Psychology, Public Policy, and Law
2001, Vol. 7, No. 2, 311–344

1076-8971/01/$5.00 DOI: 10.1037//1076-8971.7.2.311

ASSESSING THE VALIDITY OF AMNESIA IN DISSOCIATIVE IDENTITY DISORDER
A Dilemma for the *DSM* and the Courts

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Amnesia, as a central descriptive and diagnostic feature of dissociative identity disorder (DID), has received little empirical study. The few published studies are generally consistent in finding that direct tests of memory (e.g., recall and recognition) produce reports of interidentity amnesia but less transparent indirect tests of memory tend to show evidence of memory transfer between identities. Such findings highlight the need for more objective measures of memory in DID and raise questions concerning the nature of amnesia in DID. At present, empirical research fails to unequivocally substantiate patients' claims of amnesia between identities, and reports of such amnesia should not be regarded as conclusive in legal proceedings. The authors propose that psychophysiological measures of memory may provide such an objective measure and can further illuminate the nature of the reported memory deficits in DID.

Dissociative identity disorder (DID)—formerly termed *multiple personality disorder* (MPD)—is a rather controversial diagnosis that has seen a dramatic increase in reported prevalence in the United States and Canada, but not elsewhere, over the course of the last 2 decades (Merskey, 1995). DID, as defined by the *Diagnostic and Statistical Manual of Mental Disorders,* 4th edition (*DSM–IV;* American Psychiatric Association, 1994), is characterized by the presence of two or more distinct identities or personality states that recurrently take control of the individual's behavior, accompanied by an inability to recall important personal information that is too extensive to be explained by ordinary forgetfulness. Prior to the 1994 publication of the *DSM–IV,* interidentity amnesia was not required as a criterion for diagnosis. Multiple personality disorder was renamed to dissociative identity disorder in the *DSM–IV* and for the first time required the "inability to recall important personal information that is too extensive to be explained by ordinary forgetfulness" (American Psychiatric Association, 1994, p. 487) for the diagnosis. Although amnesia between different identities is not explicitly required, the *DSM–IV* narrative text explaining the amnesia only describes interidentity amnesia (American Psychiatric Association, 1994, pp. 484–485).

With amnesia now required for diagnosis, the assessment of memory in putative cases of DID assumes new importance. Legal defenses that hinged on

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This research was supported, in part, by a grant from the McDonnell-Pew Program in Cognitive Neuroscience. We thank the participants for volunteering their time to participate in the study, and we thank Hal Movius for his assistance with many aspects of this work.

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establishing that a defendant had the now-outdated diagnosis of MPD (e.g., *State v. Badger,* 1988) did not need to conclusively establish the presence of such amnesia to build a defense around the disorder, but contemporary cases wishing to establish the diagnosis of DID would, in fact, need to do so. There exist a variety of approaches that courts use in dealing with defenses such as *not guilty by reason of insanity* and *diminished capacity* (for review, see Orr, 1999). Amnesia—in addition to being relevant to establishing the diagnosis of DID—may have bearing on whether DID defendants are competent to assist their attorneys in conducting their defense (Slovenko, 1995).

Empirical Studies Of Interidentity Amnesia

There have been few empirical studies of interidentity amnesia in cases of DID/MPD. In the published literature, there are three case studies (Dick-Barnes, Nelson, & Aine, 1987; Ludwig, Brandsma, Wilbur, Bendfeldt, & Jameson, 1972; Nissen, Ross, Willingham, Mackenzie, & Schacter, 1988), three investigations involving several patients each (Eich, Macaulay, Loewenstein, & Dihle, 1997b; Peters, Uyterlinde, Consemulder, & van der Hart, 1998; Silberman, Putnam, Weingartner, Braun, & Post, 1985), and another study (Allen & Movius, 2000) that is reviewed in greater detail later in this article. Although almost all of these studies find some evidence supporting interidentity amnesia, all also find that there is some degree of transfer of memory across identities. Table 1 provides a synopsis of these findings.

Case Studies

In the first published case study of interidentity amnesia, Ludwig et al. (1972) used several memory tasks in the study of four different identities of one patient. The first memory task was a paired-associate learning task in which each identity in turn learned a different list of 10 stem words that had been paired with a list of associates. In line with predictions, when other identities were tested for recollection of the material, these other identities generally did not report the correct associate. The next memory test assessed the extent to which learning by one identity would be aided by previous learning of another identity. There was clear evidence of a practice effect across identities, such that material learned by one identity facilitated learning by subsequent identities. Similar results were found with a logical memory task in which identities were asked to recall details from a short story; identities tested later appeared to benefit substantially from the experience of the identities tested before them. The final memory-relevant task was a conditioning paradigm in which electric shock to the calf was paired with an initially neutral stimulus (e.g., a tone for some identities, a light for others). After establishing conditioning by pairing the shock with the tone or the light for a given identity, the conditioned stimulus (i.e., the tone or the light) was then presented to the three other identities. This procedure was repeated for each of the four identities; in turn, each identity was conditioned to a particular stimulus and the other three identities were presented with that particular stimulus. If the conditioned stimulus produced an "adequate" galvanic skin response (GSR), then conditioning was assumed to have occurred. In each case, conditioning thus

Table 1
Summary of Studies of Interidentity Amnesia

Authors	*N*	Findings consistent with amnesia	Findings suggesting transfer of knowledge
Ludwig et al. (1972)	1	Recall of paired associates	Facilitation of learning by subsequent identity Shock conditioning
Dick-Barnes et al. (1987)	1		Paired associates
Nissen et al. (1988)	1	Simple word recognition No facilitation recalling details of stories heard by other identity Experience of another identity did not affect word-stem completion Interpretation of ambiguous texts and sentences not aided by clues given to other identity	Forced-choice facial recognition Repetition priming enhanced identification of briefly presented masked words Word-fragment completion Sequence learning Impaired learning of repaired paired associates
Eich et al. (1997a, 1997b)	9	Free recall of words Experience of another identity did not affect word-stem completion	Picture-fragment completion facilitated by other-identity exposure
Silberman et al. (1985)	9		Unable to compartmentalize and confused which identity had learned which words
Peters et al. (1998)	4	Generally poor free recall of words	Some free recall of words (2 of 4 patients) Recognition (3 of 4 patients) Word-stem completion (3 of 4 patients)
Allen & Movius (2000)	4	Poor free recall of words	Reaction times slowed to words learned by other identity Event-related potentials indicative of recognition of words learned by other identity

defined was observed in the personality exposed to conditioning trials (indicating that the conditioning was successful), and in most cases the three other personalities also showed responses to the conditioned stimuli. It is worth noting that an adequate nonconditioned control stimulus was not included; it is thus impossible to determine whether the GSR responses represented a transfer of conditioned learning across personalities or whether such responses represented a novelty

response on the part of an identity that had not previously seen or heard the stimulus. Considered jointly, the results of the Ludwig et al. (1972) study suggest that when queried directly, identities appear to be amnesic for material learned by other identities, but when assessed indirectly (by measuring facilitation from previous learning or conditioned responses) there appears to be substantial transfer of memory.

A paired-associate learning task was used in the case study of Dick-Barnes et al. (1987). Each of three identities learned a list of paired words. Learning continued until on three consecutive trials the identity could produce the second word in the pair when presented with only the first member of the word pair. After all three identities had finished the learning phase, the testing phase involved presenting to each identity in succession only the first word of all of the word pairs that had been presented previously. The procedure thus presented each identity with words that she had learned as well as those learned by other identities. Transfer of learning was evident across all pairs of identities, as the number of errors did not differ between the lists on which the tested personality had or had not been trained. Moreover, the errors on a given list were similar across personalities, indicating that the three personalities tended to forget essentially the same word pairings regardless of the personality tested.

Nissen et al. (1988) used an extensive battery of tests involving direct inquiries as well as indirect measures of memory. Eight identities of a single patient were assessed, although a majority of the assessments involved a subset of four identities. On several tasks there was clear evidence of interidentity memory: (a) Forced-choice recognition of faces showed above-chance recognition for faces seen by another identity; (b) repetition priming across identities enhanced accurate identification of briefly presented, masked words that had been seen by another identity; (c) word-fragments (i.e., missing some letters) were more likely to be completed with a word seen by another identity; (d) reaction times were faster to a complex sequence when another identity had first learned that sequence; and (e) the ability to learn a list of paired-associate words was impaired when these same words, paired in a different combination, were learned by another identity. On several other tasks, there was no clear evidence of transfer of memory across personalities: (a) On a recognition test, one identity failed to endorse any of the 10 words seen by another identity; (b) there was no facilitation in recalling details of stories heard by other identities, a result opposite to that found in Ludwig et al. (1972); (c) there was no evidence that the experience of another identity affected word-stem completion (three-letter stems that could each be completed to form 10 different English words); and (d) the interpretation of ambiguous texts and sentences was not enhanced if another identity had the disambiguating context information (e.g., the sentence "The smell began because the signs went up" could be disambiguated by the context information "garbage strike"). To summarize these findings, Nissen et al. (1988) concluded that assessing memory indirectly was a necessary, but not a sufficient, condition for demonstrating transfer of memory across personalities. The authors further speculated that material that required greater interpretation was less likely to show transfer across personalities.

Studies With Several Patients

Eich et al. (1997b) based their study of 9 DID patients on the findings of Nissen et al. (1988). As predicted, free recall of words learned by alternate identities was virtually nonexistent, with only 1 word recalled from among a possible 360 words learned by all identities in the experiment. Similar to results found in Nissen et al. (1988), Eich et al. (1997b) found that, within an identity, completing word stems was influenced by words previously seen, but there was no evidence of such transfer of memory between identities on the word-stem completion task. Eich et al. (1997b) also included a picture-fragment completion task in which line drawings were presented in increasing degrees of completeness; prior exposure to a completed drawing allows participants to identify drawings with less detail than they would ordinarily require. On this task, the effect of previously seeing a detailed drawing facilitated recognition within an identity as well as between identities. In fact, this priming effect was as strong between different identities as it was within the same identity. These findings again follow the pattern that direct assessments of memory (recall) reveal interidentity amnesia, and indirect methods (picture-fragment completion) show evidence of interidentity transfer of knowledge. The word-stem completion task is putatively an indirect measure that shows no transfer of knowledge across personalities. Alternatively, there is no guarantee that word-stem completion tasks do not evoke an explicit memory for the words previously learned, thus becoming a direct assessment.

In a subsequent report on the same patient sample, Eich et al. (1997a) reported that a group of 9 participants instructed to simulate DID did not perform like DID patients. Whereas DID patients showed interidentity transfer on this picture-fragment completion task, the simulators did not. Eich et al. (1997a) suggested that the simulators, unlike the patients, accurately kept track of which putative identity had seen which picture and suppressed their responses accordingly. In other words, the simulators had transformed the indirect memory assessment task into a direct memory assessment task and were therefore able to create the appearance of amnesia. It is worth noting that the simulators in the Eich et al. (1997a) study were mental health professionals, including psychiatrists, psychologists, and social workers, and it is quite possible that these simulating control participants were cognitively higher functioning than the DID patients. It is therefore possible that the control participants, by virtue of their higher cognitive function, could keep track of what had been seen previously and therefore treat the indirect picture-completion task as a direct memory task. Patients, by contrast, may have been unable to do so.

Silberman et al. (1985) assessed memory directly in 9 patients and 10 control participants who were instructed to make up an imaginary alternate personality who would participate in testing. Each of two identities learned word lists, and then recall and recognition were tested under conditions of the same or different identity. Both identities first learned a list of words, and then both identities were subsequently tested after a 2 hr interval; if interidentity amnesia were present, memory "compartmentalization" should make it simple to recall only the items learned by the tested identity. To the extent that amnesia was not present, there could be confusion over which identity heard which words, and words learned by

the other identity might be recalled as well. Silberman et al. (1985) found that patients did indeed show transfer of memory across personalities and that they were no better at compartmentalization than were the control participants. These findings, which are the only instance of a direct assessment resulting in a clear transfer of memory, represent a departure from the studies reviewed earlier. A critical difference, however, between the Silberman et al. (1985) study and other studies concerns the extent to which it is possible to accurately monitor the source of the information (cf. Johnson, 1997; Johnson, Nolde, & De Leonardis, 1996). Because the words in the Silberman et al. (1985) study are not personally relevant, not presented in a distinctive context, and are to be recalled after an intervening delay, it becomes somewhat difficult to distinguish the context in which each list was heard. This difficulty presumably should not affect DID patients if they have amnesia for one of the lists of words, yet control participants and patients showed equal difficulty in discriminating the lists.

