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New Look 3

Unconscious Cognition Reclaimed

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Recent research has established several empirical results that are widely agreed to merit description in terms of unconscious cognition. These findings come from experiments that use indirect tests for immediate or long-term residues of barely perceptible, perceptible-but-unattended, or attended-but-forgotten events. Importantly, these well-established phenomena—insofar as they occur without initially involving focal attention—are limited to relatively minor cognitive feats. Unconscious cognition is now solidly established in empirical research, but it appears to be intellectually much simpler than the sophisticated agency portrayed in psychoanalytic theory. The strengthened position of unconscious cognitive phenomena can be related to their fit with the developing neural network (connectionist) theoretical framework in psychology.

A familiar theme in academic psychology has been that psychoanalytic conceptions of unconscious cognition lack empirical confirmation.[1] This skeptical view—which partly explains the omission of the topic of unconscious cognition from many textbooks, and even the omission of the word *unconscious* from the vocabularies of many psychologists—was prevalent in the 1950s, when concerted empirical research (the New Look, starting with Bruner & Postman, 1947) ultimately subsided with much achieved, but without any convincing evidence for psychoanalytic-inspired conceptions of unconscious influences on perception.[2]

Erdelyi (1974) initiated a second New Look, making a strong case for theoretical connections between cognitive psychology and psychoanalytic conceptions of unconscious cognition. Although New Look 2's rapprochement of psychoanalytic and cognitive theory remains an active project, nevertheless New Look 2 (like New Look 1) has not produced widely accepted evidence for psychoanalytic interpretations of unconscious influences on perception or judgment.

Now, almost a century after Freud's pioneer theorizing (Breuer & Freud, 1895/1955; Freud, 1900/1961), recently developed research methods have at last made unconscious cognition a routine subject of laboratory investigation. Consensus for several important findings has emerged. This consensus deviates sufficiently from the psychoanalytically inspired hypotheses of New Looks 1 and 2 to suggest that a third New Look is well under way. The most unexpected aspect of New Look 3 is its support for a simpler (cognitively less sophisticated) view of unconscious cognition than that of psychoanalytic theory.

Definitions of Unconscious Cognition

Most of the behavioral phenomena that have been linked to unconscious cognition also have well-established interpretations that make no reference to consciousness or its lack. As an everyday example, consider the highly practiced actions that one takes in driving an automobile. These actions, which are performed without apparent mental effort and often without ability to remember what one has done, are described by some as being done unconsciously. Others prefer, however, to describe such actions without reference to unconscious cognition, as being

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[1] Academic psychologists have sometimes gone beyond empirical skepticism to suggest that the concept of *unconscious cognition* has no place in psychology. These dismissals are themselves dismissed in Appendix A. Reviews of unconscious cognition can be found in Bowers (1984), Dixon (1981), Erdelyi (1985), Holender (1986), Kihlstrom (1987, 1990), Marcel (1983b), and Shevrin and Dickman (1980).

[2] As authoritative commentators have observed (e.g., Bruner & Klein, 1960; Erdelyi, 1974; see also Bruner, 1992, this issue), the broad intellectual program of the New Look was to establish the role of cognitive and motivational organizing factors in perception. In this sense, the New Look was pursuing a constructivist position similar to one previously introduced by Bartlett (1932). Unconscious motivation was just one category of the organizing factors examined in the New Look research, but was also the category around which the greatest controversy developed. In retrospect, the success of the broad New Look program is undeniable. Perhaps it should not be surprising, however, that the New Look remains identified, in historical perspective, with its most controversial aspect.

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habitual or automatic, or as comprising procedural knowledge. Similarly, some describe the partial monitoring that occurs for background conversations in a crowded room as unconscious, whereas others refer to it as preattentive. This article, in part, attempts to convince those who currently avoid speaking of unconscious cognition that this manner of speech can now be used quite respectably.

Two Senses of Unconscious

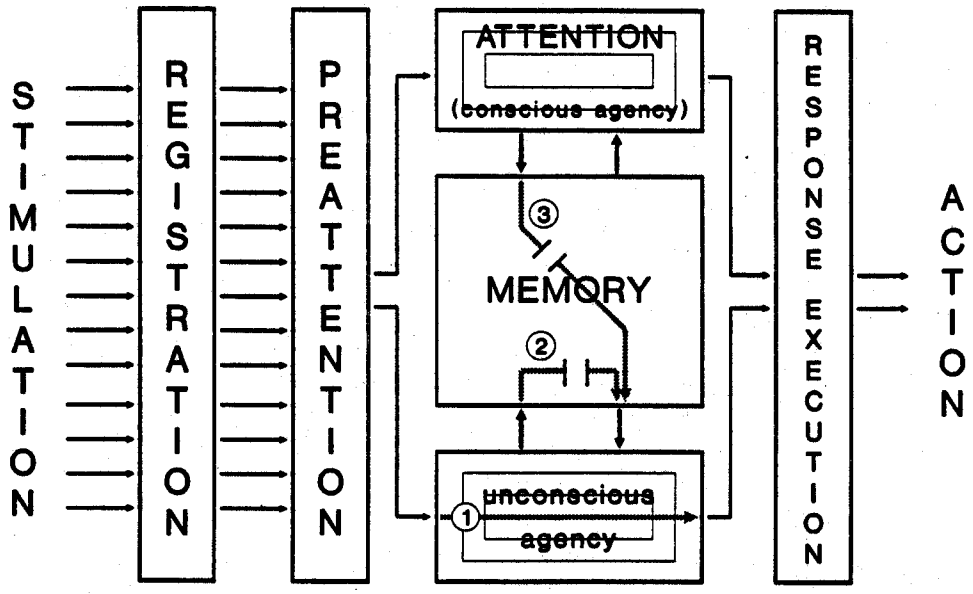
The most general meaning of *unconscious* is "unaware of." There are two quite different senses of "unaware of" that appear widely in cognitive psychological research and theory.

Sense 1: Outside of attention. If consciousness is interpreted as the selective aspect of attention (Kahneman, 1973; Posner & Boies, 1971), then one is unconscious or unaware of stimuli that impinge on receptors but fall outside the metaphorical spotlight of selective attention. This sense of the conscious–unconscious distinction is supported both by nearly 40 years of modern research on selective attention and by a long tradition in which attention has been a central topic of psychology (e.g., James, 1890; Pillsbury, 1908). The major research questions associated with this *attentionless* sense of unconscious cognition are, What are the limits of cognitive analysis of registered-but-unattended stimuli?, and What memory residues are established by such stimuli?

