CHAPTER 2

The Relation Between Conscious and Unconscious (Automatic) Influences: A Declaration of Independence

Larry L. Jacoby
Andrew P. Yonelinas
Janine M. Jennings
McMaster University

Research on unconscious processes has long been plagued by theoretical and methodological problems. Consequently, the unconscious was banished, along with consciousness, by radical behaviorists, and has only recently regained respect as a research topic. The resurgence of interest in conscious and unconscious processes is largely due to findings of dissociations between performance on direct and indirect tests of memory and perception. Effects of the past in the absence of remembering, and perceptual analysis in the absence of conscious seeing arise from studies of patients with neurological deficits. Warrington and Weiskrantz (1974) found that amnesics showed little evidence of memory for an earlier-read word list when asked to recall or recognize those words (a direct memory test). However, the amnesics used those words to complete word fragments (an indirect test) more often than if the words had not been seen earlier (see Moscovitch, Vriezen, & Gottstein, 1993, for a review of related research). Similar memory dissociations are evident in people with normal functioning memory (for a review, see Roediger & McDermott, 1993). The form of dissociations found for memory is comparable to dissociations taken as evidence for unconscious perception. For example, Marcel (1983) flashed words for a duration so brief that subjects could not "see" them, but could show effects of those words on a lexical decision task used as an indirect test of perception.

Empirical advances derived from the indirect versus direct test distinction have proceeded without confronting many of the methodological and conceptual issues that plagued earlier investigations of unconscious processes.

However, those issues have now resurfaced. The major difficulty for drawing a distinction between conscious versus unconscious processes is the problem of defining each type of process. Essential here is the relation of processes to tasks (Dunn & Kirsner, 1989). Typically, unconscious processes are equated with performance on indirect or implicit tests and conscious processes with performance on direct or explicit tests. However, this form of definition is problematic because conscious processes may contaminate performance on indirect tests (e.g., Holender, 1986; Reingold & Merikle, 1990) and, less obviously, unconscious processes might contaminate performance on direct tests (Jacoby, Toth, & Yonelinas, 1993). In addition, mapping processes onto test performance overlooks an essential aspect of defining unconscious and conscious processes, which is specifying the relation between them.

This chapter provides an overview of research done within our process-dissociation framework (e.g., Jacoby, 1991; Jacoby et al., 1993) for separating conscious and unconscious influences. Rather than equating processes with tasks, as is done by the direct versus indirect test distinction, our strategy has been to gain estimates of the contributions of each type of process to performance on a single task and show the dissociative effects of variables on those estimates. In order to distinguish between conscious and unconscious processes, we need to make an assumption about their relation. Our work has been based on the assumption that conscious and unconscious influences are independent of one another.

The goals of this overview are as follows: First, we highlight the purpose of the process-dissociation procedure and then describe an experiment using that procedure to examine age-related differences in cognitive control. Second, we consider potential assumptions for the relation between unconscious and conscious processes, specifically, independence, redundancy, and exclusivity. Third, we summarize evidence to support the choice of the independence assumption and, finally, provide strong evidence against the alternatives. Throughout, we treat the contrast between unconscious versus consciously controlled processes as identical to the contrast between automatic versus controlled processes. Later, we justify doing so and discuss how our approach offers a solution to the problem of defining conscious and unconscious processes.

PROCESS-DISSOCIATION PROCEDURE

As described earlier, dissatisfaction with indirect tests of memory and perception has centered on the possibility of their contamination by contributions of aware, intentional processes. However, there is a more serious problem: Automatic processes operating in isolation may be qualitatively different from those operating in the context of consciously controlled processes. Consider the commonplace claim that you should get an individual drunk to learn what that person really believes. Drunkenness is treated as a pure measure of automaticity or true belief. The "contamination" problem is to question how drunk a person has to be before his responding is no longer contaminated by consciously controlled processing. Even if one could achieve an uncontaminated test, there is the more serious "qualitative difference" problem of whether or not the test reveals a person's "true" beliefs or only what that person believes when drunk. Most likely, some of one's beliefs when drunk are qualitatively different from one's beliefs when sober. Automatic influences in the context of consciously controlled processes, like true beliefs when sober, are of great interest. Because the indirect versus direct test distinction identifies processes with tasks, it provides no means of measuring automaticity in the presence of consciously controlled processing.

An objective means of measuring conscious control is necessary to separate controlled and automatic influences. The process-dissociation procedure measures conscious control by combining results from a condition for which automatic and consciously controlled processes act in opposition, with results from a condition for which the two types of process act in concert. The measure is the very commonsensical one of the difference between performance when one is trying to as compared with trying not to engage in some act. The difference between performance in those two cases reveals the degree of cognitive control. The chapter illustrates the process-dissociation procedure in conjunction with the results of an experiment done to show an age-related effect on recollection—a consciously controlled use of memory.

Jacoby et al. (1993) used an Inclusion/Exclusion procedure with a stem-completion task to separate recollection from automatic influences of memory. Jacoby (1992) used a similar procedure to examine age-related differences in memory performance. In that experiment, words were presented for study and then tested by presentation of their first letters as a cue for recall (e.g., motel; mot––). Study and test items were intermixed, and both the number of items intervening between the study presentation of a word and its test (spacing) and the nature of the test were varied. For an inclusion test, the word stem was accompanied by the message "old" and subjects were instructed to use the stem as a cue for recall of an old word or, if they could not do so, to complete the stem with the first word that came to mind. An inclusion test corresponds to a standard test of cued recall with instructions to guess when recollection fails. For an exclusion test, a word stem was accompanied by the message "new" and subjects were instructed to use the stem as a cue for recall of an old word but to *not* use a recalled word as a completion for the stem. That is, subjects were told to exclude old words and complete stems only with new words. The two types of tests were randomly intermixed.

When an inclusion or exclusion test immediately followed presentation of its completion word (0 spacing), performance of the elderly and of the young was near perfect. This finding is important because it shows that the elderly were able to understand and follow instructions. In contrast, when a large number of items intervened between the presentation of a word and its inclusion or exclusion test (48 spacing), the elderly performed much more poorly than did the young (Table 2.1).

For the exclusion test, elderly subjects were more likely to mistakenly complete a stem with an old word than were younger subjects. In the exclusion test, effects of automatic influences of memory for earlier reading a word should be opposed by recollection. The poorer performance of the elderly on the exclusion test can be explained as resulting from a deficit in recollection as can their poorer performance on the inclusion test. Placing recollection and automatic influences in opposition, as was done by the exclusion test, can provide evidence of the existence of the two types of processes (Jacoby, et al., 1993). However, it is necessary to combine results from the exclusion and inclusion tests to estimate the separate contributions of consciously controlled and automatic processes.

For an inclusion test, subjects could complete a stem with an old word either because they recollected the old word, with a probability R, or because even though recollection failed $(1 - R)$, the old word came automatically to mind (A) as a completion: $Inc = R + A(1 - R)$. For an exclusion test, in contrast, a stem would be completed with an old word only if recollection failed and the word came automatically to mind: $Exc = A(1 - R)$. Thus, the difference between the inclusion (trying to use old words) and exclusion (trying not to use old words) tests provides a measure of the probability of recollection. Given that estimate, the probability of an old word automatically coming to mind as a completion can be computed. One way of doing this is to divide the probability of responding with an old word for an exclusion test by $(1 - R)$: $\text{Exclusion}/(1 - R) = A(1 - R)/(1 - R) = A$.

The estimates (Table 2.1) provide evidence that the elderly suffered a deficit in recollection as compared to younger participants, but that auto-

TABLE 2.1
Probability of Correct Fragment Completion and Estimates of Conscious and Unconscious Influences of Memory as a Function of Age

	Young	*Old*
Test		
Inclusion	.70	.55
Exclusion	.26	.39
Estimates		
Conscious	.44	.16
Unconscious	.46	.46

Note: The baseline completion for items not presented was .36.

matic influences of memory were unchanged. The estimates of automatic influences were well above the baseline probability of completing a stem with a target word when that word had not been earlier presented (.36). The difference between estimated automatic influences and baseline performance serves as a measure of automatic influences of *memory*—the effect of studying a word on the probability of its later coming to mind automatically as a completion for a stem.

If one makes the assumption that the base rate and unconscious influences of memory are additive, we can subtract base rate to compute automatic influences of memory. However, this approach is only necessary when base rates across a manipulation (e.g., age) are not equal, and is the same as the standard procedure of measuring "priming" as the difference between performance on old and new items (e.g., Roediger & McDermott, 1993). Alternatively, we could use signal-detection theory to take differences in base rate into account, and U would be replaced by $P(U > Cr)$ with Cr being the criterial level of strength required for a response reflecting unconscious memory influences to be produced. We discuss this use of signal-detection theory later.

The aforementioned results show age-related differences in memory to be very similar to effects produced by dividing attention during the study presentation of a word. Jacoby et al. (Exp. 1b, 1993) used the same materials as Jacoby (1992) but tested only young participants. Results showed that divided, as compared to full, attention during study reduced the probability of recollection (.00 vs. .25) but left automatic influences unchanged (.46 vs. .47). For the divided- versus full-attention experiment, study and test were in separate phases rather than intermixed, and, on average, the spacing between study of a word and its test was a bit longer than 48 intervening items. Nonetheless, the correspondence between age-related differences in memory and effects of full versus divided attention supports Craik and Byrd's (1982) claim that dividing attention during study can mimic the memory effects of aging.

The process-dissociation procedure has the advantage of allowing one to examine automatic influences operating in the context of consciously controlled processes (and vice versa) while eliminating problems of contamination. For example, had one relied on a test of cued recall to measure recollection, as is typically done, the probability of recollection would be overestimated because of failure to take automatic influences of memory into account (Jacoby et al., 1993). By separating the contributions of automatic and controlled processes, it was possible to show that aging and divided attention produced process dissociations, reducing recollection but leaving automatic influences invariant. Results from the manipulation of full versus divided attention provide a case that corresponds to commonplace claims about drunkenness. Divided attention, like the supposed effect of drunkenness, totally eliminated contributions of controlled processes ($R = 0$) to produce a pure test of automatic influences. Further, automatic influences measured by that process-pure test almost perfectly predicted the contribution of automatic influences when controlled processes were in play. That is, automatic influences operating in the presence of recollection (after full attention) were the same as those operating in its absence (after divided attention).

