Unconscious Influences on Behaviour:

The Advantage of Guessing Consciously Irretrievable Information.

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A thesis submitted as a partial requirement for the degree of

Master of Psychology (Clinical).

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December 1994.

Statement

This thesis contains no material which has been accepted for the award of any degree or diploma in any university, nor any material previously published or written by another person, except where due reference to such material is made in the text.

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Acknowledgments

I wish to acknowledge the supervisory support given on an ongoing basis by Dr Brian Mackenzie. Gratitude is also extended to the workshop staff for technical and other support and to James Alexander, Dr Allison Bowling, and Toby Croft for valued feedback. Without ongoing peer support, this project would have been considerably more difficult, and I wish to acknowledge in particular the peer support of Toby Croft, Maryanne Davis, and Rosemary Dobber. Finally, and most importantly, I wish to thank my wife Chris for her selfless and constant encouragement.

Abstract

A useful paradigm for investigating unconscious influences on performance derives from the study of explicit (conscious) and implicit (unconscious) memory, however direct and indirect tests used to measure these constructs are seldom process pure, and it is problematic to make firm conclusions about unconscious influences on the basis of these tests alone. Consequently, various methodologies for separating out the respective influence of unconscious processes have been devised. Two experiments are reported which employed a levels of processing (LOP) approach to manipulate encoding level at study and a unique method for accessing the effect of unconscious influences on direct test performance by analysing the correctness of responses reported as "guessed." Experiment 1 (n = 12) employed a direct (cued recall) test and was a preliminary attempt to establish the validity of the "analysis of guessing" methodology. Experiment 2 (n = 36) employed comparable direct (cued recall) and indirect (stem completion) tests and investigated unconscious influences in a more rigorous manner by obtaining confidence ratings of recollection on a 5-point scale and accepting only zero ratings as reliably guessed. Analysis of correctly guessed responses showed that guessing stems of nonsemantically processed words enhanced direct test performance whereas guessing stems of semantically processed words had no affect on performance. Results are discussed in terms of subjects' unwitting resourcefulness at being able to "retrieve" words they cannot explicitly remember, and the advantage offered by the analysis of guessing methodology over and above alternate methods for measuring unconscious influences.

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Chapter 1: Introduction

Respectability of unconscious processes as a topic for psychological research

Historically, the respectability of *unconscious mental processes* as a topic for psychological investigation has waxed and waned. The concept is well-grounded in psychodynamic theorising and, as such, prospered during the early part of this century, only to be all but banished during the full flight of behaviourism in the 1950's (Greenwald, 1992; Hilgard, 1992). However, it is exceedingly difficult to argue convincingly against the existence of mental processes of which we are not aware. Strong anecdotal evidence has existed for several thousand years (Whyte, 1960), some stemming from the very beginnings of civilisation (Margetts, 1953, cited in Whyte, 1960). Moreover, unconscious processes or influences are *implicitly* considered "a general metatheoretical assumption of almost all of contemporary cognitive psychology" (p. 796, Lewicki, Hill, & Czyzewska, 1992). In general, however, researchers have been reluctant to make these metatheoretical assumptions explicit, and the study of unconscious influences in the information processing sequence has consequently suffered considerable neglect.

The last decade, however, has witnessed a gradual ascendance of unconscious processes as a respectable and valid research topic, especially within the fields of information processing, cognitive psychology, cognitive neuropsychology, and linguistics (Reber, 1985). This change is largely due to the cumulative effects of a few innovative and momentous research efforts that have taken place within the last 50 years.

Historical context of contemporary research

The orientation toward unconscious processes this century has had a predominantly psychoanalytic flavour, the historic development of which has been extensively detailed by White (1960) and Ellenberger (1970). Freud freely adopted the metaphor of Fechner and compared the psyche to an iceberg, the underwater (unconscious) portion of which comprised a storehouse of urges, needs, wishes, repressed ideas, and other vital forces which exercised supreme control over all (conscious) behaviour (Hall & Lindzey, 1957). Thus, for Freud, the unconscious, having central importance in the life of the individual, simply should not be omitted from any complete psychology.

Non-Freudian twentieth century efforts at investigating unconscious processes have been described by Greenwald (1992) as a series of "New Looks" (see also Erdelyi, 1974). New Look 1 originated with the early work of Bruner and Postman (e.g., Bruner & Postman, 1947) which itself had little to do with distinctions between conscious and unconscious processes. The relevance of this work was that it experimentally addressed perception from a constructivist standpoint by arguing against the positivist notion of "pure perception," or a one to one mapping of reality, in favour of the Bartlettian view that perception is constructed out of available resources (e.g., memory, experience, interests, attitudes, and other motivations, Bruner, 1992). Although the influence of New Look 1 was substantial, it was also remarkably short lived (Greenwald, 1992).

New Look 2, according to Greenwald's (1992) formulation, began with the work of Erdelyi (1974) which associated theoretically the psychodynamic unconscious with cognitive psychology. According to Erdelyi (1992), all constructivist viewpoints (Bartlettian, Freudian, or those of Bruner and Postman) are *dynamic* and hence *psychodynamic* theories. However, Erdelyi (1992) also argued that current investigations of unconscious processes need not logically be connected with psychodynamic formulations and called for some separation between the two.

Greenwald (1992) considers that current interest in unconscious processes qualifies as New Look 3, characterised by its abandonment of the psychodynamically oriented flavour of earlier New Looks for its focus on far simpler "cognitively less sophisticated" (p. 766) events. Greenwald (1992) argued that the time has come to accept that the study of unconscious processes qualifies as respectable mainstream psychology. Moreover, Kihlstrom, Barnhardt, and Tataryn (1992) consider that "after 100 years of neglect, suspicion, and frustration, unconscious processes have now taken a firm hold on the collective mind of psychologists" (p. 788).

Plan of study

This study aims to investigate the influence of unconscious processes on the performance of a cued recall (direct) memory test. Chapters 1 to 5 comprise the literature review and Chapters 6 to 8 comprise the experimental investigation and discussion of hypotheses which stem from the literature review. A brief plan of each chapter follows.

Chapter 2 reviews literature on issues of significance for the measurement of unconscious influences, and establishes the conceptual importance of direct versus indirect tests, explicit versus implicit memory, and the utility of the memory dissociation approach. The validity of dissociation research and research on the measurement of unconscious influences is compromised, however, if memory tasks thought to reveal unconscious influences are not themselves process measures. The issue of process purity is explicitly addressed in Chapter 3 by distinguishing memory *tasks* from memory *processes*, and a review or relevant research establishes that performance on direct and indirect tests of memory is influenced by *both* conscious and unconscious processes.

One important unconscious influence on direct test performance may occur when subjects *guess* the responses they cannot explicitly remember, and Chapter 4 reviews current approaches for separating conscious and unconscious influences and their utility for exploring this "informed guessing" hypothesis. In Chapter 5, an alternate approach to the measurement of unconscious influences on direct test performance is presented which shares some similarities with existing methods but is also unique because it makes minimal assumptions about the relationship between conscious and unconscious processes and because it entails a *direct* analysis of guessed responses. Chapters 6 comprises an experimental investigation into the validity of this "analysis of guessing" method and Chapter 7 explores the utility of this method in a more precise and elaborate manner. Finally, Chapter 8 provides a general discussion of the experimental findings including a discussion of the strengths and limitations of the analysis of guessing method in relation to other contemporary approaches that claim to measure unconscious processes.

Chapter 2: Methods for exploring unconscious influences

The indirect method

The ubiquity of unconscious mental processes (Lewicki et al., 1992) contrasts markedly with our very limited understanding of them. One of the central problems remains their identification and measurement. Part of this difficulty was foretold by Kant (1724-1804, cited in Whyte, 1960) who observed that "only we can be indirectly aware that we have a perception, though at the same time we are not directly aware of it." Lewicki et al., (1992) provided a twentieth century account of this problem: "when researchers attempt to learn *directly* from subjects anything about how . . . judgments or decisions are generated, subjects are usually as helpless as when they are asked to explain how they identify right angles in three dimensional space or recognise patterns. All they know is they just do it" (my italics, p. 797). When researchers employ procedures to investigate a subject's experience that are *indirect*, on the other hand, more fruitful returns are often made. This is consistent with Marcel's (1983) claim that "the most effective way to investigate unconscious representations is to look at their *influence* rather than to require subjects to utilize the representations selectively" (my italics, p. 217).

Although cognitive psychologists have tended to distance themselves from psychoanalytic formulations of unconscious mental processes (Erdelyi, 1992; Greenwald, 1992), conceptually similar *indirect* procedures are used to investigate unconscious processes by both camps (Jacoby, Lindsay, & Toth, 1992). Because subjects cannot directly report unconscious material, psychoanalysts were among the first to devise strategies in an attempt to "trick" a person into revealing this information. Such was the aim of various projective techniques or devices which encouraged patients to "respond in an unrestricted manner to unstructured or ambiguous objects or situations" (p. 581, Reber, 1985). Ambiguous images like those from Rorschach's ink blot arrays (Rorschach, 1921/1963) are thought to encourage unconscious projection in terms of one's own (concealed) desires, expectancies, and motives. Jacoby et al. (1992) have drawn clear parallels between projective techniques such as the Rorschach and more recent indirect investigations of unconscious processes (see Jacoby, Allan, Collins, & Larwill, 1988). Thus, the rationale for using projective methods appears to lie in their "indirectness;" these approaches reveal unconscious information indirectly which is otherwise not consciously reportable (Jacoby et al., 1992).

Direct and indirect tests of memory

The direct/indirect distinction has had its most substantial influence in the study of conscious and unconscious forms of *memory* (see Hintzman, 1990; Reingold & Merikle, 1990; Richardson-Klavehn & Bjork, 1988). Direct tests *directly* enquire about what memories are retained by, for example, asking subjects to recall or otherwise explicitly remember prestudied material. Tests of free recall, cued recall, and recognition are therefore held to be direct tests of memory. Indirect tests, on the other hand, enquire indirectly about what memories are retained by ensuring that retention is assessed as an incidental feature of a task that ostensibly measures either something else or nothing at all (Young & De Haan, 1992). For example, subjects might be instructed to complete three letter stems of previously presented target words with the first word that comes to mind under the guise that they are generating normative data. Importantly, the distinction between a direct and indirect test of memory is usually made on the basis of task instructions alone (Graf, Squire, & Mandler, 1984; Merikle & Reingold, 1991). That is, direct test instructions emphasise a strong association between study and test but indirect test instructions do not. In order to discuss the types of cognitive processes underlying performance on direct and indirect tests of memory, it is important to address the conceptual distinction between *implicit* and *explicit* memory which represents the most substantive and successful paradigm this century for studying unconscious processes.

Explicit and implicit memory

Pivotal in the study of unconscious processes has been the substantial change in the direction of memory research in the last 15 years, typified by the conceptual distinction between explicit and implicit memory (Graf & Schacter, 1985; Schacter, 1987). This paradigm had its origins in the 1960's and early 1970's with the work of Milner (1966) and Warrington and Weiskrantz, (1970, see Shimamura, 1986, for a review) who studied memory in clinical (anterograde amnesic) populations. This early research distinguished between a type of declarative memory which utilised the conscious record of an event and a type of nondeclarative memory which apparently did not require a conscious record (Kandel & Hawkins, 1992).

Explicit memory is typically tested by a direct test which instructs subjects to explicitly remember items from a list of previously studied words or objects.

Successful performance is thought to require the intentional or *conscious* recollection of the previous study episode and its contents. Most memory research this century has utilised the explicit approach via direct tests (Schacter, Chiu, & Ochsner, 1993). Implicit memory, by contrast, is tested *incidentally* and indirectly by looking for savings in or the facilitation of indirect test performance usually following a study episode. Importantly, a subject is not required to explicitly remember, and may even be unable to recall anything whatsoever about the study episode and its contents. Thus, implicit memory effects have been reported for subjects presented with study items during sleep (Wood, Bootzin, Kihlstrom, & Schacter, 1992), whilst surgically anaesthetised (Kihlstrom, Schacter, Cork, Hurt, & Behr, 1990), and even during one phase of the alter ego in patients with multiple personality disorder, when tested in another phase (Schacter & Kihlstrom, 1989, cited in Kihlstrom et al., 1992). Therefore, implicit memory performance is thought to reveal unintentional or *unconscious* influences with little or no conscious involvement.

Several types of implicit memory phenomena have been reported in the literature for both neurologically impaired and normal populations. Among impaired populations, implicit memory has been demonstrated for subjects with anterograde amnesia, aphasia, blindsight, dyslexia, hemineglect, and prosopagnosia (see Schacter, McAndrews, & Moscovitch, 1988; Milner & Rugg, 1992). Among normal populations, by far the most thoroughly investigated type of implicit memory is that of repetition or direct *priming* in which the presentation of study or target items facilitates their later identification when degraded perceptual cues are provided with indirect instructions at test

(Schacter et al., 1993). Most research on priming has used visually presented verbal material as stimuli (e.g., Jacoby & Dallas, 1981), although priming effects with nonverbal material (e.g., Warrington & Weiskrantz, 1970) and auditory material (e.g., Eich, 1984) have also been extensively investigated (see Schacter, 1987; Schacter et al., 1993 for reviews). Some of the most common verbal indirect tests for assessing implicit memory by priming include stem completion (e.g., Graf & Mandler, 1984), fragment completion (e.g., Roediger, Weldon, Stadler, & Riegler, 1992), perceptual identification (e.g., Hashtroudi, Ferguson, Rappold, & Chrosniak, 1988), and lexical decision (e.g., Moscovitch, 1982).

In the stem completion task, which is the method for assessing unconscious or implicit memory in the present study, the first three letters of prestudied words are presented at test and subjects are required to complete the word stem with the first fitting word that comes to mind. Thus, for presentation of the word "CASTLE" at study, implicit memory in the form of priming would be indicated if, after presentation of the stem "CAS___" at test with indirect instructions, correct completion performance was significantly better than chance. Chance level performance is estimated as the proportion of word stems belonging to a distractor list, which is not shown to subjects at study, that are also "correctly" completed by chance alone.

In the present study, the direct/indirect distinction will be exclusively adopted to describe memory tests, whereas the terms implicit (unconscious) and explicit (conscious) will be reserved for describing memory procedures or processes that are intended to be evoked by direct and indirect tests.

The dissociation approach

Extensive investigation of implicit and explicit memory over the last decade has revealed many empirical dissociations between performance on direct and indirect tests. In the words of Olton (1989), "dissociations to the memory researcher are what fruit flies are to the geneticist: a convenient medium through which the phenomena and processes of interest can be explored and elucidated" (p. 161). Consequently, much explanatory theorising and speculation has arisen in an attempt to explain functional dissociations in terms of different underlying processes and/or different neurological memory systems (see Richardson-Klavehn & Bjork, 1988; Roediger, 1990; Roediger & McDermott, 1993; Schacter, 1987; Schacter et al., 1993; Shimamura, 1986).

In memory research, at least five categories of information have provided evidence for dissociations (cf. Hashtroudi, et al., 1988): (i) evidence that performance on indirect tests may be statistically (stochastically) independent of performance on direct tests (e.g., Tulving, Schacter, & Stark, 1982, but see Greene, 1986 for a negative finding), (ii) clinical evidence that amnesic subjects and other neurologically or psychiatrically impaired subjects exhibit preserved indirect test performance but severely compromised direct test performance (see Schacter & Kihlstrom, 1989; Schacter, McAndrews, & Moscovitch, 1988; Shimamura, 1986), (iii) evidence that drugs (e.g., diazepam) have differential effects on indirect and direct test performance (e.g., Danion, Zimmermann, Willard-Schroeder, Grange, Welsch, Imbs, & Singer, 1990), (iv) evidence that direct and indirect test performance is associated with different patterns of event-related-potentials (see Squire, Knowlton & Musen, 1993), and (v) evidence that specific experimental manipulations have differential effects on indirect and direct test performance (see Richardson-Klavehn & Bjork, 1988). It is this latter category which is of interest in the present study.

