# Instructional reinstatement of context: The forgotten prerequisite

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# INSTRUCTIONAL REINSTATEMENT OF CONTEXT: THE FORGOTTEN PREREQUISITE

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Memory performance is usually better when the test and study contexts match than when they do not. However, this effect is modest, particularly when recognition is tested. In this paper we develop the argument that, far from being central to episodic performance, typical contextual manipulations depend critically upon another more fundamental influence, namely the subject's ability to reinstate mentally the context to which the instructions refer. Two experiments, one by Canas and Nelson (1986), another from our own laboratory, are briefly described to illustrate the plausibility of this analysis. A model is outlined in which instructionally reinstated context acts as a cue that combines with test items to probe a distributed memory in which all memories are aggregated.

## INTRODUCTION

Since the appearance of two seminal papers some 16 years ago (Anderson & Bower, 1972; Tulving, 1972) most researchers have assumed that context is strongly implicated in the recovery of episode-specific memories. That is, whether one assumes that it is the matching of study and test context tags (Anderson & Bower, 1972, 1974), or the matching of test cues to study traces (both being assumed to include contextual features - Flexer & Tulving, 1978; Kintsch, 1974), context is seen to be the major factor that selects the desired traces and prevents irrelevant memories from intruding. The dilemma that this approach encounters is that most attempts to demonstrate the contextual dependency of episodic memories have yielded relatively weak effects.

In one way or another, all context investigations have compared two conditions, one in which an aspect of the study context is reinstated at test, and another in which that feature is absent or mismatched. Typically, these manipulations produce significant though not overwhelming context-dependency in recall, and weak and often unreliable effects in recognition. This suggests either that the experimental context contributes little to episodic performance, or that our methods for investigating it have been wide of the mark. It is our contention that the latter is the case.

In this paper we seek to do two things: to argue that the context cue that underpins episodic performance is a cognitive representation evoked by the test instructions, not the physical or internal stimuli that accompanied the episode; and to describe briefly how this proposal can be incorporated into a distributed associative model (Humphreys, Bain, & Pike, in press).

## THE CONTEXT USED IN EPISODIC MEMORY TASKS

We begin our analysis of the context that is used in episodic tasks by considering an experiment reported by Canas and Nelson (1986). In that experiment, subjects studied a list of 100 words presented one at a time with a Carousel projector. Twenty four hours later they were tested for item recognition with a test list consisting of the 100 study words plus 100 distractors. Three different test conditions were used. Subjects in one group were tested at home by a surprise telephone call, whereas the subjects in the other two groups returned to the laboratory. Because the "phone" group necessarily received its test orally, one of the laboratory groups also was given its test in this manner. The other laboratory group was tested in the same way that the items were presented during study, namely by Carousel projector. The corrected recognition data indicated that the groups tested in the laboratory did not differ (visual = .46; oral = .44) yet they had a significant advantage over those tested by phone (.31).

The main focus of Canas and Nelson's (1986) discussion was that subjects in the phone group were less able to reinstate the study context mentally than the subjects in the laboratory groups. They took this to be confirmation of the suggestion by Fernandez and Glenberg (1985) that previous failures to find contextual effects in recognition may have been due to subjects being able to reinstate the study context mentally, thereby overriding any differences between the study and test contexts. Thus, this account tends to see the subject's mental reinstatement of context as something of a nuisance that masks the other context effects of interest.

We think this emphasis is misplaced. Rather than concentrate on the *difference* between the lab and phone groups, we focus instead on the *absolute* level of performance in the phone group. Note that this group was able to achieve some 67% to 70% of the laboratory groups' performances, despite being tested under physical, social and mood conditions considerably different from those in the laboratory. In other words, there was a substantial base rate in recognition performance that was not mediated by physical reinstatement of the study context. Rather than treat this base rate as a nuisance that masks other contextual effects, we claim that it should be seen as the backbone of episodic performance to which the other contextual manipulations are ancillary.