Without the process-dissociation procedure, one could not know that, in this case, dividing attention did achieve a pure test of automaticity nor could one know that automaticity was the same across different levels of cognitive control. Neither conclusion could be reached by contrasting indirect and direct test performance. However, the equations used to estimate the separate contributions of automatic and controlled processes rest on the assumption that the two types of processes act independently. If one refuses to hold the independence assumption, the apparent process dissociations must be dismissed as chance. The next section considers alternatives to the independence assumption.

THE RELATION BETWEEN CONSCIOUS AND UNCONSCIOUS INFLUENCES

As already mentioned, one cannot distinguish between conscious and unconscious processing without making an assumption, at least implicitly, about the relation between the two types of processes. There are three fundamental relations: *exclusivity, redundancy,* and *independence* (see Jones, 1987). Unfortunately, each holds a good deal of intuitive appeal.

When describing subjective experience, an exclusivity view seems an obvious choice for the relation between conscious and unconscious processing. By that view (Fig. 2.1a), one is either conscious or unconscious of a type of influence. That is, the two processes are mutually exclusive. An historical example of the exclusivity assumption is the Freudian notion that memories reside either in the conscious or the unconscious. More recently, following Tulving (1983), Gardiner and associates (Gardiner, 1988; Gardiner & Java, 1991; Gardiner & Parkin, 1990) applied the exclusivity assumption in their Remember/Know procedure to differentiate among the subjective experiences accompanying memory.

It seems equally appealing to claim that consciousness is but the "tip of the iceberg" (e.g., Baars, 1988) so that events that gain consciousness comprise a small subset of those that are unconsciously processed. By this redundancy assumption (Fig. 2.1b), conscious processing can emerge out of unconscious processing as described in threshold models of perception. That is, items are processed unconsciously until they reach a particular threshold, at which point they become conscious. As applied to the development of automaticity, the notion is that after extended practice, the execution of skills becomes au-

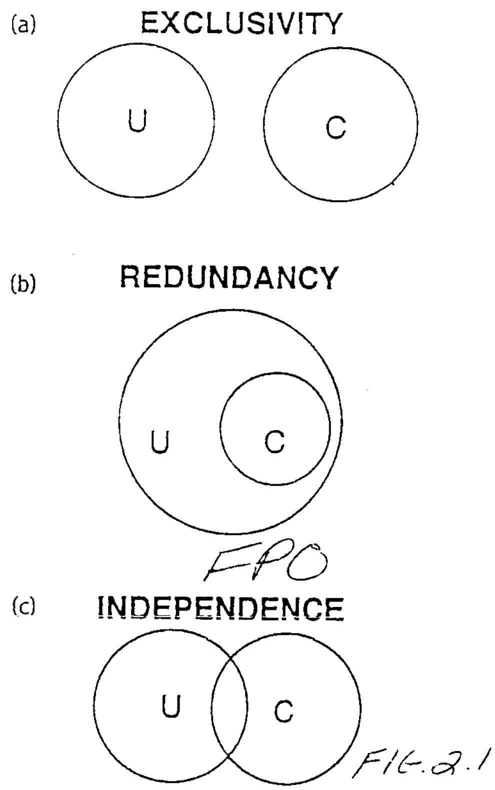

FIG. 2.1. Venn Diagrams of the exclusivity, redundancy, and independence relations between conscious (C) and unconscious (U) influences.

tomatic or unconscious by receding below the threshold of consciousness. The redundancy assumption has also been applied to the study of memory, and provides the underpinning for Generate/Recognize models (e.g., Jacoby & Hollingshead, 1990; Joordens & Merikle, 1993), which hold that items that can be recognized are a subset of those that are generated. As described later, recognition is identified with a conscious influence of memory, whereas generation is treated as reflecting unconscious influences.

An alternative approach is to assume that conscious and unconscious influences act fully independently of one another (Fig. 2.1c). Conscious processing can occur with or without unconscious processing and vice versa. This assumption differs from redundancy, which requires that the conscious cannot occur without the unconscious, and exclusivity, which specifies that the two can never co-occur. Logan's (1988) view of automaticity is based on an independence assumption and provides a contrast to the redundancy view of automatization described earlier. Automaticity reflects memory for instances in which a skill was earlier applied. Such unconscious influences of memory provide a basis for responding that is independent of the consciously controlled application of an algorithm. In other cases, independence might arise from the contribution of two separate structures to performance. The phenomenon of blind sight, for example, has been understood by postulating independent visual systems (Weiskrantz, 1986). In favor of the independence assumption, Jones (1987) noted the general consensus that "on a criterion of parsimony, processes should be assumed to be unaffected by each other's presence until a demonstration to the contrary occurs" (p. 230).

ESTIMATING CONSCIOUS AND UNCONSCIOUS INFLUENCES

The importance of the relation between conscious and unconscious processes becomes obvious when one attempts to estimate their separate effects. This can be seen by considering a more general form of the equations used by Jacoby (1992) and Jacoby et al. (1993) to separate consciously controlled and automatic (unconscious) influences of memory. For an inclusion test, a stem could be completed with an old word either because of conscious recollection (C) or because of unconscious influences (U) of the same sort that would be revealed by an indirect test. For an exclusion test, a stem could be completed with an old word on an exclusion test only if the word is produced because of unconscious influences and is not recollected as being old.

The choice among assumptions about the relation between conscious and unconscious influences can be clarified by writing equations for performance on inclusion and exclusion tests in a general form that follows Jones (1987):

$$\text{Inclusion} = C + U - (C \cap U) \quad (1)$$
$$\text{Exclusion} = U - (C \cap U) \quad (2)$$

These equations describe the probability of completing a stem with an old word as reflecting the separate contributions of conscious (C) and unconscious (U) influences. It is the definition of the intersect between the two types of influence, ($C \cap U$), that differentiates assumptions about their relation. If independence is assumed, then ($C \cap U$) is defined as CU. But, if redundancy is assumed, then ($C \cap U$) is defined as C. That is, by an independence model, the effect of conscious recollection is symmetrical in that conscious recollection increases the probability of completing a stem with an old word for the inclusion test but decreases that probability for the exclusion test. By the redundancy assumption, on the other hand, conscious recollection only plays a role for the exclusion test where it can be used to avoid responding with old words. Finally, by an assumption of exclusivity, ($C \cap U$) is defined as 0. Thus, conscious recollection adds to performance in the inclusion test but does not contribute to performance in the exclusion test.

of C.

Subtracting Exclusion from Inclusion provides an estimate of C. As can be seen by substituting the different definitions of ($C \cap U$) into Equations 1 and 2, this is true regardless of which assumption about the relation between C and U is adopted. However, the manner in which U is estimated differs depending on the assumed relation between C and U. By a redundancy model, performance on an inclusion test provides a process-pure estimate of U, whereas by an exclusivity model such an estimate is provided by performance on an exclusion test. An independence model, in contrast, does not treat either of the two tests as yielding a pure estimate of unconscious influences. Rather, once an estimate for C has been gained, then U can be determined algebraically as performance on the Exclusion test divided by ($1 - C$). The following sections provide arguments for choosing the independence assumption.

DEFINING CONSCIOUS AND UNCONSCIOUS PROCESSES BY AN INDEPENDENCE MODEL

Specifying the relation between conscious and unconscious processes achieves much with regard to their definition. Our strategy has been to try to arrange conditions such that the two types of processes independently contribute to performance. Consciously controlled processes are then defined as those producing a difference in performance that reflect current intentions. For example, the difference between the probability of producing an old word for an inclusion as compared to an exclusion test is taken as measuring intentional, consciously controlled use of memory. Automatic or unconscious processes, in contrast, are defined as producing the same effect regardless of whether the effect is in concert or in opposition to current intentions. Thus, by the process-dissociation procedure, conscious and unconscious processes are defined in terms of their differential relation to intention. This relational definition contrasts with attempts to define the two types of processes by identifying them with different tasks or experimental conditions.

Identifying conscious and unconscious influences with direct and indirect tests, respectively, also defines the two types of processes with reference to intention. However, unlike the process-dissociation procedure, the validity of that approach relies on achieving process-pure tests. Other techniques have also been used as an attempt to fully eliminate consciously controlled processes to produce pure measures of unconscious influences or automaticity. *Automaticity* has been defined as a typically rapid basis for responding that does not require attentional capacity and is privileged, for example, in being relatively uninfluenced by the effects of aging or drugs such as alcohol (e.g., Hasher & Zacks, 1979; Posner & Snyder, 1975; Schneider & Shiffrin, 1977). Each of the criteria in this definition has been used as an attempt to produce a pure measure of automaticity. It is likely that indirect tests (dividing attention, requiring fast responding, etc.) limit the contribution of consciously controlled processes. However, as discussed for the effects of alcohol, none can be relied on to always fully eliminate conscious processing.

Our definition of conscious and unconscious processes rests on the independence of their contribution. What evidence can we gain to show our attempt to achieve conditions that produce independence are successful? One source of support would be to show that variables traditionally identified with cognitive control produce process dissociations by affecting consciously controlled processing while leaving unconscious influences invariant. In this light, finding invariance in the unconscious use of memory across a group of manipulations (e.g., dividing attention and aging) that influences conscious memory provides evidence for independent processes (Jacoby et al., 1993).

Process Dissociations Supporting Independence

Results from some of our experiments showing process dissociations produced by variables identified with cognitive control are summarized in Table 2.2, where changes in conscious (Δ Consc) and unconscious (Δ Uncon) influences are presented as a function of attention, retrieval speed, and age.

We have found invariance in unconscious influences of memory accompanied by changes in conscious memory from comparing full versus divided attention for word stem completion, recognition memory, and fame judgment tasks. Conscious and unconscious perception also exhibit this pattern of results. Beside attentional manipulations, other variables used as indices of automaticity, such as retrieval speed and age have been examined. Decreasing retrieval time in recognition by forcing subjects to respond before a signal reduces conscious memory processing, but leaves the unconscious use of memory intact. Similarly, aged subjects show large deficits in conscious memory but no impairments in unconscious memory. The results in Table 2.2 are strikingly consistent. The average change in unconscious influences across all of the experimental conditions where we expect invariance is only .002, and the change in conscious memory is .24.