Peters et al. (1998) assessed the asymmetrical transfer of memory between two identities in each of 4 patients with DID. Identities were selected such that Identity A reported access to the memories of Identity B but not vice versa. Each identity learned a list of 15 words until perfect recollection was obtained (or until 8 presentations occurred). The alternate identity was then tested for recall and recognition of the words and asked to complete word stems that were the beginnings of words seen by the first identity. The procedure was repeated with new stimuli so that each identity had a chance to learn a list and to be tested for memory of the other identity's learning. Peters et al. (1988) found strong evidence that, as expected, Identity B was aware of Identity A's words (because Identity B reported, prior to the study, access to Identity A's memories). The findings for interidentity amnesia in the other direction were equivocal. When tested as Identity A, there was overall a poor level of recall of Identity B's words. Some transfer occurred, however, as 2 of the 4 patients could recall some of Identity B's words, 3 of the 4 patients could recognize some of Identity B's words, and 3 of the 4 patients provided some word-stem completions from Identity B's words. Peters et al. concluded that although it remained possible that malingering on the part of the patients could have produced this pattern of results, they thought it unlikely. Conversely, this study—and all of the studies reviewed above—highlight the need for reliable and objective measures of memory that may not be susceptible to intentional manipulation.

The Need for Objective Measures of Interidentity Amnesia

The Value of Psychophysiological Measures

Because of the controversial nature of DID (Aldridge-Morris, 1989; Fahy, 1988; Merskey, 1992, 1995; Piper, 1994) and because the potential exists for symptoms to develop in response to situational demands and interpersonal goals (Spanos, 1994; Spanos, Weekes, & Bertand, 1985), objective, reliable, and valid methods for assessing memory are essential for ascertaining the extent of amnesia in alleged cases of DID. Relying solely on self-report for assessing memory in DID is problematic for several reasons. First, by definition, DID patients have memory impairment; asking someone with a memory impairment to reflect on their memory requires that the patient can accurately do so. Second, the potential

for memory distortion or fabrication is well documented (Loftus, 1993), so there is reason to suspect the veracity of self-reports of memory in many instances of putative DID.

Psychophysiological measures provide a particularly valuable and objective method for assessing memory. Such measures do not depend on a person's verbal report but instead involve measuring autonomic and central nervous system activity. When used appropriately, they can provide an objective index of memory or familiarity that can corroborate or refute an individual's subjective report. This review provides an overview of psychophysiological methods for assessing memory and then highlights one investigation using such techniques with DID patients.

Psychophysiological Measures and Their Limitations

It is important to highlight that simply adding psychophysiological measures to an assessment protocol is not necessarily of value. There is a small and relatively uninformative literature in which psychophysiological measures in DID (or MPD) were used. Several studies of DID have reported changes in physiology that parallel reported changes in personalities, including a change in respiration rate (Bahnson & Smith, 1975; Larmore, Ludwig, & Cain, 1977), differences in patterns of galvanic skin responses (Brende, 1984; Ludwig et al., 1972), and differences in patterns of electroencephalographic (EEG) activity across alleged personalities (Braun, 1983; Larmore et al., 1977; Ludwig et al., 1972). Other studies have found differences between DID patients and control participants in terms of electrodermal and cardiovascular responses to tones (a nonsignificant trend in Putnam, Zahn, & Post, 1990) or cerebral blood flow patterns (reported with no statistics in Mathew, Jack, & West, 1985). The strategy of looking for psychophysiological differences across alleged personalities as markers of distinct identities is a poor one (Allen & Movius, 2000), as such differences (a) could represent normal changes associated with changes in emotional or cognitive state; (b) could be due to a number of factors that fall under voluntary control, such as muscle tension (Coons, 1988); or (c) could be due simply to capitalization on chance. Moreover, such psychophysiological differences between identities do not specifically address the issue of whether there exists interidentity amnesia.

A more informative approach is to use psychophysiological responses specifically in the context of memory assessment. There exist well-researched, reliable, and valid psychophysiological memory assessment procedures. To date, however, no published studies have used psychophysiological measures to specifically assess memory in DID. After reviewing the available procedures for assessing memory with psychophysiological measures, the results of a controlled psychophysiological study of memory in DID (Allen & Movius, 2000) are presented.

Psychophysiological Assessment of Memory

Skin Conductance and the Guilty Knowledge Technique

Over 40 years ago, Lykken (1959) developed a psychophysiologically based recognition memory test in which autonomic nervous system responses evoked by multiple-choice item alternatives were used to determine whether an individual

possessed certain specific memories. Because this procedure was designed to separate innocent individuals from guilty persons involved in a crime, it has been called the guilty knowledge test (GKT). The GKT should not be confused with conventional "lie detection" techniques (aka polygraph tests) that are used in criminal investigations and as employee screening tests. There is no consensus among scientists regarding the validity of these techniques, with accuracy estimates varying from chance to over 95% (Iacono, 2000). A survey of scientific opinion revealed that scientists view the GKT as scientifically sound (Iacono & Lykken, 1997). However, this same survey showed that both members of the Society for Psychophysiological Research and Fellows of the American Psychological Association's Division of General Psychology are very skeptical of the accuracy claims made by proponents of conventional polygraph testing, and they do not believe that the theory on which conventional polygraph tests are based is scientifically sound. Given the dispute surrounding the validity of conventional techniques, using them to try to resolve controversy regarding the nature of memory impairment in DID would not be fruitful.

Overview of the GKT. A GKT might consist of 10 multiple-choice questions, each with five alternatives (see Lykken, 1998, for an elaboration of GKT methodology). Each item poses a question that only the person who committed the crime and the police could answer. Items that involve information disseminated by media coverage of the crime could not be used because even innocent individuals could be expected to possess such "guilty knowledge." In the case of a burglary, two GKT items might take the form, "If you participated in the burglary last Sunday, then you'd know in which town the burglary took place. Was it in . . . (a) Maplewood, . . . (b) Winona, . . . (c) Edina, . . . (d) Plymouth, . . . (e) Richfield?" and "If you burglarized this home, you'd know how you got inside. Did you enter through . . . (a) the garage, . . . (b) the patio, . . . (c) a basement window, . . . (d) the front door, . . . (e) a second-story window?" When presented with these items, the participant would be instructed to repeat aloud the name of each city and entry possibility (to ensure that the stimuli are attended to) while physiological reactions were recorded.

Although, in principle, any of a number of physiological indices could be recorded with the GKT, and the use of multiple indices could be expected to enhance the accuracy of the procedure, typically only electrodermal activity is recorded. Electrodermal activity can be monitored easily by attaching electrodes to a participant's fingertips, passing an imperceptible current through them, and noting changes in skin conductance that occur as the participant repeats the multiple-choice alternatives. Each multiple-choice alternative elicits a skin conductance response, the amplitude of which varies in proportion to its meaningfulness. Because the guilty person would know crime details, he or she would be expected to have a positive test outcome and give the largest response to the alternatives designating the correct city and entryway. An innocent person would be expected to respond similarly only by chance (which would be $.20 \times .20 = .04$). By having multiple items and the requirement that guilty knowledge be evident for most of them, false positive outcomes can be virtually eliminated while maintaining high true-positive rates. For example, in the hypothetical 10-item GKT considered here, an innocent person would be expected to respond most strongly to the correct alternative on 5 of the 10 items by chance less than

1% of the time. However, a similar response pattern would correctly implicate a guilty person about 97% of the time. Exactly how well a particular GKT would work depends on how well the test is constructed. Developing many items, each with distinctly different alternatives that deal with memorable crime scene facts unlikely to be distinguishable by the innocent, optimizes test construction.

Laboratory research, in which undergraduate volunteers designated "guilty" carry out a mock crime (like stealing an item from a desk) or learn a list of crime-relevant facts, indicates that the GKT is highly accurate. For instance, reviews of the GKT literature have noted that 100% accuracy with innocent participants and 90% or higher accuracy with guilty participants characterize the majority of study outcomes (Ben-Shakar & Furedy, 1990). In an analysis of eight analog studies involving over 300 participants, Lykken (1998) reported accuracy rates of approximately 88% and 97% for guilty and innocent participants, respectively. As is evident from these findings, GKT research has consistently revealed higher false-negative than false-positive classification rates (i.e., sensitivity is lower than specificity). This is not surprising given the nature of the GKT. It is always possible to construct a test (e.g., by adding more items) and score it (e.g., by setting the threshold for failure high) in a manner that protects innocent individuals from failing. Developing a set of test questions of reasonable length that deals with crime facts that the perpetrator is certain to remember represents more of a challenge. Nonetheless, as the findings summarized earlier indicate, the GKT can be used to separate individuals with crime-relevant memory from those without it with a high degree of precision.

Application to DID. Although developed as a forensic tool, the GKT has obvious clinical applicability as a means for verifying the legitimacy of memory gaps as well as whether memories are shared among identities in those persons with DID. Assessment of these two types of memory dysfunction would involve different applications of the GKT. The assessment of memory gaps would require objective documentation of the lost memories and a test tailored to the specific incident. For instance, a clinician could interview those who were with an amnesic individual during the time covered by the amnesia. By inventorying what transpired during this time, the clinician would have the raw material needed to develop a GKT keyed to memories that the amnesic person could be expected to have. As a check on the efficacy of the GKT, it could be given to one or more individuals who shared the same memories but who did not report amnesia. These individuals should generate a positive outcome (i.e. show evidence of memory) on an adequately constructed GKT. Although this control test could be carried out on one of the people who served as an informant for the development of the GKT, ideally it should be given to someone likely to share the memories but who did not provide information for test development.

The sharing of memories across DID identities that are alleged to be mutually amnesic could be evaluated following a process similar to that outlined earlier. However, the information necessary for GKT development would be derived from an interview with one of the identities (Identity A). The resulting GKT would then be used as a test with a different identity (Identity B) to determine if the memory was shared. A built-in control for test efficacy could be provided by also interviewing Identity B about this identity's specific memories. These memories could be used to develop additional GKT items that could be interspersed with

those developed from Identity A. Thus, when Identity B was tested, some of the questions would deal with memories specific to Identity A that Identity B presumably would not share, but others would deal with memories that Identity B would be expected to have. Evidence of failure to share memories would require that the GKT A items generate a negative outcome whereas the GKT B items be scored positive. Evidence of shared memory would require both types of items to be scored positive. Evidence that the test was probably inadequate would involve any skin conductance response pattern indicating that the B items were not recognized.

Memory functioning in DID could also be assessed by developing a standardized GKT that could be used routinely with DID patients who have mutually amnesic identities. This test could be developed and refined using non-DID participants, the testing of whom would also provide for the establishment of normative data. The test would also involve an extension of some of the paradigms (e.g., memory for word lists and story details; Nissen et al., 1988) reviewed in preceding sections, in which memory for material taught to one DID identity (A) was evaluated with a different DID identity (B). However, Identity B's memory would be assessed with a standardized GKT probing for memory of the material taught to Identity A. This approach is similar to that used in a recent study (Allen & Movius, 2000; reviewed later) with an EEG-based assessment of interidentity amnesia in DID.