There is only one way that the Canas and Nelson (1986) base rate could have been achieved, and that is through processes set in train by the instructions given over the phone. It is our contention that subjects must have recalled aspects of the previous day's episode in response to the experimenter's identifying comments ("I'm the person who ran you through the experiment in the Psych department yesterday ..."). Had this not happened, the subjects would have disclaimed knowledge of the study episode and the test would not have proceeded. We liken the subject's reinstatement of the target episode to a concept of the episode to capture the idea that it may be a fleeting collage of aspects of the target episode, not a high fidelity reproduction of all its details.

Given that subjects mentally reinstate their concept of the target episode in response to the instructions, we make two further assumptions: that the episodic relevance of performance is achieved through use of the episode concept; and that, typically, this concept acts as a cue that has its effects during trace access (Tulving, 1983; Tulving & Thomson, 1973), not afterwards (Anderson & Bower, 1972, 1974).

To reinforce the crucial role of instructions in cuing specific and general memories, we briefly report an experiment that was designed as a simulation of everyday memory in which similar events occur in the same physical context, but in experientially unconnected episodes (Bain, Humphreys, Tehan, & Pike, 1987). Our objective was simply to show that these memories could be accessed selectively depending upon the episode specified by the instructions.

University students were presented with two overlapping sets of materials, one week apart, and then were tested either for the recognition of items from one or the other set or for general familiarity with the items. To ensure that the students would not know that they were taking part in an experiment, the first week's activities were conducted under an elaborate ruse in which they were told that they were taking part in a project for a well known Australian dictionary company. The incidental orienting task used in the first week was to generate synonyms to each of 60 words. In the second week the task was to read a 450 word passage (in which 60 test words were inconspicuously embedded), then answer a few questions about the passage. Thirty target words were common to the synonym and passage orienting tasks and 30 words appeared in one task but not the other. The tests were based on the 90 words just described plus another 30 that appeared in neither orienting task. Each subset of 30 words consisted of 15 high and 15 low frequency words (to provide a benchmark for the familiarity ratings).

Three different test instructions were used. One group was asked to recognize the words to which they had generated synonyms in the first week. Another group was asked to recognize words from the passage they had just read. A third group was asked to rate the general familiarity of the words. In all three cases no mention was made of the inapplicable context(s) so as to minimize extraneous confusion of the memories, and avoid the recognition tests becoming conventional list-discrimination tasks.

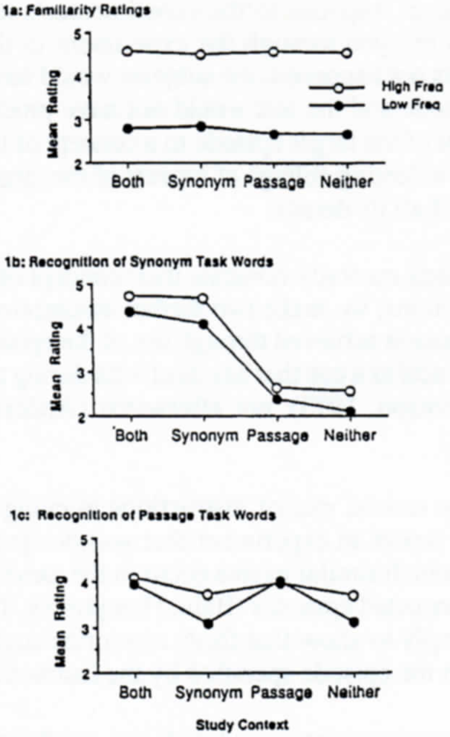


Figure 1. Mean familiarity and recognition ratings as a function of test instructions (a,b,c), study context, and word frequency in the Bain et al., (1987) experiment.