Levels of processing

One well-established experimental manipulation for dissociating performance on direct and indirect tests involves depth or level of processing (LOP) or encoding of target material at study. Craik and Lockhart (1972; Craik & Tulving, 1975) were the first to show the now ubiquitous effect that deep or semantic processing at study (e.g., rating meaningfulness, likability, or pleasantness of words) elicits considerably higher performance on direct tests than does shallow, physical, or nonsemantic processing (e.g., determining case, counting vowels, or enclosed spaces in words). In contrast to this finding for explicit memory, however, it is now clear that LOP manipulations tend to have little or no effect on indirect test performance (e.g., Bowers & Schacter, 1990; Graf & Mandler, 1984; Graf & Ryan, 1990; Hashtroudi et al., 1988; Roediger et al., 1992; Schacter & McGlynn, 1989), although Challis and Brodbeck (1992) have shown that this is not always the case. (This issue is elaborated further in the introduction to Experiment 2.)

LOP manipulations share conceptual similarity with other systematic approaches used to vary encoding level or intensity, such as dividing attention (e.g., Merikle & Reingold, 1991; Jacoby et al., 1993). Minimal processing at study and (indirect) instructions that do not draw an association between study and test phases are conducive to minimising conscious retrieval processes and maximising the contribution of implicit or unconscious processes (Merikle & Reingold, 1991). Conversely, semantic or deep processing at study and (direct) instructions that draw an explicit association between study and test are conducive to maximising the contribution of explicit or conscious processes (Craik and Lockhart, 1972; Craik & Tulving, 1975). Because LOP manipulations at study are useful for exploring dissociations between direct and indirect test performances, the LOP approach will also be employed in the present study.

Chapter 3: Memory tasks versus memory processes

The heuristic value of the dissociation approach is compromised if tasks used to argue for dissociation effects are not themselves process or factor pure measures (Jacoby, 1991). This is because the dissociation approach, as it applies to implicit memory, is implicitly grounded on the assumption that the processes indexed by each test are uniform and independent from each other. The issue of process purity also has important implications for the measurement of component processes because with process impure tests we cannot simply assume that direct tests *exclusively* evoke conscious processes and that indirect tests *exclusively* evoke unconscious processes (Jacoby, 1991; Jacoby, Lindsay, & Toth, 1992; Jacoby, Toth, & Yonelinas, 1993; Joordens & Merikle, 1993; Merikle & Reingold, 1991; Nelson, Schreiber, & McEvoy, 1992; Richardson-Klavehn & Bjork, 1988). This section distinguishes memory tasks from memory processes and reviews evidence for the process impurity of *both* direct and indirect test performance. Because, however, unconscious influences on direct test performance is the primary focus of the present study, most attention will be given to discussing the component processes of direct tests.

Conscious influences on indirect test performance

A substantial criticism leveled at the study of unconscious processes is that we can never be quite certain that subjects have no awareness of the events designated by researchers as unconscious (Eriksen, 1960; Holender, 1986). Because target stimuli in implicit memory studies are presented for durations that would normally permit clear conscious identification, should a subject's attention be directed toward them, it is a reasonable hypothesis that conscious processes may contribute somewhat to overall performance. That is, complete conscious identification (Holender, 1986) or partial identification based on partial cues (Eriksen, 1960) may indeed "contaminate" indirect test performance and artificially inflate any estimate of unconscious influences.

In support of this view, several researchers have either theoretically or empirically shown that indirect test performance is sometimes influenced by intentional retrieval strategies (see Jacoby, 1991; Light & Singh, 1987; Reingold & Merikle, 1990; Richardson-Klavehn & Bjork, 1988; Schacter, Bowers, & Booker, 1989). Schacter et al. (1989), for example, used a LOP approach to investigate the degree to which performance on an indirect test was contaminated by conscious processes. These authors reported that when subjects remained ignorant of the study-test relationship or where subjects were told prior to test that some word stems could be completed with study words but to respond with the first word that came to mind anyway, no LOP effect was obtained. Thus, these subjects apparently did precisely what they were instructed to do. However, for subjects who "caught on" to the design of the experiment, a significant LOP effect *was* found, with performance following semantic processing better than performance following nonsemantic processing. Schacter et al. (1989) argued that better performance on an indirect test following semantic processing, which we know enhances intentional recall (Craik & Lockhart, 1972; Craik & Tulving, 1975), provides evidence for the surreptitious use of conscious retrieval processes. This logic has come to be known as the "retrieval intentionality criterion" which, if valid, provides some basis for judging the process purity of an indirect test (Schacter et al., 1989).

Unconscious influences on direct test performance

Although direct test performance is traditionally thought to demand predominantly effortful conscious processes, recent evidence attests to the marked process impurity direct tests (Jacoby, 1991; Jacoby et al., 1992, 1993; Joordens & Merikle, 1993; Nelson, et al., 1992). Research on recognition memory, for example, a commonly used direct memory test (Richardson-Klavehn & Bjork, 1988; Schacter, 1987), supports this viewpoint. Mandler, Pearlstone, and Koopmans (1969, see also Juola, Fischler, Wood, & Atkinson, 1971; Mandler, 1980) have convincingly demonstrated that a recognition judgment is the conjoint result of dual processes: unconscious phenomenal familiarity on the one hand and conscious retrieval processes on the other. Furthermore, the experimental design of most direct tests is such that both conscious and unconscious influences may operate in the same direction enabling an overall facilitation of performance by both types of processing (Jacoby et al., 1992).

From an evolutionary perspective, it makes sense to expect that *all* task relevant resources are pooled and implemented when making a response, some of which may be conscious and some of which may not be. Thus, unconscious resources may be indexed by feelings of familiarity about prestudied material (e.g., Mandler, 1990) or be demonstrated where subjects simply guess responses they cannot explicitly remember (e.g., Jacoby et al., 1992; Merikle & Reingold, 1991). If we rigorously define a guessed response as a response made when *no* conscious information is available to guide responding, then guessing can be said to reveal unconscious influences on overall performance when guessing leads to significantly better than chance responding. This type of responding is not random as the term *guessing* may imply, but is in some sense *unconsciously guided* such that responses give the appearance of being *informed.* Investigating the role of "informed guessing" on direct test performance is important because it addresses (i) the issue of the process purity of direct tests and (ii) the unwitting resourcefulness of subjects at being able to "retrieve" words they cannot explicitly remember.

Converging evidence from studies of subliminal perception, which is in many ways comparable to implicit memory (Kihlstrom, 1987), is consistent with the view that guessing is a kind of indirect test for information rendered subliminal (Dixon, 1971; see also Jacoby & Hollingshead, 1990). Indeed, instructions to guess defined the earliest subliminal perception test (Sidis, 1898), and several other subliminal perception studies involving guessing have demonstrated similar findings (see Dixon, 1971) . More direct evidence comes from a recent study by Gabrieli, Milberg, Keane, and Corkin (1990) which showed that cued recall performance for the densely amnesic subject H.M. was, in fact, *better* than for normal control subjects (33.3% versus 23.5%, respectively). Because anterograde amnesics cannot explicitly remember study items and have to guess all of their responses, this result shows that when no conscious information is available to guide explicit retrieval and subjects guess, a direct test can become a sensitive indirect measure of unconscious processes.

Nonsemantically processed information also leads to poor explicit recollection for normal subjects (Craik & Tulving, 1975) which Graf, Mandler, and Haden. (1982) have argued "mirrors" anterograde amnesia (p. 1244). Thus, one might also expect informed guessing to contribute substantially to cued recall of nonsemantically processed information in normal subjects. Graf, Squire, and Mandler (1984, Experiment 3) compared amnesic and amnesic control subjects for cued recall performance and reported no difference for nonsemantically processed words (39.6% versus 39.9%, respectively) but a small difference for semantically processed words (57.7% versus 69.0%, respectively). This result is consistent with the view that similar amounts of informed guessing *may* be employed by both amnesic and normal subjects, at least for completions of nonsemantically processed words. By in large, however, the effect of LOP at study on informed guessing for normal subjects remains an open question which warrants investigation. Clearly, amnesics do benefit from unconscious informed guessing of both semantically and nonsemantically processed information, but the influence of unconscious processes on direct test performance for normal subjects is complicated because we do not know which responses subjects guess and which responses they remember. It is the empirical separation of conscious and unconscious processes on direct test performance which is the focus of the following chapter.

Chapter 4: Methods for measuring unconscious influences

If the study of unconscious influences is to progress, either process pure tests need to be devised or appropriate methods for assessing the differential contribution of conscious and unconscious influences on performance need to be implemented. This section reviews current approaches for their utility in separating the respective influence of conscious and unconscious processes on direct test performance.

Jacoby's (1991) process dissociation framework

One stream of research by Jacoby and colleagues (e.g., Jacoby, 1991; Jacoby et al., 1992, 1993) has made use of a *process dissociation framework* with *inclusion* and *exclusion* tests for separating out the respective influence of both conscious and unconscious influences on memory performance. Exclusion tests are those which place conscious and unconscious influences in opposition. Thus, subjects in the exclusion condition are generally instructed to respond with the first word that comes to mind, but to exclude words they remember being previously shown. The rationale for this test is that it excludes any conscious influences on performance, leaving an ostensibly process pure measure of unconscious influences. Inclusion tasks, in contrast, are normal direct tests which place conscious and unconscious influences in concert. Subjects in an inclusion test condition are generally instructed to try to remember words, but to write the first word that comes to mind if they cannot remember. The rationale for this test is that overall performance is facilitated by *both* conscious and unconscious influences.

The theory behind the process dissociation framework has led to the derivation of some simple equations to describe memory performance in terms of conscious (*C*) and unconscious (*U*) influences. Thus, Jacoby (1991) argued that the probability of a correct inclusion or direct test response is the sum of the proportion of trials involving a conscious influence and the proportion of trials involving an unconscious influence, minus the proportion of trials on which both conscious and unconscious processes occur:

$$Inclusion = C + U - (U + C) \quad \text{(a)}$$

Similarly, exclusion performance is considered to reflect the proportion of trials on which there is an unconscious influence minus the proportion of trials on which both conscious and unconscious influences occur:

$$Exclusion = U - (U + C) \quad \text{(b)}$$

By solving simultaneous equations, it is then possible to calculate the influence of unconscious processes on direct test performance.

Although these equations have obvious outward appeal, there are disadvantages, in using them for this purpose. One general criticism is that the process dissociation framework assumes independence between conscious and unconscious processes when there are, in fact, an infinite number of ways to describe this relationship, ranging from complete independence to complete dependence, and no basis for rejecting one method over another (Joordens & Merikle, 1993). For example, Joordens and Merikle (1993) have provided an equally tenable set of equations which assume *complete overlap* between conscious and unconscious processes. A related but more specific criticism, however, is that the process dissociation approach implies that a subject's recollective experience is either entirely present or entirely absent. That is, subjects are forced to make a dichotomous yes/no choice about recollection in the exclusion condition, from which unconscious influences in the direct test condition are calculated. An alternative approach might seek confidence ratings from subjects about their recollective experience and then adopt either a conservative or stringent criterion for accepting responses as remembered or not remembered.

Gardiner's (1988) "know-remember" approach

Another approach that has attempted to investigate unconscious influences on direct test performance was demonstrated by Gardiner (1988) who manipulated LOP at study and used recognition as the direct test. In this study, subjects were required, firstly, to indicate which study words they recognised, and then to indicate which of these words they remembered the appearance of in the study list ("R" words) and which they did not remember the appearance of but nonetheless recognised or knew by some other means ("K" words). The critical result reported by Gardiner (1988) was a dissociation between R and K words as a function of LOP. Gardiner (1988) then drew parallels between R words and explicit processes, on the one hand, and K words and implicit processes, on the other. Thus, Gardiner (1988) interpreted these results as revealing the influence of *both* implicit and explicit processes on direct test performance.

It is important to note, however, that Gardiner's (1988) study addressed *recognition* memory which, as previously discussed, is now well-known to involve *both* conscious and unconscious influences (Mandler, 1980; Mandler et al., 1969; Juola et al, 1971). Unconscious influences on recall memory (the focus of the present research) is a considerably more interesting finding because recall has not traditionally been thought of as involving dual processes in the same way that recognition has. In addition, Gardiner's (1988) conclusion that "R" words correspond to explicit processes and "K" words correspond to implicit processes may not be warranted. Although "R" words may stem from episodic memory and hence reflect explicit or conscious processes, the argued nonepisodic nature of "K" words does not imply their recognition was not also based on explicit processes. The strength of this argument rests on the validity of classifying "K" words as nonepisodic, yet in this experiment both "R" *and* "K" words were first recognised before being classified as such. It is problematic to draw conclusions about the influence of implicit or unconscious processes without ensuring that conscious influences are completely absent (cf. Schacter et al., 1989). As with the process dissociation approach, a confidence rating scale of explicit recollection may also have been useful here.

Nelson, Schreiber, and McEvoy's (1992) PIER model

Nelson et al. (1992) defined implicit memories as "preexisting memories acquired before the laboratory task in the hundreds of experiences that people have with the same stimulus in different contexts" (p. 322). These authors consider that these memories qualify as implicit because "subjects are typically unaware of their activation during encoding and retrieval and because they are unaware of the effects that these memories have on their performance" (p. 323). Nelson et al. (1992) investigated the involvement of implicit processes in direct tests by manipulating target and test-cue set size. Set size refers to the number of associates which, as a result of experience, are linked to a particular stimulus. Set size effects are observed when differences in memory performance are found for large versus small target or cue stimulus sets. Generally, the larger the target or cue set size, and hence the more preexisting associates, the lower the probability of recall, and conversely, the smaller the set size, the greater the probability of recall. Fuelled by set size effect findings for (direct) extralist cuing tasks, Nelson et al. (1992) devised a Processing Implicit and Explicit Representations (PIER) model which describes an independent and exclusive parallel relationship between implicit and explicit processes in cued recall.

An interesting feature of the PIER model is that it predicts that the magnitude of unconscious influences on direct tests should systematically vary with instructions that emphasise use of one or both parallel pathways. In one experiment (Experiment 4), Nelson et al. (1992) showed that when subjects had to explicitly remember words and guess those they could not remember (both explicit and implicit pathways) overall performance was higher than when subjects were instructed to be very sure their responses were correct and not to guess (explicit pathway only).

Nelson et al.'s (1992) model provides a neat way to conceptualise how unconscious processes, such as those perhaps utilised when guessing, contribute to overall performance on a direct test of memory. This model, however, also assumes that conscious and unconscious processes are independent which, as previously shown, may or may not be founded. The PIER model, in fact, goes one step further by stipulating an independent *and* exclusive relationship between both processes with no overlap (Jacoby et al., 1993). Moreover, in the guessing study referred to above, no check was made on which responses were guessed and which were not guessed to be sure that subjects were guessing more frequently in the guessing condition. In order to lend these results more credibility, an additional analysis of guessed completions would then be required in order to determine the proportion of guessed responses that were also correct.

The validity of subjective measures

A final issue of some significance for the measurement of unconscious influences on direct test performance concerns the validity of accepting a *subjective* report as a reliable index of conscious experience. Although there is now a large body of evidence claiming to demonstrate the existence of unconscious processes, some authors, notably Eriksen (1960) and more recently Holender (1986), have viewed the entire paradigm with suspicion. These authors would consider self report that a stimulus was not consciously remembered as not a sufficiently objective measure with which to validate nonawareness and hence the influence of unconscious processes because there always remains the possibility that aspects of the stimulus were allocated conscious resources, even though subjects may not be able to verbalise this. This reasoning has fuelled the assertion that objective measures constitute the only reliable indicator of unconscious perception (Holender, 1986). This claim poses a substantial problem for research on unconscious processes because of the difficulty in meeting the stringent requirements for defining objectivity. In contradistinction to this point of view, however, Greenwald (1992), after reviewing current research into unconscious processes, reported that objective measures provide no compelling support for the existence of unconscious processes. Moreover, Merikle (1992) stated that "subjective measures are the only class of measures that have consistently led to successful demonstrations of perception without awareness . . . [and that these]. . . measures can provide an adequate indication of the presence or absence of relevant conscious experiences" (p. 793-794). Thus, there is now quite a compelling argument that unless subjective measures are accepted as providing valid evidence for unconscious perception, productive research will cease (Merikle, 1992). Indeed, credible research paradigms like the process dissociation framework not only testify to the reality and measurability of unconscious processes, but also establish that productive research using subjective measures has come a long way. Subjective measures of conscious experience are also made use of in the present study.