Process dissociations produced by manipulations identified with automaticity are so consistent that they must be explained by any adequate model. The invariance in *U* across large effects on *C* (Table 2.2) is expected if *C* and *U* are independent. However, from the perspective of either an exclusivity or a redundancy model, this invariance must be seen as a curious accident reflecting a delicate balance between offsetting effects. For example, suppose one estimated conscious and unconscious influences using the independence model whereas, in reality, the redundancy model holds true. This would result in an underestimation of unconscious influences. To hold a redundancy model and explain the invariance in *U* estimated by the independence model, it must be argued that the "apparent" cases of invariance shown in Table 2.2 each reflect a delicate balance between the underestimation of *U* produced

TABLE 2.2
Changes in Conscious and Unconscious Influences as a Function of Attention, Retrieval Speed, and Age

Experiment	*Condition*	*Δ Consc*	*Δ Uncon*
	Attention—Full vs. Divided		
Stem Completion	Exp. 1A	.20	.00
	Exp. 1B	.25	.01
Cued Word Completion	Related Cue	.24	−.03
	Urelated Cue	−.01	.01
Cued Fragment Completion	Related Cue	.17	−.01
	Unrelated Cue	.05	−.01
Fame Judgment		.26	−.05
Recognition (Yes/No)	Related Cue	.24	.00
	Unrelated Cue	.20	.00
Perceptual Task	Exp. 2	.42	.01
	Exp. 3	.64	−.02
	Retrieval Speed—Slow vs. Fast		
Recognition (Yes/No)	Short Lists	.09	.03
	Long Lists	.08	.04
Recognition (Yes/No)	Sem Encoding	.22	−.04
	Nonsemantic	.13	.02
	Age Effects—Young vs. Elderly Adults		
Fame Judgment		.29	−.06
Recognition (Forced Choice)	Read	.33	.04
	Anagram	.21	−.01
Continuous Stem Completion	Lag 12	.45	.03
	Lag 48	.28	.00
Average Difference:		.24	.002

Note: The representation of data in this table is very conservative. For example, for the fame judgment experiments, changes in unconscious influences (−.05 and −.06) were due to differences in base rates between conditions. After correcting for base rates, the respective changes in unconscious influences are −.02 and .00. We mention this because problems with base rate along with floor and ceiling effects are the most common problems one is likely to encounter when using the inclusion/exclusion procedure.

by violating the independence assumption, and a near perfectly offsetting effect of the manipulated variable. Given that the invariance in *U* has been found across a wide range of estimates of *C*, the required balance becomes even more delicate. We feel that the burden of proof is on those who propose such delicate balances (e.g., Joordens & Merikle, 1993); that is, it must be explained why balances that mimic independence occur so frequently.

As further evidence for independence, Jacoby et al. (1993) showed that a read versus generate manipulation produced opposite effects on *C* and *U*. Generating, as compared to reading a word, enhanced conscious recollection but produced less unconscious influences on stem-completion performance. The pattern of results converges with findings of task dissociations. Generating a word at study produces better conscious memory, measured by a direct test, than does reading a word (e.g., Jacoby, 1978; Slamecka & Graf, 1978), whereas the opposite is true for an indirect test of visual word recognition (Jacoby, 1983; Winnick & Daniel, 1970). These results show that invariances found with *U* do not reflect general insensitivity of that measure, because there are manipulations that have an effect.

Comparisons with Indirect Test Performance Provide Converging Evidence

We gain additional support for our independence model by further building on findings of task dissociations. Although sometimes contaminated by effects of conscious processes, it seems likely that performance on indirect tests primarily reflect unconscious influences. The majority of findings from indirect tests provide converging evidence for conclusions based on the use of the independence model. For example, manipulations of attention (e.g., Koriat & Feuerstein, 1976), levels of processing (e.g., Jacoby & Dallas, 1981), and aging (e.g., Light & Albertson, 1989) have large effects on direct test performance but little or no effect on indirect test performance. Similarly, we find those manipulations influence *C* but not *U*.

Although estimates of *U* are generally in agreement with results from indirect tests, the two can diverge, presumably because *C* can contaminate performance on indirect tests. As an example, consider the effects of levels of processing. One way of accounting for the small effects that are obtained (e.g., Challis & Brodbeck, 1992) is to claim that performance on the indirect test is contaminated by conscious influences of memory of the same sort as measured by a direct test (Roediger, Weldon, Stadler, & Riegler, 1992). Further, if it were not for such contamination, no effects of levels on indirect test performance would be found. Recent work using the process-dissociation procedure supports this claim. Toth, Reingold, and Jacoby (1994) used a stem-completion task and showed that estimates of conscious recollection are higher after deep than shallow processing (.23 vs. .03), but unconscious influences are near identical (.45 vs. .44). This finding of invariance is similar to those found with manipulations of attention (see Table 2.2).

The issue of contamination is crucial for choosing among models. By the redundancy assumption, performance on an indirect task or even an inclusion condition is treated as a pure measure of *U*. However, if that task is contaminated by *C*, then any conclusions will be untenable. The next section describes a series of experiments to show that cross-modality transfer in performance on an indirect test can arise from the contaminating effects of conscious use of memory.

COMPARING INDEPENDENCE WITH REDUNDANCY AND EXCLUSIVITY

Cross-Modality Transfer as a Testing Ground for the Relation Between Conscious and Unconscious Influences

Experiments using indirect tests such as perceptual identification and fragment completion have generally shown effects of changing modality between study and test. For visual word identification, reading a word substantially increases its later identification, whereas hearing a word can confer little or no advantage in later identification performance (Jacoby & Dallas, 1981; Morton, 1979). For visual stem- and fragment-completion performance, reading a word also does more to increase the probability of its later being given as a completion than does hearing a word. However, words that were earlier heard are often found to enjoy a large advantage over new words (Blaxton, 1989; Graf, Shimamura, & Squire, 1985; Roediger & Blaxton, 1987). This cross-modality transfer has been taken as evidence for the existence of an abstract, modality-free representation of words that can be temporarily primed (Kirsner & Dunn, 1985).

Conclusions drawn about the basis for cross-modality transfer rest on assumptions about the relation between conscious and unconscious influences of memory, and the mapping of forms of memory onto types of test. For the conclusion that cross-modality transfer on an indirect test reflects the priming of an abstract representation, it must be assumed that an indirect test serves as a pure measure of automatic or unconscious influences. Alternatively, cross-modality transfer could arise from the contamination of performance on the indirect test by intentional uses of memory (Jacoby et al., 1993). Concerns of this sort are illustrated by results from a series of experiments done to examine cross-modality transfer, and to use findings of transfer as a testing ground for assumptions about the relation between conscious and unconscious influences of memory. The independence assumption is first contrasted with the redundancy assumption, then with the exclusivity assumption.

A series of experiments was done to examine cross-modality transfer. In the first phase of each of those experiments, a long series of words was presented with half being read and the other half being heard. Subjects read words aloud and repeated heard words to ensure perception of the presented words. Memory was tested by presenting word fragments that subjects were to complete. Word fragments rather than word stems were used because cross-modality transfer found using word stems may result from subjects pronouncing the stem and, thereby, gaining access to memory for earlier hearing the word (Donaldson & Geneau, 1991). That is, when word stems are used, transfer from heard words may not be truly cross-modal but, rather, have an aural basis because of stem pronunciation. To eliminate such transfer, unpronounceable word fragments were used. Each fragment allowed only a single solution. Test conditions were varied to reflect different assumptions about the relation between conscious and unconscious influences of memory.

Redundancy versus Independence: The Indirect Test as a Pure Measure of Unconscious Influences

The redundancy model treats consciousness as the result of processing that follows unconscious influences. For example, conscious awareness that a word was presented earlier might only be gained after the word came to mind as a completion for a fragment. Models of this sort (Jacoby & Hollingshead, 1990; Jacoby et al., 1993; Joordens & Merikle, 1993) can be classified as generate-recognize models of memory, and estimates of unconscious influences differ depending on the specific model used. For example, Joordens and Merikle used performance on an *inclusion* test as an estimate of unconscious influences, whereas Jacoby and Hollingshead used an *indirect* test. Given the argument against equating unconscious influences with indirect test performance is the potential contamination from conscious processes (e.g., Holender, 1986; Reingold & Merikle, 1990), this problem is increased with an inclusion test where subjects are instructed to intentionally use memory.

Cross-Modality Transfer as Measured by an Indirect Test. For an indirect test (Exp. 1), fragments that could be completed with an old word were intermixed with fragments that could only be completed with a new word. Subjects were instructed to complete as many of the fragments as they could. No mention was made of the relation between study and test. Results from that indirect test (Table 2.3) provide evidence of modality-specific transfer by showing that words that were earlier read were more likely to be given as a com-

TABLE 2.3
Probability of Correct Fragment Completion in Experiment 1

Study		
Read	*Heard*	*New*
.61	.48	.24

pletion than were words that were earlier heard. However, there was also a substantial amount of cross-modality transfer as shown by the advantage of words that were heard over new words. This pattern of results is the same as reported by others (e.g., Graf et al., 1985).

Cross-Modality Transfer as Measured by Process-Dissociation Procedure. The next question asked was whether we still see cross-modality transfer in unconscious processes when the process-dissociation procedure is used to eliminate contamination. In Experiment 2, the study procedure and the fragments presented at test were the same as for the previous fragment-completion experiment. Instructions for the inclusion and exclusion tests, as well as other details of the test procedure, were the same as described by Jacoby et al. (1993).

Results for the inclusion and exclusion tests along with estimates of conscious and unconscious influences based on the independence assumption are displayed in Table 2.4. Those estimates show that study modality had an effect on both conscious and unconscious influences. Words that were read were more likely to be recollected as a completion for a fragment, a conscious use of memory, than were words that were heard, and were also more likely to produce an unconscious use of memory. This unconscious influence produced by words that were read may have had the same basis as priming observed on the indirect test. However, unlike performance on the indirect test, the process-dissociation data provide no evidence of cross-modality transfer. The estimated unconscious influences for words that were heard did not differ significantly from the baseline provided by performance on fragments that could only be completed with a new word.

