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Evidence for intact memory monitoring in Alzheimer's disease: metamemory sensitivity at encoding

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Abstract

Previous research claiming that there is a metamemory deficit in Alzheimer's Disease (AD) has been based on paradigms in which metamemory judgements are compared with performance. These methods confound predictive accuracy with very poor memory performance. In the experiments presented here this confound is removed by focusing on the sensitivity of metamemory judgements to item differences at encoding, rather than on predictive accuracy. In Experiment 1 participants studied words of high or low recallability, and either made judgements of learning (JOLs) or declared recall readiness. It was found that the AD group discriminate between items in their metamemory judgements to the same extent as age matched controls. Both groups rated the highly recallable words as being more likely to be recalled, and allocated more study time to low recallability items. In Experiment 2 participants were asked to rank the likelihood of recall of items that varied in objective recallability. Once again, AD patients were as sensitive to objective differences in stimuli as controls. Therefore, using measures based on sensitivity to item differences, we find no evidence of a metamemory deficit at encoding in AD. The findings are discussed in terms of metamemory functioning in AD, and its relationship with memory performance.

Keywords: Dementia; Judgements of Learning (JOLs); Metacognition

1. Introduction

Recent research suggests that an encoding deficit, rather than increased forgetting, underlies the poor performance on episodic memory tasks in Alzheimer's disease (AD) [3,6,7]. It may therefore be important in Alzheimer's disease to assess factors such as metamemory that operate during encoding. This paper examines the idea that a deficit in metamemory functioning could be an exacerbating factor in the poor episodic performance in AD.

One cause of the encoding deficit might be that people with AD fail to control and monitor memory during encoding. Several studies have examined metamemory functioning in AD [2,11,19]. All these studies are limited in their ability to address metamemory function at encoding because they examine metamemory judgements made after encoding and before retrieval (the feeling of knowing (FOK) procedure). Moreover, the first two studies use general knowledge materials rather than assessing performance on a memory task that includes an encoding phase. These general knowledge studies suggest that there is no deficit in metacognition, with the AD group being as accurate as controls in assigning confidence to recalled answers and predicting future recognition performance.

The study by Pappas et al. [19] is more directly relevant to the present work because they studied metamemory judgements in episodic memory with recall

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and recognition tasks. For the recall task, they were unable to draw conclusions about the predictive accuracy of metamemory judgements because of floor effects in the recall of the AD group. However, for the recognition task, with performance off floor, they found that AD patients do not predict recognition as accurately as controls. They conclude, "It should be determined if predictions of recall performance are intact in AD patients. If so, this would indicate a dissociation between metamemory for recall and recognition" (p. 163).

There are profound logical difficulties in concluding that people with AD have impaired metamemory on this kind of evidence. It is inferred that metamemory is inaccurate when participants' predictions of performance fail to relate to how they actually perform: a word that is judged to be highly recallable should be more likely to be recalled than a word rated as less likely to be recalled. Problems arise with this approach when testing participants who have an episodic memory impairment, because their likelihood of remembering *any* item is at floor. Memory performance is so poor that it precludes statistical comparisons of groups' metacognitive abilities.

More importantly, the reason that metamemory judgements lack predictive power at test may be because of processes that occur after encoding. Participants may make appropriate predictions of recall during study that would be predictive were it not for the separate episodic memory deficit. That is, participants may accurately monitor the difficulty of different items to be learned, and may take appropriate steps to control their encoding to achieve learning. However, using accuracy-based measures of metamemory does not allow one to focus on what occurred at encoding.

In the present work we offer a new approach which overcomes the confound with memory performance, and focuses instead on processes occurring at encoding. Our reasoning is straightforward; if metacognition is intact at encoding in AD, then memory monitoring and control by participants with AD should be as sensitive as normals to item differences. To distinguish our approach from previous work examining metacognitive accuracy, we classify the measures we use as metacognitive sensitivity measures.[1]

In the experiments reported here, participants study words that have been selected on the basis of objective measures of difficulty. Participants either make predictions of future performance for these words in the conventional manner, or study them until they believe the items have been learned. If AD patients are monitoring memory as they encode items they should be sensitive to the differences between items, even if these predictions are not ultimately accurate. For example, they should rate objectively difficult words as being harder, and dedicate more study time to them to recall, even if they fail to recall any of the items.

In the first experiment sensitivity of memory monitoring is measured by asking participants to predict, at learning, future recall performance for a set of words with objectively known properties. This kind of metamemory prediction has been extensively used before, and is known as a judgement of learning or JOL (e.g. [13,18]). Participants were asked to rate words selected to be either difficult-to-recall or easy-to-recall, based on Rubin and Friendly's [20] free recall norms. By examining whether judgements reflect these pre-existing differences it is possible to find evidence of metamemory monitoring without having the confound of floor effects in AD participant's recall.

The first study also examines memory control at encoding using allocation of study time as a dependent variable. This measure, also known as recall readiness, is a well-established measure (e.g. [4,17]). In this paradigm participants are allowed to study words as long as they feel necessary to ensure subsequent recall before declaring recall readiness. Again, the difference in study times for objectively different items can be measured. It is predicted that if memory control is intact and correctly informed by monitoring, then participants should spend longer studying the objectively difficult items.

Whilst there is previous research addressing the role of memory monitoring in AD, there has been less work in metamemory control processes. Our own research [15] suggests that with multiple presentations during encoding, AD participants, like controls, allocate less time to items they have already encoded. However, the present work is the first to examine whether appropriate allocation of study time is found for different kinds of to-be-learned words in a single-trial test.

2. Experiment 1

2.1. Method

2.1.1. Participants

Sixteen AD patients and 16 age-matched older adult controls (OAC) were tested. Diagnosis of AD was made by a clinician using information from neuropsychological examination, mini-mental state examination (MMSE) [5], family interview, laboratory screening

[1] Hertzog and Dixon [9] argue that metacognitive judgements about memory fall into three different conceptual categories — declarative knowledge about memory processing, awareness of one's on-line memory processing, beliefs about one's own memory system. However, at present, there is no clear consensus about how these concepts inter-relate. Our measure of metacognitive sensitivity clearly relates most closely to the second of these constructs.