Event-Related Brain Potentials and the Assessment of Memory

The event-related potential. When the brain perceives and responds to a discrete event such as the presentation of a word, synchronously activated neurons predictably fire following the event. The summed voltages created by these neurons can be recorded noninvasively at the surface of the scalp. The event-related brain potential (ERP) represents this summed voltage spanning a short period of time (e.g., 1 s) following the presentation of the stimulus. The ERP is a relatively small signal embedded in the ongoing activity of the EEG. The EEG, in contrast to the ERP, represents not only activity related to the processing of and responding to the event but also the activity of many other neural systems not involved directly in the processing of the event. Directly examining the EEG in response to events therefore reveals little discernable change, as the signal related to the event (the ERP) is dwarfed by the ongoing electrical activity of the brain. With repeated presentations of an event, however, the ERP emerges as one averages—across presentations—the electrical activity surrounding each event (see Figure 1). This process is equivalent to the familiar process of obtaining multiple observations to estimate a population mean; any one observation will not provide an adequate estimate of the population mean, but with an adequate sample size, one can estimate the population mean quite accurately. Moreover, just as in the case of computing a population mean, the accuracy of the estimate of the ERP will increase as a function of the square root of the number of observations.

The assessment of memory using the ERP. There exists an extensive literature involving ERPs in the assessment of memory. Most of these studies involve examining groups of normal participants to detect group-level effects of memory manipulations on the ERP. A comparatively smaller literature details the applied

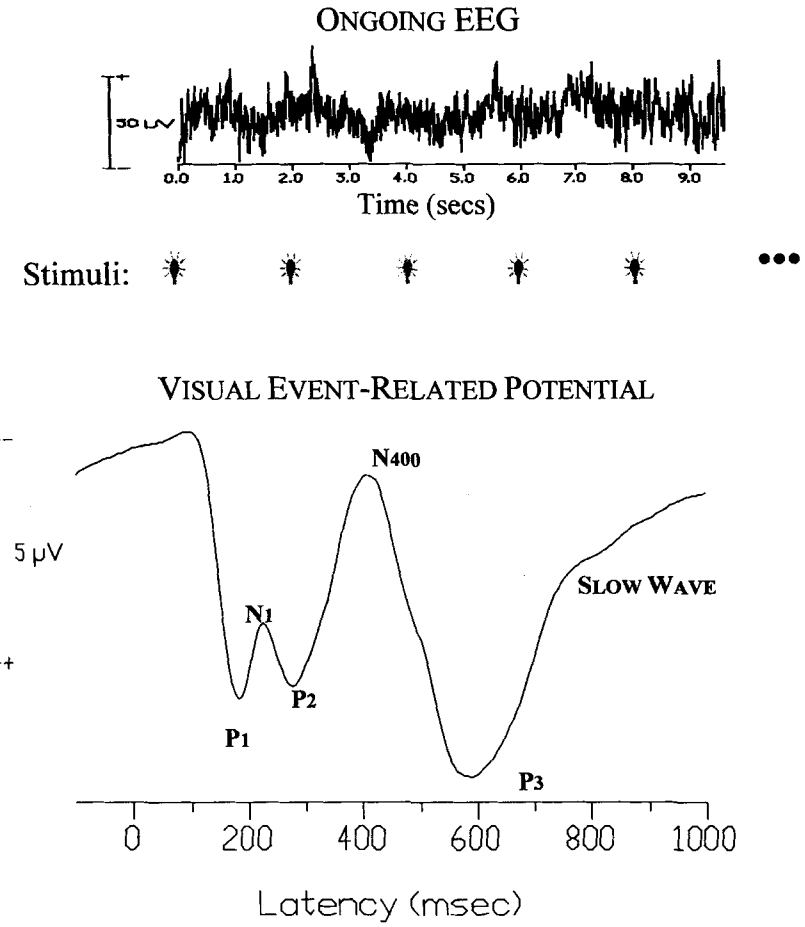

Figure 1. The relationship between ongoing electroencephalographic (EEG) activity (top) and the event-related brain potential (ERP; bottom). The top panel depicts voltage changes in the range of 50–100 microvolts that occur across several seconds. Beneath the ongoing EEG is depicted a series of stimuli that are presented approximately once every 2 s. As can be seen from the figure, no visually discernable changes occur in the EEG as a result of the stimulus presentation. When the EEG activity surrounding multiple presentations is averaged together, however, the ERP in the lower panel emerges. The ERP represents voltage changes on the order of 5–20 microvolts that occur across a 1-s (1,000 ms) interval. Positive is plotted downward, and peaks are labelled for polarity (P = positive, N = negative) and latency (N400 is the negative peak appearing at 400 ms) or for their sequential appearance (P1 is the first major positive peak, P3 is the third positive peak).

use of ERPs in the assessment of memory for individual participants. Each will be reviewed in turn.

Several components of the ERP appear to be sensitive to explicit recollection (Bentin & Moscovitch, 1990; Bentin, Moscovitch, & Heth, 1992; Neville, Kutas, Chesney, & Schmidt, 1986; Paller & Kutas, 1992; Rugg & Nagy, 1989; Rugg & Doyle, 1992, 1994; Sanquist, Rohrbaugh, Sydulko, & Lindsley, 1980; Smith,

1993; Smith & Halgren, 1989; for a review, see Rugg, 1995). When a word that was recently seen is repeated, a positive augmentation occurs in the ERP from approximately 300 to 800 ms after stimulus onset. Several investigations have sought to determine whether this augmentation reflects explicit awareness that the word was repeated or whether this augmentation can occur without such awareness. Paller and Kutas (1992) examined ERPs to words that were previously studied under two conditions: one that involved attending to superficial orthographic features, and one that involved a richer processing of the word by imaging it. Words are more likely to be explicitly recalled under the latter condition. They found that words from the imagery task produced more positive ERPs than those from the orthographic task. Arguing that words from the imagery task were more likely to be consciously recognized on subsequent testing than those in the orthographic task, Paller and Kutas (1992) concluded that the ERP repetition effect was probably a reflection of recognition memory.

Rugg and colleagues (Rugg, Cox, Doyle, & Wells, 1995; Rugg & Doyle, 1992, 1994) have found that low-frequency words produce greater repetition effects than high-frequency words. Rugg et al. (1995) examined the interaction between confidence judgments about an item's repetition status and word frequency, finding that the ERP repetition effect was virtually absent for high-frequency words regardless of confidence decisions, whereas the repetition effect was present in repeated low-frequency words. Rugg et al. (1995) therefore suggested that recollection is a necessary, but not sufficient, condition for the ERP repetition effect.

If this ERP repetition effect is an index of a recollection process, then patients with damage that impairs explicit recollection of words should not show this ERP effect. Consistent with this prediction, Smith and Halgren (1989) found that patients that had undergone a left-temporal lobectomy did not exhibit repetition-priming effects in the ERP.

The ERP repetition effects therefore appear to have strong connections to episodic memory, with episodic encoding in long-term memory a necessary prerequisite for the repetition effect. This repetition effect may therefore be a useful tool in examining the role of episodic processes in indirect memory tasks. Paller, Kutas, and McIsaac (1995) conducted such an experiment in which behavioral differences in recollection (as manipulated by study task) paralleled ERP differences due to repetition. They concluded that the later positivity (500–800 ms) reflects episodic memory in an indirect memory task as well, a conclusion also supported by Schnyer, Allen, and Forster (1997) who found similar effects in an indirect memory task (lexical decision).

Using ERPs to assess memory in individual cases. The preceding overview suggests the utility of ERPs in assessing memory, but all of the results are based on group-level comparisons. To successfully use ERPs in the assessment of memory in DID, researchers must obtain reliable and valid conclusions for individual cases. In using ERPs to assess memory at the level of individual cases, investigators often use a variant of the Guilty Knowledge Technique (Lykken, 1959). The small amount of literature in this area has involved the detection of deception (Allen, Iacono, & Danielson, 1992; Boaz, Perry, Raney, Fischler, & Shuman, 1991; Farwell & Donchin, 1991; Rosenfeld, Angell, Johnson, & Qian, 1991; Rosenfeld, Cantwell, Nasman, Wojdac, Ivanov, & Mazzeri, 1988) and

simulated amnesia (Rosenfeld, Ellwanger, & Sweet, 1995; Rosenfeld et al., 1998). In most of these paradigms, two classes of previously seen items are presented, only one of which a participant acknowledges recognizing. In other paradigms, a single class of previously seen information is presented for which the participant is to feign amnesia. In either case, the previously seen items typically appear infrequently among frequent items that have not been previously seen. In nonamnesic persons, the previously seen items will therefore stand out as rare and significant by virtue of having been learned previously. This experimental design makes it likely in nonamnesic persons that the previously seen items, regardless of whether they are acknowledged as familiar, will elicit a larger P3 amplitude in the ERP than will the frequent unfamiliar items. This prediction is based on the well-established finding that P3 amplitude is largest when one perceives rare, task-relevant, and significant stimuli (Donchin & Coles, 1988; Johnson, 1986).

In the first published report of such a procedure (Rosenfeld et al., 1988), participants pretended to steal 1 object from among 9 objects. They then viewed a visual display containing either the "stolen" object or 1 of 8 novel objects. Moreover, they were instructed to count one of the novel objects. Descriptively, all participants showed larger P3 amplitudes in the ERP to the "stolen" and to the counted items than to the novel items. This study lacked a statistical approach for determining the confidence with which one might infer that such a large P3 would indicate a "stolen" item.

Three subsequent studies provided such a statistical approach (Allen et al., 1992; Farwell & Donchin, 1991; Rosenfeld et al., 1991). Farwell and Donchin (1991) used a mock crime scenario, and Rosenfeld et al. (1991) used previously gathered information about a participant's antisocial acts. In each case, details from the mock crime or descriptions of the antisocial act were depicted as phrases on a computer screen, and such phrases appeared infrequently amidst frequent distractors that were similar (e.g., items depicting other mock crimes or other antisocial acts). Both studies also required participants to detect another target stimulus to ensure that they were paying attention to the stimuli. Both studies had a group of participants that were "guilty" of the crime or antisocial act and a group that was "innocent." Results were similar in both studies; for guilty participants, larger P3 amplitudes were seen to the crime-relevant or antisocial items than to distractor items. Farwell and Donchin (1991) used a bootstrapping procedure and were able to classify 87.5% of the participants accurately, leaving 12.5% with a classification of indeterminate. Rosenfeld et al. (1991) used a four-step algorithm and were able to correctly classify 89% of the participants (leaving 11% incorrectly classified). Rosenfeld et al.'s (1991) results were then replicated by Johnson and Rosenfeld (1992), who obtained an 87% accurate classification rate.

The procedure of Allen et al. (1992), although quite similar to those just reviewed, was designed to assess memory in a clinical context rather than to assess guilt in a mock-crime or antisocial act scenario. Participants in the paradigm of Allen et al. (1992) learned two lists of words but later were only asked to explicitly acknowledge having learned only the most recently learned list. Words from both previously learned lists appeared infrequently, amidst frequent distractor items; this experimental design made it likely that previously learned words would, if recognized, elicit a large P3 component of the ERP. Bayesian analysis was used to compute the probability that items from each list—previ-

ously learned lists as well as several distractor lists—were familiar to a participant (for details, see Allen et al., 1992). Across three groups of 20 participants each (Allen et al., 1992), a Bayesian combination of five indicators from the ERPs was successful in correctly identifying previously learned material—regardless of whether a person explicitly acknowledged having learned it—94% of the time. It was similarly successful in classifying unfamiliar material 96% of the time.

Application to DID. This experimental procedure, and associated analytical strategy, lends itself readily to the study of memory in DID. If one were to identify two distinct identities (Identity A and Identity B), each of whom reported mutual amnesia for recollections of the other identity, then each could learn a set of material that should be familiar to only that identity and not the other. Because this ERP memory assessment procedure identifies familiar material regardless of whether a participant explicitly acknowledges having learned it, the ERP could serve as an objective measure of amnesia in DID. If Identity B were amnesic for items learned by Identity A, then only items learned by Identity B should stand out as distinct and significant and only such items should therefore produce a large P3. In such a case, therefore, the ERP procedure should only classify ERPs to Identity B's items as familiar while classifying ERPs to Identity A's material as unfamiliar. If, by contrast, Identity B in fact denied recognizing Identity A's items despite being aware of these items, this ERP procedure should be sensitive to that as well. In other words, as a clinical assessment tool, either outcome would prove informative. The former outcome would provide objective evidence of amnesia, whereas the latter outcome would suggest that the report of amnesia was not necessarily credible. This is the approach taken in a recent study (Allen & Movius, 2000), the results of which are detailed later in this report.

