Error	46	1.95	4.24		
Performance	1	.30	.30	12.02	.001
Pr.Rate x Perfor	1	5.20	5.20	.002	.964
Error	46	1.16	2.54		
Context	1	9.18	9.18	.04	.832
Pr.Rate x Cont.	1	1.36	1.36	.67	.415
Error	46	.92	2.01		
Perfo. X Context	1	2.00	2.00	.14	.707
Pr.R. x Per. x C	1	1.96	1.96	1.40	.243
Error	46	.64	1.39		

Table 28: Experiment 6

Summary of Two Way Analyses of Variance of Hit Rates for Context (Congruent vs. Incongruent) and Presentation Rate (5sec. vs. 700msec.)

Source	df	SS	MS	F	p
Remember					
Present. Rate	1	.72	.72	29.47	.000
Error	30	.73	.02		
Context	1	.05	.05	7.33	.011
Pr. Rate x Cont.	1	.03	.03	3.86	.059
Error	30	.21	.01		
Know					
Present. Rate	1	.05	.05	4.55	.041
Error	30	.36	.01		
Context	1	.00	.00	.09	.765
Pr. Rate x Cont.	1	.01	.01	1.00	.325
Error	30	.19	.01		
Guess					
Present. Rate	1	.00	.00	1.42	.243
Error	30	.09	.00		
Context	1	.00	.00	2.19	.149
Pr. Rate x Cont.	1	.00	.00	.64	.431
Error	30	.06	.00		

Table 29: Experiment 6

Summary of One Way Analyses of Variance of Know Responses for Hit vs. False Alarm Rates (5sec)

Source	df	SS	MS	F	p
Know					
Between Groups	1	24.50	24.50	3.96	.0557
Within Groups	30	185.50	6.18		
Total	31	210.00			

Table 30: Experiment 6

Summary of Analysis of Variance of Hit Rates for Presentation Rate (5sec vs. 700msec.), Context (Congruent vs. Incongruent) and Response (Remember vs. Know vs. Guess)

Source	df	SS	MS	F	p
Presentat. Rate	1	90.75	90.75	22.96	.000
Error	30	3.95	118.58		
Response Type	2	714.03	357.02	37.96	.000
Pr.Rate x Resp.	2	357.02	178.64	18.99	.000
Error	60	564.35	9.41		
Context	1	20.02	20.02	5.11	.031
Pr.Rate x Cont.	1	7.52	7.52	1.92	.176
Error	30	117.46	3.92		
Resp. x Context	2	12.07	6.04	2.42	.097
Pr.R. x Res. x C	2	11.32	5.66	2.27	.112
Error	60	149.60	2.49		

Table 31: Experiment 6

Summary of Analysis of Variance of False Alarm Rates for Presentation Rate (5sec vs. 700msec.), Context (Congruent vs. Incongruent) and Response (Remember vs. Know vs. Guess)

Source	df	SS	MS	F	p
Presentat. Rate	1	5.51	5.51	.86	.361
Error	30	192.06	6.40		
Response Type	2	65.58	32.79	4.21	.019
Pr.Rate x Resp.	2	20.08	10.04	1.29	.283
Error	60	467.00	7.78		

Table 32: Experiment 6

Summary of Analysis of Variance of A' Estimates for Presentation Rate (5sec vs. 700msec), Context (Congruent vs. Incongruent) and Performance (Remember vs. Remember + Know)

Source	df	SS	MS	F	p
Presentat. Rate	1	.58	.58	14.83	.001
Error	30	1.17	.04		
Performance	1	.00	.00	.15	.705
Pr.Rate x Perfor	1	.01	.01	1.42	.242
Error	30	.16	.01		
Context	1	.03	.03	4.22	.049
Pr.Rate x Cont.	1	.00	.00	.01	.938
Error	30	.24	.01		
Perfo. x Context	1	.00	.00	.63	.432
Pr.R. x Per. x C	1	.00	.00	1.51	.228
Error	30	.07	.00		

Table 33: Experiment 7

Summary of Two Way Analyses of Variance of Hit Rates for Context (Congruent vs. Incongruent) and Presentation Rate (5sec. vs. 700msec.)

Source	df	SS	MS	F	p
Remember					
Present. Rate	1	39.06	39.06	.88	.356
Error	30	133.69	44.46		
Context	1	56.25	56.25	5.54	.025
Pr. Rate x Cont.	1	.06	.06	.01	.938
Error	30	304.69	10.16		
Know					
Present. Rate	1	14.06	14.06	1.15	.293
Error	30	367.69	12.26		
Context	1	.00	.00	.00	1.000
Pr. Rate x Cont.	1	.06	.06	.02	.889
Error	30	93.94	3.13		
Guess					
Present. Rate	1	17.02	17.02	2.97	.095
Error	30	171.72	5.72		
Context	1	3.52	3.52	1.27	.269
Pr. Rate x Cont.	1	9.77	9.77	3.52	.070
Error	30	83.22	2.77		

Table 34: Experiment 7

Summary of One Way Analyses of Variance of Know Responses for Hit vs. False Alarm Rates (5sec)

Source	df	SS	MS	F	p
Know					
Between Groups	1	.00	.00	.97	.3321
Within Groups	30	.24	.00		
Total	31	.24			

Summary of One Way Analyses of Variance of Know Responses for Hit vs. False Alarm Rates (700msec.)