Sense 2: Lack or failure of introspection. If consciousness is interpreted as the ability to report experience validly, then one is unconscious or unaware of the occurrence, causes, or other attributes of attended objects, events, or actions when one cannot report those properties validly. Unlike the attentionless sense, this one presumes (a) a language-using organism, (b) a reflexive (self-describing) cognitive ability, and (c) the existence of a valid reference description of one's experience. For phenomena involving misperceptions of causes or of other object or event attributes, it is often difficult to distinguish faulty introspection from other cognitive errors. As a consequence, most studies of this sense of unconscious cognition involve failures to remember events that are known to have been attended. The major research question associated with this *verbally unreportable* sense of unconscious cognition is, How are cognition and action influenced by failures to remember experienced-but-unrecollected events?

Attention, which plays a critical role in the analysis in this article, is a central concept of cognitive psychology's once-dominant *information processing* theoretical framework (e.g., Broadbent, 1958; Neisser, 1967; Norman, 1968). Information-processing analyses characterize cognition as a series of stages, or transformations, between stimulus input and response output (Smith, 1968). Among these stages, as the locus of conscious agency, attention occupies a major position. Figure 1 locates the

Figure 1
Information-Processing Model of Conscious and Unconscious Cognition



Note. Boxes represent information processing stages, which occur in the order indicated by the arrows connecting them. The nested boxes within the stages of *conscious agency/attention* and *unconscious agency* indicate substages, or levels of analysis of increasing analytic complexity. The attentionless sense of unconscious cognition is represented by paths that do not pass through the box for *conscious agency/attention.* Path 1 indicates the route assumed for unconscious automatic activation in research on subliminal activation and selective attention. Path 2 indicates the route assumed for unconscious establishment of memory, and Path 3 for unconscious retrieval of memory. Gaps in the latter two paths indicate passage of time between establishment and use of memory.

three research domains that are summarized in this article in terms of the conception of information-processing stages. Two of the domains, *unconscious cognitive activation* and *unconscious establishment of memory,* involve attentionless unconscious cognition; the third, *unconscious retrieval of memory,* involves verbally unreportable unconscious cognition.

Like information-processing diagrams generally, Figure 1 separates memory from preattentive processing. This is theoretically problematic, because preattentive processing has long been understood to be modified by experience (e.g., Lynn, 1967; Sokolov, 1963). This theoretical limitation, it will be seen, is overcome in neural network models, an example of which appears below in Figure 2.

Levels of Analysis in Unconscious Cognition

The concept of *level of analysis* (or level of representation) is a familiar one in cognitive theory. As an example, in discussions of speech perception, low levels of analysis identify physical features such as sound frequency, intensity, and spatial location. By contrast, higher levels identify words, propositions, or even more complex structures such as multiproposition syllogisms. Similarly, in discussions of control over overt action, low levels of analysis encompass constructs such as conditioned reflexes (Pavlov, 1927) or habits (Hull, 1943), whereas higher levels include goal-directed actions, covert verbal intentions to act, or even more complex processes such as reasoned decisions. Figure 1 includes the levels concept in the form of multiple boxes nested within those for conscious and unconscious agency.

Several active controversies concerning unconscious cognition involve claims that unconscious cognition uses high levels of analysis. This controversy can be restated in very plain terms as, How smart is unconscious cognition? Compared with conscious cognition, is it smart or dumb? Psychoanalytic theory is strongly identified with the view that unconscious cognition uses sophisticated cognitive defenses and intelligently manages complex bodies of repressed (unconscious) knowledge—in other words, that it is smart. In psychoanalytic theory, then, the box for "unconscious agency" in Figure 1 represents mechanisms that are at least as cognitively sophisticated as those represented by the box for "attention (conscious agency)."

This article gives closest scrutiny to research findings that indicate the level of analysis at which unconscious cognition operates. Much research has sought evidence for unconscious processing of physical features, which require only low levels of analysis. A quite large body of research has sought evidence for processing of meanings of single words, which require a more complex analysis. Still higher levels of analysis are required for use of information encoded in multiword strings; however, relatively little research has sought evidence for unconscious cognition at this or higher levels. These three categories of stimulus material (physical features, single words, and multiword strings) account for the great majority of all research on unconscious cognition; in the following review these categories are used to distinguish studies by the level of unconscious analysis sought.

Unconscious Cognitive Activation

Because of limited space for this review, only major findings are described, and citations are used to identify sources of more detailed coverage. In compensation for this scholarly short shrift, cautious criteria have been used in treating empirical generalizations as established. And, although the review occasionally takes note of isolated findings, its major conclusions are based on findings that have been replicated independently in two, and preferably more, laboratories.

Subliminal Activation

In subliminal activation research, presentations of target stimuli are at weak energy levels, of brief durations, or are accompanied by masking stimuli that reduce target perceptibility. Claims for subliminal activation rest chiefly on findings that provide indirect evidence for analysis of semantic content of target word stimuli under conditions that limit or prevent awareness of the presence of these words. This presumed category of attentionless unconscious cognition is called *subliminal semantic activation.*

In analyzing research on subliminal semantic activation, Cheesman and Merikle (1984, 1986; Merikle & Cheesman, 1986) introduced a distinction between *objective threshold* (a level of stimulus presentation at which forced-choice responding indicates that a stimulus is undetectable) and *subjective threshold* (a level of greater duration, energy, or signal:noise ratio at which subjects report awareness of stimulus presence). Cheesman and Merikle proposed that semantic activation should be expected only when stimulus presentation conditions exceed objective threshold. Their view resembles a position that was strongly presented by Eriksen (1960); however, whereas Eriksen located the conscious–unconscious boundary at stimulus conditions at which forced-choice detection responding was at chance (objective threshold), Cheesman and Merikle located it at conditions that yielded above-chance responding (subjective threshold).[3]

Several published findings have been interpreted as demonstrating semantic activation under conditions at or very near objective threshold (Avant & Thieman, 1985; Balota, 1983; Dagenbach, Carr, & Wilhelmsen, 1989; Fowler, Wolford, Slade, & Tassinary, 1981; Greenwald, Klinger, & Liu, 1989; Groeger, 1988; Kostandov, 1985; Marcel, 1983a; Shevrin, 1988). However, both because of limited evidence that priming stimuli in some of these studies were undetectable and because of lack of inde-