Chapter 5: Conclusions from literature review

Summary and conclusion

The literature reviewed above clearly establishes the importance of not taking direct test performance at face value by accepting that it exclusively reflects conscious influences. A reasonable hypothesis is that subjects utilise all resources at their disposal, both conscious *and* unconscious, in meeting task demands, and a few approaches have been devised which have attempted to separate out the respective influence of these two processes. Foremost among these are the process dissociation framework of Jacoby (1991) and the PIER model of (Nelson et al., 1992). However neither approach *directly* investigates the contribution that guessing makes to overall performance. An assumption is sometimes made that guessing does contribute, yet no attempt has been made to analyse the correctness or otherwise of responses designated by subjects as guessed, or to determine how informed guessing may vary as a function of LOP at study. Moreover, where unconscious and conscious processes have been empirically separated (e.g., Jacoby, 1991; Gardiner, 1988), no assessment of subjects' confidence in their recollective experience, which would permit the use of stringent criteria for accepting responses as guesses, has been made. The present experiments were designed to address these limitations and to enquire *directly* about the role that guessing plays in overall performance.

Present experiments

The two experiments reported below aimed to shed further light on the contribution that unconscious processes make to performance on a direct test of memory. There are clear similarities between the process dissociation framework of Jacoby (1991) and Nelson et al.'s (1992) PIER model. The approach taken in this study also shares similarities with these approaches, but differs in the manner in which unconscious processes are measured. In the present study, an estimate of unconscious influences was obtained *directly* by determining the proportion of words correctly completed when conscious recollection was reported as completely absent and subjects had to guess their responses.

For the direct tests in the present study, subjects were asked to try to remember words previously shown, but if they could not remember they were required to make a guess. Subjects were also required to indicate their confidence that each response was a word they remember from the study list. Subjects made use of a dichotomous guess-know rating scale in Experiment 1 and a 5-point confidence rating scale in Experiment 2 to indicate their degree of conscious recollection for each response made. For both studies, words reported by subjects as guessed were examined for correctness in order to determine the extent to which subjects were able to make use of unconscious informed guessing for words they could not explicitly remember.

Chapter 6: Experiment 1

Introduction [1]

The effect of guessing on direct test performance is an important issue that warrants investigation with a number of different methodologies. One might attempt to address the issue of informed guessing directly by asking subjects to refrain from responding if they are unsure of their direct test responses (e.g., Graf & Mandler, 1984; Hashtroudi et al., 1988; Roediger et al., 1992; Weldon, Roediger, & Challis, 1989). This procedure, however, apart from precluding an analysis of the correctness or otherwise of guesses, may also introduce response bias into the data. For example, if subjects are instructed to respond to every stem for an indirect test but are not permitted to guess direct test responses, any dissociation between direct and indirect test performance may simply reflect criterion differences in responding between the two tests rather than to different underlying processes (Merikle & Reingold, 1991).

In the two experiments which follow, direct test responses labelled by subjects as not remembered and guessed were analysed in order to determine the extent to which informed guessing contributes to overall performance, and how this may vary as a function of LOP at study. The approach taken in this study – a direct analysis of guessed direct test completions – has not previously been undertaken. Therefore, Experiment 1 was a preliminary attempt to establish the validity of the "analysis of guessing" methodology and the existence of an informed guessing effect for normal subjects.

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[1] A paper comprising Experiments 1 and 2 was accepted for publication in *Psychological Research* and is currently in press. A copy of this paper is included in Appendix F.

On the basis of the reviewed literature, it was hypothesised, first, that substantially more nonsemantically processed words and distractor words will be rated as guessed than semantically processed words. This hypothesis reflects the usual LOP effect obtained with direct tests, but its investigation will also reveal the advantage (if any) gained by minimal processing over and above no processing in terms of explicit recollection. Second, because it appears that direct test performance for (at least) nonsemantically processed words is ordinarily improved by informed guessing, it was also expected that: (i) performance for nonsemantically processed words will decline after removal of all guessed data, to a level of performance similar to that found in comparable studies where subjects were not permitted to guess (i.e., Graf & Mandler, 1984; Hashtroudi et al., 1988), and (ii) that by directly analysing the proportions of guessed responses that were also correct, a clear informed guessing effect will be revealed for nonsemantically processed words. There was no current basis for predicting an informed guessing effect for semantically processed words, and this issue was explored.

Method

Subjects and design

Twelve subjects aged 17 to 31 (*M* = 20.089, *SD* = 4.730) were recruited. Subjects were first year psychology students from the University of Tasmania who received course credit for participation. The experimental design was completely within subjects with Word Type (semantic, nonsemantic, and distractor) as the only factor.

Materials

Words were obtained from the MRC Psycholinguistic Database (Coltheart, 1981). This database comprises an extensive collection of words and associated normative data on, for example, ratings of frequency of occurrence, familiarity, concreteness, imageability, and meaningfulness for each word. The criteria for selecting words was adopted from Graf and Mandler (1984) such that (i) each word had six letters, (ii) the first three letters of each word uniquely defined that word in the list, (iii) words had a low Kucera-Francis (Kucera & Francis, 1967) frequency of occurrence, and (iv) the three letter stem of each word was shared by at least 10 other dictionary words.

From a pool of 98 words, 72 words were selected with Kucera-Francis frequencies of 14 occurrences per million or less. Sixty words were randomly allocated to one of three lists (List A, List B, or List C) each comprising 20 words, and the remaining 12 words were used as fillers. (Target words are shown in Appendix A.) No significant differences were found between word lists for any of the normative data. An additional list of 10 high Kucera-Francis frequency words were used as practice items. The combination and permutation order of the lists were consistently varied so that each list equally often served as the semantic study list, the nonsemantic study list, and the distractor list, and each list was equally often preceded and followed by different lists.

Words and word stems were presented by an IBM compatible computer on to the computer's monitor. All responses were made on lined study and test forms provided, one response per line.

Procedure

Subjects were tested individually in a sound attenuated room. Subjects were comfortably seated approximately 600 mm from the monitor screen so that stimuli subtended approximately 1.8 degrees of visual angle.

For the study phase, subjects were presented with two consecutive lists of 31 words. Each subject performed a semantic study task on one of the lists and a nonsemantic study task on the other. The order of tasks was counterbalanced across subjects. The first 5 words in each list served as practice items and the next 3 and last 3 words on each list served as filler items to counter primacy and recency effects. Thus, only 20 words on each list served as target words and only the stems of these words and 20 new distractor words were used in the test phase. The temporal sequence of events for the study phase was (i) 500 Hz tone (50 ms), (ii) pause (500 ms), (iii) presentation of study word (3000 ms, Hashtroudi et al., 1988), and (iv) pause (500 ms). Subjects made their response during the 3000 ms word presentation period.

Instructions for the two processing tasks were adapted from Graf and Mandler (1984). The semantic processing task required subjects to rate along a 5-point scale how much they liked the meaning of the word presented. On this scale, "1" equalled "don't like at all" and "5" equalled "like a lot." The nonsemantic processing task required subjects to count the number of enclosed spaces in the letters of the word presented. (Verbatim instructions are shown in Appendix B.) Subjects' responses were examined before they commenced the study task proper to ensure that they were correctly following instructions.

Immediately following the study phase, subject's retention performance was assessed by either a cued recall direct test or stem completion indirect test, depending upon the subject's experimental condition. For each test, the first three letters of the 40 target words and 20 new distractor words were presented randomly interspersed. For the direct test, subjects were required to use these letters as cues to help them recall words from the lists. If subjects had to guess they were required to indicate that they had guessed by placing an asterisk next to their response. For the indirect test, subjects were required to write down the first word they could think of, excluding proper nouns, which began with the letters. (Verbatim instructions are shown in Appendix B.) The temporal sequence of events for the test phase was (i) button press, (ii) pause (500 ms), and (iii) presentation of word stem. The test phase was self paced; subjects completed their response then pressed a button to initiate the next trial.

Results and Discussion

The level of significance adopted for all statistical analyses was $\alpha < .05$. Where variables revealing significant main effects also entered into a significant interaction, only the interaction effect was further analysed. All planned comparisons between means were evaluated with two-tailed t-tests, and all t-tests were matched or paired unless otherwise indicated. (The raw data set for Experiment 1 is shown in Appendix C.)

Table 1.

Mean Proportion of Correct Completions of Each Word Type for the Direct Test of Experiment 1 Before and After Removal of Guessed Data.

	Word Type					
	Semantic		Nonsemantic		Distractor	
Retention Test	Mean	*SD*	Mean	*SD*	Mean	*SD*
Direct						
Correct	.429	.101	.204	.101	.092	.079
Adjusted	.338	.105	.113	.117	--	--
Direct - Guesses *						
Correct	.396	.089	.067	.078	.004	.014
Adjusted	.392	.089	.063	.078	--	--

* Direct – Guesses = Direct test performance after the removal of all guessed responses.

The proportion of correct completions as a function of Word Type (semantic, nonsemantic, and distractor) are presented in Table 1. To compare the direct test results of this study with those from other studies where subjects were *not* permitted to guess their direct test responses (e.g., Graf and Mandler, 1984; Hashtroudi et al., 1988; Roediger et al., 1992), a second condition was created by excluding all guessed data. Data for this new condition is also shown in Table 1.

The proportion of (nonstudied) distractor stems "correctly" completed provides a baseline measure of the proportion of stems correctly completed by chance alone. To adjust for chance, this figure was subtracted from the proportion of correct completions for both semantically and nonsemantically processed words.

As hypothesised, Table 1 shows that after removing guessed data, correct completion drops markedly for nonsemantically processed words but has little effect on semantically processed words. These values closely resemble those from published studies where guessing was not permitted on the direct test (Graf and Mandler, 1984; Hashtroudi et al., 1988). Prior to adjustment for chance, the change for nonsemantically processed words (.204 – .067 = .137) was highly significant [$t(11) = 7.021, p < .0001$], but after chance adjustment, this change (.113 – .063 = .05) did not quite reach significance [$t(11) = 2.002, p = .071$]. Thus, guessing clearly contributes to direct test performance, but differentially as a function of LOP. A closer inspection of this differential effect follows.

Table 2 displays the proportion of responses for each word type that were

Table 2.

<u>Mean Proportion of Completions of Each Word Type on the Direct Test in Experiment 1 That Were Reported as Guessed, and the Proportion of These Completions That Were Also Correct.</u>

	Word Type					
	Semantic		Nonsemantic		Distractor	
	Mean	*SD*	Mean	*SD*	Mean	*SD*
Guessed	.508	.140	.804	.141	.808	.148
Correctly Guessed *	.065	.076	.178	.099	.104	.085

* Proportion of guessed completions that were also correct divided by the proportion of total guessed completions.

guessed as well as the proportion of these responses that were also correct (i.e., correct guesses divided by total guesses). A one-way repeated measures ANOVA on the total proportion of guessed completions revealed a significant effect of Word Type [($F(2,22) = 86.929$, $p < .0001$]. Significantly fewer semantically processed words were guessed than nonsemantically processed words [$t(11) = 11.504$, $p <.0001$] and distractor words [$t(11) = 9.052$, $p < .0001$]. The latter two did not significantly differ from each other [$t(11) = .248$, *ns*]. As hypothesised, this result shows that no advantage was gained for nonsemantic processing over and above no processing in terms of explicit recollection.

For guessed responses that were also correct, a second ANOVA also revealed a significant effect of Word Type [$F(2,22) = 6.343$, $p = .007$]. Although the level of completion of semantically processed words and distractor words did not significantly differ [$t(11) = 1.310$, *ns*], significantly more nonsemantically processed words were completed than either semantically processed words [$t(11) = 3.347$, $p = .007$] or distractor words [$t(11) = 2.238$, $p = .047$]. Thus, when completions were guessed, completions of nonsemantically processed words were more likely to be correct than were completions of semantically processed words or distractor words. As hypothesised, this result establishes that direct test completion of nonsemantically processed words is influenced by unconscious processes. For these words, 17.8% of guessed completions were correct, a figure significantly larger than what would be expected by chance alone (10.4%). In real terms, this amounts to an increase in direct test performance of about 13.7% prior to adjusting for chance correct completions or 5.0% after subtracting for chance. Thus, it appears that subjects can be unwittingly resourceful in completing a task for which no conscious information is available provided that information is minimally processed at study and guessing is permitted at test. Experiment 2 was undertaken to quantify this effect in a more rigorous manner.

Chapter 7: Experiment 2

Introduction

In Experiment 1, study tasks were presented within subjects as two counterbalanced blocks of trials. This is how study tasks are often presented in implicit memory research. Recent work by Challis and Brodbeck (1992), however, has shown that blocked study designs can lead to task-specific or context (e.g., cognitive "set") effects which contribute to LOP dissociation effects. These authors showed that when semantic and nonsemantic tasks were presented blocked within subjects or as a between subjects factor, indirect test performance was better following semantic processing but when tasks were presented mixed within subjects, no LOP effect was found. Challis and Brodbeck (1992), drawing upon the work of Weldon (1991) who reported that lexical processing is essential for priming, suggested that blocked or between subject presentations may discourage complete lexical processing in the nonsemantic condition because subjects may learn to pay little attention to the words as a whole, but only to structural aspects of them. Mixed within subjects designs, on the other hand, because of the unpredictability of the tasks, may encourage more thorough lexical processing prior to additional semantic or nonsemantic processing. In Experiment 2, study tasks were randomly presented within subjects in an effort to determine whether cognitive set effects contributed to the LOP-based informed guessing effects found in Experiment 1.

Experiment 2 also trialed a new 5-point confidence rating scale as a method of obtaining subjective information about which direct test responses were guessed. This rating method was favoured because it permits use of a more stringent criterion for guessing and it may also reduce the likelihood of response bias contributing to dissociation effects (see discussion in introduction to Experiment 1). Reductions in response bias are expected because a rating scale of this type permits subjects the option of indicating the degree to which they are unsure about their responses rather than simply omitting them (as in some previous studies) or dichotomously grouping them (as in Experiment 1).

On the basis of the reviewed literature and the findings from Experiment 1, it was hypothesised, first, that there will be significant priming on the indirect test for both semantically and nonsemantically processed words, and a dissociation between direct test and indirect test performance as a function of LOP. It is important to show these normally obtained results to establish the validity of the data for further analysis of informed guessing effects. Second, it was hypothesised that with a more rigorous experimental design including randomised study tasks and the use of a confidence rating scale, the LOP-based informed guessing effect from Experiment 1 will be replicated. Confirmation of this hypothesis would establish that the informed guessing effect is both reliable and robust. Finally, because thinking of the first word that comes to mind and making a guess are expected to involve similar cognitive processes, it was hypothesised that the level of performance for nonsemantically processed words across retention tests is comparable.

Method

Subjects and design

Thirty six subjects aged 17 to 28 (M = 19.394, SD = 2.065) were recruited.

Subjects were first year psychology students from the University of Tasmania who received course credit for participation. The experimental design conformed to a 3 X 2 mixed format with Word Type (semantic, nonsemantic, and distractor) as a within subjects factor and Retention Test (direct or indirect) as a between subjects factor.

Materials

The materials were the same as for Experiment 1 except for the following modifications: (i) Because the direct and indirect nature of the tests given to subjects rests critically on the instructions supplied (Graf & Mandler, 1984; Merikle & Reingold, 1991; Schacter et al., 1989), all instructions were standardised across subjects by audio cassette administration, and (ii) a 5-point confidence rating scale was used, instead of a dichotomous scale as in Experiment 1, to assess conscious recollective experience.

Procedure

The procedure was also similar to Experiment 1 with the following alterations. A new random allocation of words to lists A, B, and C was undertaken. During the study phase, subjects were presented with 62 words. The first 10 words served as practice items and the next 6 and last 6 words served as filler items. The remaining 40 words comprised two lists of 20 target words each. Only the stems of these target words and 20 new distractor words were used in the test phase. Each subject performed a semantic processing task on one of the lists and a nonsemantic processing task on the other. The order of presentation of the two tasks was counterbalanced across subjects.