Using ERPs to detect malingered amnesia. Several ERP studies have specifically examined the issue of malingered amnesia (Ellwanger, Rosenfeld, Sweet, & Bhatt, 1996; Rosenfeld et al., 1995; Rosenfeld et al., 1998; Rosenfeld, Sweet, Chuang, Ellwanger, & Song, 1996), although none have produced sufficiently high rates of detection to warrant clinical use of ERPs in these paradigms at present. The procedures discussed thus far (Allen et al., 1992; Farwell & Donchin, 1991; Rosenfeld et al., 1991) appear to hold greater promise for applied use. These procedures may work better because they test memory for well-learned material, whereas the procedures to be discussed below tend to assess memory for less well-known material (with the exception of testing for one's birth date, which tends to produce the best results).

To investigate whether ERPs might prove useful in detecting malingering, Rosenfeld et al. (1995) asked volunteers to simulate amnesia for autobiographical material (phone number, birth date, and mother's maiden name) and were able to detect a memory for the material between 77% and 93% of the time, depending on the nature of the autobiographical material and the extent of coaching the participants received regarding how real amnesics might perform. Ellwanger et al. (1996) similarly asked volunteers to simulate amnesia for autobiographical material (birth date) and also for material in episodic memory (the experimenter's name and a list of 14 words). In addition, Ellwanger et al. (1996) included a nonsimulating control group. For recently learned words, the procedure was only able to detect memories 43–53% of the time, and for the experimenter's name the rate was 77–80% of the time. For overlearned autobiographical material (birth

date), memories were detected 86–100% of the time. In all cases, the ability to detect the memories was not influenced by whether a participant was simulating amnesia or responding truthfully.

Rosenfeld et al. (1996) assessed the malingering of working memory deficits by asking participants to detect whether a three-digit number was the same as or different than a number presented just before a several-second interval. Under the most effective of the experimental manipulations, participants simulating amnesia were detected 70% of the time. Rosenfeld et al. (1998) obtained similar results using another working memory task (matching to sample procedure) in which simulated amnesia was detected 69% of the time.

These ERP-based malingering assessment procedures, although promising, do not yet produce sufficiently high rates of correct classification to warrant clinical or case study use. Moreover, in most instances, their procedures involve testing memory in an manner that would not be helpful in assessing interidentity amnesia because the interval between first presentation and subsequent testing is less than 1 min. Working memory deficits are not diagnostically crucial in DID, nor have such deficits been described in the research literature on DID. Therefore, to test interidentity amnesia, using one of the previously described ERP-based memory assessment procedures (Allen et al., 1992; Farwell & Donchin, 1991; Rosenfeld et al., 1991) would be optimal because these procedures test memory across a longer time interval (akin to the interval that might elapse between identities) and because these procedures produce higher rates of accurate classifications than do the malingering procedures.

The Psychophysiological Assessment of Memory in DID

A previous report (Allen & Movius, 2000) detailed the use of an ERP-based memory assessment procedure with 4 persons with DID. A synopsis of those results is presented below.

Overview

Four female participants (age range = 36–51 years) met *DSM–IV* criteria for DID on the basis of the Structured Clinical Interview for *DSM–IV* Dissociative Disorders (SCID–D; Steinberg, 1993). Participants reported 4 to 13 identities and are described in greater detail in the original report (Allen & Movius, 2000). Each of the 4 participants was rather typical of cases reported in the literature (Spanos, 1994) in that they were female, they had a history of other psychiatric problems that preceded their diagnosis of DID, and they reported on average about eight identities.

On the testing day, participants were examined first as Identity A and subsequently as Identity B. Identity A learned a list of 6 unrelated words and then performed a simple computerized recognition task to ensure that she knew those words. After asking her to switch personalities, Identity B then learned a list of 6 unrelated words other than those learned by Identity A. Once Identity B had learned the list to the criterion of two perfect serial recitations, she was presented with the critical procedure in which words learned by Identity A appeared on 1/7 of the trials, words learned by Identity B appeared on 1/7 of the trials, and words not previously seen by either Identity appeared on 5/7 of the trials. This arrange-

ment made it likely that the learned lists, appearing relatively infrequently against a background of unlearned material, would elicit a large P3 if they were recognized. The experimenter instructed Identity B that she would see a long list of words consisting of words she had learned as well as other words. She was instructed to press the "YES" button with one hand if the word on the screen was one of the words she remembered learning today and to press the "NO" button with the other hand for all of the other words.

Results

Behavioral responses by Identity B. Table 2 shows the percentage of trials on which Identity B responded "YES" to indicate recognition of different word lists. As can be seen from Table 2, DID participants denied recognition on a majority of trials in which words learned by Identity A were presented and very seldom indicated recognition for words that should have been unfamiliar (Lists U1 through U5). As can be seen in Table 2, the responses of the DID patients are virtually identical to the pattern seen in college student control participants (Allen et al., 1992) who underwent virtually the identical procedure, except that they were instructed to conceal the fact that they had learned a previous list (comparable to that learned by Identity A in the patient sample). Although DID partic-

Table 2
Responses by Identity B Compared With College Student Control Participants Who Concealed Recognition

	DID participants' responses as Identity B						
	Learned words		Unlearned words				
Measure	Identity B	Identity A	U1	U2	U3	U4	U5
Recognition (%)							
M	71	8	2	2	3	3	2
SD	20	4	2	2	3	5	2
Response latency (ms)							
M	765	726	588	596	572	586	612
SD	44	61	57	56	52	82	58
	College student control participants						
	Learned words		Unlearned words				
Measure	Acknowledged	Concealed	U1	U2	U3	U4	U5
Recognition (%)							
M	81	5	0	0	0	0	0
SD	17	6	0	1	1	0	1
Response latency (ms)							
M	582	546	456	462	463	458	460
SD	88	101	79	77	81	77	81

Note. DID = dissociative identity disorder. U1 through U5 are five different unfamiliar lists. The college student control participants are the 60 participants reported in Allen et al. (1992), who were instructed to acknowledge learning a recently learned list (Acknowledged) and to deny knowledge of a previously learned list (Concealed). Response latencies are calculated for "YES" responses to words learned by Identity B and to "NO" responses to all other words (see text).

ipants made significantly more errors in responding than the college student control participants, their pattern was identical in that there was no hint of an interaction to suggest that DID participants differed from college student controls in their pattern of responses across the lists. In other words, the responses of Identity B were influenced by Identity A's learning in almost exactly the same fashion as responses in college students were influenced by previous learning of a list for which they were asked to conceal knowledge.

Table 2 also shows the mean response latency for "correct" responses, that is, indicating "YES" for Identity B's items, "NO" for Identity A's items, and "NO" for all unfamiliar items. As shown in Table 2, the DID participants' pattern of response latencies were very similar to that demonstrated by the college student control participants. Although DID participants were slower than college student control participants overall, again there was no difference in the pattern of response latencies across lists. Once again, these data show that the responses of Identity B were influenced by Identity A's learning in almost exactly the same fashion as responses in college students were influenced by previous learning of a list for which they were asked to conceal knowledge.

Responses tend to be slowed to both lists of learned words in this procedure, in which a majority of words are unlearned and require a "NO" response. Previously learned items that are acknowledged (a "YES" response) require participants to switch response set and use the other hand for response. Previously learned items about which participants deny knowledge, but in fact recognize, pose a response conflict whereby participants are primed to press both the "YES" and the "NO" buttons. The responses therefore tend to be slowed and to be less accurate because of this response competition.

These response data can also inform whether—at an individual-participant level—a list of words is familiar to a participant. In the studies of Allen et al. (1992), Bayesian posterior probability estimates were computed to provide an indication of the probability that a list of words had been learned given the combination of response latency and incorrect responses. In these studies, this Bayesian estimate accurately classified 96% of learned items as familiar and 98% of unlearned items as not familiar. In the DID patient sample, without exception these behavioral indicators classified words learned by both Identity A and Identity B as familiar and very seldom (2 times among 20 chances) classified unlearned words as familiar. This finding suggests that Identity B responds to both Identity A's and Identity B's words in a manner that indicates knowledge of the words. Moreover, these behavioral measures once again suggest that Identity A's words are influencing Identity B's behavior in much the same way as previously learned words affect the college student control participants, who deliberately concealed their recognition of previously learned items.

ERP results. Figure 2 displays the grand average waveforms across all 4 DID participants and the college student control participants. As can be seen in Figure 2, among DID participants (left panel), P3 amplitude is larger for words learned by Identity B than for unlearned words, but the ERP in response to words learned by Identity A is not as clearly differentiated from the unlearned words. Looking at individual participants, P3 amplitude was in fact significantly larger to words learned by Identity A than to unlearned words for 2 of the 4 DID participants (Allen & Movius, 2000).

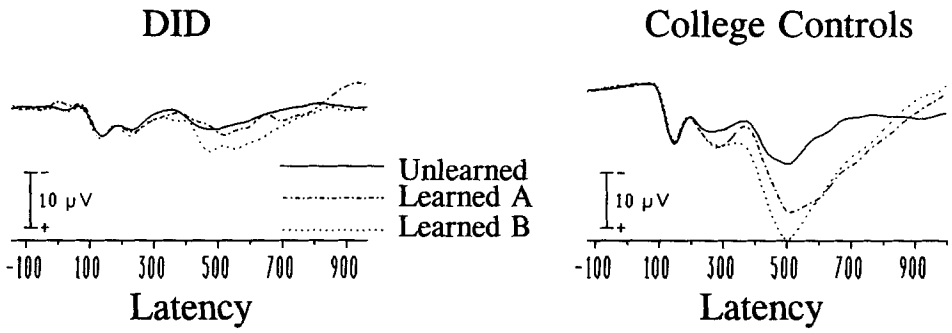

Figure 2. Grand average event-related brain potential (ERP) waveforms at Site Pz for dissociative identity disorder (DID) participants and college student participants. DID participants were tested as Identity B for recognition of words learned by Identity A, Identity B, and unlearned words. College student control participants were tested for recognition of words they denied and concealed having learned (labelled "Learned A"), of words they acknowledged learning (labelled "Learned B"), and of words they had not learned. Only trials in which participants responded correctly are included in the ERP averages.

Although P3 amplitude was not uniformly sensitive to the words learned by Identity A, other features of the ERP waveform were sensitive, as indicated by the results of another Bayesian classification procedure (see Table 3). Solely on the basis of features of the ERP waveform that have proven sensitive to recognized items in previous work (Allen et al., 1992), there is a greater than 98% chance that ERPs to words learned by either identity (A or B) are elicited by recognized items. It is also important to reiterate that these ERP data were based only on trials in which Identity B responded "YES" to indicate recognition of Identity B's items and responded "NO" to indicate nonrecognition of Identity A's items. In other words, even when Identity B denied knowledge of Identity A's words, her ERP suggested that there was recognition of Identity A's words.

Table 3
Bayesian Posterior Probability That a List Was Recognized as Learned for DID Participants

ID	Identity B	Identity A	U1	U2	U3	U4	U5
M02	0.98	1.00	0.00	0.87	0.19	0.00	0.00
M03	1.00	0.98	0.00	0.00	0.56	0.01	0.00
M04	1.00	0.98	0.00	0.13	0.00	0.00	0.00
M05	1.00	0.98	0.00	0.00	0.98	0.00	0.00

Note. DID = dissociative identity disorder; ID = identification number of participant. Values in the table indicate the probability that a list of words was recognized as learned by Identity B, based on the five event-related brain potential (ERP) indicators. Only epochs in which Identity B acknowledged learning Identity B's words, and denied recognizing Identity A's words or unlearned words, were included in this analysis.