Comparing results across the two experiments reveals a striking similarity

TABLE 2.4
Probability of Correct Fragment Completion and Estimates of Conscious and Unconscious Influences of Memory as a Function of Study Processing in Experiment 2

	Study	
	Read	*Heard*
Test		
Inclusion	.63	.46
Exclusion	.27	.24
Estimates		
Conscious	.36	.23
Unconscious	.39	.29

Note: The baseline completion rate for items not presented at study was .26.

between results for the indirect test (Table 2.3) and results for the inclusion test (Table 2.4). The near-identity of those results would be explained differently depending on whether one assumed redundancy or independence between unconscious and conscious memory. To uphold a redundancy model one could argue that instructing subjects to use fragments as cues for recall, as was done for the inclusion test, did nothing but add a recognition-memory check to the generation processes relied on for the indirect test (Jacoby & Hollingshead, 1990). That recognition-memory check would be irrelevant for the inclusion test, because subjects were instructed to complete fragments with any word that came to mind if unable to recall an old word. If the redundancy model holds, the lack of cross-modality transfer revealed by applying the independence model can be dismissed as resulting from the underestimation of U produced by violation of the independence assumption.

Alternatively, by the independence model, the near-equivalence of performance on the indirect and inclusion tests can be produced from the indirect test being functionally equivalent to the inclusion test in its reliance on intentional use of memory. That is, although subjects were not informed about the relation between study and the indirect test, they may have "caught-on" and intentionally used memory to complete word fragments just as did subjects given an inclusion test. If so, cross-modality transfer effects found on the indirect test likely result from contamination by intentional use of memory.

Converging Evidence for Independence. Jacoby et al. (1993) showed that divided, as compared to full, attention during study reduced subjects' ability to recollect those items but left unconscious influences of memory unchanged. Arguing from that result, manipulating full versus divided attention during study provides a potential means for choosing between the different assumptions. In particular, if cross-modality transfer observed on an indirect test is due to contamination by intentional use of memory, and if dividing attention during study reduces the ability to later use intentional memory, then cross-modality transfer should be eliminated on an indirect test by dividing attention during study. The rationale is the same as described earlier for the effects of drunkenness. If the indirect test could be made process pure, performance on that test should match the estimate of automatic influences gained by the process-dissociation procedure.

In an experiment done to examine that possibility (Exp. 3), subjects heard a long list of words and repeated aloud each word in the list immediately after its presentation. While hearing and repeating words, subjects in a divided-attention condition engaged in the additional task of searching through numbers that were rapidly presented visually for runs of three odd numbers in a row (e.g., 9, 7, 3). They were instructed that this visual search task was their primary task, and repeating the words should be done rather automatically to not interfere with the search task. Subjects in a full-attention condition did

TABLE 2.5
Probability of Correct Fragment Completion
Under Conditions of Full and Divided Attention in Experiment 3

	Study	
Attention	*Heard*	*New*
Full	.50	.30
Divided	.36	.30

not engage in the search task while hearing and repeating words. The indirect test of fragment completion was the same as described previously.

Results on that test (Table 2.5) showed that cross-modality transfer was radically reduced after divided, rather than full, attention was given to hearing and repeating words. The reduction in transfer is consistent with the suggestion that cross-modality transfer relies on intentional use of memory, which was reduced after attention was divided during study. Further evidence that recollection played a role was gained by questioning subjects after the fragment-completion test. All subjects in the full-attention condition claimed to have noticed the relation between study and test and to have intentionally used memory for the earlier heard words to complete fragments. In the divided-attention condition, subjects were assigned to an "aware" or "unaware" group on the basis of their self-reports. Subjects in the unaware group either claimed to have been unaware of the relation between study and test or to have become aware of that relation very late in the test, whereas those in the aware group claimed to have become aware early on and to have intentionally used memory to respond. Separating fragment-completion performance for these two groups revealed that only aware subjects showed cross-modality transfer, completing more fragments with earlier heard words than with new ones (.40 vs. .29). For unaware subjects, the probability of completing fragments with earlier-heard words was nearly identical to that of completing fragments with new words (.32 vs. .31).

To summarize Experiment 3, dividing attention during study provides evidence that performance on the indirect test of fragment completion is sometimes badly contaminated by an intentional use of memory. After dividing attention, cross-modality transfer is radically reduced and is near zero when self-reported awareness is taken into account. These results are identical to those estimated using the independence assumption. That is, performance on an indirect test that is unlikely to be contaminated by intentional uses of memory almost perfectly matches the estimate of automatic influences gained by relying on the independence assumption. Similarly, Toth et al. (1994) found that indirect test performance after shallow, but not after deep, processing almost perfectly matched *U*. These findings of correspondence between "uncontaminated" indirect test performance and *U* converge with findings of process dissociations produced by manipulating attention and level of processing. Just as earlier described for the pure test of automatic influences produced by dividing attention, results from uncontaminated indirect tests almost perfectly predict automatic influences operating in the presence of consciously controlled processes. However, we could not know this without the process-dissociation procedure.

The effects of dividing attention on later cross-modality transfer, as measured by an indirect test, converge with results reported by Weldon and Jackson-Barrett (1993). They were able to eliminate picture-to-word transfer on an indirect test by having subjects divide attention during encoding (Exp. 2) or by requiring rapid responding (Exp. 3). Weldon and Jackson-Barrett interpreted their divided-attention results as showing that picture-to-word priming relies on covert naming of a picture during study. However, the results might be better interpreted as showing that picture-to-word transfer reflects contamination of performance on the indirect test by intentional use of memory. Such contamination is decreased when recollection is made less likely by dividing attention during encoding, or requiring fast responding at test (see Toth & Reingold, in press, for further arguments to support this interpretation). Of course, we cannot be certain that all cross-form transfer on indirect tests reflects contamination. However, there is reason to suspect that when contamination is removed, there will be less need to postulate abstract, modality-free representations (cf. Kirsner & Dunn, 1985).

We are unable to specify conditions that ensure an indirect test will be uncontaminated. The problems are the same as would be faced by an attempt to specify a criterial level of drunkenness to achieve a pure test of automaticity. There are likely individual differences in response to drunkenness, divided attention, instructions for an indirect test, and so forth. We have been able to show that changing conditions so that they are less hospitable to conscious control increases the similarity between indirect test performance and our estimates of *U*. Findings from this series of experiments are problematic for any redundancy model that views indirect or inclusion tests as a pure measure of unconscious processing. Moreover, a redundancy model is unable to account for the findings of process dissociations produced by manipulations traditionally identified with cognitive control, or for the match between estimated *U* and performance on an uncontaminated indirect test.

Independence versus Exclusivity: Remember/Know Judgments

Tulving (1983), along with Gardiner and colleagues (Gardiner, 1988; Gardiner & Java, 1991; Gardiner & Parkin, 1990) emphasized differences in subjective experience by requiring subjects to judge whether they "remember" an item was presented in an earlier list or only "know" that the item was in the list. Subjects are instructed to respond Remember if they can consciously recollect aspects of the study episode, such as the item's appearance or an association it brought to mind. They are instructed to respond Know if they find the item familiar but they cannot recollect any details of its prior occurrence. A large number of experiments have been conducted to show differential effects of manipulated variables on Remember and Know judgments (see Gardiner & Java, 1993, for a review).

Because subjects are only allowed to make one response to each item, it is unarguable that the *R* and *K* responses are mutually exclusive, just as are Yes and No responses in a standard recognition memory test. More importantly, Gardiner and colleagues assumed that the underlying processes are mutually exclusive, and treat *R* and *K* responses as providing pure measures of recollection and familiarity. For example, if a variable is found to have an effect on the proportion of *K* responses, they concluded that the variable has an effect on familiarity.

If, on the other hand, the two processes are independent, then how do we interpret Remember and Know responses? Remember responses should provide a relatively pure measure of conscious recollection. This is true as long as subjects respond *R* when, and only when, they recollect. If they mistakenly respond Remember to items that are only familiar, our estimates of recollection will be inflated, as will false Remember responses to new items. Fortunately, in most Remember/Know experiments the probability of falsely remembering a new item is very low, suggesting that Remember provides an adequate measure of recollection.

In contrast, Know responses will not provide a pure measure of familiarity. Rather, they only reflect familiarity in the absence of recollection ($F(1 - R)$). In fact, subjects are instructed to respond Know only if the item is recognized as familiar but is not recollected. If the two processes are independent, there will be some proportion of items that are both familiar and recollected (a possibility not allowed by the exclusivity assumption). For these items, subjects will respond Remember even though the items are also familiar. Consequently, the proportion of Know responses underestimates the probability that an item is familiar. To determine the probability that an item is familiar (F), one most divide the proportion of Know responses by the opportunity the subject has to make a Know response ($1 - R$). That is, $F = K / (1 - R)$. We refer to this method for measuring recollection and familiarity as the Independence Remember/Know Procedure (IRK) to distinguish it from approaches relying on the exclusivity assumption.

To reiterate, according to both independence and exclusivity, Remember responses provide a measure of conscious recollection. However, the two assumptions differ in their estimation of familiarity. By the exclusivity assumption, the proportion of *K* responses provides a pure measure of familiarity, whereas by the independence assumption, familiarity is calculated by dividing the proportion of K responses by $1 - R$.

In the following experiments, we contrast the exclusivity and independence assumptions using the Remember/Know procedure. Experiment 4 examines cross-modality transfer in a fragment completion task. In Experiment 5, we examine the effects of size congruency on recognition performance, comparing our results to those obtained by Rajaram and Roediger (Chapter 11, this volume). In a final experiment, we conduct an ROC analysis to further compare the independence and exclusivity assumptions.