Prior to each trial an instructional cue appeared centrally on the screen to indicate which processing task the subject was to perform on the forthcoming study word. For the semantic processing task, the boxed cue "rate likability" appeared on the screen and for the nonsemantic processing task, the boxed cue "count enclosed spaces" appeared. The most appropriate exposure duration for the task cues was selected on the basis of a pilot work. Unlike the blocked and counterbalanced method of presentation of study tasks in Experiment 1, the study tasks in the present experiment were presented randomly. The temporal sequence of events for the study phase was: (i) 500 Hz tone (50 ms), (ii) task cue (4000 ms), (iii) pause (500 ms), (iv) presentation of study word (3000 ms), and (v) pause (500 ms). Subjects made their responses during the 3000 ms presentation time and were alerted to the start of the next trial by the 500 Hz tone.

For the test phase the temporal sequence of events and the presentation of word stems was the same as for Experiment 1. Subjects in the indirect test condition were told to write down the very first word they could think of, excluding proper nouns, which completed the stem. Instructions for the direct test were the same as for Experiment 1 except subjects were instructed to respond to every trial even if they could not remember a word from the list that goes with the stem and, after making their response, to rate along a scale from 0 to 4 to indicate how confident they were that their response *was* a word that they remember. On this scale, 0 equalled "Don't remember at all; a complete guess" and 4 equalled "Clearly remember." (Verbatim instructions are shown in Appendix D.)

Results and Discussion

Priming and dissociation effects

For each word type, the proportion of correct completions and chance adjusted correct completions for direct and indirect tests are shown in Table 3. (The raw data set for Experiment 2 is shown in Appendix E.)

For the indirect test, significantly more semantically processed words [$t(17) = 8.573$, $p < .0001$] and nonsemantically processed words [$t(11) = 6.413$, $p < .0001$] were correctly completed than were distractor words, the completion rate of which represents chance level performance. Thus, as hypothesised, significant priming occurred for both semantically processed words and nonsemantically processed words.

The chance adjusted data was analysed by a 2 (LOP) X 2 (Retention Test) mixed design ANOVA which revealed a significant main effect of LOP [$F(1,34) = 24.161$, $p < .0001$] and Retention Test [$F(1,34) = 7.116$, $p = .012$], and a significant LOP X Retention Test interaction [$F(1,34) = 14.290$, $p = .0006$]. Further analysis of this interaction revealed (i) no significant effect of LOP on the indirect test [$t(17) = .877$, *ns*], (ii) significantly more completions of semantically processed words than nonsemantically processed words on the direct test [$t(17) = 5.702$, $p <.0001$], (iii) significantly more direct test completions than indirect test completions for semantically processed words [$t(34) = 4.669$, p

Table 3.

Mean Proportion of Correct Completions of Each Word Type For Direct and Indirect Tests of Memory in Experiment 2.

	Word Type					
	Semantic		Nonsemantic		Distractor	
Retention Test	Mean	*SD*	Mean	*SD*	Mean	*SD*
Indirect						
Correct	.293	.088	.264	.125	.069	.060
Adjusted	.223	.110	.194	.129	--	--
Direct						
Correct	.473	.126	.253	.106	.081	.055
Adjusted	.393	.128	.172	.098	--	--

< .0001, unmatched *t*-test], and (iv) no significant effect of Retention Test for nonsemantically processed words [$t(34) = .582$, *ns*, unmatched *t*-test].

This analysis confirms the expected dissociation between direct test and indirect test performance as a function of LOP. That is, performance on the indirect test was relatively insensitive to LOP at study whereas direct test performance is highly sensitive to LOP. As hypothesised, this analysis also shows that retaining guessed data leads to a level of performance for nonsemantically processed words that is comparable irrespective of whether a direct test or an indirect test is given. Finally, although the magnitude of direct test performance is somewhat lower in Experiment 1 than in Experiment 2 (compare Tables 1 and 3), the LOP effect for the direct test in each experiment was almost exactly the same (.225 and .221 respectively). That is, as hypothesised, the change in the design of the study phase, from within subjects blocked in Experiment 1 to within subjects random in Experiment 2, did not to alter the pattern of results obtained.

Analysis of confidence ratings

The confidence rating scale permits the categorisation of responses as "guessed" or "remembered" according to different criteria. Because the interest here was in informed guessing hypothesised to take place when *no* conscious information is available to assist retrieval, a stringent criterion was chosen to define a guess. This criterion accepts that only responses rated 0 (i.e., "Don't remember at all; a complete guess") be considered *guessed,* on the basis that a

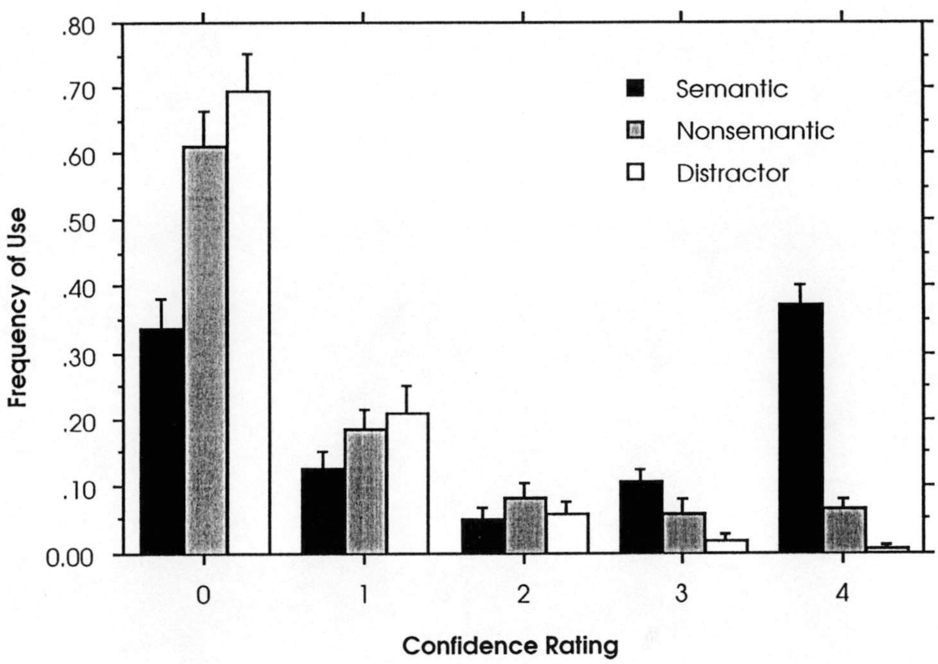

Figure 1. Frequency of use of each confidence rating for direct test completion of semantically processed, nonsemantically processed, and distractor words in Experiment 2. Error bars represent standard errors of the mean.

rating of 1 or more indicates uncertainty or the possible presence of conscious information that may be used to guide retrieval. Conversely, only responses rated 4 (i.e., "Clearly remember") were accepted as *remembered* on the basis that a rating of anything less than 4 indicates uncertainty or familiarity rather than explicit recollection. The pattern of usage of confidence ratings for all completions as a function of Word Type are shown in Figure 1.

Inspection of Figure 1 illustrates that ratings of 0 (i.e., guessed) and ratings of 4 (i.e., remembered) accounted for a large proportion of all ratings made whereas the intermediate or "uncertain" ratings of 1, 2, and 3 were used much less often. The percentage of responses rated either 0 or 4 was 71.5%, 67.8%, and 70.6% (M = 70.0%) for semantically processed, nonsemantically processed, and distractor words, respectively. This clearly represents a nonsignificant effect of Word Type [$F(2,34)$ = .789, *ns*] and establishes that subjects were *equally* confident about their use of extreme ratings (0 and 4) for each word type. That is, there was no bias among subjects toward adopting different response criteria for designating completions for any word type as extreme. This conclusion attests to the validity of comparing each word type for the frequency of use of extreme ratings and the significance ascribed to them in this experiment.

Analysis of guessed data

Table 4 displays the proportion of responses for each word type that were designated as guessed (i.e., correct completions that received a confidence

Table 4.

Mean Proportion of Completions of Each Word Type on the Direct Test in Experiment 2 That Were Reported as Guessed, and the Proportion of These Completions That Were Also Correct.

	Word Type					
	Semantic		Nonsemantic		Distractor	
	Mean	*SD*	Mean	*SD*	Mean	*SD*
Guessed	.339	.176	.611	.229	.698	.230
Correctly Guessed *	.016	.036	.133	.126	.061	.067

* Proportion of guessed completions that were also correct divided by the proportion of total guessed completions.

rating of 0) and the proportion of these responses that were also correct (i.e., correct guesses divided by total guesses).

A one-way repeated measures ANOVA on the guessed data showed a significant effect of Word Type [$F(2,34) = 51.129$, $p < .0001$]. Significantly fewer semantically processed words were guessed than were nonsemantically processed words [$t(17) = 6.092$, $p < .0001$] and distractor words [$t(17) = 10.334$, $p < .0001$], and significantly fewer nonsemantically processed words were guessed than distractor words [$t(17) = 2.879$, $p = .010$]. As hypothesised, this result shows that substantially less information was available to guide retrieval of nonsemantically processed words than for semantically processed words. Comparison of Tables 2 and 4 shows that overall levels of guessing were lower in Experiment 2 than in Experiment 1. This difference, and the finding that some advantage was gained for nonsemantic processing over no processing in terms of explicit recollection of study words in Experiment 2 but not in Experiment 1, probably reflects the differing criteria used to define a guess between the two experiments. The stringent criterion of Experiment 2 excluded ratings of 1 which might conceivably have been grouped as guesses by subjects in Experiment 1, thus leading to an increase in total guessing rates, especially for distractor words which were typically rated 0 or 1 (see Figure 1).

For correctly guessed completions, a final ANOVA revealed a significant effect of Word Type [$F(2,34) = 10.746$, $p = .0002$]. There were significantly more correctly guessed responses of nonsemantically processed words than distractor words [$t(17) = 2.590$, $p = .019$] and significantly more correctly guessed responses of distractor words than semantically processed words [$t(17)$

= 3.192, p = .005]. Moreover, the proportion of correctly guessed semantically processed words was not significantly greater than zero [$t(17)$ = 1.836, *ns*]. As hypothesised, these results replicate the correct guessing results from Experiment 1 in showing that when completions were guessed, completions of nonsemantically processed words were more likely to be correct than completions of semantically processed words or distractor words. This result adds additional weight to the conclusion that overall direct test performance is reliably influenced by unconscious processes. With a larger subject sample and a more stringent criterion for guessing, however, these results also reveal that correct guessing of semantically processed words is substantially worse than chance and no better than zero. Thus, informed guessing does not influence cued recall of semantically processed words at all. The fact that these results, based on random presentation of study tasks, replicate Experiment 1 results, based on counterbalanced blocked presentation, confirms the hypothesis that it is trial-by-trial information that is critical in attaining these informed guessing results rather than any context or cognitive set effects.

A final point to note is that although the confidence rating scale used in Experiment 2 is arguably a more sensitive method for categorising guessed responses than the dichotomous scale of Experiment 1 (i.e., there is less likelihood of contaminating 0 ratings with uncertainty), the results of Experiment 1 are quite consistent with the results of Experiment 2.

Chapter 8: General discussion

Discussion

Although blocked study task designs for indirect tests appear to encourage context or set effects resulting in an increased LOP effect (Challis & Brodbeck, 1992), the present study found that the study task design of the direct test does not appear to affect the size of the LOP effect. The finding that the direct test LOP effect was the same between Experiment 1 and 2 despite different study task designs discourages the view that dissociation and informed guessing effects are due to context or cognitive set effects inherent in processing tasks in general rather than to encoding of item-specific information on each study trial. This finding provides greater confidence that the informed guessing effects discussed further below are both reliable and robust.

Of particular importance to the aims and hypotheses of this study was a close analysis of those direct test responses that subjects guessed. Results from both Experiments 1 and 2 showed that a substantially larger proportion of nonsemantically processed words and distractor words were guessed than were semantically processed words. Consistent with the ubiquitous finding that LOP at study affects direct test performance (Craik and Lockhart, 1972; Craik & Tulving, 1975), this result confirms that considerably more information related to the explicit (conscious) retrievability of words is available following semantic processing than following nonsemantic processing.

Because direct tests were traditionally thought to measure intentional or conscious influences on performance, measurable unconscious influences on direct test performance is, however, a far more interesting finding. A minimal assumption in interpreting evidence for unconscious influences in the present study was that above chance correct guessing on the direct test reflects unconscious influences. The viability of this assumption rests, first, on the validity of accepting a subjective report as reflecting an absence of conscious experience, and second, on the logic of defining a guess as when such an absence of conscious experience occurred at the time of test. With regard to the former issue, literature reviewed earlier clearly established the validity of subjective measures (Greenwald, 1992; Merikle, 1992). Moreover, in terms of the present study, subjective measures were clearly the relevant ones to use because they revealed what was and what was not available to consciousness. In Experiment 1, however, where subjects used a forced-choice dichotomous rating scale to designate guessed responses, there is some question as to whether a guess always conformed to the strict definition of no conscious awareness. With the 5-point confidence rating scale used in Experiment 2, on the other hand, we can be considerably more certain that responses classified as "guessed" reflect a complete absence of conscious experience. With this more stringent criterion, results showed that correct guessing of nonsemantically processed words remained significantly greater than chance level performance, thereby establishing the unequivocal presence of unconscious influences.

The analysis of guessing methodology used in the present study shares similarities with other approaches aimed at separating conscious from unconscious influences within a specific task, but also offers something unique. Both Jacoby's (1991) process dissociation framework and Nelson et al.'s (1992) PIER model make assumptions about the relationship between implicit and explicit processes. The process dissociation approach assumes that implicit and explicit processes are independent of each other, but that there may be some degree of overlap (Jacoby et al., 1993). The PIER model also assumes independence, but proposes a more mutually exclusive relationship between implicit and explicit processes with no overlap (Jacoby et al., 1993). Although this difference between the two models is likely to have little effect on predictions made (Jacoby, 1991), a recent reinterpretation of Jacoby's (1991) framework by Joordens and Merikle (1993), which assumes complete dependence and overlap between implicit and explicit processes, is likely to lead to quite different predictions. The analysis of guessing approach used in this study, in contrast, makes no assumption about the relationship between implicit and explicit processes. It does share a similarity with Jacoby's (1991) exclusion task methodology, however, in that it attempts to eliminate any contribution of explicit processes prior to measuring an implicit or unconscious effect. Explicit processes are eliminated in the exclusion task by asking subjects to exclude responses they remember from the study list and explicit processes were excluded in the present study by using only responses with memory confidence ratings of zero.

The analysis of guessing approach shares additional similarities with the process dissociation framework and Gardiner's (1988) "know-remember" approach inasmuch as data derived from each approach comprises subjective estimates of recollective experience. Almost all memory studies measure subjective data, but subjective data is a particularly salient feature of the design of the present study and the study of Gardiner (1988). In both studies, subjects were asked to make decisions about the strength or salience of subjective events based on criteria set by task instructions. Gardiner (1988) required subjects to discern whether their conscious recollections could be categorised as episodic or nonepisodic. In the present study, subjects were required to discern whether their recollective experience was strong, weak, or absent. Presumably a similar subjective assessment is also required for deciding whether a target item qualifies as remembered or not remembered in Jacoby's (1991) exclusion task.

An advantage of the present approach over the process dissociation approach and Gardiner's (1988) approach, however, stems from the use of a confidence rating scale to assess recollection rather than requiring subjects to dichotomously choose between explicit recollection and absence of explicit recollection. It is likely that a dichotomous scale is considerably more open to the effects of response bias, where subject responses come to reflect differing criteria for accepting any word as remembered, than is a confidence rating scale. This is because a rating scale permits subjects the option of indicating their *degree* of recollective experience rather than forcing them to choose between explicit recollection and absence of explicit recollection.