[3] Cheesman and Merikle's (1984) view permits empirical location of the conscious–unconscious boundary to be partly under the subject's conscious control, in the same sense that location of the criterion in a signal-detection task (Swets, Tanner, & Birdsall, 1961) is controllable by the subject. This circumstance was partly responsible for Reingold and Merikle's (1988; see also Merikle, 1992, this issue) proposal of alternative operations for characterizing the conscious–unconscious distinction.

pendent replications, a cautious conclusion should not go beyond Cheesman and Merikle's (1984) conservative position—that semantic activation requires above-objective-threshold presentation conditions. At the same time, experiments using stimulus conditions that are clearly above objective thresholds (but presumably below subjective thresholds) have obtained semantic activation findings with apparent relative ease (e.g., Bargh & Pietromonaco, 1982; Cheesman & Merikle, 1984; Devine, 1989; Erdley & D'Agostino, 1987; Kitayama, 1990; Neuberg, 1988; Perdue, Dovidio, Gurtman, & Tyler, 1990; see also Bargh, in press).

Can subliminal presentations result in cognitive analyses of multiword strings? There have been reports of such effects, especially in association with tests of psychoanalytic hypotheses. The best known of these findings (described as *subliminal psychodynamic activation* [SPA], using "Mommy and I are One" as the text of a subliminal stimulus; Silverman & Weinberger, 1985) has been identified, on the basis of meta-analysis, as a reproducible phenomenon (Hardaway, 1990; Weinberger & Hardaway, 1990). Despite this strong evidence, many researchers remain skeptical about the SPA result (see, e.g., the survey reported in Appendix B). Such skepticism is almost certainly due to the lack of widespread enthusiasm for the SPA result's proposed psychodynamic interpretation (Silverman & Weinberger, 1985). Because of the positive affective values of words in the critical stimulus (especially *Mommy* and *I*), it is possible that observed effects might be explained by cognitive analysis limited to the level of single words. Some support for that interpretation is afforded by Hardaway's demonstration (1990, p. 183, Table 3) that other affectively positive strings that include *Mommy* or *One* also produce significant effects. However, these other effects are weaker than the effect of the specific string, "Mommy and I are One."

In summary of evidence from studies of subliminal activation, it is now well established that analysis occurs for stimuli presented at exposure conditions in a region between objective and subjective thresholds; this analysis can extract at least some semantic content of single words. Conclusions about subliminal analysis of higher-level (multiword) information remain controversial, as does the proposition that word or other stimuli can produce subliminal activation when presented at or below objective threshold. Thus, subliminal activation research provides replicable evidence for attentionless unconscious cognition, but indicates only limited analysis for such stimuli and is not yet convincing that this analysis occurs for stimuli that are undetectable.

Selective Attention

Experiments on selective listening and selective viewing require subjects to focus attention on one of two or more sources of stimulation. Subjects are instructed to attend closely to and report information from one source (the primary channel), while being tested indirectly for effects of information from another (secondary channel). As can be seen in some recent reviews (Allport, 1989; Johnston & Dark, 1986; Holender, 1986; Miller, 1987), selective attention procedures vary considerably in the extent to which they prompt or permit subjects to divide attention between the two channels, rather than focusing exclusively on one. When selective attention procedures succeed in withdrawing attention from the secondary channel, they can provide evidence bearing on the extent of analysis of unattended information—attentionless unconscious cognition.

In *dichotic listening* procedures, which present different messages to the two ears, it is readily demonstrated that low-level (physical feature) content of the secondary channel, such as pitch, loudness, and spatial location of sound, is analyzed (e.g., Cherry, 1953). By contrast, it is more difficult to demonstrate that single word meanings are analyzed, and some results that indicate analysis of words in the secondary channel are plausibly due to procedures that permitted voluntary switching of attention to the secondary channel (see Holender, 1986; Johnston & Dark, 1986). Nevertheless, numerous findings indicate not only analysis of secondary channel content at the level of individual words, but short persistence of memory for that content (see the discussion of negative priming findings, below). An especially valuable result is the identification of content in the secondary channel that can cause a spontaneous shift of attention to that channel. From such studies, it is well established that significant verbal stimuli in a secondary channel, such as one's name (Moray, 1959), or a word that is expected on the basis of primary channel content (Treisman, 1960), or a word that has been associated with electric shock (Dawson & Schell, 1982), are more likely than other verbal stimuli to attract attention. These findings strongly suggest that the secondary channel is analyzed at a level involving at least minimal aspects of word meaning. The authoritative review by Johnston and Dark (1986), "Selective Attention," concluded that semantic analysis of secondary-channel words occurs only when the words have high relevance to an attended task.

Dichoptic viewing is the procedure of presenting separate stimuli to the two eyes. *Binocular rivalry* occurs when images received by the two eyes mismatch in low-level features such as orientation or spatial frequency (Blake, 1989). In the visual region of such mismatch, the image from only one eye (the dominant eye) is visible. Parallel to research on dichotic listening, one strategy for assessing the level of analysis that occurs for the suppressed (unconscious) visual field is to determine what stimuli presented to it can cause it to capture attention (become dominant). In a 1978 review, Walker concluded "that there is evidence that the suppressed stimulus in rivalry is being fully analyzed and evaluated" (p. 376). However, in a more recent review, Blake (1989) suggested a reversal of Walker's conclusion on the basis of further studies that more thoroughly ruled out possibilities of attention to the secondary channel. Blake concluded that "suppression is accomplished at a relatively early stage

in the visual system in which only information about feature primitives has been extracted" (p. 162).[4]

Because evidence for analysis of single words in a secondary channel has itself been controversial, few studies have tested for analysis of secondary channel content at levels higher than individual word meaning. In one such test, Kidd and Greenwald (1988) sought evidence for the analysis of sequential content of secondary-channel messages. Their results were negative, showing that 10 repetitions of a nine-digit sequence in the secondary channel gave no evidence of even a partial memory residue when the same sequence was subsequently tested for digit-span performance in the primary channel.