The mean recognition and familiarity ratings are reported in Figure 1. These ratings are based on a response scale on which 1 indicates that a word is unrecognizable or unfamiliar and 6 indicates that the word is recognizable or very familiar. The absolute levels of performance indicate that synonym generation gave rise to stronger episodic learning than reading the target words in a text passage. This is not too surprising, particularly given that the test words were not highlighted in the passage. More importantly, it is readily apparent that subjects adapted their judgments in conformity with the instructions. Subjects who were asked to rate the familiarity of the words (Figure 1a) were unaffected by their incidental experiences with the synonym and passage tasks. Their ratings were only influenced by the language frequency of the words, high frequency words being rated more familiar than low frequency words, $F(1,22) = 163.67$, $MS_e = .9533$, $p < .05$. By contrast, subjects who were asked to recognize the words from the synonym orienting task (Figure 1b) or from the passage (Figure 1c) could do so with marginal confusion between the two. For the synonym recognition test, the main comparison is between *both* + *synonym alone* (targets) with *passage alone* + *neither* (distractors): $F(1,66) = 700.21$, $MS_e = .2872$, $p < .05$. For the passage recognition test the analogous comparison is between *both* + *passage alone* versus *synonym alone* + *neither* : $F(1,66) = 83.08$, $MS_e = .2151$, $p < .05$).

The inference we draw is that the instructions determine whether or not some memory of a prior episode is retrieved and used as an episodic cue. When familiarity is to be rated, neither orienting task is thought of by the subjects, and hence their ratings are unaffected by those experiences. When one of the orientating tasks is specified as the target, subjects are substantially able to prevent confusion with the other orienting task. Our contention is that this filtering is achieved *during* trace access using the mentally reinstated concept of the target episode as part of the cue.

We should emphasise that, in the general case, use of the episode concept is necessary but not sufficient for good performance. Even if the episode has been reinstated, performance may be weak if, for example, trace information has not been encoded for target items, or when trace information has been lost or interfered with during the retention interval. Likewise, performance may be poor if the target episode is similar to other episodes from which its events must be discriminated, or when the target experience consists of many loosely connected events that are not well characterised by the reinstated episode concept. Conversely, performance may sometimes be improved by providing aspects of the target context as additional cues, or by having subjects recall additional details about the target episode before attempting recognition or recall (Geiselman, 1988; Krafka, & Penrod, 1985; Smith, 1979). Also, despite the fundamental role of the episode concept in episodic performance, other factors such as perceptual fluency may also have an influence (e.g., Jacoby & Dallas, 1981). We assume that these factors will be most pronounced when the normal episodic processes fail, as in amnesic performance (Humphreys, Bain, & Burt, 1988).

## THE MATRIX MEMORY MODEL

In the remainder of this paper we briefly describe how many memory tasks can be understood in terms of a coherent system in which memories are aggregated during storage, yet the outputs can be substantially different depending upon how the cues are used during (and after) trace access (Humphreys, Bain, & Pike, in press).

The memory representation is assumed to be a distributed associative structure in which items (stimuli, concepts, responses, etc) are represented as vectors of feature weights, and memories are associations that are defined by the matrix product of the item vectors. The episodic uniqueness of an item (or of an association between two or more items) is recorded by its association with the subject's conception of the target episode. As noted earlier, it is assumed that this representation is like a concept in that it is a collage of the episode components; accordingly it too is represented as a vector of feature weights. Because an episodic association involves a unique pattern in which the features defining an item are weighted by the features defining the episode concept, each episodic memory is unique. However, *all* memories summate in this model (Figure 2) and hence they lose their uniqueness unless appropriate cues are used during trace access.

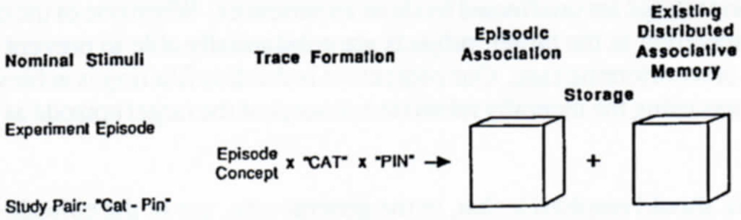


Figure 2. Storage of the episodic association for the word pair "CAT-PIN" in the Matrix model

The instructions potentiate two important cuing properties of this model: the type of access process to be used (matching or retrieval); and the objective of the memory task (whether the response is to be episodically specific or generalised). These concepts can be quickly conveyed by example (Table 1).