The other important advantage of a confidence rating scale is that it permits use of a *stringent* criterion of absence of recollection. The highly conservative criterion adopted for defining a guess in Experiment 2 (i.e., the confidence ratings of zero only) firmly increases the certainty with which *complete* absence of awareness can be claimed. This is quite an important advantage over dichotomous scales given the general suspicion surrounding the use of subjective measures (e.g., Holender, 1986). Thus, in terms of ensuring no contamination by explicit processes, it is reasonable to consider the analysis of guessing methodology with a confidence rating scale to be at least as reliable as the process dissociation framework.

The present study also revealed that the measurable influence of unconscious processes on direct test performance varies as a function of LOP at study. The finding from Experiment 2 that there was no significant difference across retention tests for the completion of nonsemantically processed words when guesses were included as data is consistent with the view that a direct test on nonsemantically processed information when guessing is permitted is analogous to an indirect test of this information (cf. Merikle & Reingold, 1991). That is, if subjects do not explicitly remember a word but are required to supply a response anyway, subjects' guesses may engage the same cognitive processes engaged during an indirect test where subjects simply write the first word that comes to mind (cf. Jacoby & Hollingshead, 1990). This reasoning is consistent with the finding from the subliminal perception literature that guessing is like an indirect test for information rendered subliminal (Dixon, 1971), and is consistent with the results of Gabrieli et al. (1990) and Graf et al. (1984) for amnesic subjects. The informed guessing that amnesic subjects readily demonstrate for both semantically processed and nonsemantically processed words, may parallel the informed guessing that normal subjects show, except normal subjects do not seem to benefit from guessing semantically processed words. The most parsimonious explanation for these seemingly disparate results is that it is only when little or no information is available to guide retrieval that informed guessing comes into play. For amnesic subjects this may be the rule, but for normal subjects this might only occur when information has been minimally processed. When some information *is* available to guide retrieval (i.e., after semantic processing), unconscious influences for normal subjects may be inhibited. Together, these findings stress the importance of a close analysis of direct test responses which subjects claim they do not remember. If subjects do not remember but are required to make a response anyway, unconscious influences unwittingly come into play.

The fact that subjects can unwittingly use unconscious resources to correctly complete some words they cannot explicitly remember implies that there exists some complementary relationship between conscious and unconscious processes. That is, if information is not forthcoming with the application of conscious effort, this same information *may* be forthcoming if such effort is allayed. This conclusion, however, does not imply that conscious and unconscious influences are additive, independent, or exclusive in their contribution to overall performance level (cf. Jacoby, 1991; Nelson et al., 1992). In contrast, the present results warrant only the more conservative conclusion that conscious and unconscious influences are somewhat (at least empirically) separable resources, their admixture of which defines a more complete experience than either resource alone.

It is important to note, however, that the informed guessing effects that were measured in this study might not be the only unconscious influence on direct test performance. The scope of the present study was limited to measuring a small subset of correct direct test responses which, with some certainty, could be ascribed as having been influenced by unconscious processes. It would be inappropriate, however, to classify the remaining correct responses as being exclusively due to explicit influences. First, independent of assumptions about the relationship between implicit or explicit processes, the stringent criterion for guesses in Experiment 2 may have led to an underestimate of unconscious influences. Second, and perhaps more importantly, estimating the *true* magnitude of unconscious influences depends on how the relationship between conscious and unconscious processes is conceptualised.

The assumption of independence, upon which the process dissociation approach and the PIER model are based, will always lead to a lower estimate of unconscious influences then the *equally* tenable alternate assumption that conscious and unconscious influences are strongly correlated (Joordens & Merikle, 1993). This alternative conceptualisation assumes that conscious influences are always associated with corresponding unconscious antecedents (Joordens & Merikle, 1993) and, hence, that conscious influences define only a small subset of a much larger set of unconscious influences that happen to be momentarily conscious in order to meet task demands (cf. Ornstein, 1991). From an evolutionary viewpoint, Joordens and Merikle's (1993) model is highly persuasive. It argues for the *primacy* of unconscious influences at the highest levels of human cognition (Lhermitte & Serdaru, 1993; Reber, 1990; 1993).

Conclusion

The analysis of guessed responses in this study revealed that direct test performance improves by guessing completions of nonsemantically processed words but does not improve by guessing completions of semantically processed words. This result points to a fundamental distinction in the experience of a direct test as a function of whether a word has been deeply processed or minimally processed at study. These results also contribute to the gradually developing viewpoint that memory tests are rarely process pure measures (cf. Jacoby, 1991; Jacoby et al., 1992; Jacoby et al., 1993; Joordens & Merikle, 1993; Merikle & Reingold, 1991; Nelson, et al., 1992; Richardson-Klavehn & Bjork, 1988). That is, subjects can effectively utilise unconscious resources in performing a test which traditionally has been thought to measure explicit influences only. These findings challenge psychologists to develop improved methods of measuring cognitive processes and to be cautious in their interpretation of data from already existing methods.

It is traditionally held that conscious resources are the essential requirement for generating effective, useful, and adaptive behaviour (e.g., Ornstein, 1991). The finding in this study that guessing aids performance by accessing unconscious resources, however, establishes that subjects can be unwittingly or unconsciously resourceful in their capacity to "remember" information they cannot consciously retrieve. The present study and other studies that reveal unconscious influences on behaviour establish the importance of a holistic conceptualisation of human potentiality. This conceptualisation should encompass *both* resources of which we are aware and resources of which we have no conscious awareness.

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Appendix A: Target words used in Experiments 1 and 2

Table A1.
List Allocation and Normative Data for Target Words Used in Experiments 1 and 2.

Target	List Expt 1	List Expt 2	No. Stems	K-F freq	Fam	Conc	Image
BALLOT	A	C	11.00	12.00	453.00	455.00	437.00
BASKET	A	A	11.00	17.00	485.00	606.00	560.00
BURROW	A	C	16.00	4.00	421.00	426.00	444.00
CARROT	A	B	34.00	1.00	539.00	622.00	577.00
CHAPEL	A	B	48.00	20.00	471.00	587.00	560.00
CLOVER	A	C	16.00	16.00	486.00	554.00	606.00
FRENZY	A	A	13.00	6.00	409.00	303.00	450.00
GENDER	A	B	10.00	2.00	450.00	408.00	376.00
INSULT	A	C	14.00	7.00	552.00	375.00	477.00
OUTSET	A	A	23.00	13.00	394.00	305.00	270.00
POSTER	A	C	13.00	4.00	545.00	592.00	600.00
PREFIX	A	C	32.00	0.00	407.00	370.00	353.00
REFUSE *	A	C	15.00	16.00	518.00	426.00	419.00
RESORT	A	B	16.00	12.00	523.00	499.00	523.00
SALUTE	A	B	15.00	3.00	479.00	471.00	538.00
SCROLL	A	B	18.00	0.00	350.00	593.00	572.00
SHOVEL	A	B	18.00	5.00	528.00	581.00	538.00
SHRIMP	A	B	10.00	2.00	546.00	629.00	618.00
TRANCE	A	B	40.00	4.00	436.00	368.00	463.00
TRIPOD	A	C	29.00	3.00	363.00	577.00	574.00
BLOUSE	B	A	14.00	1.00	562.00	640.00	595.00
BREEZE	B	A	18.00	14.00	511.00	500.00	560.00
CASKET	B	A	13.00	0.00	466.00	613.00	588.00
COLLAR	B	C	23.00	17.00	509.00	622.00	582.00
CRADLE	B	C	22.00	7.00	478.00	587.00	592.00
FLOWER	B	B	15.00	23.00	566.00	584.00	618.00
GRAVEL	B	B	32.00	9.00	502.00	587.00	569.00
GROCER	B	A	14.00	1.00	519.00	576.00	551.00
HERMIT	B	A	11.00	0.00	407.00	508.00	537.00
INFANT	B	C	19.00	11.00	513.00	579.00	600.00
MANURE	B	C	26.00	6.00	458.00	644.00	534.00
MORTAL	B	B	12.00	10.00	454.00	406.00	402.00
PLANET	B	B	28.00	21.00	457.00	523.00	578.00
PLUNGE	B	A	15.00	5.00	441.00	396.00	548.00
QUIVER	B	B	18.00	0.00	368.00	485.00	505.00
REPAIR	B	A	21.00	20.00	543.00	394.00	440.00
SPONGE	B	A	10.00	7.00	538.00	597.00	577.00
SPRINT	B	A	12.00	0.00	461.00	411.00	526.00
STARCH	B	A	48.00	4.00	459.00	555.00	497.00
TENNIS	B	B	15.00	15.00	528.00	574.00	634.00
BANDIT	C	C	15.00	3.00	388.00	547.00	562.00
BARREL	C	A	26.00	24.00	487.00	590.00	602.00
BEAVER	C	A	15.00	3.00	470.00	589.00	612.00
BRANDY	C	B	22.00	7.00	542.00	595.00	590.00
CANARY	C	A	22.00	0.00	411.00	577.00	533.00
CHERRY	C	B	17.00	6.00	514.00	611.00	582.00
CHISEL	C	A	20.00	4.00	469.00	597.00	567.00
GALAXY	C	A	12.00	3.00	423.00	465.00	575.00
GARLIC	C	C	11.00	4.00	509.00	636.00	565.00
IMPORT	C	C	14.00	17.00	511.00	320.00	361.00
MAROON	C	C	22.00	3.00	492.00	486.00	503.00
MISUSE	C	B	20.00	5.00	457.00	318.00	367.00
PARCEL	C	A	43.00	1.00	503.00	525.00	509.00
PRIEST	C	C	28.00	16.00	484.00	561.00	568.00

Table A1 (*continued*).
List Allocation and Normative Data for Target Words Used in Experiments 1 and 2.

Target	List Expt 1	List Expt 2	No. Stems	K-F freq	Fam	Conc	Image
SERIAL	C	B	14.00	7.00	440.00	365.00	340.00
SQUINT	C	C	20.00	1.00	528.00	456.00	515.00
STRIPE	C	C	34.00	4.00	457.00	550.00	562.00
THRILL	C	A	16.00	5.00	504.00	320.00	483.00
TREMOR	C	B	20.00	2.00	401.00	487.00	491.00
TURTLE	C	C	11.00	8.00	509.00	644.00	564.00
Mean	--	--	19.83	7.35	476.57	512.78	523.98
SD	--	--	9.19	6.66	52.93	101.06	80.70

Note: No. Stems = number of words in MRC Database which had the same three letter stem, K-F freq = Kucera-Francis frequency of occurrence, Fam = familiarity, Conc = concreteness, and image = imageability.

* In Experiment 2, the word REFUSE was replaced with the word POLLEN because subjects were strongly biased toward responding with the word REFECTORY (which is the name of the university canteen usually denoted "the ref").

Appendix B: Instructions for Experiment 1

Table B1.
Study Phase Instructions for Experiment 1.

Semantic processing condition

In this part of the experiment, words will appear on the screen in front of you, one every 3 seconds. You are to rate how much you like the *meaning* of each word along a scale from 1 to 5 where 1 equals "don't like at all" and 5 equals "like a lot." By *meaning* it is meant what the word stands for or denotes, not what it sounds like. Is that clear? Write your answers on the sheet in front of you, one line per trial. To help you get used to the task, the first 5 trials are for practice. Are you ready?

Nonsemantic instructions

In this part of the experiment, words will appear on the screen in front of you, one every 3 seconds. You are to count the number of enclosed spaces in the letters of the word. For example, in the word TABLE (*show example*), there are 3 enclosed spaces; one in the 'A' and 2 in the 'B.' Can you see them? Write your answers on the sheet in front of you, one line per trial. To help you get used to the task, the first 5 trials are for practice. Are you ready?

Table B2.
Test Phase Instructions for Experiment 1.

Indirect test condition

Before you begin the next part of the experiment, here is a small filler task for you to do. You will be shown a number of word stems comprising the first three letters of words. Your job is to write down the *very first* word that comes to mind that completes the stem. But please don't write any proper nouns. Is that clear? Press the button to begin and as soon as you make your response press it again for the next word, and so on. Its important to respond to every trial and work speedily. Write your answers on the sheet in front of you, one line per trial. Remember, write down the *very first* word that comes to mind. Are you ready?

Direct test condition

In this part of the experiment, you will be shown a number of word stems comprising the first three letters of the words you just saw. Your job is to use the stems to help you remember as many of these words as you can. You should respond to every trial even if you can't remember the word from the list that goes with the stem. If you cannot remember and make a guess, indicate that you have guessed by placing an asterisk next to your response. Is that clear?

Press the button to begin and when you've made your response, press it again for the next word, and so on. It's important to work speedily while maintaining accuracy. Write your answers on the sheet in front of you, one line per trial. Are you ready?

Appendix C: Raw data for Experiment 1

Table C1.
Proportion of Semantically Processed, Nonsemantically Processed, and Distractor Words Correctly Completed for the Direct Test in Experiment 1.

		Word Type		
s	Test	Sem	NSem	Dist
1	Direct	.300	.200	.050
2	Direct	.400	.050	.000
3	Direct	.450	.250	.050
4	Direct	.400	.200	.200
5	Direct	.550	.100	.250
6	Direct	.300	.150	.050
7	Direct	.500	.300	.100
8	Direct	.350	.200	.150
9	Direct	.600	.200	.050
10	Direct	.550	.450	.150
11	Direct	.350	.150	.050
12	Direct	.400	.200	.000
Mean		.429	.204	.092
SD		.101	.101	.079

Note: Sem = semantic processing condition, NSem = nonsemantic processing condition, Dist = distractors.

Table C2.
Mean Proportion of Completions for Each Word Type on the Direct Test in Experiment 1 That Were Reported as Guessed, and the Proportion of These Completions That Were Also Correct.

	pG			pC			pCG		
s	Sem	NSem	Dist	Sem	NSem	Dist	Sem	NSem	Dist
1	.400	.700	.750	.050	.150	.050	.125	.214	.067
2	.550	.750	.750	.050	.000	.000	.091	.000	.000
3	.450	.750	.900	.000	.050	.050	.000	.067	.056
4	.600	.850	.850	.050	.150	.200	.083	.177	.235
5	.500	1.000	1.000	.050	.100	.250	.100	.100	.250
6	.700	.900	.900	.000	.100	.050	.000	.111	.056
7	.550	.750	.650	.100	.250	.100	.182	.333	.154
8	.650	.950	.950	.000	.200	.150	.000	.211	.158
9	.500	.800	.750	.100	.150	.050	.200	.188	.067
10	.250	.650	.650	.000	.200	.100	.000	.308	.154
11	.650	1.000	1.000	.000	.150	.050	.000	.150	.050
12	.300	.550	.550	.000	.150	.000	.000	.273	.000
Mean	.508	.804	.808	.033	.138	.088	.065	.178	.104
SD	.140	.141	.148	.039	.068	.077	.076	.099	.085

Note: pG = Proportion of guessed completions, pC = proportion of guessed completions that were also correct, pCG = pC/pG.

Appendix D: Instructions for Experiment 2

Table D1.
Study Phase Instructions for Experiment 2.

In this part of the experiment, words will appear on the screen in front of you, one every 3 seconds. For each trial, you will be instructed to do one of two things: *Either* rate how much you like the *meaning* of the word along a scale from 0 to 4 where 0 equals "don't like at all" and 4 equals "like a lot." By *meaning* it is meant what the word stands for or denotes to you, not what it sounds like; *Or* count the number of enclosed spaces in the letters of the word. For example, in the word TABLE shown now on the screen, there are 3 enclosed spaces; one in the 'A' and 2 in the 'B.' Can you see them?

The two tasks will be delivered in a random order and before each task an instruction on the screen will tell you which task to do for the next word that appears. Write your answers on the answer sheet in front of you, one line per trial. In case you forget, the scale for the rating task is shown on the card in front of you. The first 10 trials are for practice. Are you ready?

Table D2.
Test Phase Instructions for Experiment 2.

Indirect test condition

Before you begin the next part of the experiment, there is a small filler task for you to do. You will be shown a number of word stems comprising the first three letters of words. Your job is to write down the *very first* word that comes to mind that completes the stem. But please don't write any proper nouns. Is that clear? Press the button to begin and as soon as you make your response press it again for the next word, and so on. Its important to respond to every trial and work speedily. Write your answers on the answer sheet in front of you, one line per trial. Remember, write down the *very first* word that comes to mind. Are you ready?