In summary of the findings from studies of unattended stimuli, it is established that low levels of analysis (i.e., for physical features) occur for information in secondary channels. At intermediate levels, various procedures indicate that word meaning is processed at least partially in a secondary auditory or visual channel. At the same time, there is no established evidence (perhaps partly because there have been few good tests) indicating that multiword strings, or other comparably complex patterns, are analyzed in secondary auditory or visual channels. Therefore, selective attention research identifies approximately the same upper limit of (attentionless) unconscious cognition that was indicated by subliminal activation research.

Unconscious Establishment of Memory

Subliminal Activation Research

In demonstrations of the *subliminal mere exposure effect,* a graphic stimulus, such as an irregular octagon or a nonsense pictograph ("Chinese character"), is given several exposures under conditions that are too brief or dim to support subsequent recognition. Nevertheless, on two-alternative forced-choice tests of preference, comparing previously exposed and nonexposed stimuli, subjects prefer the previously exposed stimuli on about 60% of choices. First reported by Kunst-Wilson and Zajonc (1980), this result has been replicated by several investigators in various laboratories (e.g., Bonanno & Stillings, 1986; Mandler, Nakamura, & Van Zandt, 1987; Seamon, Marsh, & Brody, 1984; reviewed recently by Bornstein, in press). These studies generally have not included extensive testing to establish the detectability characteristics of exposure conditions.[5]

Several investigators have sought a visual *subliminal affective conditioning* result, characterized by the transfer of affect from a briefly flashed stimulus (an affectively positive or negative word, smiling or frowning face, or an emotion-arousing scene) to a fully visible neutral stimulus. Some positive results have been reported (e.g., Krosnick, Betz, Jussim, & Lynn, 1992; Niedenthal, 1990). However, by this article's conservative criteria, there has not yet accumulated a sufficient body of positive evidence to treat subliminal affective conditioning as empirically established. Attempts to demonstrate more complex enduring effects of subliminal stimuli have generally not succeeded. In double-blind tests of claimed beneficial effects of verbal suggestions buried subliminally in audiotapes, only negative results have been reported (Greenwald, Spangenberg, Pratkanis, & Eskenazi, 1991; Russell, Rowe, & Smouse, 1991; see also Moore, 1992; Vokey & Read, 1985).

Selective Attention Research

Some of the most compelling evidence concerning analysis of unattended stimuli comes from studies in which (a) subjects are required to generate rapid responses to a series of discrete trials in the primary channel, and (b) the secondary channel contains simultaneous stimuli that interfere by tending to elicit competing responses. These procedures, which give subjects no motivation to attend the secondary channel, robustly find disruptive effects of secondary channel content (Greenwald, 1970; Lewis, 1970). Of added significance is interference that occurs when the response required to the primary channel on a given trial is the one associated with the secondary channel's stimulus from the preceding trial (e.g., Greenwald, 1972; Neill, 1977; Tipper, 1985). These *negative priming* results, along with numerous variations on them (see review in Allport, 1989; and recent studies by Neill & Valdes, in press; Tipper, Weaver, Cameron, Brehaut, & Bastedo, 1991; Treisman, 1991) indicate not only that the ignored stimulus from the preceding trial was analyzed to a level sufficient to distinguish it from other stimuli, but also that a memory record of it survives for at least one further trial.

Kihlstrom, Schacter, Cork, Hurt, and Behr (1990) tested memory for paired-associate items that were presented repeatedly while subjects were under general anesthesia for a surgical procedure. Although finding no gains on a recall measure, Kihlstrom et al. found indirect evidence for learning on a free association measure. Attempts to demonstrate more complex enduring effects of unattended stimuli have generally not succeeded. As noted previously, Kidd and Greenwald (1988) found no learning of a digit sequence that was repeated 10 times in a secondary auditory channel. And attempts to transmit factual knowledge by presenting lectures aurally to

[4] A second strategy, which has yielded conclusions similar to those from tests of attention-capturing potency of stimuli presented to the suppressed eye, is to test for evidence of adaptation to stimuli presented to the suppressed eye; the occurrence of adaptation to any features of stimuli presented to the suppressed eye provides indirect evidence for processing of the adapted feature during the period of suppression (Blake & Overton, 1979).

[5] The subliminal mere exposure effect has not been tested with auditory stimuli, and is therefore established only for the visual domain. A possibly unconscious auditory mere exposure effect was reported by Wilson (1979), using dichotic listening to present novel melodic patterns supraliminally in a secondary channel. However, after more than a decade, Wilson's result has not been replicated (cf. Obermiller, 1983), and cannot be regarded as established. A related result was reported by Johnson, Kim, and Risse (1985) with Korsakoff patients, for whom, however, the melodies were initially presented in the primary channel; being attended, these auditory stimuli might be unconscious only in the sense of subsequently being unreportable.

sleeping subjects have generally not succeeded (Aarons, 1976; Swets & Bjork, 1990).

In summary of research on unconscious establishment of memory, the best established effects are subliminal mere exposure and negative priming effects. These replicable findings indicate that attentionless unconscious cognition produces memory traces at the level of object or word representations. However, tests for establishment of more complex memory traces have generally not found them.

Unconscious Retrieval of Memory

Unconscious Learning

In a series of experiments started during the 1960s, Reber (e.g., 1967, 1989; Reber & Allen, 1978) developed an *artificial grammar* procedure in which subjects study 20 or more strings, each containing a half-dozen or so consonants, produced by a set of rules (a finite-state grammar) that is complex enough to be virtually impossible for subjects to discover. Nevertheless, after the study phase, subjects typically show significant, although considerably less than perfect, ability to discriminate novel strings generated by the grammar from novel nongrammatical strings. Similar results have been obtained by others (e.g., Mathews et al., 1989).

A conceptually related method is the *pattern learning* experiment (Lewicki, Czyzewska, & Hoffman, 1987; Lewicki, Hill, & Bizot, 1988). In an illustrative version of this procedure, a target stimulus for which the subject is searching may occur in any of four quadrants of a computer display on each trial. Rather than being entirely random, however, the target's location on a subset of trials is determined by its location over a sequence of preceding trials. The rules that govern target location are too complex to allow discovery by subjects but, nevertheless, subjects typically show gradual improvements in performance, indicated by decreasing latencies in locating the target quadrant in displays that contain many distractors. In some other versions of the pattern learning procedure (e.g., Kushner, Cleeremans, & Reber, 1991), the subject's task is to predict the identity of the target on the next trial; with this task, gradual increases in prediction accuracy occur.

