Implicit memory: intention and awareness revisited

Laurie T. Butler and Dianne C. Berry

One of the major developments in memory research in the past decade or so has been a growing interest in implicit memory – task performance that is not accompanied by conscious or intentional recollection. In this article, we examine evidence for perceptual and conceptual implicit memory, using the accepted definitions, and suggest that there is in fact a lack of strong evidence for implicit memory in normal subjects. If more convincing evidence cannot be obtained, one solution might be to modify the current terminology. We suggest that the term implicit memory might have outgrown its usefulness as an overall descriptor.

Over the past 15 years there has been a phenomenal growth in the number of studies investigating implicit memory. This interest can be traced to Schacter (see also Ref. 2) who in a seminal paper defined the phenomenon as being ‘revealed when previous experiences facilitate performance on a task that does not require conscious or intentional recollection of those experiences’ (Ref. 1, p. 501). Accordingly, to be described as a demonstration of implicit memory, two conditions should be satisfied: (1) performance reflects an unintentional retrieval strategy, and (2) performance is not accompanied by conscious recollection. Ensuring that these conditions are met has proved to be difficult, especially in studies using normal participants. After outlining this problem in greater detail, we review studies of implicit memory, specifically repetition priming, that have met one or both of these conditions. We consider evidence pertaining to perceptual and well as conceptual implicit memory tasks, and seek to address three main questions: (1) are there convincing examples of implicit memory performance in normal participants; (2) should we be concerned that many studies do not meet both conditions for demonstrating implicit memory; and (3) how useful is the term implicit memory as an overall descriptor?

Methods for measuring implicit memory
Numerous procedures exist for studying implicit memory (e.g. word stem completion, perceptual identification). Although many would be classified as testing perceptual implicit memory there is a growing number of conceptual implicit memory tasks (e.g. category exemplar production, word-cued association). This perceptual/conceptual distinction is made on the basis of the task’s processing demands and is an important means of classification. It should be noted that some researchers have made the classification on the basis of the obtained data (e.g. Ref. 3), such that for a task to be described as perceptual, higher data driven scores should be shown, and vice versa for conceptual tasks.

Briefly, a test engages perceptual processes when performance involves the analysis of stimulus form (e.g. identifying words), and conceptual processes when performance involves the analysis of stimulus meaning (e.g. producing category exemplars). Both types of task can be contrasted with explicit memory tasks (e.g. recall, recognition) in that no instruction is given to think back intentionally to an earlier study list. Rather participants carry out a seemingly unrelated task that can be completed without reference to the study episode. Thus, following exposure to a study list (e.g. including the word elephant), participants might be asked to respond with the first word that comes to mind to a series of word stems (e.g. de-); or produce examples for various categories (e.g. animals). In each case, priming is observed; that is a greater proportion of studied words is produced, relative to non-studied ones.

The contamination problem
In recent years the issue of contamination by explicit memory processes has become increasingly prominent in discussions of implicit memory. There are two distinct ways in which an implicit memory task can be contaminated: firstly, participants might adopt an intentional retrieval strategy (i.e. deliberately retrieve study words). Secondly, participants might be phenomenally aware (i.e. possess knowledge that retrieved test words are study list ones). Schacter et al. provide a set of scenarios to illustrate the subtle ways in which intention and awareness might interact and influence implicit task performance.

Although many studies have used patient groups where recourse to intentional retrieval strategies, and presumably conscious recollection, is reduced or absent, there is a real concern that the performance of normal participants on implicit memory tasks might be contaminated in one or both of these ways. Thus, performance could reflect an intentional retrieval strategy (normally accompanied by awareness), or alternatively an unintentional retrieval strategy accompanied by awareness. Distinguishing between these and genuine cases of implicit memory (i.e. unintentional and unconscious) presents a considerable challenge.

This article is primarily concerned with methodological issues. However, some orientating background information on relevant theoretical explanations of implicit memory is provided in Box 1.

Approaches to contamination
Researchers have developed a number of approaches to address the problem of contamination (see Box 2).