Other Tests of Memory and Malingering

Following this oddball recognition task, Identity B was given a forced-choice recognition task in which two words were presented side-by-side on the computer screen and Identity B was instructed that she should indicate which of the two words she had learned. This task consisted of three different types of stimuli: (a) *explicit memory probes* (n = 6), which contained words learned by Identity A paired with previously unseen items matched for frequency; (b) *incidental memory probes* (n = 12), which contained words that had been previously seen as unlearned distractors by Identity A paired with previously unseen items matched for frequency; and (c) *control trials* (n = 6), which were two previously unseen items matched in frequency to all of the other words. The intent of the forced-choice task was to provide an index of whether participants were systematically avoiding acknowledging words learned by Identity A and whether words seen as distractors by Identity A (incidental learning) would show evidence of transfer to Identity B. Veritable amnesia would not result in systematic avoidance of learned material but rather would show up as the tendency to respond with recognition 50% of the time (i.e., if one were amnesic for previously learned words, one would choose them 50% of the time by chance in this forced-choice task). This task was successfully implemented after the testing of the first two participants; data are therefore only for Participants M04 and M05.

Following this task, Identity B once again switched back to Identity A. After participants reported a successful switch to Identity A, a similar forced-choice recognition task was administered to Identity A, with the expectation that the learned words (explicit probes) and the previously seen words (incidental probes) were those that were seen only by Identity B.

One participant (M04), when tested as Identity B, systematically avoided all of the words learned by Identity A (binomial probability < 2%). The other participant (M05), by contrast, acknowledged 2 of the 6 words learned by Identity A, a result not significantly different from chance (i.e., 50%). In terms of evidence of transfer of incidentally learned information, neither participant—when tested as Identity B—showed any compelling evidence of incidental learning, acknowledging 6 of 12 and 5 of 12 items, respectively (chance = 50%).

Following this first forced-choice task, participants were asked to switch again to Identity A and were then tested for words learned by Identity B. Although Participant M04 did not perform significantly different from chance performance, M05 recognized 5 of 6 words learned by Identity B (binomial probability < 10%), suggesting that her Identity A may have been aware of some of the words learned by Identity B. For neither participant was there clear evidence of transfer of incidental learning.

Interpretation

Virtually every measure provided evidence consistent with the hypothesis that DID participants, contrary to their overt report, recognized material learned by the other identity. In all cases, ERPs were derived only from trials in which Identity B denied knowledge of Identity A's words. Moreover, in all cases, the Bayesian combination of ERP indicators suggested that Identity B recognized words learned by both Identity B and Identity A. Moreover, the procedure has a built-in

control so that one can determine whether it is vulnerable to false-positive or false-negative outcomes. False-positive outcomes would be indicated by the proportion of times that the procedure mistakenly identifies unlearned items as learned (4% in the college student sample, and 10% in the DID sample). False-negative outcomes would be indicated by the number of times the procedure mistakenly identifies the overtly acknowledged list (the recently learned list) as unlearned (3% in the college student sample, and 0% in the DID sample).

Behavioral responses also suggest in all cases that the words learned by Identity A were familiar to Identity B. Identity B showed the predicted and typical pattern of slowed "YES" responses for words learned by Identity B relative to "NO" responses to unlearned words. Important to note, however, is that, just like the college student comparison sample, Identity B showed slower "NO" responses to words learned by Identity A relative to unlearned words. In the college student control participants, this has been conceptualized as a response conflict associated with the requirement to say "YES" to recently learned words but "NO" to previously learned words (Allen & Iacono, 1997). Previously learned words involve priming of both response channels: "YES" by virtue of being learned, and "NO" by virtue of the instruction to deny and conceal knowledge. Note that this response conflict would only arise if the previously learned words were in fact recognized. The magnitude of the slowing is virtually identical in the DID participants and the college student control participants. The response data in Table 2 further corroborate the interpretation that Identity B has knowledge of Identity A's words because Identity B classifies Identity A's words as learned more often than she classifies unlearned words as learned. Again, the pattern of results is remarkably similar to the college student comparison sample (see Table 2) and is consistent with the hypothesis that DID participants—as Identity B—were aware of, but denied knowledge of, words learned by Identity A.

The results of this study suggest the need to be cautious in making the diagnosis of DID based on self-report, even with the use of a Structured Clinical Interview. Electrophysiological as well as behavioral findings indicate that individuals who appear (by self-report and diagnostic interview) to meet diagnostic criteria for DID may not be assumed to show unequivocal evidence of interidentity amnesia.

It would be premature to generalize to all diagnosed cases of DID. There may exist some cases that in fact show a dramatically different pattern than that evidenced by the 4 participants in this study. Their demographic profile, however, is not that different than many of the case reports in the literature (Spanos, 1994). Note also that the present study did not, and probably could not, test all possible pairs of identities for any given participant. It may be the case that, even among the 4 participants tested in this report, some pairs of identities may demonstrate a mutual amnesia that would produce dramatically different results than those seen here. Finally, it is noteworthy that the type of test applied in this study does not assess directly the type of memory impairment that typically characterizes dissociative disorders such as DID. The *DSM–IV* specifies amnesia for "personal information" (p. 487), and typically such information is considered relevant to the experiences of one of the identities. As noted previously in the section of this article discussing the GKT, it would be possible to develop a psychophysiological test to determine if one identity has memory for the personally relevant experi-

ences of another. To date, this type of psychophysiological study has not been applied to DID.

The Nature of Amnesia in DID

Implicit Memory

Previous authors (e.g., Nissen et al., 1988) have concluded that transfer of information across personalities may be indicative of implicit memory, that is, evidence of memory without the conscious and explicit recollection of the material. The *DSM–IV* amnesia criterion never makes mention of implicit or explicit memory per se, however, it implies that the memory deficit in DID is an explicit memory problem. The diagnostic criterion of an "inability to recall important personal information that is too extensive to be accounted for by ordinary forgetfulness" (*DSM–IV,* p. 487) focuses on recall—an explicit memory phenomenon. The *DSM–IV* further elaborates that individuals with DID experience frequent gaps in memory for personal history and loss of biographical memory for extended periods, which both reflect a problem with explicit memory. The *DSM–IV* makes no mention of implicit memory phenomena in DID; thus, the *DSM–IV* appears to allow for the possibility that DID patients could show evidence of implicit memory in the absence of explicit memory.

Determining whether explicit memory has been demonstrated hinges on the critical issue of whether the participant is aware of the memory. In many instances, researchers and clinicians take at face value the claim of a participant who reports amnesia, especially in the case of brain injury or disease (e.g., Graf, Squire, & Mandler, 1984). The studies reviewed earlier, however, suggest that there may be reason to suspect the self-report of at least some DID patients. It may therefore be difficult to convince any reasonably skeptical person that an explicit memory deficit has in fact been observed in DID because such an interpretation would presuppose the veracity of the report of amnesia by the patient.

Direct and indirect tests. An alternative conceptualization to the implicit/explicit distinction is to discuss memory tests in terms of whether they are direct or indirect (Merikle & Reingold, 1991). Rather than attempting to classify the type of memory, this distinction focuses on the type of test. *Direct tests* require participants to explicitly discriminate old or previously seen stimuli from new stimuli. *Indirect tests,* by contrast, use instructions that do not make any reference to the old/new discrimination (e.g., a word-stem completion task in which participants are simply asked to complete the few-letter stem to form a word). When the studies of interidentity amnesia are summarized within this framework, there is ample evidence that direct tests reveal interidentity amnesia, whereas many indirect tests show evidence of memory transfer across personalities (see Table 1 and review above). This fact suggests at least two possible interpretations. The first interpretation is that indirect tests tap implicit memory and that direct tests tap explicit memory. There is some evidence that in normal college students, this is in fact the case (Merikle & Reingold, 1991), in which direct tasks are more sensitive to explicit memories and indirect tasks are more sensitive to memory processes that elude participants' conscious awareness. The second interpretation, however, is that for individuals who are motivated to create an impression that is congruent with their understanding of what is required of those with DID (cf.

Spanos, 1994, 1996), direct tasks are obvious and are responded to in accord with the perceived demand characteristics. Indirect tasks, or at least some indirect tasks, are not obviously a tool for assessing memory and therefore may not elicit in DID patients the need to alter their responses in accord with the expectations that DID patients should be amnesic.

To evaluate the plausibility of these two interpretations, it would be useful to have some objective measure of explicit memory, and one on which memory deficits cannot be easily feigned. This review suggests that psychophysiological measures may be such a tool, although there is some evidence to suggest that—at least in some cases—the psychophysiological measures reviewed in this report may be sensitive to implicit memory in the absence of explicit awareness.

Psychophysiological measures and implicit memory. It has not been satisfactorily resolved whether psychophysiological evidence of memory should be taken as an index of explicit memory or implicit memory. Diagnostically, this distinction is paramount. If a psychophysiological assessment produces results that show memory transfer across identities, and if the psychophysiological measure indexes explicit memory, then clearly there is not evidence of amnesia "too extensive to be accounted for by ordinary forgetfulness" (*DSM–IV,* p. 487) and a diagnosis of DID would not be warranted. If, by contrast, the psychophysiological measure taps implicit memory (i.e., without awareness), then such a finding would not bear directly on the existence of amnesia as currently defined by the *DSM–IV.*

There are few studies that bear on this issue directly. As reviewed above, the vast majority of electrodermal studies and ERP studies have assessed memory among individuals without memory impairment and appear to be sensitive to explicit recognition of stimuli. In the studies of the GKT using electrodermal responding, individuals were aware of the acts that they had committed and were tested explicitly. Similarly, the ERP procedures detailed above have tested individuals with intact memories and therefore were testing stimuli of which participants presumably had full awareness.

Only a few studies bear on this issue of whether psychophysiological measures may tap explicit versus implicit memory. Three studies have examined skin conductance responses in prosopagnosia using an assessment strategy based on variants of the GKT (Bauer, 1984; Bauer & Verfaellie, 1988; Tranel & Damasio, 1985). Prosopagnosia is a rare neurological disorder involving damage to the occipital–temporal regions of the brain. Prosopagnosic patients are unable to recognize familiar faces despite being able to identify faces as faces and to recognize an individual's identity based on other features, such as the sound of a person's voice. For all three of these studies involving a total of 4 cases, patients were exposed to slides of familiar faces (acquaintances, famous people, and their own face). In the studies by Bauer (1984; Bauer & Verfaellie, 1988), while a familiar face was displayed, participants were presented with five names in succession, one of which correctly identified the face. The skin conductance response generated by each name presentation served as the dependent variable. The results indicated that names that correctly identified faces generated significantly greater electrodermal activity than the incorrect alternatives. The prosopagnosic patients' electrodermal activity was similar to that of normal comparison participants, assessed with the same protocol, who recognized the faces. In the

Tranel and Damasio (1985) investigation, a small number of familiar faces were intermixed with a larger number of unfamiliar faces. Again, the skin conductance response to each stimulus served as the dependent variable. The results indicated substantially stronger electrodermal responding to familiar than to unfamiliar faces.

Similarly, ERPs may be sensitive to once-familiar faces in the absence of a phenomenological experience of recognition in prosopagnosia (Renault, Signoret, Debruille, Breton, & Bolgert, 1989). In this case study, although the patient was unable to explicitly identify faces, P3 amplitude was much larger to infrequent familiar faces than to more frequent unfamiliar faces. Another interesting study in this regard examined the phenomenon of "blindsight" (Goodin, Shefrin, & Aminoff, 1987). Although blind in one hemifield, the patient could identify target words presented to the blind hemifield at rates somewhat above chance and, more important, she showed larger P3 responses to target than nontarget words presented to that hemifield despite her subjective impression that nothing had been presented to the hemifield or that ill-defined "blobs" had appeared.