Fragment Completion: Cross-Modality Transfer. In Experiment 4, subjects were presented with the same study and test list as described in the previous section, and were instructed to use the word fragments as cues for the recall of words they read or heard at study. After completing each fragment, subjects were to indicate whether they remembered the completion word as one presented earlier, did not remember but knew the completion word was presented earlier, or thought that the completion word had not been presented earlier (New). Definitions of Remember and Know given to subjects were adapted from the instructions used by Gardiner.

First consider the results using the exclusivity assumption. Examination of Table 2.6 shows that subjects were more likely to remember words they had read as compared to words they had heard. Thus changes in modality between study and test decreased conscious recollection. However, by the exclusivity assumption there was no evidence of unconscious memory for either heard or seen words. That is, for items receiving a Know response there was no advantage for heard or seen words over new words. Given one would expect some unconscious influence of memory on a fragment completion task, based on the indirect test literature already described, these results are puzzling.

One question that may arise here is whether Know judgments are truly unconscious, given subjects indicate some memory for an item. We treat Know responses as a measure of unconscious memory because subjects do not recollect any details of having seen an item. The notion is that, in some cases,

TABLE 2.6
Probability of Responding Remember, Know, or New as a Function of Study Processing in Experiment 4

	Study		
Response	*Read*	*Heard*	*New*
Remember	.36	.24	.04
Know	.14	.10	.13
New	.11	.10	.15

TABLE 2.7
Estimates for Conscious and Unconscious Influences Calculated by Applying the Independence Assumption to the Remember/Know Procedure (IRK) in Experiment 4

	Study	
Estimates	*Read*	*Heard*
Conscious	.36	.24
Unconscious	.40	.27

Note: The baseline completion rate for items not presented at study was .32.

items may come to mind very fluently, and subjects may attribute this fluency to prior presentation, responding Know. However, the degree of fluency associated with unconscious influences may differ such that some items come to mind but result in a New response. Therefore, to assess familiarity one may want to examine both Know and New responses combined. However, doing so does not change the conclusion, because there was no advantage for old words over new words for items eliciting either a Know or a New response. The notion that Know and New items differ in terms of the strength or fluency is discussed later.

How does the pattern of results (Table 2.6) change if the independence, rather than the exclusivity, assumption is adopted? Results, recomputed with the independence assumption, are shown in Table 2.7. To calculate C and U, completions that subjects remember are equated with conscious recollection, whereas all occasions on which a fragment was completed with old words that were not remembered were used to estimate unconscious memory ($U = (K + N)/(1 - R)$).

Examination of Table 2.7 shows that both conscious and unconscious influences were greater for read words than heard items. What is most striking though, is the similarity of the results in Table 2.7 to those gained by using the Inclusion/Exclusion test procedure to estimate conscious and unconscious influences (Table 2.4). The probabilities of recollection for read and heard words are nearly identical to the probabilities of responding Remember when completing fragments with those words. The estimates of unconscious influences gained by the two procedures are also comparable. Clearly, the choice between the assumptions of exclusivity and independence (Table 2.6 vs. Table 2.7) was more important than the choice between the Inclusion/Exclusion and the Remember/Know approaches, given the independence assumption for both procedures.

In retrospect, it should not be surprising that Remember/Know and Inclusion/Exclusion procedures produced near-identical results. The rationale underlying the Inclusion/Exclusion procedure holds that recollection serves as a basis for control. It was argued that if subjects recollected a word as earlier presented, they could either include or exclude that word as a fragment completion, when instructed to do so (e.g., Jacoby et al., 1993). If recollection serves as a basis for control, then it should be identifiable by self-report.

When the treatment of data is based on the independence assumption, results from the Remember/Know procedure agree with those from the Inclusion/Exclusion procedure in showing no cross-modality transfer in unconscious influences of memory. Indeed, the estimate of unconscious influences for words that were heard is slightly, though not significantly, below the baseline for new words (.27 vs. .32). The major difference between the two sets of results is in baseline performance. If one simply averages the baselines, which is legitimate because the same materials were used in the two experiments, one finds that estimates of unconscious influences for heard words are near identical to baseline for both procedures.

Recognition Memory: Parallel Effects of Size Congruency. Results described in the last section showed that the Remember/Know and Inclusion/Exclusion procedures produce parallel results when the independence assumption is adopted. In contrast, Gardiner and his associates (Gardiner, 1988; Gardiner & Java, 1991; Gardiner & Parkin, 1990) relied on the exclusivity assumption to show that many manipulations produce dissociations between Remember and Know responses. Among the dissociations reported are some that are difficult to interpret. For example, in an investigation of recognition-memory performance, Rajaram and Roediger (Chapter 11, this volume) found that manipulating size congruency produced a dissociation between Remember responses, which were greatest when study and test stimuli were congruent in size, and Know responses, which produced the opposite pattern of results. That finding appears curious if Know responses are identified with the use of familiarity as a basis for recognition in a two-factor theory of memory (e.g., Mandler, 1980). The claim would have to be that increasing similarity (size congruency) decreased familiarity.

We investigated the effects of size congruency, and contrasted results based on the exclusivity assumption with results gained using the independence assumption (Yonelinas & Jacoby, in press). Subjects studied a list of randomly generated shapes and were then given a recognition-memory test that included old shapes mixed with new shapes. Half of the old shapes were the same size they had been during study, whereas the other half were either larger or smaller in size. Similar to the Remember/Know procedure described earlier, subjects made recognition decisions by responding Recollect if they could consciously recollect having seen a test item in the study list, Know if they felt the item was in the study list but they could not recollect it, or New if they felt the item had not been seen before. Despite the fact that the sub-

TABLE 2.8
The Effects of Size Congruency on Remember and Know Responses, and Estimates of Familiarity in Experiment 5

	Size		
	Congruent	*Incongruent*	*New*
Recollect	.45	.30	.08
Know	.36	.41	.36
Familiarity	.65	.58	

jects were told that the size of the shapes would vary and size was irrelevant, they recognized more of the size congruent objects than the size incongruent objects (see Table 2.8).

Using the Recollect responses as a measure of conscious memory, we find that size congruency increased conscious influences. Estimates of familiarity were then derived using independence as well as the exclusivity assumptions. Adopting the exclusivity assumption, whereby Know responses are treated as a pure measure of familiarity, leads to the strange conclusion that size congruency *decreased* the familiarity of old shapes. Furthermore, the estimated familiarity of same-size shapes was no greater than that of new shapes (.36 and .36). Only when shapes changed size was an advantage in familiarity for old shapes found. These results are odd because it is common to assume that increasing similarity, as produced by size congruency, increases familiarity. Indeed, that was found when the independence assumption was used to estimate familiarity. By the independence assumption, old shapes were more familiar than new shapes, and old items that were the same size at study and test were more familiar than those for which size changed.

The exclusivity assumption, in effect, forces the odd results found for familiarity. Because of the assumption that items can be either recollected or familiar, high recollection levels associated with old size congruent shapes push the level of Know responses down. That is, the measure of familiarity is influenced as much by factors influencing recollection as by factors influencing familiarity per se.

Similar problems produced by the exclusivity assumption can be seen in examinations of the effect of aging. Using the *R/K* procedure, Parkin and Walter (1992) found that older adults showed poorer recollection than younger adults, but use of Know responses increased. Although it may be comforting to think that deficits in recollection are offset by improvements in familiarity, this pattern of results appears to be an artifact of the *R/K* procedure, as was the size congruency effect. That is, the increase in Know responses shown by the elderly does not reflect an increase in familiarity. Instead, young adults are showing a decrease in Know responses forced by their higher level of Remember responses. In support of this possibility, the results of Jacoby (1992) described earlier, and Jennings and Jacoby (1993) showed that despite decreases in recollection with age, familiarity remained intact. These results converge with those of several experiments that show indirect test performance, which presumably relies on processes similar to familiarity, is not greatly influenced by aging (e.g., Light & Alberton, 1989).

The same problem described earlier also produces inconsistencies across other Remember/Know experiments. For example, Gardiner (1988) found that deeper levels of processing increased the probability of Remember responses without influencing the probability of Know responses, and concluded that depth of processing selectively influences the process that supports remembering. However, Rajaram (1993) found that deeper processing led to an increase in Remember responses accompanied by a significant decrease in Know responses. These inconsistencies are a product of the exclusivity assumption. If, as held by the independence assumption, Know responses reflect familiarity and recollection, then large effects on recollection will tend to artifactually produce opposite effects on the Know responses. Know responses remained constant in the Gardiner study but changed in the Rajaram study because of differences in the magnitude of levels of processing effect on recollection. In the Rajaram study, manipulating levels of processing led to a difference of .34 in recollection versus the .20 difference shown by Gardiner.[1] Further problems for the exclusivity assumption are considered in the next section.

Signal Detection Theory in a Dual-factor Model. We have argued elsewhere (Jacoby et al., 1993; Yonelinas, 1994) that the unconscious influences of memory, such as familiarity, are well described by signal-detection theory, and a weakness of earlier applications of signal-detection theory was the failure to separate unconscious influences from the effects of recollection. In order to test these notions we collected confidence judgments in a Remember/Know recognition task, and plotted a receiver operator characteristic (ROC). The ROC allowed us to determine whether familiarity was related to false alarm rates in a manner that would be predictable by signal-detection theory. It also allowed us to further evaluate the independence and exclusivity assumptions.

[1] Using the IRK procedure with Gardiner's (1988) and Rajaram's (1993) data showed that both recollection and familiarity increased with levels of processing. Such results are in agreement with those found using the process-dissociation procedure with a recognition task (Jacoby & Kelley, 1991; Toth, 1992). Note that the effects of levels of processing in recognition do not parallel those found with cued recall, where levels of processing had no effect on the unconscious uses on memory (see Toth et al., 1994). This is reasonable given that retrieval cues differ across the two tests (see Jacoby et al., 1993). By in large, we find that dissociations are more easily obtained between conscious and unconscious influences in cued recall than in recognition.