In the following sections we review evidence for...
Such results suggest that finer distinctions proven problematic for the framework.

conceptual implicit memory tasks, have memory tasks, and within the class of between conceptual implicit and explicit least, recent evidence of dissociations experimental data, for normal subjects at conceptual processes, respectively.

Although a number of theories have been predicted between implicit and explicit memory tasks to the extent that they typically engage perceptual and memory tasks to the extent that they prediction reflects the operation of a perceptual representation system that functions independently of the episodic memory system believed to support explicit memory performance. The perceptual representation system comprises three domain-specific subsystems (visual word-form system, auditory word-form system, structural description system) dedicated to the processing and representation of information concerning the form and structure of words and objects. The approach has been particularly useful for integrating findings from both normal and memory impaired patients. However, the systems that exist to date are vague in terms of how conceptual priming is supported (see Ref. g). Additionally, it is not clear at what stage observed patterns of findings require the specification of a new memory system.

References


implicit memory from studies which have used these methods. At the outset we note that the ‘process dissociation procedure’ does not allow for separate estimates of intention and awareness (see Ref. 4 for discussion). However, we cite evidence obtained using this procedure because of its centrality in discussions on contamination. Initially, we describe evidence indicating that performance reflects unintentional retrieval and then we examine evidence that performance is both unintentional and unconscious. A separate section on awareness is not included as it is assumed that test unawareness is incompatible with an intentional retrieval strategy. Whilst intentional unconscious memory is definitively possible there is no evidence regarding its actual occurrence.

Evidence for implicit memory

**Intentionality condition**

**Perceptual implicit memory.** Numerous studies have shown performance on perceptual implicit memory tasks to reflect unintentional retrieval. These have usually taken the form of single dissociations between perceptual implicit and explicit memory tasks differing only in terms of test instructions. For example, Mulligan and Hartman found that dividing attention at study had no effect on performance on a word fragment task, but impaired performance on a matched word fragment cued recall task. Other well-replicated effects, in the form of single dissociations, have been observed across a range of different variables, for example, levels of processing and retinal size. J. ava provides even stronger evidence in the form of a crossed double dissociation on implicit and explicit tasks matched on everything but test instructions. In each of these cases we can be confident that performance on the implicit version of the task predominantly reflected an unintentional retrieval strategy. Recently though, Richardson-Klavehn et al. reported evidence showing that performance on a word stem completion task was entirely the result of an unintentional retrieval strategy. This conclusion was supported by a complex pattern of results jointly showing functional, double and parallel (i.e. same effect of a variable on both implicit and explicit versions of the task) dissociations.

**Conceptual implicit memory.** There is a relative paucity of evidence regarding dissociations between conceptual implicit and explicit memory tasks, and what evidence there is tends to be based on the findings of single studies. This might be because the systematic study of conceptual tasks is relatively recent. However, it could indicate that explicit memory tasks share more similar processes in common with conceptual implicit than with perceptual implicit memory tasks (see, for example, Ref. 12). In terms of relevant evidence Weldon and Coyote showed that explicit and conceptual implicit
Box 2. Approaches to contamination

The following are some of the proposals that have attempted to address the problem of contamination of implicit memory tasks by explicit (intentional or conscious) processes.

Retrieval intentionality criterion
- Proposed to distinguish between unintentional and intentional retrieval strategies.
- Requires that implicit and explicit memory tasks be matched on all properties, bar test instructions. Consequently, differential effects of experimental manipulations can be attributed to the use of unintentional versus intentional retrieval strategies.
- Although now a feature of most experimental designs, it does not address the more intractable issue of phenomenological awareness.

Chance recognition
- Requires that the effects of a variable be shown to be greater on an implicit rather than explicit memory task. If this is the case it can be argued that performance on the implicit memory task reflects the use of unconscious information as it would be used on the explicit memory task if it were consciously available.
- Few studies have met this conservative criterion.

Awareness questionnaires
- Consists of a sequence of questions designed to assess state of awareness during testing.
- Easy to administer, but permits only a global assessment of awareness. That is, it cannot distinguish between cases where a few test responses are associated with awareness and cases where most responses are.