Direct test condition

In this part of the experiment, you will be shown a number of word stems comprising the first three letters of the words you just saw. Your job is to use the stems to help you remember as many of these words as you can. You should respond to every trial even if you can't remember the word from the list that goes with the stem.

When you've made your response, rate along a scale from 0 to 4 your confidence that your response *was* a word that you remember from the list. On this scale, 0 equals "Don't remember at all; a complete guess" and 4 equals "Clearly remember." Is that clear? Press the button to begin and when you've made your response, press it again for the next word, and so on. It's important to work speedily while maintaining accuracy. Write your answers on the answer sheet in front of you, one line per trial and your rating from 1 to 4 in the space following your answer. In case you forget, the confidence rating scale is shown on the card in front of you. Are you ready?

Appendix E: Raw data for Experiment 2

Table E1.
Proportion of Semantically Processed, Nonsemantically Processed, and Distractor Words Correctly Completed for the Direct and Indirect Test in Experiment 2.

		Word Type		
s	Test	Sem	NSem	Dist
1	Direct	.7000	.1500	.1000
2	Direct	.2500	.1000	.0000
3	Direct	.5000	.3500	.1500
4	Direct	.5500	.3500	.1500
5	Direct	.5500	.1500	.1000
6	Direct	.4500	.1053	.0500
7	Direct	.3500	.2500	.0000
8	Direct	.5500	.1500	.0500
9	Direct	.4500	.1000	.1000
10	Direct	.3000	.3684	.0500
11	Direct	.5000	.2000	.0000
12	Direct	.5000	.2500	.0500
13	Direct	.5000	.3000	.1500
14	Direct	.5000	.3500	.1500
15	Direct	.6500	.3000	.0500
16	Direct	.3000	.3000	.1000
17	Direct	.3158	.3500	.1500
18	Direct	.6000	.4211	.0500
Mean		0.4731	0.2525	0.0806
SD				
19	Indirect	.3000	.4000	.2000
20	Indirect	.2500	.2632	.0500
21	Indirect	.3500	.1000	.0500
22	Indirect	.2500	.2500	.0500
23	Indirect	.3500	.3158	.0000
24	Indirect	.3000	.2000	.0500
25	Indirect	.3000	.1579	.0500
26	Indirect	.3500	.5000	.0000
27	Indirect	.4500	.3000	.0500
28	Indirect	.1500	.4500	.1500
29	Indirect	.3000	.1000	.0500
30	Indirect	.2000	.2500	.0000
31	Indirect	.5000	.3500	.1500
32	Indirect	.2500	.1500	.1000
33	Indirect	.2500	.1500	.0000
34	Indirect	.2000	.1500	.1000
35	Indirect	.2000	.2105	.1500
36	Indirect	.3158	.4500	.0500
Mean		0.2925	0.2637	0.0694
SD				

Table E2.

Mean Proportion of Completions for Each Word Type on the Direct Test in Experiment 2 That Were Reported as Guessed, and the Proportion of These Completions That Were Also Correct.

	pG			pC			pCG		
s	Sem	NSem	Dist	Sem	NSem	Dist	Sem	NSem	Dist
1	.250	1.000	.900	.000	.150	.100	.000	.150	.111
2	.450	.600	.632	.000	.000	.000	.000	.000	.000
3	.100	.250	.300	.000	.050	.050	.000	.200	.167
4	.100	.200	.350	.000	.000	.000	.000	.000	.000
5	.500	.900	.850	.050	.100	.100	.100	.111	.118
6	.450	.842	.950	.000	.053	.050	.000	.063	.053
7	.600	.750	1.000	.000	.050	.000	.000	.067	.000
8	.200	.650	.600	.000	.050	.050	.000	.077	.083
9	.600	.600	.850	.050	.000	.100	.083	.000	.118
10	.600	.650	.800	.000	.211	.000	.000	.324	.000
11	.350	.750	.579	.000	.100	.000	.000	.133	.000
12	.200	.600	.650	.000	.150	.000	.000	.250	.000
13	.300	.750	.950	.000	.150	.150	.000	.200	.158
14	.500	.850	1.000	.050	.200	.150	.100	.235	.150
15	.200	.400	.550	.000	.000	.000	.000	.000	.000
16	.350	.450	.750	.000	.200	.100	.000	.444	.133
17	.100	.350	.350	.000	.000	.000	.000	.000	.000
18	.250	.400	.500	.000	.053	.000	.000	.132	.000
Mean	.339	.611	.698	.008	.084	.047	.016	.133	.061
SD	.176	.229	.230	.019	.076	.056	.036	.126	.067

Note: pG = Proportion of guessed completions, pC = proportion of guessed completions that were also correct, pCG = pC/pG.

Table E3.

Frequency of Use of Each Confidence Rating (0, 1, 2, 3, and 4) for Direct Test Completion of Semantically Processed Words, Nonsemantically Processed Words, and Distractor Words in Experiment 2.

	Semantic					Nonsemantic					Distracter				
s	*0*	*1*	*2*	*3*	*4*	*0*	*1*	*2*	*3*	*4*	*0*	*1*	*2*	*3*	*4*
1	.250	.050	.050	.150	.500	1.000	.000	.000	.000	.000	.900	.050	.050	.000	.000
2	.450	.250	.000	.150	.150	.600	.250	.100	.000	.050	.632	.316	.053	.000	.000
3	.100	.150	.250	.050	.450	.250	.350	.100	.200	.100	.300	.500	.200	.000	.000
4	.100	.200	.200	.100	.400	.200	.300	.250	.200	.050	.350	.350	.150	.150	.000
5	.500	.050	.000	.100	.350	.850	.100	.000	.000	.050	.850	.150	.000	.000	.000
6	.450	.050	.000	.000	.500	.842	.053	.105	.000	.000	.950	.000	.050	.000	.000
7	.600	.050	.000	.000	.350	.750	.100	.000	.000	.150	1.000	.000	.000	.000	.000
8	.200	.050	.100	.150	.500	.650	.150	.100	.050	.050	.600	.350	.000	.000	.050
9	.600	.000	.000	.000	.400	.600	.300	.050	.000	.200	.850	.150	.000	.000	.000
10	.600	.050	.000	.100	.250	.684	.263	.053	.000	.000	.800	.100	.100	.000	.000
11	.350	.100	.000	.050	.500	.750	.200	.000	.000	.050	.579	.211	.105	.053	.053
12	.200	.300	.050	.200	.250	.600	.250	.050	.050	.050	.650	.200	.100	.000	.050
13	.300	.250	.000	.100	.350	.750	.100	.050	.050	.050	.950	.050	.000	.000	.000
14	.500	.000	.000	.050	.450	.850	.000	.000	.050	.100	1.000	.000	.000	.000	.000
15	.200	.150	.000	.200	.450	.400	.400	.050	.000	.150	.550	.400	.050	.000	.000
16	.350	.150	.050	.100	.350	.450	.200	.200	.100	.050	.750	.150	.000	.100	.000
17	.105	.316	.105	.158	.316	.350	.150	.150	.250	.100	.350	.450	.150	.050	.000
18	.250	.150	.100	.250	.250	.421	.211	.263	.105	.000	.500	.400	.100	.000	.000
Mean	.339	.129	.050	.160	.376	.611	.188	.085	.059	.067	.698	.213	.062	.020	.009
SD	.176	.101	.075	.073	.104	.225	.115	.084	.081	.057	.230	.166	.063	.043	.020

Appendix F: Material published from thesis

A paper comprising Experiments 1 and 2 was accepted for publication in *Psychological Research* and is currently in press:

Langsford, P. B., & Mackenzie, B. D. (in press). Unconscious influences on direct test performance. *Psychological Research*.

Unconscious Influences on Direct Test Performance

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The authors wish to acknowledge the support of James Alexander, Alison Bowling, and Toby Croft in the preparation of this paper.

Running head UNCONSCIOUS INFLUENCES

Summary

From intense interest in implicit memory has evolved various methodologies for separating the respective influence of implicit (unconscious) and explicit (conscious) processes on performance of various tasks. Two experiments are reported that utilised a levels of processing (LOP) approach to manipulate encoding level and comparable indirect (word stem completion) and direct (cued completion) retention tests. Confidence ratings of recollection were taken for each direct test response. The aim of these experiments was to explore the role guessing plays on direct test performance (Experiment 1 and 2) and to contrast this with performance on a comparable indirect test (Experiment 2). Analysis of correctly guessed responses showed that direct test performance was reliably influenced by unconscious processes, but differentially as a function of LOP. Guessing stems of nonsemantically processed words was found to enhance performance whereas guessing stems of semantically processed words had no affect on performance. Results are discussed in terms of the similarity between guessing on a direct test and engaging in an indirect test, and subjects' unwitting resourcefulness at being able to "retrieve" words they cannot explicitly remember.

Introduction

The last decade has witnessed a substantial change in the direction of memory research reflected in the now well-known distinction between explicit and implicit memory (Graf and Schacter, 1985; Schacter, 1987). Explicit memory is tested by asking subjects to remember items from a list of previously studied words or pictures, and is held to require the intentional or conscious recollection of the study episode and its contents. The explicit memory paradigm has been the dominant approach for exploring memory phenomena this century. Implicit memory, by contrast, is tested incidentally by looking for evidence of savings or facilitation of performance following a study episode. For implicit memory, a subject is not required to explicitly remember, and may even be unable to recall, the study episode and its contents. Thus, implicit memory is thought to be based on unintentional or unconscious processes or influences.

The discovery in recent years of a myriad of dissociations between performance on direct and indirect tests has given rise to much explanatory theorising and speculation (see Richardson-Klavehn & Bjork, 1988; Roediger, 1990; Roediger & McDermott, 1993; Schacter, 1987; Schacter, Chiu, & Ochsner, 1993; Shimamura, 1986 for reviews). One well-established dissociation is found for the depth or level of processing (LOP) at study. Craik and Lockhart (1972) and Craik and Tulving (1975) were the first to operationalise and demonstrate the now ubiquitous effect that deep or semantic processing, achieved by directing attention to meaningful attributes of stimuli (e.g., rating the meaningfulness of a word), elicits a higher level of performance on direct tests than does shallow or nonsemantic processing, achieved by directing attention to structural features of stimuli (e.g., counting the number of enclosed spaces in the letters of a word). In contrast, most research points to LOP having little or no effect on performance across a number of indirect tests[1] (e.g., Bowers & Schacter, 1990; Graf & Mandler, 1984; Graf, Mandler, & Haden, 1982; Hashtroudi, Ferguson, Rappold, & Chrosniak, 1988; Jacoby & Dallas, 1981; Light & Singh, 1987; Roediger, Weldon, Stadler, & Riegler, 1992; Schacter & McGlynn, 1989), however, a large review of the literature by Challis and Brodbeck (1992) clearly showed that a small but reliable LOP effect is evident in almost all implicit studies.

The heuristic value of the dissociation approach is weakened, however, if tasks used to argue for dissociation effects are not themselves process or factor pure measures. Current thought attests to the fact that direct and direct tests are rarely process or factor pure measures (Jacoby, 1991; Jacoby, Toth, & Yonelinas, 1993; Joordens & Merikle, 1993; Nelson, Schreiber, & McEvoy, 1992). For indirect tests, where subjects are asked to complete word stems with the first word that comes to mind, some authors have claimed that intentional retrieval processes may "contaminate" performance and therefore lead to increased overall correct completion levels (Light and Singh, 1987; Schacter, Bowers, & Booker, 1989), and recently a few investigations have explicitly addressed the effects of "contamination" of unconscious influences on direct or direct tests (e.g., Gardiner, 1988; Jacoby et al., 1993; Nelson et al., 1992). The objective of the present study is to use the LOP approach to further investigate the cognitive processes involved in performing the direct cued completion task. The optimistic aim of this type of research is to devise improved factor pure tests of conscious and unconscious influences on performance. The conservative and perhaps more realistic aim is to determine the magnitude of the respective influences of the two types of processes.

One stream of research by Jacoby and colleagues (e.g., Jacoby, 1991; Jacoby et al., 1993) employs a process dissociation methodology with "inclusion" and "exclusion" tests for separating out the respective magnitude of explicit and implicit processes on memory performance. In a study typical of this approach, Jacoby et al. (1993) manipulated attention at study (e.g., full versus divided) and presented word stems as cues at test. In the exclusion condition, subjects were instructed to respond with the first word that comes to mind, but to exclude words they were previously shown. For the inclusion condition, subjects were encouraged to try to remember words, and to write the first word that comes to mind if they could not remember. By assuming that explicit and implicit processes make independent contributions to performance and by solving rather simple simultaneous equations, the magnitude of implicit influences on a direct test can be measured.

Another study by Gardiner (1988) manipulated LOP at study and used recognition as a direct test and reported results which were interpreted as showing both implicit and explicit contributions to direct test performance. In this study, subjects were required to indicate which words they remembered the appearance of in the study list ("R" words) and which they did not remember the appearance of but nonetheless recognised or knew by some other means ("K" words). A dissociation was found between the type of recognised word as a function of LOP and parallels were drawn between "R" words and explicit processes and "K" words and implicit processes. This conclusion, however, may not be warranted. For example, although

"R" words may stem from episodic memory, the (ostensibly) non-episodic nature of "K" words does not imply their recognition was not based on explicit processes. Indeed, all "R" and "K" words were first consciously recollected before being categorised as such.

Nelson et al. (1992) have defined implicit memories as "preexisting memories acquired before the laboratory task in the hundreds of experiences that people have with the same stimulus in different contexts" (p. 322). These authors consider that such memories qualify as implicit because "subjects are typically unaware of their activation during encoding and retrieval and because they are unaware of the effects that these memories have on their performance" (p. 323). Nelson et al. (1992) investigated the involvement of implicit processes in direct tests by manipulating target and test-cue set size. Set size refers to the number of associates which, as a result of experience, are linked to a particular stimulus. Set size effects are observed when differences in memory performance are found for large versus small target or cue stimulus sets. Generally, the larger the cue or target set size, and hence the more preexisting associates, the lower the probability of recall, and conversely, the smaller the set size, the greater the probability of recall. Fuelled by set size effect findings for (direct) extralist cuing tasks, Nelson et al. (1992) have devised a Processing Implicit and Explicit Representations (PIER) model which describes an exclusive parallel relationship between implicit and explicit processes to explain retrieval. An interesting feature of this model is that it predicts that implicit influences on direct tests should systematically vary with instructions that emphasise use of one or both parallel pathways. In one experiment (Experiment 4), Nelson et al. (1992) showed that when subjects had to guess words they could not explicitly remember (explicit plus implicit pathway) overall performance was higher than when subjects were instructed to be very sure their response was correct (explicit pathway only).

There are clear similarities between the process dissociation framework of Jacoby (1991) and Nelson et al.'s (1992) set size framework. The approach taken in this study shares similarities with all these approaches devised to measure unconscious influences on direct tests but differs in the manner in which unconscious processes are measured. In the present study, an estimate of the magnitude of unconscious influences was directly obtained by determining the proportion of words correctly completed when self-reported conscious recollection is completely absent and subjects have to guess responses. If subjects do not explicitly remember a word but are required to supply a response anyway, subjects' guesses may engage the same cognitive processes engaged during an indirect test.

Converging evidence from studies of subliminal perception, which is in many ways comparable to implicit memory (Kihlstrom, 1987), is consistent with the view that guessing is a kind of indirect test for information rendered subliminal (e.g., Dixon, 1971). Indeed, instructions to guess defined the earliest subliminal perception test (Sidis, 1898). More direct evidence comes from a recent study by Gabrieli, Milberg, Keane, and Corkin (1990) which showed that cued completion performance for the densely amnesic subject H.M. was better than for normal control subjects (33.3% versus 23.5%, respectively). Because anterograde amnesics cannot explicitly remember study items, this result shows that when no information is available to guide explicit retrieval, a direct test can become a sensitive measure of unconscious processes (i.e., an indirect test).