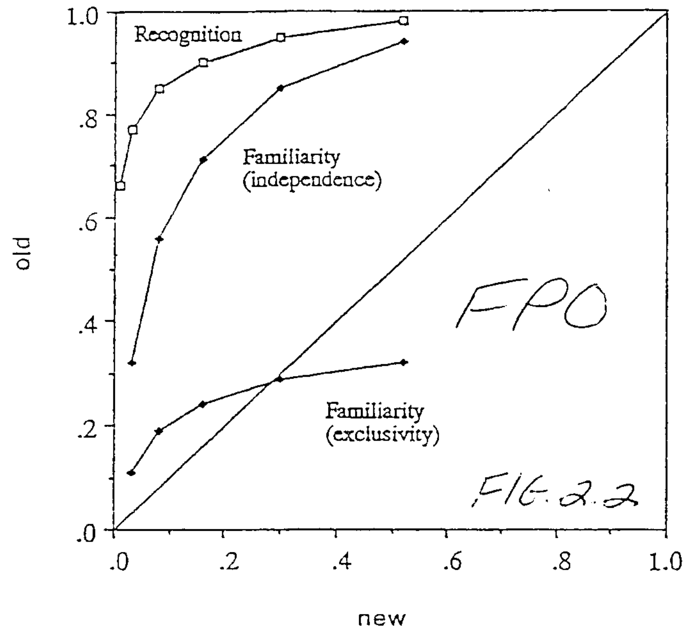

FIG. 2.2. Receiver operating characteristics for recognition performance and for familiarity derived using the independence and exclusivity assumptions.

We used a repeated study–test procedure in which each study list was immediately followed by a recognition memory test for the words in that list. For each test item, subjects reported whether they could recollect the item, and if they could not, they used a 6-point scale to rate the item's familiarity in the experimental context. That is, they rated their confidence that the item was in the study list, although they could not recollect any details of its presentation. We plotted correct recognitions against false alarms across all levels of confidence, treating recollected items as the most confident level (see Fig. 2.2). The obtained recognition function is typical of those found for recognition memory (see Ratcliff, Sheu, & Gronlund, 1992). The function is curvilinear, and exhibits a skew or asymmetry so the curve does not approach the zero–zero intercept but seems to intersect the *y*-axis.

Estimates of familiarity were derived using the independence and exclusivity assumptions, and are plotted in Fig. 2.2. The independence assumption produces a curvilinear familiarity function that increases gradually as a function of false alarm rate. The discriminability (measured by d') afforded by familiarity remained constant as false alarm rate increased. Such a function would be expected if subjects were relying on assessments of item familiarity as would be described by signal-detection theory. In fact, the familiarity function no longer has the asymmetry that was apparent in the overall recognition curve that included both familiarity and recollection. In fact, Yonelinas (1994) argued that the asymmetry in the ROC reflects the contribution of recollection to recognition performance.

It is informative to examine the estimates of familiarity in light of the exclusivity assumption. As can be seen in Fig. 2.2. estimates of familiarity increase slightly as a function of false alarm rate. However, when the false alarm rate increases, the function falls below the diagonal. This would lead one to conclude that new items become more familiar than old items! We have found this unreasonable pattern of results before. In fact, it seems to be a by-product of the exclusivity assumption. Similar to our size congruency experiment, the measure of familiarity based on the exclusivity assumption produces unreasonable results because it reflects the level of recollection as much as familiarity per se. Because of results of this sort, we think the exclusivity assumption can be dismissed as a viable characterization of the relation between conscious and unconscious influences of memory.

Applying signal-detection theory to describe unconscious influences also sheds light on the difference between Know and New judgments. Both judgments reflect the familiarity or strength of an item and differ only in that the Know judgment is made if the strength is above some criterion. To gain an estimate of unconscious influences, it is justifiable to ignore the difference between the two types of judgments as done earlier. Elsewhere (e.g., Jacoby, Kelly, & Dywan, 1989) we argued that familiarity reflects a memory attribution, and the strength or fluency that results in that attribution can be misattributed to other sources, such as famousness or pleasantness.

In contrast to the manipulations that are found to influence *C* but to leave *U* in place (e.g., Table 2.2), the ROC analysis showed that familiarity was influenced by response criterion. Similar ROC studies using the process–dissociation procedure have shown that relaxing response criterion increased the proportion of items accepted on the basis of familiarity but did not influence estimates of recollection (Yonelinas, 1994). Other manipulations, such as varying stimulus–response probabilities, are also found to selectively affect unconscious influences (Jacoby & Hay, 1993; Yonelinas & Jacoby, 1995). Such dissociations provide further support for the independence assumption.

CONCLUDING COMMENTS

Our approach to defining conscious and unconscious processes differs in important ways from those taken by others. Eriksen (1960), for example, operationally defined awareness in terms of performance on tasks measuring perceptual discriminations, and sought evidence of perception under conditions establishing chance discrimination. Eriksen's approach relied on signal-detection theory (Swets, Tanner, & Birdsall, 1961) to separate discriminability from criterion differences. However, discriminative responding may be sensitive to both conscious and unconscious processing so that equating awareness with discriminative responding defies unconscious perception out of existence (Bowers, 1984). Later researchers abandoned the single-process or "strength" view of perception and memory, represented by signal-detection theory, and used task dissociations as evidence for the existence of unconscious processes. Conscious and unconscious processes are identified with performance on direct and indirect tests, respectively. However, that approach also suffers from the criticism that tasks may not be process pure. Effects on performance of an indirect test that are taken as evidence of unconscious perception or memory might truly reflect intentional, aware perception or memory that is undetected by the experimenter (e.g., Holender, 1986; Jacoby, 1991; Reingold & Merikle, 1990).

Because of the process-pure assumption made by other approaches, controversy has surrounded claims of the existence of unconscious processes. In contrast to Eriksen's discriminative responding approach, we define unconscious influence into existence. We begin with a two-factor model that assumes the separate existence of conscious and unconscious processes, and holds that they independently contribute to performance. We then construct tests and conditions in ways aimed at satisfying the assumptions of that model. Doing so allows us to separate the contributions of conscious and unconscious processes within a task and, thereby, avoid the process-pure assumption made when the different types of processes are identified with different tasks. As important, our process-dissociation approach allows us to examine unconscious processes operating in the context of conscious processes, which cannot be done using the direct–indirect test approach. We go beyond attempts to prove the existence of unconscious processes to search for process dissociations that show the differential effect of manipulations on the separate contributions of conscious and unconscious processes.

A prerequisite for separating the contributions of conscious and unconscious processes is that an assumption be made about their relation. It is important to note that we do not claim that conscious and unconscious processes are always independent. Rather, we have spent considerable effort constructing conditions meant to meet the independence assumption along with other assumptions underlying the process–dissociation approach. To get neat data, it is important to avoid floor and ceiling effects. For example, if performance in an exclusion condition is perfect so that old items are never given as a response (Exclusion = 0), our equations will necessarily estimate unconscious influences as being zero. Such floor effects can mask invariances that would otherwise be found (Jacoby et al., 1993). Another important concern involves the instructions given at the time of test. For the experiments described here, instructions for both the inclusion and exclusion tests strongly encouraged subjects to use word fragments as cues for direct retrieval of studied items. However, we have unpublished data to show that changing these direct retrieval instructions to encourage a Generate/Recognize strategy results in violation of the independence assumption. Given that it is easy to violate the assumptions underlying our process-dissociation approach, how can we be certain that we have been successful in our attempts to satisfy those assumptions? Why should one bother to attempt to construct situations for which conscious and unconscious processes independently contribute to performance? We answer those questions in the next two sections.

Support for the Independence Assumption

The independence assumption has the advantage of revealing invariance in unconscious influences across manipulations that produce a large effect on conscious recollection (Table 2.2). Importantly, the conditions that produce such process dissociations are those that have traditionally been identified with automaticity, such as divided attention, aging, and speeded responding. These results often converge with those of indirect tests. For example, the read/anagram manipulation produces opposite effects on conscious and unconscious influences, and a corresponding dissociation between performance on direct and indirect tests (Jacoby et al., 1993). However, results for estimates of the unconscious and indirect tests do sometimes differ, as illustrated by the effects of dividing attention on cross-modality transfer (Tables 2.3 and 2.4).

Comparisons across our experiments examining cross-modality transfer show that radically different conclusions can be drawn depending on the assumed relation between unconscious and conscious memory influences. Based on the assumption of independence, one would conclude that changing modality between study and test reduced both conscious recollection and unconscious influences of memory. In addition, estimates of unconscious processes showed no evidence of cross-modality transfer (Table 2.4). In contrast, based on the redundancy assumption (unconscious influences are identified either with performance on an indirect test or the inclusion test), one would conclude that manipulating study modality affected the magnitude of unconscious influences, but that a substantial amount of cross-modality transfer occurred (Table 2.3). However, when we divided attention at study, to reduce the likelihood of conscious contamination of the indirect test we found little evidence of cross-modality transfer (Table 2.5). As mentioned, we are not claiming that indirect tests are always badly contaminated or that it is impossible to create conditions under which redundancy may hold. However, for our conditions meant to satisfy the independence assumption, the data strongly favor the independence assumption over the redundancy assumption. Adoption of the redundancy assumption requires the sacrifice of our consistent findings of process dissociations produced by manipulations traditionally associated with cognitive control as well as the converging evidence gained from "uncontaminated" indirect tests of memory.

The exclusivity assumption proved to be even less satisfactory than the redundancy assumption. As shown here, several conclusions based on exclusivity are problematic. By an exclusivity assumption, there was no evidence of unconscious influences in word fragment completion (a task known to reveal unconscious memory). In addition, changing the size of objects between study and test led to an unexpected increase in familiarity on a recognition task. Finally, relaxing response criterion in an ROC task led to the conclusion that old items were less familiar than new ones. Adoption of the independence assumption with the Remember/Know procedure (IRK) produced a more reasonable pattern of results. IRK showed evidence for unconscious influences in fragment completion, familiarity increased with size congruency, and familiarity was well described by signal-detection theory. Because of these results, the exclusivity assumption can be dismissed as a viable characterization of the relation between conscious and unconscious processes. We emphasize that it is only the treatment of Know responses that is problematic for exclusivity in the Remember/Know procedure. Applying the independence assumption to Remember/Know data (IRK) produces results that converge with those from the Inclusion/Exclusion procedure.