Most researchers using procedures similar to the artificial grammar and pattern learning experiments have used easily perceived, attended stimuli. When subjects' nonverbal performances indicate learning that they cannot articulate verbally—referred to by Reber (1967) as "implicit learning" and by Lewicki, Hill, and Czyzewska (1992, this issue) as "nonconscious acquisition of covariation"—that learning can be regarded as unconscious (in the verbally unreportable, not the attentionless, sense). However, that interpretation is controversial. Several researchers (e.g., Brooks & Vokey, 1991; Dulany, Carlson, & Dewey, 1984, 1985; Perruchet, Gallego, & Savy, 1990; Perruchet & Pacteau, 1990) have suggested that some (not all) artificial grammar or pattern learning findings are explainable by assuming that subjects acquire partial conscious knowledge about the experimental patterns. This skeptical position is supported by finding that subjects in some artificial grammar and pattern learning experiments can report fragmentary stimulus patterns that, even though falling well short of the complexity of the rules used to generate the stimuli, could consciously mediate the observed modest levels of rule-consistent performance. At the same time, subjects' ability to articulate partial rules on demand does not oblige concluding that those rules actually governed their observed (nonverbal) performance. It remains plausible that performance improvements in some pattern learning tasks are mediated by unconscious (i.e., verbally unreportable) knowledge.

Recently, Lewicki, Hill, and colleagues have introduced a new procedure that they describe as revealing *self-perpetuation of encoding biases* (Hill, Lewicki, Czyzewska, & Boss, 1989; Lewicki, Hill, & Sasaki, 1989). This procedure is similar to the pattern learning experiment, but includes an extinction period, which occurs after initial exposure to rule-generated stimuli, and during which the stimulus-generating rules are suspended. These experiments produce the surprising finding that rule-consistent performance increases during the extinction period. The increase is typically weak, but it is remarkable that it occurs at all. The evidence for this phenomenon is too recent to allow opportunity for appearance of any counterliterature of the sort that surrounds the artificial grammar and pattern learning experiments. Nevertheless, the phenomenon seems likely to be useful in understanding such real-world occurrences as maintenance of prejudicial stereotypes that exceed environmentally observed category–trait covariations; it poses an interesting challenge for theoretical explanation.

It now appears that the earliest strong claim of some investigators—that subjects acquired verbally unreportable complex rules—is no longer being actively advocated. Greatest consensus supports the view that subjects can learn covariations, or fragmentary rules, that partially approximate the complex rules that were used to generate the experimental stimuli. The conclusion in favor of unconscious (in the sense of verbally unreportable) learning rests on findings that subjects' verbal descriptions of the basis for their performance do not agree with experimenters' descriptions of what they are (nonverbally) doing.

Although debate over interpretations of artificial grammar and pattern learning findings continues, it seems undeniable that subjects are often *un*able to verbally describe complex performances, even ones that they acquired with full benefit of attention. For example, a skilled typist may be unable to report which left-hand finger is used most frequently to type the digit *1*, or which thumb is used most often to press the space bar after ending a word by typing the letter *d*. Because of the ease of producing (and confirming) examples such as those just given for typing, it seems unproductive to focus research on the question of whether or not verbally unreportable learning occurs—it certainly does. Of more interest is to establish the conditions under which it occurs, the com-

plexity of representations required to explain such findings, and the further behavioral or cognitive consequences of subjects being unable to report accurately what they have learned.

In regard to the important question of the role of attention in unconscious learning, a few results indicate that attention to patterns, as they are being presented, critically determines the extent of pattern learning that occurs. Cohen, Ivry, and Keele (1990) showed that, with a divided attention procedure that reduced attention to a cyclically repeating pattern, six-item-long patterns of three elements were not learned. Nissen and Bullemer (1987) similarly reported that division of attention during original pattern exposure reduced learning of repetitive patterns (see also Hartman, Knopman, & Nissen, 1989).

Implicit Memory

An extremely productive line of memory research has recently evolved from work that started as scattered clinical observations of spared memory abilities of patients suffering massive amnesias. An especially influential early observation was Claparède's (1911/1951) noticing that a hospitalized Korsakoff-syndrome amnesic was reluctant to shake hands with the doctor (Claparède) who had, a few minutes earlier, pricked this patient's hand with a hatpin. On being pressed, the patient stated, "Sometimes pins are hidden in people's hands," but did not understand this to be a memory (p. 70). In the past 20 years or so, similar observations have been gathered much more systematically as researchers developed tasks that revealed amnesics' performance gains from unrecallable practice trials (e.g., Cohen & Squire, 1980; Warrington & Weiskrantz, 1968). Present understanding of the theoretical significance of amnesics' mnemonic abilities has been greatly expanded by the work of Jacoby (who provides an overview in this issue—Jacoby et al., 1992). Jacoby and Witherspoon (1982) demonstrated a close similarity between data obtained from Korsakoff amnesics and from normal university students on a spelling task that indirectly tapped memory for words encountered earlier in the experiment. Jacoby and Dallas (1981) showed that another indirect measure of memory for words, the ability to identify them from brief exposures, similarly indicated memory that was not revealed by (conscious) recognition measures.

Jacoby and Dallas's (1981) findings suggested the existence of a dissociation among functions of memory in normal subjects, a conclusion that was quickly confirmed in other research (e.g., Graf, Mandler, & Haden, 1982; Tulving, Schacter, & Stark, 1982). The form of memory that is apparent on indirect measures (such as Jacoby and Dallas's perceptual identification measure) closely resembles that which is spared in many amnesics. A broad review of the historical background of memory research using indirect measures, and its active development through the mid-1980s, has been given by Schacter (1987; see also Richardson-Klavehn & Bjork, 1988; Roediger, 1990). Schacter's review effectively attached the shorthand label of *implicit memory* (introduced by Graf & Schacter, 1985) to the diverse and growing set of phenomena that involve indirect evidence of memory unaccompanied by ability to report recollection of the trace-establishing event.

Jacoby's further work (reviewed in Jacoby, Lindsay, & Toth, 1992) has identified several *memory illusions* that derive from implicit memory effects. One example is the subject's incorrect assignment of fame to a name that was endowed with some familiarity by being encountered earlier in the experimental procedure (Jacoby, Kelley, Brown, & Jasechko, 1989). The discovery of this and other memory illusions has made it possible to connect implicit memory to the large class of judgment errors (or misattributions) that have been studied by social psychologists during the past 20 years. As an example, Banaji and Greenwald (in press; Greenwald, 1990) found that Jacoby et al.'s false fame effect occurs, among both male and female subjects, much more strongly for male than female names, suggesting the unconscious operation of a stereotype that associates maleness with achievement (see related unconscious attribution findings in Higgins, 1989; Schwarz et al., 1991).