Item by item analysis
- Allows more fine grained analysis of individual responses. Participants receive an extra recognition task in which they have to indicate the status (previously studied or not) of each item. From this, priming effects can be calculated based on items that participants do and do not show awareness for.
- As with questionnaires, can be used with different implicit memory tasks. However, in assessing awareness retrospectively, all such methods are subject to criticisms such as inability to recall the true nature of the mental state at test.

On-line awareness analysis
- Awareness is measured 'on line', that is, at the time of testing.
- Method comprises standard stem-completion and cued-recall tasks, plus an opposition task where participants are encouraged to complete stems with the first word that comes to mind but to omit previously studied words. Latter task provides the crucial awareness data because participants are required to suppress items associated with awareness.
- Although promising, its ability to generalize to other implicit memory tasks has yet to be established.

Process dissociation procedure
- Eschewing standard task-based methodology, the approach endorses the idea that any task (implicit or explicit) can be sensitive to both conscious and unconscious influences.
- The method comprises two test conditions (inclusion and exclusion), which place conscious and unconscious processes in concert and in opposition, respectively. Simple equations are then used to derive separate estimates of conscious and unconscious memory.
- Although an important development, intense methodological and theoretical scrutiny renders its current status unclear.

References
f Richardson-Klavehn, A. et al. (1994) Involuntary conscious memory and the method of opposition. Memory 2, 1-29

Intentionality and awareness conditions

Perceptual implicit memory. The strongest form of evidence comes from studies where priming on the implicit task is shown in the absence of explicit memory performance, the logic being that if relevant information was consciously available it would be used on the latter test. A few studies do meet this conservative criterion (e.g. Refs 17,18) including one that obtained significant priming, but chance recognition, on tasks matched on all characteristics apart from test instructions18. Some evidence is also provided by studies using the process dissociation procedure (Box 2). Schmitter-Edgecombe showed, for example, that although consciously controlled estimates of memory were impaired by manipulating divided attention, unconscious estimates remained invariant19. Other studies have applied the approach to a number of different variables including depth of processing20 and modality21. Using an on-line awareness method (see Box 2), Richardson-Klavehn et al. demonstrated that priming following a perceptual encoding task reflected unintentional unconscious memory22. Finally, awareness has been assessed retrospectively using item by item or questionnaire measures. In these cases there is some
evidence that priming can be observed even when participants claim to have no awareness of the study–test relationship\(^{16,19,23}\).

**Conceptual implicit memory.** There is virtually no evidence that priming on conceptual tasks reflects unintentional and unconscious memory. To the best of our knowledge only one study has obtained reliable estimates of unconscious retrieval processes for a conceptual task (category association) using the process dissociation procedure\(^{19}\). These were found under both full and divided attention conditions. Other than this, two studies have reported significant priming under conditions whereby participants report no awareness\(^{16,19}\).

**Relaxing the implicit memory definition**

In the preceding sections we have shown that considerably more studies using perceptual, rather than conceptual, implicit memory tasks have met the intentionality criterion. More importantly, of the small fraction of studies that have met both conditions, as defined by Schacter\(^1\), almost all have used perceptual implicit memory tasks.

As the reader will probably agree, the lack of strong evidence for implicit memory in normal participants is surprising. Given the difficulty of meeting the second criterion this apparent lack of methodological rigour is to some degree understandable. Nevertheless, it is certainly the case that the majority of studies make no attempt to assess ‘conscious recollection’ when purporting to demonstrate implicit memory. Furthermore, some studies make no reference to this second condition at all, particularly, it seems to us, those measuring conceptual implicit memory\(^{14,24}\). Thus although the term implicit memory still enjoys widespread usage, we ask whether it is acceptable that the originally proposed conditions for demonstrating implicit memory have been relaxed and in some cases ignored altogether?

**Awareness on implicit memory tasks**

We suggest that such a relaxation is not acceptable. The reason for this is that when some measure of the second criterion is included in implicit memory studies, performance often seems to reflect an unintentional but conscious use of memory. This appears to be particularly evident when the implicit memory task under consideration is a conceptual one.