What is the relation between the IRK and the Inclusion/Exclusion procedures? Both qualify as process-dissociation procedures in that their goal is the within-task separation of conscious and unconscious processing. However, the IRK procedure, by its reliance on subjective reports, identifies consciousness with awareness. The Inclusion/Exclusion procedure, in contrast, defines consciousness with reference to intentional control of responding. In everyday life, people often make conscious awareness a prerequisite for intentional actions (Kelly & Jacoby, 1990; Marcel, 1988) and, so, it should not be surprising to find agreement between measures of awareness and intentional responding. However, one should not expect to always find such agreement. The possibility of dissociations between awareness and control suggests parallels with observations of frontal lobe patients. One of the most interesting findings with those patients is their deficit in controlled responding despite awareness of the information that would allow such control to operate. For example, on the Wisconsin Card Sorting Task, frontal patients can often explicitly state the principles underlying the task, thus showing awareness, yet fail to utilize these principles in their actual performance (Stuss & Benson, 1984). Comparisons between results from IRK and Inclusion/Exclusion procedures may be useful for examining this "dysexecutive syndrome."

Reaping the Benefits of Independence

The preceding sections have illustrated empirical and theoretical support for the independence assumption, but perhaps even stronger support lies in the assumption's ability to reconceptualize old problems and offer new solutions. The independence assumption has provided us with tools to investigate practical problems, such as action slips, subjective report of cognitive failures, and memory rehabilitation. Action slips offer a powerful example of the interplay between automatic and consciously controlled processes in daily life. James (1890) observed that "very absent-minded persons in going to their bedroom to dress for dinner have been known to take off one garment after another and finally to get into bed" (p. 115). Action slips arise when habit (automatic) and intention (conscious control) are in opposition, just as conscious and unconscious influences of memory were in opposition in our exclusion condition. Exploiting this similarity, we have been able to use the process-dissociation procedure to examine habits and action slips in the lab (e.g., Yonelinas & Jacoby, 1995). We have shown that there is an increase in action slips in the aged, as well as under conditions of divided attention, both of which are produced by a reduction in conscious control (Jacoby & Hay, 1993).

An obvious question that arises when measuring action slips in the lab is whether these measures correspond to performance in real life. Typically, this issue has been addressed by giving subjects a questionnaire about real-life memory experiences, and comparing self-reported memory failures with lab performance. However, such investigations have found only modest correlations between questionnaires and lab tasks, ranging from .2 to .3 (Herrman, 1982). Given action slips and memory deficits tend to result from deficits in consciously controlled processing, the problem with the correlational data could stem from a failure to separate lab performance into automatic and consciously controlled components. For example, preliminary work by Jennings and Hay examined the relation between lab tests of memory and questionnaire measures with older adults. They too found that the correlation between self-reported memory failure and overall recognition was quite modest at .35. However, when they used the process-dissociation procedure, they found that the correlation between self-report and a measure of conscious control was substantially higher, at .58, whereas the correlation with automatic influences was near zero. Jennings and Hay's data suggests that performance in daily life is predictable from the lab when one focuses on conscious control.

Perhaps our most ambitious application of the independence assumption goes beyond measuring memory performance, investigating the process-dissociation procedure as a means for rehabilitating memory in older adults. Generally, memory rehabilitation with older adults has relied on general practice or on teaching elaborate encoding strategies (for a review, see Kotler-Cope & Camp, 1990). However, our goal is to train intentional, consciously controlled memory processes (Jacoby, Jennings, & Hay, in press). The rationale of our training procedure builds on the observation that elderly adults repeatedly ask the same question, or tell the same story more than once to the same audience. Reasoning that the shorter the interval between mistakenly repeating oneself, the poorer one's recollection, we train people to accomplish consciously controlled use of memory over increasingly long intervals. Using an exclusion task, we placed the elderly in a situation where recollection was easy (a short time interval between presentation and test) and gradually increased the difficulty of the memory setting (length of the time interval) to shape recollection. Slowly moving the elderly from a level where they could perform competently allowed them to adapt their recollective process to more demanding test intervals. Preliminary results are promising, showing evidence of marked improvement in conscious recollection after only five training sessions.

Can Independence Be Proven?

We find our data beautiful (e.g., Table 2.2) and the directions for our research quite exciting. However, others (Graf & Komatsu, 1994; Joordens & Merikle, 1993) are willing to dismiss our findings of near-perfect invariance produced by manipulations traditionally associated with cognitive control as well as our converging evidence from "uncontaminated" indirect tests as reflecting lucky accidents. They pointed out that we are making assumptions and asked that we either prove the validity of the independence assumption or invent an approach not requiring that assumptions be made. We believe both demands are unreasonable but will not digress into a discussion of philosophy of science (for responses to critics, see Jacoby, Toth, Yonelinas, & Debner, 1994; Toth, Reingold, & Jacoby, 1995). Perhaps there is so much critical attention to our assumptions because we have highlighted our assumptions rather than overlooking them or not acknowledging them as such (see Reingold & Toth, in press). We have done so because we believe that specifying the relation between conscious and unconscious processes is a necessary part of their definition.

A proposal that conscious and unconscious influences are independent will likely be met with scepticism by those who have followed Hintzman's (e.g., Hintzman & Hartry, 1990) criticisms of claims for stochastic independence between direct and indirect tests. He argued that little of theoretical importance can be learned by testing the stochastic independence of tasks because measures of association are limited by suppressor variables such as item differences. However, there are important differences between assuming independence of processes and claiming to have proven independence of performance on direct and indirect tests. First, we are not reliant on the use of successive tests of the same items as are those who rely on contingency analyses (e.g., Tulving, Schacter, & Stark, 1982) and, so, we avoid problems produced by prior testing of an item influencing performance on its later test. Second, because our claim is independence of processes, finding correlations between performance on tasks is irrelevant. For example, finding item differences that influence the correlation between word-fragment completion and recognition-memory performance (Hintzman & Hartry, 1990) might reflect the importance of item differences for recollection. Even if the probability of recollection when completing a fragment was highly correlated with the probability of using recollection as a basis for recognition, recollection could be independent from unconscious influences of memory for both tasks.

The greatest obstacle for research contrasting conscious and unconscious processes has been defining the two types of processes. Earlier approaches have attempted to solve this problem by identifying processes with distinctions between tasks such as the distinction between indirect and direct tests of memory. Because tasks cannot be relied on to provide a pure measure of a process, it is better to separate the effects of processes within a task. However, to do so, one must adopt an assumption about the relation between conscious and unconscious influences. The choice among assumptions is important because specifying the relation between conscious and unconscious processes accomplishes a major part of the task of defining the two types of processes. For our situations, we declare that conscious and unconscious processes are independent. Even if independence is not total, just as independence resulting from political declarations is not complete, its declaration is still useful for highlighting dissociations and for setting future directions.

REFERENCES

Baars, B. J. (1988). *A cognitive theory of consciousness.* Cambridge, England: Cambridge University Press.

Blaxton, T. A. (1989). Investigating dissociations among memory measures: Support for a transfer appropriate processing framework. *Journal of Experimental Psychology: Learning, Memory, and Cognition, 15,* 657–668.

Bowers, K. S. (1984). On being unconsciously influenced and informed. In K. S. Bowers & D. Meichenbaum (Eds.), *The unconscious reconsidered* (pp. 227–273). New York: Wiley.

Challis, B. H., & Brodbeck, D. R. (1992). Level of processing affects priming in word fragment completion. *Journal of Learning, Memory, and Cognition, 18,* 595–607.

Craik, F. I. M., & Byrd, M. (1982). Aging and cognitive deficits. The role of attentional resources. In F. I. M. Craik & S. Trehub (Eds.), *Aging and cognitive processes* (pp. 191–211). New York: Plenum.

Donaldson, W., & Geneau, R., (1991, November). *Cross-modal priming in word fragment completion.* Paper presented at the meetings of the Psychonomic Society, San Francisco, CA.

Dunn, J. C., & Kirsner, K. (1989). Implicit memory: Task or process? In S. Lewandowsky, J. C. Dunn, & K. Kirsner (Eds.), *Implicit memory: Theoretical issues* (pp. 17–31). Hillsdale, NJ: Lawrence Erlbaum Associates.

Eriksen, C. W. (1960). Discrimination and learning without awareness: A methodological survey and evaluation. *Psychological Review, 67,* 279–300.

Gardiner, J. M. (1988). Functional aspects of recollective experience. *Memory and Cognition, 16,* 309–313.

Gardiner, J. M., & Java, R. I. (1991). Forgetting in recognition memory with and without recollective experience. *Memory and Cognition, 19,* 617–623.

Gardiner, J. M., & Java, R. I. (1993). Recognizing and remembering. In A. Collins, M. A. Conway, S. E. Gathercole, & P. E. Morris (Eds.), *Theories of memory*. Hillsdale, NJ: Lawrence Erlbaum Associates.

Gardiner, J. M. & Parkin, A. J. (1990). Attention and recollective experience in recognition memory. *Memory and Cognition, 18,* 579–583.

Graf, P., & Komatsu, S. (1994). Process dissociation procedure: Handle with caution! *European Journal of Cognitive Psychology, 6,* 113–129.

Graf, P., Shimamura, A. P., & Squire, L. R. (1985). Priming across modalities and priming across category levels: Extending the domain of preserved function in amnesia. *Journal of Experimental Psychology: Learning, Memory, and Cognition, 2,* 386–396.

Hasher, L., & Zacks, R. T. (1979). Automatic and effortful processes in memory. *Journal of Experimental Psychology: General, 108,* 356–388.

Herrman, D. J. (1982). Know thy memory: The use of questionnaires to assess and study memory. *Psychological Bulletin, 92,* 434–452.

Hintzman, D. L., & Hartry, A. L. (1990). Item effects in recognition and fragment completion: Contingency relations vary for different subsets of words. *Journal of Experimental Psychology: Learning, Memory, and Cognition, 16,* 955–969.

Holender, D. (1986). Semantic activation without conscious identification in dichotic listening, parafoveal vision, and visual masking: A survey and appraisal. *Behavioral and Brain Sciences, 9,* 1–23.

Jacoby, L. L. (1978). On interpreting the effects of repetition: Solving a problem versus remembering a solution. *Journal of Verbal Learning and Verbal Behavior, 17,* 649–667.