As was also true for the artificial grammar and pattern learning research, most of the implicit memory research involves procedures in which critical stimuli are fully attended on initial exposures. A few findings indicate that this attention is important, although more research to establish the role of attention would be desirable. As previously described, Kidd and Greenwald (1988) found no evidence of implicit memory for a digit sequence when it was presented 10 times in a secondary channel; they also found that implicit memory for digit order was lacking even for attended sequences, when subjects' orienting task did not oblige active attention to serial order of the digits.

Summary: Levels of Analysis in Unconscious Cognition

Studies of unconscious cognition demonstrate that physical features and at least some aspects of word meaning are analyzed for unattended stimuli, and that memory traces of objects or words are established for unattended stimuli. As yet these studies have provided no evidence that can confidently be interpreted as indicating (attentionless) unconscious analysis at the level of multiword strings. Studies of verbally unreportable memory consistently demonstrate that subjects acquire much more knowledge of attended events than they can later verbalize. These unreportable residues have been described as priming (increased accessibility of object representations) and acquisition of covariation (learning relationships among object attributes). In subliminal mere exposure research, object representations (covariations among physical features) are apparently learned very efficiently with no or little attention. However, more abstract covariations appear to require attention; this is indicated by failures to acquire unattended patterns in Kidd and Greenwald's (1988) research, and by the reduced levels of pattern learning demonstrated when attention is di-

vided in the research of Nissen and Bullemer (1987) and Cohen et al. (1990).

Unconscious Cognition in Clinical Phenomena

The preceding review establishes that attentionless unconscious cognition is generally quite limited in the sophistication of analyses it can perform. This conclusion severely calls into question the psychoanalytic conception in which unconscious cognition matches or exceeds the cognitive sophistication of conscious cognition. At the same time, it is important not to belittle the significance of the unconscious cognition that has been demonstrated.

Previous scholarly reviews of unconscious cognition have often contrasted the poverty of laboratory research evidence with the richness of clinical case reports (e.g., Erdelyi, 1985; Holmes, 1974). Consequently, and in light of this article's stress on the analytic poverty of unconscious cognition, the reader may ask, Can (or how can) analytically unsophisticated unconscious cognition manage achievements such as the self-deceptions (e.g., Lockard & Paulhus, 1988; Sackeim & Gur, 1978) and repression (e.g., Erdelyi & Goldberg, 1979; Horowitz, 1988) that are documented so extensively by clinical psychologists and psychoanalysts? Perhaps surprisingly, these questions have potentially simple answers.[6]

Self-Deception

In clinical accounts of self-deception it is assumed that, when an ego-threatening situation arises, this situation is first discovered by unconscious agency, which then prevents the threatening knowledge from reaching conscious attention. A presumed example is a hospitalized cancer patient who, although terminally ill, manages to retain belief in a favorable prognosis. The self-deception interpretation is that unconscious agency comprehends the terminal diagnosis, but prevents that knowledge from achieving conscious status.

A simpler account of self-deception follows from the observation that one can avoid a threatening situation without having done the cognitive analysis needed to know exactly what the threat is. As an analogy, consider that in order to discard unwanted (junk) mail one need only identify a few superficial cues, such as low postage cost, machine addressing, commercial return address, and low-quality envelope paper. These cues quite suffice to guide behavior of discarding the mail. This adaptive avoidance response obviously has no requirement of knowledge of the specific nature of the event being avoided (the contents of the envelope). Similarly, adaptive cognitive defenses should be able to operate on the basis of superficial warning signals, with no more than partial knowledge of the threatening state of affairs. The psychoanalytic assumption, that the cognitive system unconsciously constructs and uses a representation of the exact nature of an ego threat in order to manage an effective defense, is simply unnecessary. (The junk mail analogy to cognitive ego defense was described more fully by Greenwald, 1988.)

Repression

The psychoanalytic account of repression assumes that cognizant unconscious agency, aware of ego-threatening memories, prevents those memories from being consciously retrieved and thereby causing distress. This interpretation parallels the just-given psychoanalytic account of self-deception; the two accounts differ primarily in that self-deception involves current perception and judgment, whereas repression involves memory. Perhaps the most plausible evidence for repression comes from clinical cases showing that—with effort—long-unavailable, painful memories are occasionally retrieved (e.g., Erdelyi, 1985, pp. 244ff.).

A simpler account of repression uses empirically established phenomena of implicit memory as the basis for understanding apparent instances of recovery of repressed memories (see also Kihlstrom, Barnhardt, & Tataryn, 1992). Explanations of implicit memory assume that memory traces of an attended event are often preserved despite inability to recall the event. Because these unconscious traces influence conscious experience (as manifestations of implicit memory), they can provide a basis for recovering the otherwise unretrievable event. The present author has noticed such influences when watching a televised drama, presumably for the first time, while being able to guess upcoming plot turns with remarkable prescience. This experience leads to recovery of the lost (explicit) memory of having previously seen that particular drama. Clearly, this implicit-becomes-explicit memory account is far simpler in its theoretical interpretation than the psychoanalytic account, which requires a sophisticatedly cognizant (and near omniscient) unconscious agency. Note, too, that the implicit memory account can explain false memories (paramnesias and déjà vu). For example, the first-time viewer who is unsurprised by the plot turns of a drama might mistakenly conclude that it was previously seen.