These skin conductance and ERP findings suggest that the prosopagnosia and blindsight patients possessed knowledge of which they were unaware. Because malingering seems unlikely to account for the lack of awareness in these individuals (all of whom showed objective evidence of brain damage), taken collectively, these results show that a positive outcome on a psychophysiological recognition memory test can be obtained in the absence of explicit awareness. These patients, however, did not have memory problems per se. Blindsight is simply a perceptual difficulty. The case of prosopagnosia is more complex. Prosopagnosia involves difficulties in the perception of complex configural stimuli (faces) and accessing stored representations that are presumed to be intact in memory. For prosopagnosic patients, the GKT task requires that an intact representation stored in memory be compared with the percept of a face that cannot be adequately identified. Electrodermal discrimination of familiar from unfamiliar faces could occur in these patients because the intact representation in memory matches some features of the presented face (Bauer & Verfaellie, 1988). Whereas prosopagnosic patients may be unable to integrate the facial features to access the memory representation and thus explicitly identify the face, there presumably exists an intact representation of the face in memory. If one presumes that there exists an intact memory representation in DID patients for other identities' experiences, then the prosopagnosia case is analogous to the DID case. Both would reflect an access problem.

In terms of what is known about the later positive component of the ERP, this component has been shown to index explicit, but not implicit, memory not only in persons with intact brains (reviewed previously) but also in individuals with brain involvement as well. In Alzheimer's disease, which is characterized by a rapid forgetting of material, ERPs only show evidence of repetition priming when there is a short lag between the first and second appearance of the item but not at longer lags (Schnyer, Allen, Kaszniak, & Forster, 1999).

Jointly, these studies suggest that in cases of demonstrable brain damage, psychophysiological measures may reflect some access to intact memories that patients cannot explicitly access. They further suggest that psychophysiological measures, in particular ERPs, sometimes covary with explicit memory, as in the

case of repetition priming in both normal participants and those with amnesia due to dementing illness.

Psychophysiological measures in amnesia not due to brain damage. There is only one study that addresses whether psychophysiological measures tap explicit or implicit memory in individuals with amnesia that does not result from brain damage. Allen, Iacono, Laravuso, and Dunn (1995) examined posthypnotic amnesia using the procedure of Allen et al. (1992). Highly hypnotizable individuals reporting posthypnotic amnesia and low-hypnotizable simulators instructed to simulate posthypnotic amnesia were tested, and both exhibited larger P3 amplitudes to infrequently presented material that had been learned under hypnosis than to frequently presented unfamiliar stimuli. The large P3 amplitude clearly reflected explicit awareness in the low-hypnotizable simulators, as these participants could accurately recognize the words they had learned during the hypnosis period just prior to testing. To address the question of whether P3 amplitudes reflected implicit versus explicit awareness in the highly hypnotizable participants, Allen et al. (1995) examined the pattern of behavioral responses and other components of the ERP. Although the low-hypnotizable simulators showed the typical slowing of responses to previously learned items, there was not such slowing for the highly hypnotizable participants. In other words, previous exposure to the words affected the behavior of the low-hypnotizable participants who were simulating amnesia but did not affect the behavior of the highly hypnotizable participants who putatively experienced amnesia. In addition, only the highly hypnotizable participants exhibited a pronounced N400 component, which may have indexed a difficulty in accessing the words and contextual cues that may aid in recognition. Allen et al. (1995) therefore concluded that, in the case of highly hypnotizable participants in this study, the large P3 evoked by material learned under hypnosis was indicative of implicit memory.

Disambiguating whether psychophysiological measures tap implicit versus explicit memory. To conclusively determine whether a psychophysiological measure reflects explicit or implicit memory will require further research and, moreover, must be determined for each experimental procedure in which a psychophysiological measure is used. What is required for each experimental procedure is a study examining the psychophysiological and associated behavioral measures in individuals with incontrovertible explicit memory deficits. Although such a definitive study has yet to be conducted, the results of 2 patients that we tested some years ago using the ERP assessment procedure of Allen et al. (1992) provide a preliminary test. Both patients had undergone neurosurgery to remove a portion of the left medial temporal lobe for the control of epilepsy. Although such surgery typically reduces the frequency of seizure activity, it also results in a rather profound explicit memory problem for verbal material. These participants were not instructed to conceal any information but performed poorly on the memory tests. Important to note is that the Bayesian combination of ERP features identified the learned material as familiar only 50% of the time (compared with 100% in the DID sample). Although further work is clearly warranted, these limited data suggest that the ERP procedure may not, in fact, tap implicit memory but rather may be sensitive to explicit memory deficits in some patients with demonstrable amnesia.

Interpreting psychophysiological results. Although there is still no consensus on whether, and under what conditions, psychophysiological measures reflect implicit versus explicit memory, there are several possible outcomes of a psychophysiological memory assessment. The literature to date would suggest that the following outcomes and interpretations are warranted:

1. *Psychophysiological measures suggest amnesia is present, and an inference of amnesia is warranted.* Because the psychophysiological measures using variants of the GKT have both high sensitivity and high specificity, this finding is reasonable assurance that amnesia, involving a failure of explicit memory, is present.

2. *Psychophysiological measures suggest amnesia is not present.* In this case, further information is required to differentiate between the two aforementioned possibilities: (a) a participant has explicit memory for the event and has engaged in deceitful responding, or (b) a participant has no explicit recollection and the psychophysiological measure reflects implicit memory. There are a variety of measures one might use to assess the likelihood of these two possibilities, including behavioral data from the assessment procedure that elicited the psychophysiological responses (as per Allen et al., 1995). In addition, there are malingering measures specifically designed to assess the possibility that a participant may be intentionally overreporting the extent of memory impairment.

Malingering

It remains possible that memory deficits are feigned in some cases of DID. Clinical interest in the vexing problem of malingering has inspired considerable research, and there exist many well-researched procedures (for a review, see Rogers, 1997) for detecting cases in which individuals are exaggerating their deficits. To assess specifically whether participants may be malingering memory deficits, investigators have tended to use one of two strategies. The first strategy involves using a forced-choice response format and interpreting below-chance performance as an indication that a participant has deliberately attempted to conceal knowledge of recognized stimuli. The assumption underlying this approach is that performance significantly below chance represents a systematic response that requires intact memory. Although this approach has proven somewhat useful, most malingerers appear sufficiently savvy to use a more complex strategy than to simply avoid recognizing all of the material in question. The test therefore has good specificity but relatively poor sensitivity (Cercy, Schretlen, & Brandt, 1997) because many malingerers fail to report recognition at levels significantly below chance. If below-chance responding is seen, it is compelling evidence of malingering; if responding is not below chance, however, the test proves indeterminate.

The other widely used approach in the assessment of malingering of memory problems involves finding a task that is sufficiently simple that amnesic individuals perform well but that appears to be more difficult than it actually proves to be. Malingerers will tend to overestimate the degree of impairment that amnesic patients would show and thus perform considerably more poorly than would be expected. Several such tests (e.g. Portland Digit Recognition Test: Binder & Willis, 1991; Hiscock Digit Memory Test: Hiscock & Hiscock, 1989; Amsterdam

Short-Term Memory Test: Schagen, Schmand, de Sterke, & Lindeboom, 1997) involve short-term memory assessments (delays on the order of seconds to minutes) and have found evidence that (a) malingerers tend to perform more poorly than those with demonstrable amnesia due to brain injury (e.g., Shagen et al., 1997; Slick, Hopp, Strauss, Hunter, & Pinch, 1994), and (b) those with brain injury who are seeking compensation perform more poorly than those with brain injury not seeking compensation (Binder, 1993; Binder & Willis, 1991). Other tests involve a slightly longer delay between learning and testing (e.g., Recognition Memory Test: Warrington, 1984; Test of Memory Malingering: Tombaugh, 1997) and have also found evidence that malingerers perform more poorly than those with bona fide amnesia (e.g., Iverson & Franzen, 1994, 1998; Rees, Tombaugh, Gansler, & Moczynski, 1998; Tombaugh, 1997).

It is unknown how well either of these two approaches would work to assess malingering in a population with putative dissociative disorders. Below-chance performance would clearly be an indication of systematic use of memory but, as mentioned above, many malingerers do not produce such a dramatic profile of responding. If below-chance performance were observed, as it was in one of the two cases thus assessed by Allen and Movius (2000), malingering could be inferred. If below-chance performance were not observed, however, it does not necessarily follow that malingering did not occur. The second approach to assessing malingering, in which malingerers should overestimate the deficits, may prove especially problematic in assessing amnesia in DID. Whereas amnesia due to brain injury allows for adequate performance on a variety of tasks involving memory (such as those listed above), it is unlikely that this could be expected in DID. If Identity B had no memory of what transpired when Identity A was in control, one would not expect Identity B to perform as well as those individuals who have amnesia due to brain injury. The amnesia seen in brain injury, of course, dramatically impairs memory but does not (except in very rare cases such as that described by Scoville & Milner, 1957) completely obliterate memory for what recently transpired. In DID, by contrast, the suggestion is that some identities have no recollection whatsoever for what transpired for other identities. A second problem with the overestimate of deficit approach is that it would presume that there exist good data concerning the degree of deficit in well-documented cases of DID with clearly demonstrable amnesia. Such cases are nonexistent at present.

Source-Monitoring Deficits

An unexplored interpretation of the memory deficits in DID derives from work on source monitoring (for a review, see Johnson, 1997). According to the multiple-entry, modular (MEM) model of memory, memory function requires various processes, including those that are typically considered a part of memory such as encoding, storage, and retrieval. In addition, however, the MEM model proposes that to be able to identify a mental representation as a memory, a process of *evaluation* or monitoring is also required. The MEM model thus highlights that memory is reconstructive and involves problem-solving approaches in the retrieval and reconstruction of a memory. A given mental representation will be experienced explicitly as a memory to the extent that it has features that help in identifying the origin of that mental representation as a previous experience.

These features include perceptual features (e.g., auditory or visual features), information about the context in which the experience may have occurred (e.g., the time or place), information that is inferred through active reconstruction or problem solving (e.g., "It could not have been today, it must have been yesterday"), semantic information, and affective information (Johnson, 1997). Moreover, the strategic reconstruction of memory, to place it in context and identify some features of the experience, will be guided by "agendas" (Johnson, 1997) that recruit reflective and perceptual processes. Under some circumstances, therefore, not all features of an experience will be simultaneously activated and, in other circumstances, features of an experience will be activated in new combinations or with new features that will give rise to memory errors.

In speculating how this model might be applied to memory disruption in DID, one might propose that DID patients do not retrieve a sufficient number of, or proper configuration of, features to appropriately identify a mental experience as a memory. To the extent that there exists interidentity state or mood differences (Eich & Metcalfe, 1989) between the time of encoding and testing, the strategic search processes will differ between identities, and it will be less likely that the same features will be activated at testing that were present at encoding. Instead, a partial set of the original features may be activated, thus making a mental representation somehow significant or familiar but not explicitly identifiable as an experience in one's past. This interpretation would predict, therefore, that previous exposure to an event or stimulus by one identity could, by virtue of producing a mental representation with only some features of the event or stimulus, influence behavior of another identity in the absence of the experience of a memory. In other words, there should be evidence of implicit memory when explicit memory fails between personalities.

This source-monitoring explanation of amnesia in DID is as yet untested. A fruitful strategy would involve using source-monitoring tasks in which, after viewing or listening to material that is presented in two different contexts (e.g., two different speakers or two different background colors), participants are asked to make judgments about the context in which a given stimulus was seen or heard. Accurate source monitoring requires that participants can accurately recall not only that an event occurred but also that it occurred in a specific context. Studies producing the following results would provide some support for the hypothesis that source-monitoring deficits underlie amnesia in DID: (a) finding that DID patients are poorer at source-monitoring memory tasks than are matched controls, (b) finding that source monitoring is poorer between different DID identities than within an identity, (c) finding that source monitoring deficits are larger between identities in DID patients than between mood states in normal controls, and (d) finding that DID patients do not show evidence of malingering. In addition, if one wished to claim that source monitoring is a fundamental deficit that may underlie the other deficits in DID, one would need to demonstrate that DID patients have a differential deficit (cf. Chapman & Chapman, 1978) in source monitoring relative to other memory tasks matched for difficulty and reliability that do not involve source monitoring. Such findings would point to a specific vulnerability—a tendency to confuse the origin of various mental representations—that makes DID patients susceptible to memory problems. This vulnerability may manifest as memory distortion when such individuals engage in practices that tend

to increase confusion over the source of events, such as hypnosis, dream rehearsal, and guided imagery (Belli & Loftus, 1994; Lindsay & Read, 1994; Loftus, 1993).