For example, Mulligan and Hartman found that 93% participants claimed to be aware of what was being tested on a category production task\(^7\). Also, Thapar and Greene produced evidence showing, not only that all their participants were test aware on a general knowledge task, but also that participants ‘became aware very early on in the test’\(^{25}\) (see also Ref. 26). Furthermore, applying the process dissociation procedure to a category-production task Mecklenbräucker et al. showed that performance almost entirely reflected a conscious use of memory\(^{27}\).

Whilst they argued that interpretation was difficult, they concluded that performance on conceptual tasks typically represents an unintentional, but conscious use of memory.

**‘There is virtually no evidence that priming on conceptual tasks reflects unintentional and unconscious memory.’**

Overall, despite occasional exceptions (e.g. Ref. 16), these findings strike us as being incompatible with those compelling instances of perceptual implicit memory (e.g. Ref. 18) where performance is characterized by a form of memory that is not only unintentional but also unconscious. We should point out that this issue is not exclusively restricted to conceptual tasks. Both Richardson-Klavehn et al.\(^{28}\) and Rybash and Osborne\(^{29}\) have produced evidence that participants in their studies were routinely aware of the study–test relationship. However, whereas there is compelling evidence that perceptual implicit memory performance for normal participants can operate in the absence of accompanying awareness, the same cannot be said for conceptual implicit memory tasks.

**Confusion between unintentional conscious and unconscious memory**

Extrapolating from these studies, it seems likely that a large percentage of purported demonstrations of implicit memory, especially ones using conceptual tasks, really reflect unintentional conscious memory. So why is this a problem?

Firstly, if participants become aware during test then they may switch to an intentional (and conscious) retrieval strategy. Secondly, it makes comparisons between perceptual and conceptual implicit memory difficult because the latter appears to be more routinely accompanied by awareness than the former. However, the most fundamental problem is that the majority of studies purporting to demonstrate ‘implicit memory’ might not be measuring what they claim to be. The need to distinguish between unintentional unconscious and unintentional conscious memory has been noted by a number of researchers (e.g. Richardson-Klavehn et al.\(^4\)), including Schacter\(^1\) who explicitly warned against confusing the two. Why then do researchers persist in describing obtained effects as ‘implicit memory’ whereas in all probability many are nothing of the kind (i.e. they are consciously mediated)?

**Are we being too harsh?**

Some will of course claim that we are being harsh when questioning evidence for implicit memory obtained using normal populations. One can refer to numerous examples of both perceptual and conceptual implicit memory in a variety of patient...
groups (see Ref. 30 for a review), whereby contamination by explicit memory processes is unlikely. These do provide compelling evidence for the existence of both forms of implicit memory. However, there are well-documented measurement and interpretative problems with these forms of evidence (see, for example, Ref. 31) and they may not have any bearing on how normal participants will behave on implicit memory tasks. We believe that the lack of genuine evidence regarding implicit memory in normal participants is a real concern. Thus, as we enter the third decade of research into the phenomenon, we wonder whether the term ‘implicit memory’ has in fact outlived its usefulness.

**Options for the future**

At this point we believe that there are two main options available. If the term ‘implicit memory’ is to be retained then it is imperative that more compelling demonstrations are produced using both perceptual and conceptual tasks. Roediger and McDermott outline a number of precautions designed to reduce the likelihood of participants becoming test aware. We suggest that researchers, particularly those using conceptual tasks, incorporate such measures, for example, high ratios of filler to target test items, into their designs (but see Ref. 4 for a different perspective).

‘...we wonder whether the term implicit memory has in fact outlived its usefulness.’

In meeting the second criterion for implicitness we believe that some indicator of test awareness should be routinely included in future studies (see also Ref. 19). At the very least, this should take the form of a retrospective questionnaire. A better approach might be to incorporate the method of ‘on-line’ awareness testing devised by Richardson-Klavehn and colleagues. It could, for example, be used with a conceptual task such as a category exemplar production. Finally, Beauregard et al. have developed an approach based on the logic of demonstrating priming under conditions where recognition is at chance. Although this approach precludes manipulating variables at the time of study (e.g. levels of processing) we believe it could be fruitfully applied to a variety of implicit memory tasks.