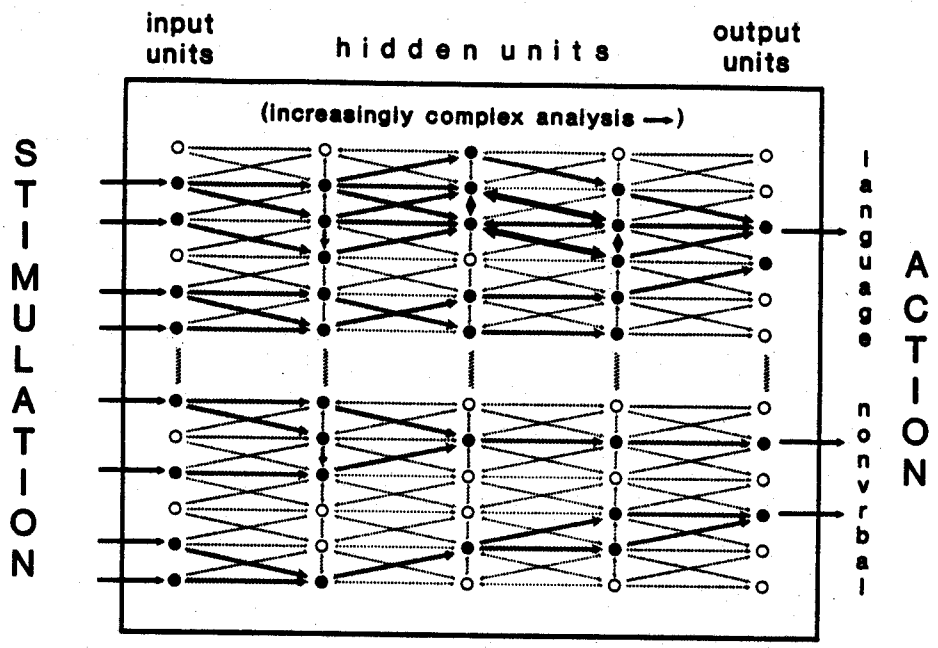
Unconscious Cognition in Neural Networks

Any substantial foundation for the once-fashionable skeptical position of many academic psychologists—that empirical findings do not warrant belief in psychologically significant unconscious cognitive phenomena—has crumbled in the face of recent research. The recent developments that seem most significant are (a) development of the concept of subjective threshold, which has guided the design of procedures that produce replicable subliminal semantic activation effects, and (b) the proliferating discovery of performances that serve as indirect memory measures, establishing the great extent to which memory operates independently of verbal ability to report past experience.

These innovations have occurred along with other changes in psychology that are widely recognized as con-

[6] The simple answers that follow can be recognized as bearing some similarity to ones offered in Dollard and Miller's (1950) behaviorist interpretation of psychoanalytic theory.

Figure 2
Representation of Conscious and Unconscious Cognition in the Format of Neural Network (Connectionist, or Parallel Distributed Processing) Models



Note. Activity is represented by thickened links (arrows) and darkened nodes (circles). Resonant (i.e., sustained) high levels of activation within a subnetwork of hidden units (black arrows, interconnecting black dots) indicate the selective attention sense of conscious cognition. Connections from hidden units to language outputs provide a capacity of the network to report on its operations. Unconscious cognition in the sense of verbally unreportable cognition occurs to the extent that language outputs fail to report validly on network operation. (Nothing in the network structure guarantees validity of such self-conscious, or introspective, reports.) Unconscious cognition in the attentionless sense occurs in the form of activation of outputs other than those mediated by resonantly active subnets.

stituting a major new orientation to psychological theory—the sort of scientific development that is sometimes declared to constitute a paradigm shift. Figure 2 suggests the location of unconscious cognition in the setting of this newer approach, which is identified variously as *parallel distributed processing* (PDP), *neural network* modeling, or *connectionism* (Rumelhart & McClelland, 1986). The primarily sequential character of cognition in the information processing framework of Figure 1 has been replaced by extensive parallelism in Figure 2. Network models give much attention to microstructure of the processing system. Many connection strengths in the neural network are modified each time the network is used. The network merges the functions of memory and perception, overcoming the theoretically most problematic aspect of information-processing representations such as Figure 1.

As is the case with major theoretical reorientations in other sciences, in this case the newer approach appears able to do everything that the previous one did (e.g., some of its instantiations should be able to simulate a serial stage processor) and considerably more. The network representation of Figure 2 readily accommodates this article's distinction between two senses of conscious cognition. One of these—consciousness as network operation that boosts activation to resonantly stable high levels in subnetworks—corresponds to the interpretation of conscious cognition as attention.[7] The second is the network's possibility of having verbal outputs that, by virtue of connections to hidden units (see Figure 2), can "report" on internal network status. These outputs provide the system's capacity for introspection, corresponding to the second sense of consciousness (or self-consciousness). Of course, the presence of this capacity provides no assurance that introspective reports are valid. As Nisbett and Wilson (1977) argued, introspective reports should be heavily shaped by external social influences, and therefore can frequently be quite invalid.

In regard to unconscious cognition, the network form of theory overcomes a basic awkwardness of information processing theory's characterization of subliminal activation. In information processing terms, subliminal activation involves the paradoxical (in serial, information processing terms) operation of a late stage (semantic analysis) when an earlier stage (analysis of physical features) has not yielded output. In contrast, by virtue of its permitting semantic and physical feature analysis to occur in parallel rather than in series, the network paradigm

[7] Hebb's (1949) theory of resonant neural activity organized into hypothetical units identified as *cell assemblies* and *phase sequences* is widely recognized as a precursor of this aspect of contemporary network models.

can account nonparadoxically for semantic analysis without presence-absence discrimination.

In addition, the network form of theory readily permits response outputs to combine conscious (reportable) and unconscious contributions. The assumption that conscious and unconscious contributions are mixed in single performances has, indeed, been appearing with increasing emphasis in the unconscious cognition literature (see Jacoby et al. 1992; Merikle, 1992; Reingold & Merikle, 1988). In contrast, Figure 1's model encourages the view that conscious and unconscious agency operate simultaneously and largely independently, which is to say that they are *dissociated.* (Dissociation continues to be possible in, even if not suggested or required by, Figure 2's network structure.)

Summary of the Argument

1. Two meanings of unconscious cognition are distinguished: (a) cognition without attention, and (b) verbally unreportable cognition. A recent blossoming of research on these two types of unconscious cognition has established several procedures that have replicable findings.

2. Unconscious cognition has been found to be severely limited in its analytic capability. For attentionless unconscious cognition, research on selective attention and subliminal activation has established nothing cognitively more sophisticated than analysis of partial meanings of single words. Furthermore, claims that such analysis occurs for stimuli that are undetectable (i.e., subliminal stimuli at or below objective thresholds) are not yet solidly supported.

3. It is well established that attended stimulus presentations yield much more learning than can be subsequently reported verbally by subjects. This learning includes establishment of physical-feature representations of objects and learning of covariations among objects. There is some evidence that the complexity of such learning varies directly with attention at the time of initial learning.