There exists support for the idea that the source-monitoring framework can explain false memories and beliefs (e.g., Belli & Loftus, 1994); the present proposal is that it is possible that the source-monitoring framework can explain amnesic phenomena in DID as well. An underlying vulnerability to errors of identifying the source of mental representations could create a vulnerability that leads to both amnesia and false recollections in DID patients. Mental experiences that reflect the experience of another identity may not be accurately identified as memory and, moreover, may be actively reconstructed to be congruent with the DID patient's understanding of her situation. If such mental representations do not possess the phenomenological qualities sufficient to correspond to a memory, such representations may be actively discounted or reclassified to fit the current identity's understanding of events (e.g., "That must just be a signal from an alter identity"). Such a process may result from the underlying vulnerability to DID, or from the presence of the disorder, or from social factors. As Johnson (1997) noted, social context provides potent influences on the strategic and reconstructive processes affecting memory. In this sense the current hypothesis is consistent with the sociocognitive perspective (Spanos, 1994, 1996) of DID that holds that the symptoms of DID are context bounded, goal-directed, social behavior produced in response to demand characteristics.

Implications for Diagnostic Criteria

Amnesia is a central descriptive and diagnostic feature of dissociative identity disorder and one that is typically assessed on the basis of clients' reports of memory disturbance. There exist only a few controlled experimental investigations of interidentity amnesia in the published literature, and all suggest that there is some degree of transfer of memory across identities that claim to be mutually amnesic. These findings raise concerns about the veracity of the self-report in cases of DID and highlight the need for objective measures of interidentity amnesia in DID. For some other *DSM–IV* diagnoses, objective laboratory findings are required to substantiate a diagnosis (e.g., certain dementias, and substance-induced phenomena). Considering the paucity of data to support the self-report of interidentity amnesia, it is worth considering whether objective evidence of amnesia should be required by the *DSM* to confirm a diagnosis of DID. The results of the few published studies of interidentity amnesia suggest that in all cases in which patients report interidentity amnesia, there is at least some degree of memory sharing across identities. This does not imply that there do not exist cases in which objective measures would document the presence of amnesia, but to date the published literature has not detailed such cases. The cases in the literature thus meet the *DSM–IV* criteria by self-report but, on closer examination, do not show unequivocal evidence of interidentity amnesia.

If the *DSM* criteria were revised to require objective evidence of amnesia to substantiate a diagnosis of DID, cases that previously met DID criteria on the basis of reports of distinct personalities and reports of amnesia—but that did not show objective evidence of amnesia—could still be aptly diagnosed with dissociative disorder not otherwise specified (DDNOS). The current criteria for

DDNOS allow for cases similar to DID that fail to meet full criteria for this disorder. An alternative approach for accommodating these research findings would be to suggest a return to a *DSM–III–R* notion of multiple personality disorder, in which amnesia was not a requirement for diagnosis. DID would then be a disorder in which two or more distinct identities recurrently take control of the person's behavior. This approach brings with it the vexing problem of defining what constitutes a distinct identity. An advantage of the amnesia criterion, assuming that it can be substantiated, is that it helps in distinguishing people who are simply highly variable across situations from those that have a pathological condition.

Another approach would be to not focus on substantiating the report of amnesia but instead alter the *DSM* criteria to reflect that it is the *report* of amnesia that is required. In other words, in addition to two or more distinct identities, it would be required that the individual report amnesia too extensive to be accounted for by ordinary forgetfulness. This approach would accommodate all currently diagnosed cases of DID and would sidestep the heated issue of whether DID "exists" (Saks, 1994). With such an approach, anyone who reports the symptoms has DID. The disadvantage to this approach is that it could create a heterogeneous diagnostic category that includes two rather different clinical presentations: cases with objectively verifiable amnesia, and cases in which objective evidence suggests the absence of amnesia despite the self-report that amnesia is present. These two clinical presentations may differ in the following important aspects: (a) in terms of etiology, (b) in terms of prognosis, (c) in the associated clinical features that are present, (d) in the treatment most likely to reduce symptoms and restore function, and (e) in terms of how the legal system should respond in cases in which DID patients encounter legal violations.

Conclusion

Interidentity amnesia is a central feature of DID but one that has received little empirical attention. The few published studies are generally consistent in finding that direct tests of memory produce reports of interidentity amnesia, but less transparent, indirect tests of memory tend to show evidence of memory transfer between identities. Such findings suggest the need to be cautious in trusting patient self-report as the sole means of assessing interidentity amnesia and highlight the need for more objective measures of memory in DID. Psychophysiological assessment, using variants of the GKT, holds the potential to provide an objective index of amnesia and may assist in understanding the nature of amnesia in DID. In cases in which such psychophysiological assessments reveal no transfer of information between identities, they provide objective confirmation of amnesia. In cases in which such psychophysiological assessments reveal evidence of interidentity transfer of memory, further investigation is required to determine whether they reflect implicit memory in the absence of explicit awareness or whether they reflect explicit memory in individuals who attempt to portray themselves as amnesic. Additional measures that may assist in making such a determination include other measures of memory and the inclusion of tests specifically designed to detect malingering.

The outcome of such assessments may ultimately reveal three distinct clinical presentations that could all currently be diagnosed with DID according to

DSM–IV criteria: (a) patients with objective evidence of amnesia and no evidence of implicit or explicit memory between identities, (b) patients with credible evidence of explicit memory deficits between identities but with evidence of preserved implicit memory, (c) patients who report amnesia but appear to have no objectively verifiable memory deficits. To date, the published literature of interidentity amnesia has provided evidence of cases consistent with presentations (b) and (c), but no investigation has unequivocally identified a case of type (a), with objective evidence of no transfer of information between identities.

In weighing the value of the scientific evidence for the courts, the extant data indicate that patients' claims of amnesia are not guaranteed to be corroborated by independent objective methods. Psychophysiological measures, however, may prove informative. A properly constructed guilty knowledge test—using either electrodermal or event-related potential measures—would produce one of two possible outcomes. Failure to show memory would be strong objective evidence in support of amnesia, although no cases in the published literature have produced such a result. Psychophysiological evidence of memory, by contrast, would not distinguish between the existence of implicit versus explicit memory. Until further research or the *DSM* clarifies what constitutes the nature of the memory impairment in DID, psychophysiological evidence of memory could be viewed as refuting the diagnosis or as inconclusive because the diagnostic criteria are unclear. Given the current body of research, the courts would be well advised to use caution in evaluating or admitting claims of amnesia in putative cases of DID.

References

Aldridge-Morris, R. (1989). *Multiple personality: An exercise in deception.* London: Erlbaum.

Allen, J. J. B., & Iacono, W. G. (1997). A comparison of methods for the analysis of event-related potentials in deception-detection. *Psychophysiology, 34,* 234–240.

Allen, J. J., Iacono, W. G., & Danielson, K. D. (1992). The development and validation of an event-related-potential memory assessment procedure: A methodology for prediction in the face of individual differences. *Psychophysiology, 29,* 504–522.

Allen, J. J., Iacono, W. G., Laravuso, J. J., & Dunn, L. A. (1995). An event-related potential investigation of posthypnotic recognition amnesia. *Journal of Abnormal Psychology, 104,* 421–430.

Allen, J. J. B., & Movius, H. L. (2000). The objective assessment of amnesia in dissociative identity disorder using event-related potentials. *International Journal of Psychophysiology, 38,* 21–41.

American Psychiatric Association. (1994). *Diagnostic and statistical manual of mental disorders* (4th ed.). Washington, DC: Author.

Bahnson, C. B., & Smith, K. (1975). Autonomic changes in a multiple personality. *Psychosomatic Medicine, 37,* 85–86.

Bauer, R. M. (1984). Autonomic recognition of names and faces in prosopagnosia: A neuropsychological application of the guilty knowledge test. *Neuropsychologia, 22,* 457–469.

Bauer, R. M., & Verfaellie, M. (1988). Electrodermal discrimination of familiar but not unfamiliar faces in prosopagnosia. *Brain and Cognition, 8,* 240–252.

Belli, R., & Loftus, E. (1994). Recovered memories of childhood abuse: A source monitoring perspective. In S. J. Lynn & J. W. Rhue (Eds.), *Dissociation: Clinical and theoretical perspectives* (pp. 415–433). New York: Guilford Press.

Ben-Shakar, G., & Furedy, J. J. (1990). *Theories and applications in the detection of deception.* New York: Springer-Verlag.

Bentin, S., & Moscovitch, M. (1990). Psychophysiological indices of implicit memory performance. *Bulletin of the Psychonomic Society, 28,* 346–352.

Bentin, S., Moscovitch, M., & Heth, I. (1992). Memory with and without awareness: Performance and electrophysiological evidence of savings. *Journal of Experimental Psychology: Learning, Memory, and Cognition, 18,* 1270–1283.

Binder, L. M. (1993). Assessment of malingering after mild head trauma with the Portland Digit Recognition Test. *Journal of Clinical and Experimental Neuropsychology, 15,* 170–182.

Binder, L. M., & Willis, S. C. (1991). Assessment of motivation after financially compensable minor head trauma. *Psychological Assessment: A Journal of Consulting and Clinical Psychology, 3,* 175–181.

Boaz, T. L., Perry, N. W., Raney, G., Fischler, I. S., & Shuman, D. (1991). Detection of guilty knowledge with event-related potentials. *Journal of Applied Psychology, 76,* 788–795.

Braun, B. G. (1983). Neurophysiologic changes in multiple personality due to integration: a preliminary report. *American Journal of Clinical Hypnosis, 26,* 84–92.

Brende, J. O. (1984). The psychophysiologic manifestations of dissociation: Electrodermal responses in a multiple personality patient. *Psychiatry Clinics of North America, 7,* 41–50.

Cercy, S. P., Schretlen, D. J., & Brandt, J. (1997). Simulated amnesia and the pseudomemory phenomena. In R. Rogers (Ed.), *Clinical assessment of malingering and deception* (2nd ed., pp. 85–107). New York: Guilford Press.

Chapman, L. J., & Chapman, J. P. (1978). The measurement of differential deficit. *Journal of Psychiatric Research, 14,* 303–311.

Coons, P. M. (1988). Psychophysiological aspects of multiple personality disorder: A review. *Dissociation, 1,* 47–53.

Dick-Barnes, M., Nelson, R. O., & Aine, C. J. (1987). Behavioral measures of multiple personality: The case of Margaret. *Journal of Behavior Therapy & Experimental Psychiatry, 18,* 229–239.

Donchin, E., & Coles, M. G. H. (1988). Is the P300 component a manifestation of context updating? *Behavioral and Brain Sciences, 11,* 357–374.

Eich, E., Macaulay, D., Loewenstein, R. J., & Dihle, P. H. (1997a). Implicit memory, interpersonality amnesia, and dissociative identity disorder: Comparing patients with simulators. In J. D. Read & D. S. Lindsay (Eds.), *Recollections of trauma: Scientific evidence and clinical practice* (pp. 469–474). New York: Plenum.

Eich, E., Macaulay, D., Loewenstein, R. J., & Dihle, P. H. (1997b). Memory, amnesia, and dissociative identity disorder. *Psychological Science, 8,* 417–422.

Eich, E., & Metcalfe, J. (1989). Mood dependent memory for internal versus external events. *Journal of Experimental Psychology: Learning, Memory, and Cognition, 15,* 443–455.

Ellwanger, J., Rosenfeld, J. P., Sweet, J. J., & Bhatt, M. (1996). Detecting simulated amnesia for autobiographical and recently learned information using the P300 event-related potential. *International Journal of Psychophysiology, 23,* 9–23.