Table 1. Some Episodic and Generalised Tasks Classified According to the Memory Access Process

| Access Process | Output | Objective of Task: Episodic | Objective of Task: Generalised |
|---|---|---|---|
| Matching | Scalar | Recognition | Familiarity rating<br>Lexical decision |
| Retrieval | Vector | Cued recall* | Free association<br>Word completion |

* Episodic specificity is achieved during trace access with an intralist cue, but it occurs after trace access with an extralist cue

*Matching* involves the comparison of the test cue with all the information in memory. This is modelled by finding the dot product of the cue and the memory structure. The output from a match is a scalar quantity (the strength of the match), not qualitative details about the trace that has been accessed or about other traces associated with the cue. The recognition of a specific occurrence of a word and the rating of that word's general familiarity are based primarily upon a matching process.

*Retrieval*, on the other hand, involves the recovery of qualitative information associated with the cue. Retrieval is modelled by finding the matrix product of the cue and the entire memory structure. The output from a retrieval is a vector of weighted features, not a scalar. Cued recall, free association, and completion of word fragments are all examples of the retrieval process.

Within the matching and retrieval examples just cited, some require that a particular episode be accessed (recognition and cued recall) whereas others are generalized across all episodes (familiarity rating, lexical decision, free association, word completion). In essence, the difference between these turns, respectively, on whether an episode concept is combined with each test item to form a unique, interactive cue or whether test items are used singly, without being combined with an episode concept. These ideas are summarised in Figure 3.

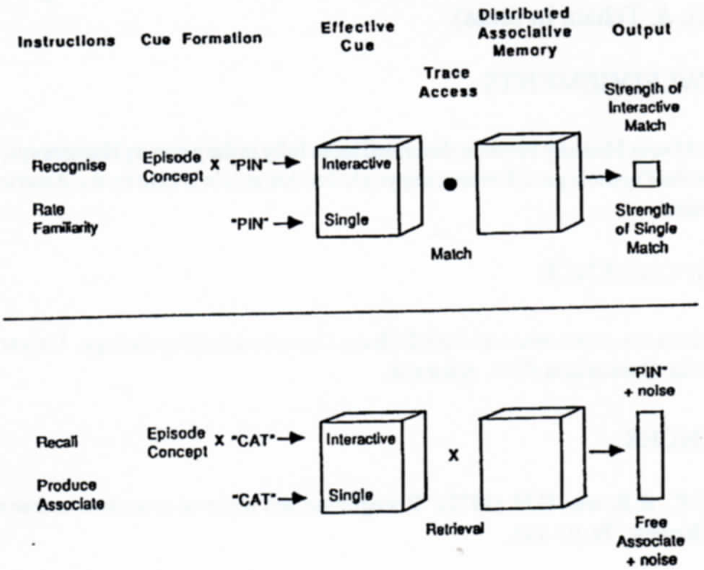


Figure 3. Trace access in the Matrix model as a function of type of access process (matching, top section; or retrieval, bottom section), and objective of the task (episodic or generalised)

The Matrix model demonstrates that episodic cues must be combined in a non-linear fashion if episodic information is to be adequately stored in and recovered from a distributed memory structure. The degree of non-linearity that is required is sufficiently great to justify Tulving and Thomson's (1973) assertion that episodic tasks require the use of encoding-specific information. However, our model was developed as a counter-example to the additional claim that unique episodic traces necessitate a separate memory system (Tulving, 1985). We assume, on the contrary, that all memories are stored in a coherent system, and that the functional differences between tasks are derived from the ways that cues are used during (and sometimes after) trace access.

In our opinion, it was an important insight of Tulving's (1976) when he argued that the difference between recognizing and recalling an item derives from the cues that are used. We agree with him on this, and on his insistence that the same trace information is used by the two processes (Flexer & Tulving, 1978). Where we differ is in his further assumption that recognition and recall access the trace in the same way, yet produce different outputs by applying different "conversion operations" after the trace has been recovered (Tulving, 1983). In the Matrix model, matching and retrieval are different ways to access the same memory, and an integral part of their function is to produce qualitatively different kinds of outputs: a strength of match versus an associated response. This distinction does have testable consequences, and we have begun the process of evaluating it (Humphreys, Pike, Bain, & Tehan, in press).

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The Matrix Memory Model is described more fully in the paper by Humphreys, Bain, and Pike, published in the Psychological Review; copyright for that article is held by the American Psychological Association.

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