4. The current view of analytic simplicity of unconscious cognition deviates sharply from the psychoanalytic theories that dominated research on unconscious cognition prior to the 1980s. This deviation is great enough to justify characterizing the recent work as constituting a new (third) New Look at unconscious cognition.

5. Because of recent developments of research methods, some remaining empirical controversies are likely to be resolved soon. The most significant current controversies concern (a) the minimal stimulus conditions under which subliminal semantic activation occurs, (b) the theoretical significance of the replicated subliminal psychodynamic activation phenomenon, and (c) the role of conscious mediation in unconscious learning results.

6. In recognition of the theoretical importance of understanding the analytic limits of attentionless unconscious cognition, some of the present conclusions can be focused on an empirical challenge—the *two-word challenge.* In the current state of empirical knowledge, the task of demonstrating that attentionless unconscious cognition can extract the meaning of a two-word sequence poses a theoretically significant challenge. In any attempt to meet this challenge, to assure that the effect depends on analysis of the words in sequence, the meaning of the two-word sequence should not be communicated (even in part) by each word individually. And, to assure that the two words are not attended, it is suggested that the test use one of the two types of procedure (selective attention or subliminal activation) that are best established as precluding such attention.[8]

7. If the evidence for cognitively sophisticated capabilities of unconscious cognition does not soon switch from being controversial to being conclusive, it will be time, at last, to abandon psychoanalytic theory's proposal that unconscious cognition is the analytic peer (or superior) of conscious cognition.

[8] Greenwald and Liu (1985) made an unsuccessful attempt to meet this challenge, using the subliminal evaluative priming task of Greenwald et al. (1989). In Greenwald and Liu's test, evaluative meanings of two-word subliminal priming sentences were designed to be uncorrelated with the evaluative meanings of their component words (examples were *enemy loses* and *friend wins,* both of which are evaluatively positive as sentences despite having opposed evaluative meanings at the level of single words). It was found that the priming effects of these stimuli were determined by their component individual words' meanings, rather than by their sentence meanings.

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APPENDIX A

Dismissing the Dismissals of Unconscious Cognition

Three strategies of argument appear in psychologists' dismissals of the possibility of unconscious cognition.

General conceptual dismissals define the business of psychology in such a way that a concept of unconscious cognition has no place. Radical behaviorists, for example, treat the conscious–unconscious distinction as part of a mentalistic paradigm that has no place in their science of behavior. A variant of this position is to consider only consciousness as such an unneeded mentalistic concept; in this variant, all behavior is performed unconsciously, rendering the conscious–unconscious distinction useless.

Specific conceptual dismissals allow the existence of both conscious and unconscious cognition, but define one or both in a way that renders the distinction uninteresting. One version of this dismissal is the proposition that "we are conscious of mental contents, not processes" (see review and summary of this position by Nisbett & Wilson, 1977; see also Mandler, 1985). Such statements serve simultaneously to define a process–content distinction and the conscious–unconscious distinction. In this view, the process = unconscious and content = conscious conception functions as a set of circular definitions, which are not useful until the component terms are given operational definitions. As interpreted from this position, *conscious mental process* and *unconscious mental content* are no more than oxymoronic notions.

Operational dismissals offer empirical criteria of unconscious cognition that are impossible to achieve. One version of this is the assertion that the occurrence of any discriminative response to a stimulus indicates that conscious cognition has been engaged. With this operational definition of conscious cognition, only a stimulus that cannot influence any response might operate unconsciously. Because such a stimulus by definition can have no effects, there can be no unconscious cognition! (A more detailed consideration of this dismissal was given by Bowers, 1984.)

Two further examples of operational dismissal of unconscious cognition are the assumptions that (a) in selective attention procedures, attention is necessarily divided among all concurrent inputs, and (b) in subliminal semantic activation procedures, subliminal stimuli are attended but rapidly forgotten (therefore producing the appearance of not being perceived). By effectively operationalizing attention as physical stimulus presentation, these analyses make it impossible, by definition, to present a stimulus outside of attention in selective attention or subliminal activation procedures, thereby dismissing the possibility of demonstrating attentionless unconscious cognition.

These three types of definitional dismissals of unconscious cognition are empirically unassailable. Consequently, the research-based arguments provided in this article simply do not speak to committed adherents of those views. The article is, rather, addressed to those who prefer not to rule out, definitionally, the possibility of a psychologically significant distinction between conscious and unconscious cognition.

APPENDIX B

Survey of Expert Opinion on Unconscious Cognition

In preparing this article, the author conducted a survey of opinion concerning the attentionless unconscious cognition phenomena associated with selective attention and subliminal activation research. For each putative empirical phenomenon included in the survey, respondents had the option of indicating either than they lacked sufficient familiarity to offer a judgment,

or that (a) some example of the phenomenon is empirically established, (b) empirical data are convincing that no version of the phenomenon occurs, or (c) there has not been enough research to warrant either a positive or negative conclusion.

Copies of the 14-item survey were circulated to 65 persons who have been active in research on unconscious cognition, including many whose work is cited in the article; 31 responses were received. The responses, summarized below, do not qualify in any sense as an evaluation of current empirical knowledge. Rather, they indicate the extent to which existing research has been persuasive in producing acceptance or rejection of the various propositions with which the survey was concerned.

Four unconscious cognition phenomena received endorsement by more than 50% of respondents. With percentage of respondents who judged that some version of the phenomenon is empirically established given in parentheses, these were: (a) subliminal semantic activation by single words presented under conditions between objective and subjective threshold (93%), (b) analysis of single words in a secondary (unattended) auditory channel in selective attention experiments (84%), (c) subliminal mere exposure effect for objects presented between objective and subjective threshold (74%), and (d) analysis of single words in a secondary (unattended) visual channel (61%).

Greatest skepticism was associated with phenomena involving analysis of multi-word stimuli (30% to 45% of respondents indicating that empirical evidence establishes that the survey's four phenomena in this category do not occur). Nevertheless, 16% judged that subliminal analysis of multi-word stimuli was established when stimuli are presented between objective and subjective threshold; these positive judgments certainly were based chiefly on evidence from subliminal psychodynamic activation ("Mommy and I are One") experiments. Propositions concerning subliminal activation by single words and subliminal mere exposure effects for stimuli at or below objective threshold were more positive than negative, but were also clearly controversial, with response distributions among positive/negative/more-research-needed categories, respectively, of 42%/29%/26% and 39%/19%/39%.