Fahy, T. A. (1988). The diagnosis of multiple personality disorder: A critical review. *British Journal of Psychiatry, 153,* 597–606.

Farwell, L. A., & Donchin, E. (1991). The truth will out: Interrogative polygraphy ("lie detection") with event-related potentials. *Psychophysiology, 28,* 531–547.

Goodin, D. S., Shefrin, S. L., & Aminoff, M. J. (1987). Electrophysiologic correlates of "blindsight." In C. Barber & T. Blum (Eds.), *Evoked potentials III: The Third*

International Evoked Potentials Symposium (pp. 351–354). Stoneham, MA: Butterworth Publishers.

Graf, P., Squire, L. R., Mandler, G. (1984). The information that amnesic patients do not forget. *Journal of Experimental Psychology: Learning, Memory, and Cognition, 10,* 164–178.

Hiscock, M., & Hiscock, C. L. (1989). Refining the forced-choice method for the detection of malingering. *Journal of Clinical & Experimental Neuropsychology, 11,* 967–974.

Iacono, W. G. (2000). The detection of deception. In J. T. Cacioppo & L. G. Tassinary (Eds.), *Handbook of psychophysiology* (2nd ed., pp. 772–793). New York: Cambridge University Press.

Iacono, W. G., & Lykken, D. T. (1997). The validity of the lie detector: Two surveys of scientific opinion. *Journal of Applied Psychology, 82,* 426–433.

Iverson, G. L., & Franzen, M. D. (1994). The Recognition Memory Test, Digit Span, and Knox Cube Test as markers of malingered memory impairment. *Assessment, 1,* 323–334.

Iverson, G. L., & Franzen, M. D. (1998). Detecting malingered memory deficits with the Recognition Memory Test. *Brain Injury, 12,* 275–282.

Johnson, M. K. (1997). Identifying the origin of mental experience. In M. S. Myslobodsky (Ed.), *The mythomanias: The nature of deception and self-deception* (pp. 133–180). Mahwah, NJ: Erlbaum.

Johnson, M. K., Nolde, S. F., & De Leonardis, D. M. (1996). Emotional focus and source monitoring. *Journal of Memory & Language, 35,* 135–156.

Johnson, M. M., & Rosenfeld, J. P. (1992). Oddball-evoked P300-based method of deception detection in the laboratory: II. Utilization of non-selective activation of relevant knowledge. *International Journal of Psychophysiology, 12,* 289–306.

Johnson, R. (1986). A triarchic model of P300 amplitude. *Psychophysiology, 23,* 367–384.

Larmore, K., Ludwig, A. M., & Cain, R. L. (1977). Multiple personality: An objective case study. *British Journal of Psychiatry, 131,* 35–40.

Lindsay, D. S., & Read, J. (1994). Psychotherapy and memories of childhood sexual abuse: A cognitive perspective. *Applied Cognitive Psychology, 8,* 281–338.

Loftus, E. F. (1993). The reality of repressed memories. *American Psychologist, 48,* 518–537.

Ludwig, A. M., Brandsma, J. M., Wilbur, C. B., Bendfeldt, F., & Jameson, D. H. (1972). The objective study of a multiple personality: Or, Are four heads better than one? *Archives of General Psychiatry, 26,* 298–310.

Lykken, D. T. (1959). The GSR in the detection of guilt. *Journal of Applied Psychology, 43,* 385–388.

Lykken, D. T. (1998). *A tremor in the blood: Uses and abuses of the lie detector.* (2nd ed.). New York: Plenum.

Mathew, R. J., Jack, R. A., & West, W. S. (1985). Regional cerebral blood flow in a patient with multiple personality. *American Journal of Psychiatry, 142,* 504–505.

Merikle, P. M., & Reingold, E. M. (1991). Comparing direct (explicit) and indirect (implicit) measures to study unconscious memory. *Journal of Experimental Psychology: Learning, Memory, and Cognition, 17,* 224–233.

Merskey, H. (1992). The manufacture of personalities. The production of multiple personality disorder. *British Journal of Psychiatry, 160,* 327–340.

Merskey, H. (1995). Multiple personality disorder and false memory syndrome. *British Journal of Psychiatry, 166,* 281–283.

Neville, H. J., Kutas, M., Chesney, G., & Schmidt, A. L. (1986). Event-related brain potentials during initial encoding and recognition memory of congruous and incongruous words. *Journal of Memory and Language, 25,* 75–92.

Nissen, M. J., Ross, J. L., Willingham, D. B., Mackenzie, T. B., & Schacter, D. L. (1988).

Memory and awareness in a patient with multiple personality disorder. *Brain and Cognition, 8,* 117–134.

Orr, J. K. (1999). Multiple personality disorder and the criminal court: A new approach. 28 Sw. U. L. Rev. 651.

Paller, K. A., & Kutas, M. (1992). Brain potentials during memory retrieval provide neurophysiological support for the distinction between conscious recollection and priming. *Journal of Cognitive Neuroscience, 4,* 375–391.

Paller, K. A., Kutas, M., & McIsaac, H. K. (1995). Monitoring conscious recollection via the electrical activity of the brain. *Psychological Science, 6,* 107–111.

Peters, M. L., Uyterlinde, S. A., Consemulder, J., & van der Hart, O. (1998). Apparent amnesia on experimental memory tests in dissociative identity disorder: An exploratory study. *Consciousness and Cognition, 7,* 27–41.

Piper, A. Jr. (1994). Multiple personality disorder: A critical review. *British Journal of Psychiatry, 164,* 600–612.

Putnam, F. W., Zahn, T. P., & Post, R. M. (1990). Differential autonomic nervous system activity in multiple personality disorder. *Psychiatry Research, 31,* 251–260.

Rees, L. M., Tombaugh, T. N., Gansler, D. A., & Moczynski, N. P. (1998). Five validation experiments of the Test of Memory Malingering (TOMM). *Psychological Assessment, 10,* 10–20.

Renault, B., Signoret, J. L., Debruille, B., Breton, F., & Bolgert, F. (1989). Brain potentials reveal covert facial recognition in prosopagnosia. *Neuropsychologia, 27,* 905–912.

Rogers, R. (1997). *Clinical assessment of malingering and deception* (2nd ed.). New York: Guilford Press.

Rosenfeld, J. P., Angell, A., Johnson, M., & Qian, J. H. (1991). An ERP-based, control-question lie detector analog: Algorithms for discriminating effects within individuals' average waveforms. *Psychophysiology, 28,* 319–335.

Rosenfeld, J. P., Cantwell, B., Nasman, V. T., Wojdac, V., Ivanov, S., & Mazzeri, L. (1988). A modified event-related potential-based guilty-knowledge test. *International Journal of Neuroscience, 42,* 157–161.

Rosenfeld, J. P., Ellwanger, J., & Sweet, J. (1995). Detecting simulated amnesia with event-related brain potentials. *International Journal of Psychophysiology, 19,* 1–11.

Rosenfeld, J. P., Reinhart, A. M., Bhatt, M., Ellwanger, J., Gora, K., Sekera, M., & Sweet, J. (1998). P300 correlates of simulated amnesia on a matching-to-sample task: Topographic analyses of deception vs. truth-telling responses. *International Journal of Psychophysiology, 28,* 233–248.

Rosenfeld, J. P., Sweet, J. J., Chuang, J., Ellwanger, J., & Song, L. (1996). Detection of simulated malingering using forced choice recognition enhanced with event-related potential recording. *Clinical Neuropsychologist, 10,* 163–179.

Rugg, M. D. (1995). Event-related potential studies of human memory. In M. S. Gazzaniga (Ed.), *Cognitive neurosciences* (pp. 789–802). Cambridge, MA: MIT Press.

Rugg, M. D., Cox, J. C. C., Doyle, M. C., & Wells, T. (1995). Event-related potentials and the recollection of low and high frequency words. *Neuropsychologia, 33,* 471–484.

Rugg, M. D., & Doyle, M. C. (1992). Event-related potentials and recognition memory for low- and high-frequency words. *Journal of Cognitive Neuroscience, 4,* 69–79.

Rugg, M. D., & Doyle, M. C. (1994). Event-related potentials and stimulus repetition in direct and indirect tests of memory. In H. Heinze, T. Munte, & G. R. Mangun (Eds.), *Cognitive electrophysiology* (pp. 124–148). Boston: Birkhauser.

Rugg, M. D., & Nagy, M. E. (1989). Event-related potentials and recognition memory for words. *Electroencephalography and clinical neurophysiology, 72,* 395–406.

Saks, E. R. (1994). Does multiple personality disorder exist?: The beliefs, the data, and the law. *International Journal of Law and Psychiatry, 17,* 43–78.

Sanquist, T. F., Rohrbaugh, J. W., Sydulko, K., & Lindsley, D. B. (1980). Electrocortical levels of processing: Perceptual analysis and recognition memory. *Psychophysiology, 17,* 568–576.

Schagen, S., Schmand, B., de Sterke, S., & Lindeboom, J. (1997). Amsterdam Short-Term Memory Test: A new procedure for the detection of feigned memory deficits. *Journal of Clinical and Experimental Neuropsychology, 19,* 43–51.

Schnyer, D. M., Allen, J. J. B., & Forster, K. (1997). An event-related brain potential examination of implicit memory processes: Masked and unmasked repetition priming. *Neuropsychology, 11,* 243–260.

Schnyer, D. M., Allen, J. J. B., Kaszniak, A. W., & Forster, K. I. (1999). An ERP examination of masked and unmasked repetition priming in Alzheimer's disease: Implications for theories of implicit memory. *Neuropsychology, 13,* 1–15.

Scoville, W. B., & Milner, B. (1957). Loss of recent memory after bilateral hippocampal lesions. *Journal of Neurology, Neurosurgery, and Psychiatry, 20,* 11–21.

Silberman, E. K., Putnam, F. W., Weingartner, H., Braun, B. G., & Post, R. M. (1985). Dissociative states in multiple personality disorder: A quantitative study. *Psychiatry Research, 15,* 253–260.

Slick, D., Hopp, G., Strauss, E., Hunter, M., & Pinch, D. (1994). Detecting dissimulation: Profiles of simulated malingerers, traumatic brain-injury patients, and normal controls on a revised version of Hiscock and Hiscock's forced-choice memory test. *Journal of Clinical and Experimental Neuropsychology, 16,* 472–481.

Slovenko, R. (1995). *Psychiatry and criminal culpability.* New York: Wiley.

Smith, M. E. (1993). Neurophysiological manifestations of recollective experience during recognition memory judgments. *Journal of Cognitive Neuroscience, 5,* 1–13.

Smith, M. E., & Halgren, E. (1989). Dissociation of recognition memory components following temporal lobe lesions. *Journal of Experimental Psychology: Learning, Memory, and Cognition, 15,* 50–60.

Spanos, N. P. (1994). Multiple identity enactments and multiple personality disorder: A sociocognitive perspective. *Psychological Bulletin, 116,* 143–165.

Spanos, N. P. (1996). *Multiple identities and false memories: A sociocognitive perspective.* Washington, DC: American Psychological Association.

Spanos, N. P., Weekes, J. R., & Bertand, L. D. (1985). Multiple personality: A social psychological perspective. *Journal of Abnormal Psychology, 94,* 362–376.

State v. Badger, 551 A.2d 207, 209 (N.J. Super. Ct. Law Div. 1988).

Steinberg, M. (1993). *Structured Clinical Interview for DSM–IV Dissociative Disorders* (SCID-D). Washington, DC: American Psychiatric Press.

Tombaugh, T. N. (1997). The Test of Memory Malingering (TOMM): Normative data from cognitively intact and cognitively impaired individuals. *Psychological Assessment, 9,* 260–268.

Tranel, A. R., & Damasio, D. (1985). Knowledge without awareness: An autonomic index of facial recognition by prosopagnosics. *Science, 228,* 1453–1454.

Warrington, E. K. (1984). *Recognition Memory Test manual.* Windsor, Berkshire, England: NFER-Nelson.

Received March 15, 2000
Revision received May 31, 2000
Accepted June 1, 2000 ■