Source	df	SS	MS	F	p
Know					
Between Groups	1	.00	.30	.25	.6192
Within Groups	30	.35	.01		
Total	31	.36			

Table 35: Experiment 7

Summary of Analysis of Variance of Hit Rates for Presentation Rate (5sec. vs. 700msec.), Context (Congruent vs. Incongruent) and Performance (Remember vs. Know vs. Guess)

Source	df	SS	MS	F	p
Presentat. Rate	1	.88	.88	.10	.756
Error	30	268.20	8.94		
Response	2	527.84	263.75	98.53	.000
Pr.Rate x Respon	2	69.26	34.63	1.29	.282
Error	60	160.90	26.75		
Context	1	10.55	10.55	4.01	.054
Pr.Rate x Cont.	1	4.38	4.38	1.67	.207
Error	30	78.91	2.63		
Respon X Context	2	49.22	24.61	3.66	.032
Pr.R. x Res. x C	2	5.51	2.76	.41	.665
Error	60	402.94	6.72		

Table 36: Experiment 7

Summary of Analysis of Variance of Hit Rates for Trials (1 vs. 3 trials), Presentation Rate (5sec vs. 700msec.), and Context (Congruent vs. Incongruent)

Source	df	SS	MS	F	p
Remember					
Trials	1	2000.2	2000.2	68.79	.000
Presentation Rat	1	351.1	351.1	12.08	.001
Trials x Present	1	98.0	98.0	3.37	.071
Error	60	1744.5	29.0		
Context	1	81.28	81.28	11.61	.001
Trials x Context	1	2.53	2.53	.36	.550
Pr.Rate x Cont.	1	6.13	6.13	.87	.353
Trial x Pr x Con	1	8.00	8.00	1.14	.289
Error	60	420.06	7.00		
Know					
Trials	1	1.12	1.12	.12	.734
Presentation Rat	1	42.78	42.78	4.45	.039
Trials x Present	1	1.53	1.53	.16	.691
Error	60	577.44	9.62		
Context	1	.28	.28	.08	.774
Trials x Context	1	.28	.28	.08	.774
Pr.Rate x Cont.	1	1.12	1.12	.33	.566
Trial x Pr x Con	1	2.00	2.00	.59	.444
Error	60	202.31	3.37		
Guess					
Trials	1	37.20	37.20	9.82	.003
Presentation Rat	1	3.45	3.45	.91	.344
Trials x Present	1	15.82	15.82	4.18	.045
Error	60	227.22	3.79		
Context	1	.07	.07	.04	.851
Trials x Context	1	5.70	5.70	2.90	.094
Pr.Rate x Cont.	1	8.51	8.51	4.33	.042
Trial x Pr x Con	1	2.26	2.26	1.15	.288
Error	60	117.97	1.97		

Table 37: Experiment 7

Summary of Analysis of Variance of A′ Estimates for Presentation Rate (5sec vs. 700msec), Context (Congruent vs. Incongruent) and Performance (Remember vs. Remember + Know)

Source	df	SS	MS	F	p
Presentat. Rate	1	.06	.06	.64	.431
Error	30	2.92	.10		
Performance	1	.00	.00	.48	.496
Pr.Rate x Perfor	1	.00	.00	1.43	.241
Error	30	.04	.00		
Context	1	.01	.01	.78	.386
Pr.Rate x Cont.	1	.01	.01	1.06	.313
Error	30	.35	.01		
Perfo. X Context	1	.00	.00	1.97	.170
Pr.R. x Per. x C	1	.00	.00	.06	.809
Error	30	.03	.00		

Table 38: Experiment 8

Summary of One Way Analyses of Variance of Hit Rates for Presentation Rate (5sec vs. 700msec)

Source	df	SS	MS	F	p
Remember					
Between Groups	1	684.5	684.5	6.42	.0167
Within Groups	30	3197.3	106.5		
Total	31	3881.8			
Know					
Between Groups	1	98.0	98.0	1.56	.2200
Within Groups	30	1873.8	62.4		
Total	31	1971.8			
Guess					
Between Groups	1	132.0	132.03	4.33	.0460
Within Groups	30	914.1	30.47		
Total	31	1046.2			

Table 39: Experiment 8

Summary of One Way Analyses of Variance of False Alarm Rates for Presentation Rate (5sec vs. 700msec)

Source	df	SS	MS	F	p
Remember					
Between Groups	1	15.12	15.12	.78	.38
Within Groups	30	579.75	19.32		
Total	31	594.87			
Know					
Between Groups	1	26.28	26.28	2.00	.16
Within Groups	30	393.43	13.11		
Total	31	419.71			
Guess					
Between Groups	1	12.5	12.5	.22	.64
Within Groups	30	1694.3	56.4		
Total	31	1706.8			

Table 40: Experiment 8

Summary of Two Way Analysis of Variance of Know Responses for Hit vs. False Alarm Rates and Presentation Rate (5sec. and 700msec.)

Source	df	SS	MS	F	p
Know					
Present. Rate	1	112.8	112.8	2.16	.152
Error	30	1565.5	52.1		
Response	1	236.39	236.39	10.11	.003
Pr. Rate x Resp.	1	11.39	11.39	.49	.491
Error	30	701.72	23.39		

Table 41: Experiment 8

Summary of Analysis of Variance of A′ Estimates for Presentation Rate (5sec vs. 700msec) and Performance (Remember vs. Remember + Know)

Source	df	SS	MS	F	p
Presentat. Rate	1	.17	.17	12.43	.001
Error	30	.41	.01		
Performance	1	.00	.00	1.14	.294
Pr.Rate x Perfor	1	.00	.00	.05	.832
Error	30	.04	.00		

APPENDIX B

Materials used for Study and Test Conditions across Experiments 1-8

Materials used for Practice and Buffer Items for Experiments 2,3,6,7,8