Nonsemantically processing information also leads to poor explicit recollection for normal subjects (Craik & Tulving, 1975) which Graf et al. (1982) have argued "mirrors" anterograde amnesia (p. 1244). Thus, one might also expect informed guessing to contribute substantially to cued completion of nonsemantically processed information in normal subjects. Graf, Squire, and Mandler (1984, Experiment 3) compared amnesic and amnesic control subjects for cued completion performance and reported no difference for nonsemantic processing (39.6% versus 39.9%, respectively) but a small difference for semantically processed words (57.7% versus 69.0%, respectively), which suggests that similar (informed guessing) processes may be employed by both amnesics and control subjects, at least for completions of nonsemantically processed words. Clearly, amnesics do benefit from informed guessing of both semantically and nonsemantically processed information, but the problem in interpreting the direct test results for normal subjects is complicated because we do not know which responses are guessed and which ones are remembered.

The effect of guessing on direct test performance is an important issue that warrants investigation with a number of different methodologies. One might attempt to address the issue of informed guessing directly by asking subjects to refrain from responding if they are unsure of their direct test responses (e.g., Graf & Mandler, 1984; Hashtroudi et al., 1988; Roediger et al., 1992; Weldon, Roediger, & Challis, 1989). This procedure, however, apart from precluding the analysis of how guessing might affect performance may introduce response bias. If subjects are instructed to respond to every stem for the indirect test but are not permitted to guess direct test responses, any dissociation between direct and indirect test performance may simply reflect criterion differences in responding between the two tests rather than different underlying processes (Merikle & Reingold, 1991). The approach taken in this study - a direct analysis of guessed direct test completions - has not previously been undertaken. In the two experiments which follow, direct test responses labelled by subjects as not remembered and guessed were analysed in order to determine the extent to which correct completion of guessed words contributes to overall performance, and how this may vary as a function of LOP at study. Experiment 1 was a preliminary attempt to establish the existence of the informed guessing effect for normal subjects. Experiment 2 was then undertaken to quantify this effect in a more precise and elaborate way by using (i) both direct and indirect tests with which to compare performance, (ii) random presentation of study tasks, and (iii) a more stringent criterion for guessing.

Experiment 1

<u>Method</u>

Subjects and design

Twelve subjects aged 17 to 31 (<u>M</u> = 20.089, <u>SD</u> = 4.730) were recruited. Subjects were first year psychology students from the University of Tasmania who received course credit for participation. The experimental design was completely within subjects with Word Type (semantic, nonsemantic, and distractor) as the only factor.

Materials

Words were obtained from the MRC Psycholinguistic Database (Coltheart, 1981). This database comprises an extensive collection of words and associated normative data on, for example, ratings of frequency of occurrence, familiarity, concreteness, imageability, and meaningfulness for each word. The criteria for selecting words was adopted from Graf and Mandler (1984) such that (i) each word had six letters, (ii) the first three letters of each word uniquely defined that word in the list, (iii) words had a low Kucera-Francis (Kucera & Francis, 1967) frequency of occurrence, and (iv) the three letter stem of each word was shared by at least 10 other dictionary words.

From a pool of 98 words, 72 words were selected with Kucera-Francis frequencies of 14 occurrences per million or less. Sixty words were randomly allocated to one of three lists (List A, List B, or List C) each comprising 20 words, and the remaining 12 words were used as fillers. No significant differences were found between word lists for any of the normative data. An additional list of 10 high Kucera-Francis frequency words were used as practice items. Lists were permutated (i.e., ABC, BCA, CAB, BAC, ACB, and CBA) so that each list equally often served as the semantic study list, nonsemantic study list, and distractor list, and was equally often preceded and followed by different lists.

Words and word stems were presented by an IBM compatible computer on to the computer's monitor. All responses were made on lined study and test forms provided, one response per line.

Procedure

Subjects were tested individually in a sound attenuated room. Subjects were comfortably seated 600 mm from the monitor screen so that stimuli subtended approximately 1.8 degrees of visual angle.

For the study phase, subjects were presented with two consecutive lists of 31 words. Each subject performed a semantic study task on one of the lists and a nonsemantic study task on the other. The order of tasks was counterbalanced across subjects. The first 5 words in each list served as practice items and the next 3 and last 3 words on each list served as filler items to counter primacy and recency effects. Thus, only 20 words on each list served as target words and only the stems of these and 20 new distractor words were used in the test phase. The temporal sequence of events for the study phase was (i) 500 Hz tone (50 ms), (ii) pause (500 ms), (iii) presentation of study word (3000 ms, Hashtroudi et al., 1988), and (iv) pause (500 ms). Subjects made their response during the 3000 ms word presentation period.

Instructions for the two processing tasks were adapted from Graf and Mandler (1984). The semantic processing task required subjects to rate along a 5-point scale how much they liked the meaning of the word presented. On this scale, "1" equalled "don't like at all" and "5" equalled "like a lot." The nonsemantic processing task required subjects to count the number of enclosed spaces in the letters of the word presented. Subjects' responses were checked before they commenced the study task proper to ensure that they followed instructions.

Immediately following the study phase, subject's retention performance was assessed by a cued completion direct test. For this test, the first three letters of the 40 target words and 20 new distractor words were presented randomly interspersed, and subjects were required to use the letters as cues to help them recall words from the study lists. If subjects had to guess their responses, they were asked to indicate that they had guessed by placing an asterisk next to their completion. The temporal sequence of events for the test phase was (i) button press, (ii) pause (500 ms), and (iii) presentation of word stem. The test phase was self paced; subjects completed their response then pressed a button to initiate the next trial. However, subjects were also encouraged to respond as quickly as possible without compromising accuracy.

Results and Discussion

The level of significance adopted for all statistical analyses was a < .05. Where variables revealing significant main effects also entered into a significant interaction, only the interaction effect was further analysed. All planned comparisons between means were evaluated with two-tailed tests, and all t-tests were matched or paired unless otherwise indicated.

The proportion of correct completions as a function of Word Type (semantic, nonsemantic, and distractor) are presented in Table 1. To compare the direct test results of this study with those from other studies where subjects <u>were not</u> permitted to guess their direct test responses (e.g., Graf and Mandler, 1984; Hashtroudi et al., 1988; Roediger et al., 1992), a second condition was created by excluding all guessed data. Data for this new condition is also shown in Table 1.

The proportion of (nonstudied) distractor stems "correctly" completed provides a baseline measure of the proportion of stems correctly completed by chance alone. To adjust for chance, this figure was subtracted from the proportion of correct completions for both semantically and nonsemantically processed words.

Insert Table 1 about here

Table 1 shows that after removing guessed data, correct completion drops markedly for nonsemantically processed words but has little effect on semantically processed words. These values closely resemble those from published studies where guessing was not permitted on the direct test (Graf and Mandler, 1984; Hashtroudi et al., 1988). Prior to adjustment for chance, the change for nonsemantically processed words (.204 – .067 = .137) was highly significant [$t(11) = 7.021$, $p < .0001$], but after chance adjustment, this change (.113 – .063 = .05) did not quite reach significance [$t(11) = 2.002$, $p = .071$]. Thus, guessing clearly contributes to direct test performance, but differentially as a function of LOP. A closer inspection of this differential effect follows.

Table 2 displays the proportion of responses for each word type that were reported as guessed as well as the proportion of these responses that were also correct (i.e., correct guesses divided by total guesses).

Insert Table 2 about here

A one-way repeated measures ANOVA on the total proportion of guessed completions revealed a significant effect of Word Type [($F(2,22) = 86.929$, $p < .0001$]. Significantly fewer semantically processed words were guessed than nonsemantically processed words [$t(11) = 11.504$, $p < .0001$] and distractor words [$t(11) = 9.052$, $p < .0001$], but the latter two did not significantly differ from each other [$t(11) = .248$, ns]. This result shows that no advantage was gained for nonsemantic processing over and above no processing in terms of explicit recollection.

For guessed responses that were also correct, a second ANOVA also revealed a significant effect of Word Type [$F(2,22) = 6.343$, $p = .007$]. Although the level of completion of semantically processed words and distractor words did not significantly differ [$t(11) = 1.310$, ns], significantly more nonsemantically processed words were completed than either semantically processed words [$t(11) = 3.347$, $p = .007$] or distractor words [$t(11) = 2.238$, $p = .047$]. Thus, when completions were guessed, completions of nonsemantically processed words were more likely to be correct than were completions of semantically processed words or distractor words. This result demonstrates that direct test completion of nonsemantically processed words is influenced by unconscious processes. 17.8% of guessed completions of nonsemantically processed words were correct, a figure significantly larger than what would be expected by chance alone (10.4%). In real terms, this amounts to an increase in direct test performance of about 13.7% prior to adjusting for chance correct completions or 5.0% after subtracting for chance. Thus, it appears that subjects can be unwittingly resourceful in completing a task for which no conscious information is available provided that information is minimally processed at study and guessing is permitted at test. Experiment 2 was undertaken to quantify this effect in a more rigorous manner.

In Experiment 1, study tasks were presented within subjects as two counterbalanced blocks of trials. This is how study tasks are often presented in implicit memory research. Recent work by Challis and Brodbeck (1992), however, has shown that blocked study designs can lead to task-specific or context (e.g., cognitive "set") effects which contribute to LOP-based dissociation effects. These authors showed that when semantic and nonsemantic tasks were presented blocked within subjects or as a between subjects factor, indirect test performance was better following semantic processing but when tasks were presented mixed within subjects, no LOP effect was found. Challis and Brodbeck (1992), drawing upon the work of Weldon (1991) who reported that lexical processing is essential for priming, suggested that blocked or between subject presentations may discourage complete lexical processing in the nonsemantic condition because subjects may learn to pay little attention to the words as a whole, but only to structural aspects of them. Mixed within subjects designs, on the other hand, because of the unpredictability of the tasks, may encourage more thorough lexical processing prior to additional semantic or nonsemantic processing. In Experiment 2, study tasks were randomly presented within subjects in an effort to determine whether cognitive set effects contributed to LOP-based informed guessing effects found in the direct test of Experiment 1.

Experiment 2 also trialed a new 5-point confidence rating scale as a method of obtaining subjective information about which direct test responses were guessed. This rating method was favoured because it permits use of a more stringent criterion for guessing, and it may reduce the likelihood of response bias contributing to dissociation effects (see discussion in introduction). Reductions in response bias might be expected because a rating scale of this type permits subjects the option of indicating the degree to which they are unsure about their responses rather than simply omitting them (as in some previous studies) or dichotomously grouping them (as in Experiment 1).

Experiment 2

Method

Subjects and design

Thirty six subjects aged 17 to 28 (M = 19.394, SD = 2.065) were recruited. Subjects were first year psychology students from the University of Tasmania who received course credit for participation. The experimental design conformed to a 3 X 2 mixed format with Word Type (semantic, nonsemantic, and distractor) as a within subjects factor and Retention Test (direct or indirect) as a between subjects factor.

Materials

The materials were the same as for Experiment 1 except for the following modifications: (i) Because the direct and indirect nature of the tests given to subjects rests critically on the instructions supplied (Graf & Mandler, 1984; Merikle & Reingold, 1991; Schacter et al., 1989), all instructions were standardised across subjects by presenting them by audio cassette, and (ii) a 5-point confidence rating scale was used to determine which direct test responses were guessed and which were not guessed.

Procedure

The procedure was also similar to Experiment 1 with the following alterations. A new random allocation of words to lists A, B, and C was undertaken. During the study phase, subjects were presented with 62 words. The first 10 words served as practice items and the next 6 and last 6 words served as filler items. The remaining 40 words comprised two lists of 20 target words each. Only the stems of these target words and 20 new distractor words were used in the test phase. Each subject performed a semantic processing task on one of the lists and a nonsemantic processing task on the other. The order of presentation of the two tasks was random.

Prior to each trial an instructional cue appeared centrally on the screen to indicate which processing task the subject was to perform on the forthcoming study word. For the semantic processing task, the boxed cue "rate likability" appeared on the screen and for the nonsemantic processing task, the boxed cue "count enclosed spaces" appeared. The most appropriate exposure duration for the task cues was selected on the basis of a pilot work. Unlike the blocked and counterbalanced presentation of study tasks in Experiment 1, the study tasks in this experiment were randomly presented. The temporal sequence of events for the study phase was: (i)

500 Hz tone (50 ms), (ii) task cue (4000 ms), (iii) pause (500 ms), (iv) presentation of study word (3000 ms), and (v) pause (500 ms). Subjects made their responses during the 3000 ms presentation time and were alerted to the start of the next trial by the 500 Hz tone.

For the test phase the temporal sequence of events and the presentation of word stems was the same as for Experiment 1. Subjects in the indirect test condition were told to write down the very first word they could think of, excluding proper nouns, which completed the stem. Instructions for the direct test were the same as for Experiment 1 except subjects were instructed to respond to every trial even if they could not remember a word from the list that goes with the stem and, after making their response, to rate along a scale from 0 to 4 how confident they were that their response was a word that they remember. On this scale, 0 equalled "Don't remember at all; a complete guess" and 4 equalled "Clearly remember."

Results and Discussion

Priming and dissociation effects

For each word type, the proportion of correct completions and the proportion of chance adjusted correct completions for direct and indirect tests are shown in Table 3.

Insert Table 3 about here

For the indirect test, significantly more semantically processed words [$t(17) = 8.573$, $p < .0001$] and nonsemantically processed words [$t(11) = 6.413$, $p < .0001$] were correctly completed than were distractor words, the completion rate of which represents chance level performance. Thus, significant priming occurred for both semantically processed words and nonsemantically processed words.

The chance adjusted data was analysed by a 2 (LOP) X 2 (Retention Test) mixed design ANOVA which revealed a significant main effect of LOP [$F(1,34) = 24.161$, $p < .0001$] and Retention Test [$F(1,34) = 7.116$, $p = .012$], and a significant LOP X Retention Test interaction [$F(1,34) = 14.290$, $p = .0006$]. Further analysis of this interaction revealed (i) no significant effect of LOP on the indirect test [$t(17) = .877$, ns], (ii) significantly more completions of semantically processed words than nonsemantically processed words on the direct test [$t(17) = 5.702$, $p < .0001$], (iii) significantly more direct test completions than indirect test completions for semantically processed words [$t(34) = 4.669$, $p < .0001$, unmatched t], and (iv) no significant effect of Retention Test for nonsemantically processed words [$t(34) = .582$, ns, unmatched t].

This analysis shows that performance on the indirect test was relatively insensitive to LOP at study whereas direct test performance is highly sensitive to LOP. It also replicates the pattern of direct test results observed in Experiment 1 and shows that retaining guessed data leads to a level of performance for nonsemantically processed words that is the same irrespective of whether a direct test or an indirect test is given. Finally. although the magnitude of direct test performance is somewhat lower in Experiment 1 than in Experiment 2 (compare Tables 1 and 3), the LOP effects are the same (+.225 and +.220 respectively). That is, the change in the design of the study phase, from within subjects blocked in Experiment 1 to within subjects random in Experiment 2, appears not to alter the pattern of results.

Analysis of confidence ratings

The confidence rating scale permits the categorisation of responses as "guessed" or "remembered" according to different criteria. Because we were interested in informed guessing hypothesised to take place when no conscious information is available to assist retrieval, we chose to adopt a stringent criterion to define a guess. This criterion accepts that only responses rated 0 (i.e., "Don't remember at all; a complete guess") be considered guessed, on the basis that a rating of 1 or more indicates uncertainty or the possible presence of conscious information that may be used to guide retrieval. Conversely, only responses rated 4 (i.e., "Clearly remember") were accepted as remembered on the basis that a rating of anything less than 4 indicates uncertainty or familiarity rather than explicit recollection. The pattern of use of confidence ratings for all completions as a function of Word Type are shown in Figure 1.

Insert Figure 1 about here

Inspection of Figure 1 illustrates that ratings of 0 (i.e., guessed) and ratings of 4 (i.e., remembered) accounted for a large proportion of all ratings made whereas the intermediate or "uncertain" ratings of 1, 2, and 3 were used much less often. The percentage of responses rated either 0 or 4 was 71.5%, 67.8%, and 70.6% ($\underline{M}$ = 70.0%) for semantically processed, nonsemantically processed, and distractor words, respectively. This clearly represents a nonsignificant effect of Word Type [$\underline{F}(2,34) = .789$, ns] and establishes that subjects were equally confident about their use of extreme ratings (0 and 4) for each word type. That is, there was no bias among subjects toward adopting different response criteria for designating completions for any word type as extreme. This conclusion attests to the validity of comparing each word type for the frequency of use of extreme ratings and the significance we have ascribed to them.