Jacoby, L. L. (1983). Remembering the data: Analyzing interactive processes in reading. *Journal of Verbal Learning and Verbal Behavior, 22,* 485–508.

Jacoby, L. L. (1991). A process dissociation framework: Separating automatic from intentional uses of memory. *Journal of Memory and Language, 30,* 513–541.

Jacoby, L. L. (1992, November). *Strategic versus automatic influences of memory: Attention, awareness, and control.* Paper presented at the 33rd annual meeting of the Psychonomic Society, St. Louis.

Jacoby, L. L., & Dallas, M. (1981). On the relationship between autobiographical memory and perceptual learning. *Journal of Experimental Psychology: General, 3,* 306–340.

Jacoby, L. L., & Hay, J. F. (1993, November). *Action slips, proactive interference, and probability matching.* Paper presented at the 34th annual meeting of the Psychonomic Society, Washington, DC.

Jacoby, L. L., & Hollingshead, A. (1990). Toward a generate/recognize model of performance on direct and indirect tests of memory. *Journal of Memory and Language, 29,* 433–454.

Jacoby, L. L., Jennings, J. M., & Hay, J. F. (in press). Dissociating automatic and consciously controlled processes: Implications for diagnosis and rehabilitation of memory deficits. In D. J. Herrman, M. K. Johnson, L. L. McEvoy, C. Hertzog, & P. Hertel (Eds.), *Basic and applied memory research: Theory in context.* Hillsdale, NJ: Lawrence Erlbaum Associates.

Jacoby, L. L., & Kelley, C. M. (1991). Unconscious influences of memory: Dissociations and automaticity. In D. Milner & M. Rugg (Eds.), *The neuropsychology of consciousness* (pp. 201–233). London: Academic Press.

Jacoby, L. L., Kelley, C. M., & Dywan, J. (1989). Memory attributions. In H. L. Roediger & F. I. M. Craik (Eds.), *Varieties of memory and consciousness: Essays in Honour of Endel Tulving,* (pp. 391–422). Hillsdale, NJ: Lawrence Erlbaum Associates.

Jacoby, L. L., Toth, J. P., & Yonelinas, A. P. (1993). Separating conscious and unconscious influences of memory: Attention, awareness, and control. *Journal of Experimental Psychology: General, 122,* 139–154.

Jacoby, L. L., Toth, J. P., Yonelinas, A. P., & Debner, J. A. (1994). The relationship between conscious and unconscious influences: Independence or redundancy? *Journal of Experimental Psychology: General, 123,* 216–219.

James, W. (1890). *Principles of psychology.* New York: Henry Holt.

Jennings, J. M., & Jacoby, L. L. (1993). Automatic versus intentional uses of memory: Aging, attention and control. *Psychology and Aging, 8,* 283–293.

Jones, G. V. (1987). Independence and exclusivity among psychological processes: Implications for the structure of recall. *Psychological Review, 94,* 229–235.

Joordens, S., & Merikle, P. M. (1993). Independence or redundancy? Two models of conscious and unconscious influences. *Journal of Experimental Psychology: General, 122.* 462–467.

Kelley, C. M., & Jacoby, L. L. (1990). The construction of subjective experience: Memory attributions. *Mind and Language, 5,* 49–68.

Kirsner, K., & Dunn, J. (1985). The perceptual record: A common factor in repetition priming and attribute retention? In M. I. Posner & O. S. M. Marin (Eds.), *Mechanisms of attention: Attention and performance* (Vol. 11, pp. 547–565). Hillsdale, NJ: Lawrence Erlbaum Associates.

Koriat, A., & Feuerstein, N. (1976). The recovery of incidentally acquired information. *Acta Psychologica, 40,* 463–474.

Kotler-Cope, S., & Camp, C. J. (1990). Memory intervention in aging populations. In E. A. Lovelace (Ed.), *Aging and cognition: Mental processes, self-awareness and interventions* (pp. 231–261). North Holland: Elsevier Science.

Light, L. L., & Albertson, S. A. (1989). Direct and indirect tests of memory for category exemplars in young and older adults. *Psychology and Aging, 4,* 487–492.

Logan, G. D. (1988). Toward an instance theory of automatization. *Psychological Review, 95,* 492–527.

Mandler, G. (1980). Recognizing: The judgment of previous occurrence. *Psychological Review, 87,* 252–271.

Marcel, A. J. (1983). Conscious and unconscious perception: Experiments on visual masking and word recognition. *Cognitive Psychology, 15,* 197–237.

Marcel, A. J. (1988). Phenomenal experience and functionalism. In A. J. Marcel & E. Bisiach (Eds.), *Consciousness in contemporary science* (pp. 121–158). Oxford: Clarendon Press.

Morton, J. (1979). Facilitation in word recognition: Experiments causing change in the logogen model. In P. A. Kolers, M. E. Wrolstal, & H. Bonma (Eds.), *Processing of visible language* (Vol. 1, pp. 259–268). New York: Plenum.

Moscovitch, M., Vriezen, E. R., & Gottstein, J. (1993). Implicit tests of memory in patients with focal lesions or degenerative brain disorders. In H. Spinnler & F. Boller (Eds.), *Handbook of Neuropsychology* (Vol. 8, pp. 133–173). Amsterdam: Elsevier.

Parkin, A. J., & Walter, B. (1992). Recollective experience, normal aging, and frontal dysfunction. *Psychology and Aging, 7,* 290–298.

Posner, M. I., & Snyder, C. R. R. (1975). Attention and cognitive control. In R. L. Solso (Ed.), *Information processing in cognition: The Loyola symposium* (pp. 55–85). Hillsdale, NJ: Lawrence Erlbaum Associates.

Rajaram, S. (1993). Remembering and knowing: Two means of access to the personal past. *Memory and Cognition, 21,* 89–102.

Ratcliff, R. M., Sheu, C. F., & Gronlund, S. D. (1992). Testing global memory models using ROC curves. *Psychological Review, 3,* 518–535.

Reingold, E. M., & Merikle, P. M. (1990). On the inter-relatedness of theory and measurement in the study of unconscious processes. *Mind and Language, 5,* 9–28.

Reingold, E. M., & Toth, J. P. (in press). Process dissociations versus task dissociations: A controversy in progress. In G. Underwood (Ed.), *Implicit cognition.* Oxford, England: Oxford University Press.

Roediger, H. L., & Blaxton, T. A. (1987). Effects of varying modality, surface features, and retention interval on priming in word-fragment completion. *Memory and Cognition, 5,* 379–388.

Roediger, H. L., & McDermott, K. B. (1993). Implicit memory in normal human subjects. In

H. Spinnler & F. Boller (Eds.), *Handbook of neuropsychology* (Vol. 8, pp. 63–131). Amsterdam: Elsevier.

Roediger, H. L., Weldon, M. S., Stadler, M. L., & Riegler, G. L. (1992). Direct comparison of two implicit memory tests: Word fragment and word stem completion. *Journal of Experimental Psychology: Learning, Memory, and Cognition, 18,* 1251–1269.

Schneider, W., & Shiffrin, R. M. (1977). Controlled and automatic human information processing: I. Detection, search and attention. *Psychological Review, 84,* 1–66.

Slamecka, N. J., & Graf, P. (1978). The generation effect: Delineation of a phenomenon. *Journal of Experimental Psychology: Human Learning and Memory, 4,* 592–604.

Stuss, D. T., & Benson, D. F. (1984). Neuropsychological studies of the frontal lobes. *Psychological Bulletin, 95,* 3–28.

Swets, J. A., Tanner, W. P., & Birdsall, T. G. (1961). Decision processes in perception. *Psychological Review, 68,* 301–340.

Toth, J. P. (1992). *Familiarity is affected by prior conceptual processing: Differential effects of elaborative study and response-signal delay on separable processes in recognition memory.* Unpublished data and manuscript.

Toth, J. P., & Reingold, E. M. (in press). Beyond perception: Conceptual contributions to unconscious influences of memory. In G. Underwood (Ed.), *Implicit cognition.* Oxford, England: Oxford University Press.

Toth, J. P., Reingold, E. M., & Jacoby, L. L. (1994). Towards a redefinition of implicit memory: process dissociations elaborative processing and self-generation. *Journal of Experimental Psychology: Learning, Memory, and Cognition, 20,* 290–303.

Toth, J. P., Reingold, E. M., & Jacoby, L. L. (1995). A response to Graf and Komatsu's (1994) critique of the process-dissociation procedure: When is caution necessary? *European Journal of Cognitive Psychology, 1,* 113–130.

Tulving, E. (1983). *Elements of episodic memory.* New York: Oxford University Press.

Tulving, E., Schacter, D. L., & Stark, H. A. (1982). Priming effects in word-fragment completion are independent of recognition memory. *Journal of Experimental Psychology: Learning, Memory, and Cognition, 8,* 366–342.

Warrington, E. K., & Weiskrantz, L. (1974). The effect of prior learning on subsequent retention in amnesic patients. *Neuropsychologia, 12,* 419–428.

Weiskrantz, L. (1986). *Blindsight: A case study and implications.* Oxford, England: Oxford University Press.

Weldon, M. S., & Jackson-Barrett, J. L. (1993). Why do pictures produce priming on the word-fragment completion test? A study of encoding and retrieval factors. *Memory and Cognition, 21,* 519–528.

Winnick, W. A., & Daniel, S. A. (1970). Two kinds of response priming in tachistoscopic recognition. *Journal of Experimental Psychology, 84,* 74–81.

Yonelinas, A. P. (1994). Receiver-operating characteristics in recognition memory: Evidence for a dual-process model. *Journal of Experimental Psychology: Learning, Memory, and Cognition, 20,* 1341–1354.

Yonelinas, A. P., & Jacoby, L. L. (1995). Dissociating automatic and controlled processes in a memory-search task: Beyond implicit memory. *Psychological Research, 57,* 156–165.

Yonelinas, A. P., & Jacoby, L. L. (in press). The relation between remembering and knowing as bases for recognition: Effects of size congruency. *Journal of Memory and Language.*

?
366 342