Should more convincing evidence not be forthcoming, then we believe the only other viable option would be to drop the term ‘implicit memory’. Recently, Gabrieli et al. have reframed the explicit/implicit distinction in terms of ‘conscious remembrance’ and occurring ‘incidentally’, respectively. This represents an attempt to distance the term ‘implicit’ from ‘unconscious recollection’. However, we believe that such a step is confusing because the term ‘implicit’ has become so firmly ingrained with the concept of unconsciousness.

As an alternative, we suggest that it might be appropriate to adopt the terminology used by Richardson-Klavehn et al., who differentiate between implicit and explicit memory tasks in terms of retrieval instructions. Thus, they describe a word-stem completion task as an incidental (i.e. unintentional) perceptual memory task and cue recall as an intentional task. Again, this represents a shift away from the troublesome issue of consciousness. Although, in our opinion, it is precisely the idea that memory can proceed without awareness that makes implicit memory such an exciting field of scientific inquiry, dropping the term might prove to be the only realistic way forward.

**References**

Surface perception and the generic view principle

Marc K. Albert

The hypothesis that perceptual experience can be understood in terms of rule-based processing has strongly influenced recent theories of visual surface perception. However, many of the rules that these theories propose apply only in relatively restricted situations. I suggest that more general and robust principles for reducing perceptual ambiguity are available, such as the generic view principle (GVP) described here. According to the GVP, vision assumes that qualitative (e.g., topological) image structure is stable with respect to small changes of viewpoint. Some consequences of the GVP for visual surfaces, including illusory surfaces, are described. I also demonstrate the decisive role of real and illusory background surfaces in specifying the 3-D shape and layout of visual objects and scenes.

Surfaces are the building blocks of our visual experience. Although images of visual surfaces frequently do not contain depth cues in their interiors, such as perceptible texture or shading, they are often perceived relatively unambiguously in 3-D (Ref. 3). What resolves the depth ambiguity in sparse monocular images such as the silhouettes in Fig. 1? As any given image is consistent with many possible 3-D interpretations, why is perception not equally ambiguous?

One response to these questions is that the world is not a random place, and our experiences are not random sequences of events. They have a significant degree of ‘regularity’ to them. Certain visual images are seemingly clear and unambiguous signs of the presence of certain familiar objects in the world. For example, we can easily identify our grandmother in a crowd of people, particularly in situations in which we expect to see her. Although in strict geometrical terms any retinal image of granny is ambiguous, because it is a 2-D projection of a 3-D scene and therefore loses the spatial component along the line of sight, we seem to recognize her effortlessly, without consciously considering any alternative percepts.

Prior probabilities and Bayesian theories of perception

This suggests that the richness of our visual experience depends upon the exploitation of regularities of the environment to constrain image interpretation. On this view, our prior beliefs about our chances of encountering certain 3-D objects (and/or viewing them from certain vantage points) are represented by biased prior probability distributions. Thus, we would give a relatively high prior probability to our chances of encountering granny relative to any other object that could be confused with her. This kind of emphasis on prior probabilities has been advocated by many investigators who favor a Bayesian analysis of visual perception.

However, visual priors that are not based on reliable regularities of the environment in which an organism evolved must be learned by each organism from scratch through experience. Add to this the fact that many priors are highly context-dependent, and we see that the Bayesian view entails that prior probabilities are likely to include large amounts of data that must be learned over an extended period of time before an organism would attain a reasonable level of competence. For these reasons, among others, it has been suggested that the use of detailed priors (implicitly or explicitly) in a Bayesian analysis is not a feasible strategy for a biological visual system with limited resources that must get ‘up and running’ quickly, and consequently, that this strategy is not a sufficient theoretical basis for understanding human visual surface perception.

I argue instead for the central role played by more general principles of vision, specifically the ‘generic view principle’ (GVP). This principle states that visual images are likely to be qualitatively stable with...