Analysis of guessed data

Table 4 displays the proportion of responses for each word type that were designated as guessed (i.e., correct completions that received a confidence rating of 0) and the proportions of these responses that were also correct (i.e., correct guesses divided by total guesses).

Insert Table 4 about here

A one-way repeated measures ANOVA on the guessed data showed a significant effect of Word Type [$\underline{F}(2,34) = 51.129$, $\underline{p} < .0001$]. Significantly fewer semantically processed words were guessed than were nonsemantically processed words [$\underline{t}(17) = 6.092$, $\underline{p} < .0001$] and distractor words [$\underline{t}(17) = 10.334$, $\underline{p} < .0001$], and significantly fewer nonsemantically processed words were guessed than distractor words [$\underline{t}(17) = 2.879$, $\underline{p} = .010$]. This result shows that substantially less information was available to guide retrieval of nonsemantically processed words than for semantically processed words. Comparison of Tables 2 and 4 shows that overall levels of guessing are lower in Experiment 2 than in Experiment 1. This difference, and the finding that some advantage was gained for nonsemantic processing over no processing in terms of awareness of study words in Experiment 2 but not in Experiment 1, probably reflects the differing criteria used to define a guess between the two experiments. The stringent criterion of Experiment 2 excluded ratings of 1 which might conceivably have been included in Experiment 1, thus leading to an increase in total guessing rates, especially for distractor words which were typically rated 0 or 1 (see Figure 1).

For correctly guessed completions, a final ANOVA revealed a significant effect of Word Type [$F(2,34) = 10.746$, $p = .0002$]. There were significantly more correctly guessed responses of nonsemantically processed words than distractor words [$t(17) = 2.590$, $p = .019$] and significantly more correctly guessed responses of distractor words than semantically processed words [$t(17) = 3.192$, $p = .005$]. Furthermore, the proportion of correctly guessed semantically processed words was not significantly greater than zero [$t(17) = 1.836$, ns]. These results replicate the correct guessing results of Experiment 1 in showing that when completions were guessed, completions of nonsemantically processed words were more likely to be correct than completions of semantically processed words or distractor words. This result adds additional weight to the conclusion that overall direct test performance is reliably influenced by the involvement of unconscious processes. With a larger subject sample and a more stringent criterion for guessing, this experiment also reveals that correct guessing of semantically processed words is substantially worse than chance and no better than zero. Thus, informed guessing does not influence cued completion of semantically processed words. The fact that these results based on random presentation of study tasks replicate Experiment 1 results based on counterbalanced blocked presentation also demonstrates that it is trial-by-trial information that is critical in attaining these results rather than any context or cognitive set effects.

A final point to note is that although the confidence rating scale used in Experiment 2 is arguably a more sensitive method for categorising guessed responses than the dichotomous scale of Experiment 1 (i.e., there is less likelihood of contaminating 0 ratings with uncertainty), the results of Experiment 1 are consistent with the results of Experiment 2.

General Discussion

Although, blocked study task designs for indirect tests appear to encourage context or set effects resulting in an increased LOP effect (Challis & Brodbeck, 1992), the study task design of the direct test does not appear to affect on the size of the LOP effect. The finding that the direct test LOP effect was the same between Experiment 1 and 2 despite different study task designs discourages the view that dissociation and informed guessing effects are due to context or cognitive set effects inherent in processing tasks in general rather than to encoding of item-specific information on each study trial. If a blocked set of nonsemantically processed words elicits incomplete lexical processing at study (Challis & Brodbeck, 1992), it is logical that this would pose more of a problem for indirect tests, where lexical processing and physical similarity between study and test stimuli is most important (Weldon, 1991), than for direct tests where physical similarity appears less important (e.g., Nelson et al. 1992). In any case, the present results supply greater confidence that the informed guessing effects discussed further below are reliable and robust.

Of particular importance to the aims and hypotheses of this study was a close analysis of those direct test responses that subjects guessed. Results from both Experiments 1 and 2 showed that a substantially larger proportion of nonsemantically processed words and distractor words were guessed than semantically processed words. Consistent with the ubiquitous finding that LOP at study affects direct test performance (Craik & Tulving, 1975), this result confirms that considerably more information related to the explicit (conscious) retrievability of words is available following semantic processing than following nonsemantic processing. Because direct tests were traditionally thought to measure intentional or conscious influences on performance, measurable unconscious influences on direct test performance is a far more interesting finding. A minimal assumption in interpreting evidence for unconscious perception in the present study was that above chance correct guessing on the direct test reflects unconscious influences. The viability of this assumption rests first on the validity of accepting a subjective report as reflecting an absence of conscious experience, and second on the logic of defining a guess as when such an absence of conscious experience occurred at the time of test.

Although <u>subjective</u> measures of awareness have been severely criticised in favour of more <u>objective</u> measures (e.g., Holender, 1986), it is now clear that "subjective measures are the only class of measures that have consistently led to successful demonstrations of perception without awareness" (Merikle, 1992, p. 793-794, see also Greenwald, 1992). In terms of the current study, subjective measures are clearly the relevant ones to use because they reveal what is and what is not available to consciousness. In Experiment 1, however, where subjects used a forced-choice dichotomous rating scale to designate guessed responses, there is some question as to whether a guess always conformed to the strict definition of no conscious awareness. With the 5-point confidence rating scale used in Experiment 2, however, we felt more certain that responses that we classified as "guessed" reflected a complete absence of conscious experience. With this more stringent criterion, results showed that correct guessing of nonsemantically processed words remained significantly greater than chance level performance, thereby establishing the presence of unconscious influences.

The results observed with the "analysis of guessing" methodology used in this study corroborate with results from studies using other methodologies aimed at separating conscious from unconscious influences within a specific task. Both Jacoby's (1991) process dissociation approach and Nelson et al.'s (1992) PIER model make assumptions about the relationship between implicit and explicit processes. The process dissociation approach assumes that implicit and explicit processes are independent of each other but that there may be some degree of overlap (Jacoby et al., 1993). The PIER model also assumes independence but defines a more mutually exclusive relationship between implicit and explicit processes with no overlap (Jacoby et al., 1993). However, Jacoby et al. (1993) concede that there is likely to be little difference in predictions between the two models. The analysis of guesses approach adopted in this study does not make any assumptions about the relationship between implicit and explicit processes, however it does share a similarity with the exclusion task methodology of the process dissociation approach in that it attempts to eliminate any contribution of explicit processes prior to measuring an implicit effect. Explicit processes are eliminated in the exclusion task by asking subjects to exclude responses they remember from the study list and explicit processes were excluded in the present study by using only responses with memory confidence ratings of zero. In terms of ensuring no contamination by explicit processes, it is reasonable to consider the approach taken in this study to be at least as reliable as the process dissociation approach.

The approach used in this study shares additional similarities with the process dissociation model and Gardiner's (1988) "remember-know" approach inasmuch as data from each study comprises subjective estimates of recollective experience. Strictly speaking, almost all memory studies measure subjective data, but subjective data is a particularly salient feature of the design of the present study and the study of Gardiner (1988). In both studies, subjects were asked to make decisions about the strength or salience of subjective events based on criteria set by task instructions. Gardiner (1988) required subjects to discern whether their conscious recollections could be categorised as episodic or nonepisodic. In the present study, subjects were required to discern whether their recollective experience was strong, weak, or absent. Presumably a similar subjective process is required for deciding whether a target item qualifies as remembered or not remembered in Jacoby's (1991) exclusion task.

The present study also revealed that the measurable influence of unconscious processes on direct test performance varies as a function of LOP at study. Furthermore, the finding from both experiments that there was no significant difference across tests for completion of nonsemantically processed words when guesses were included as data is consistent with the view that a direct test on nonsemantically processed information when guessing is permitted is analogous to an indirect test of this information (cf. Merikle & Reingold, 1991). Thus, guessing may engage the same cognitive processes as does thinking of the first word that comes to mind. This reasoning is consistent with the finding from the subliminal perception literature that guessing is like an indirect test for information rendered subliminal (e.g., Dixon, 1971), and corroborates with the results of Gabrieli et al. (1990) and Graf et al. (1984) with normal subjects. The informed guessing that amnesic subjects readily demonstrate for both semantically processed and nonsemantically processed words, may parallel the informed guessing that normal subjects show, except normal subjects do not seem to benefit from guessing semantically processed words. The most parsimonious explanation for these seemingly disparate results is that it is only when little or no information is available to guide retrieval that informed guessing comes into play. For amnesic subjects this may be the rule, but for normal subjects, this might only occur when information has been minimally processed. When some information is available to guide retrieval (i.e., after semantic processing), unconscious influences in normal subjects may be inhibited. Together, these findings stress the importance of a close analysis of direct test responses which subjects claim they do not remember. If subjects do not remember but are required to make a response anyway, unconscious influences may unwittingly enhance performance.

It is important to note that the informed guessing effects that we measured in this study might not be the only unconscious influence on direct test performance. The present study was concerned with measuring a small subset of correct direct test responses which we could with some certainty delegate as having been influenced by unconscious processes. It would be inappropriate, however, to classify the remaining correct responses as due to purely explicit influences. Regardless of independence or exclusivity assumptions between implicit or explicit processes, our conservative criterion for accepting completions as guessed, probably much like the oppositional nature of Jacoby's (1991) exclusion task, may underestimate the contribution of implicit influences. Perhaps more importantly, however, the assumptions of independence or exclusivity may be unfounded. For example, a different but equally tenable assumption considers that conscious and unconscious influences be highly correlated because conscious influences are always associated with corresponding unconscious antecedents (Joordens & Merikle, 1993). This approach implies that conscious influences may define a subset of a larger set of unconscious influences, that happen to be momentarily conscious in order to meet task demands. From a biological and evolutionary viewpoint, this approach is highly persuasive (e.g., Ornstein, 1991). It argues for the primacy of unconscious influences at the highest levels of human cognition (Lhermitte & Serdaru, 1993; Reber, 1990; 1993).

In summary, the analysis of guessed responses in this study showed that direct test performance improves by guessing completions of nonsemantically processed words but does not improve by guessing completions of semantically processed words. This result points to a fundamental distinction in the experience of a direct test as a function of whether a word has been deeply processed or minimally processed at study. These results also contribute to the gradually developing viewpoint that memory tests are rarely process pure measures (cf. Jacoby, 1991; Jacoby, Lindsay, & Toth, 1992; Jacoby et al., 1993; see also Joordens & Merikle, 1993). The fact that guessing may access unconscious information in the same way that an indirect test does suggests that subjects can be unwittingly resourceful in their capacity to "remember" information that cannot consciously be retrieved. This conclusion contrasts with the often implicit assumption that conscious awareness is requisite for enabling one to act upon and respond to the world (see Ornstein, 1991). Instead, results from this and other studies encourage the viewpoint that awareness is not always necessary for eliciting effective or useful behaviour.

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Footnotes

[1] In recent years, a distinction has been made between indirect tests subclassified as perceptual or conceptual (e.g., Weldon, Roediger, & Challis, 1989). Performance on perceptual tests is held to depend on perceptual similarity between study and test stimuli whereas conceptual test performance requires no such similarity. The present study does not address this distinction other than to clarify, first, that the indirect test used in this study would be classified as a perceptual test, and second, that LOP effects are less likely to be found for perceptual than conceptual tests (Roediger & McDermott, 1993).

Table 1.

Mean Proportion of Correct Completions of Semantically and Nonsemantically Processed Words for the Direct Test of Experiment 1 Before and After Removal of Guessed Data.

	Word Type					
	Semantic		Nonsemantic		Distractor	
Retention Test	Mean	SD	Mean	SD	Mean	SD
Direct						
pC	.429	.101	.204	.101	.092	.079
cpC	.338	.105	.113	.117	--	--
Direct - Guesses						
pC	.396	.089	.067	.078	.004	.014
cpC	.392	.089	.063	.078	--	--

Note: pC = proportion of correct completions; cpC = chance adjusted pC; Direct – Guesses = Direct test performance after removal of guessed responses.

Table 2.

Mean Proportion of Completions for Each Word Type on the Direct Test in Experiment 1 That Were Reported as Guessed, and the Proportion of These Completions That Were Also Correct.

	Word Type					
	Semantic		Nonsemantic		Distractor	
	Mean	SD	Mean	SD	Mean	SD
pG	.508	.140	.804	.141	.808	.148
pCG	.065	.076	.178	.099	.104	.085

Note: pG = proportion of guessed completions; pCG = proportion of correctly guessed completions (i.e., proportion of guessed completions that were also correct divided by pG).

Table 3.

Mean Proportion of Correct Completions of Semantically and Nonsemantically Processed Words For Direct and Indirect Tests of Memory in Experiment 2.

	Word Type					
	Semantic		Nonsemantic		Distractor	
Retention Test	Mean	SD	Mean	SD	Mean	SD
Indirect						
pC	.293	.088	.264	.125	.069	.060
cpC	.223	.110	.194	.129	--	--
Direct						
pC	.473	.126	.253	.106	.081	.055
cpC	.393	.128	.172	.098	--	--

Note: pC = proportion of correct completions; cpC = chance adjusted pC.

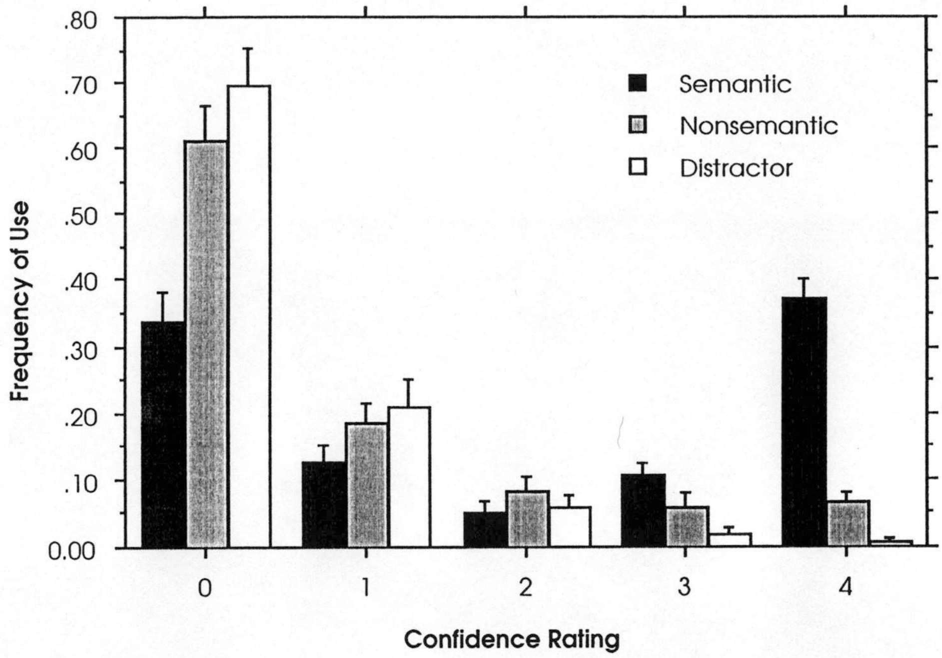

Figure 1. Frequency of use of each confidence rating for direct test completion of semantically processed, nonsemantically processed, and distractor words in Experiment 2. Error bars represent standard errors of the mean.

Table 4.

Mean Proportion of Completions for Each Word Type on the Direct Test in Experiment 2 That Were Reported as Guessed, and the Proportion of These Completions That Were Also Correct.

	Word Type					
	Semantic		Nonsemantic		Distractor	
	Mean	SD	Mean	SD	Mean	SD
pG	.339	.176	.611	.229	.698	.230
pCG	.016	.036	.133	.126	.061	.067

Note: pG = proportion of guessed completions; pCG = proportion of correctly guessed completions (i.e., proportion of guessed completions that were also correct divided by pG).