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Theory driven rehabilitation of executive functioning: Improving planning skills in people with traumatic brain injury through the use of an autobiographical episodic memory cueing procedure

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Abstract

Traumatic brain injury (TBI) frequently leads to the development of a 'dysexecutive syndrome'. The associated difficulties with problem solving (including specific impairments in planning, initiation/plan-implementation and self-monitoring) represent a major challenge to functional recovery and adaptation following brain injury and serve as an important target for rehabilitation. Previous research suggests that one reason people with TBI are poor at everyday planning is that they fail to spontaneously use specific autobiographical memories to support planning in unstructured situations. In this study, we examined whether a self-instructional technique involving self-cueing to recall specific autobiographical experiences would improve performance on a planning task. Two groups of 15 participants who had suffered a closed traumatic brain injury carried out the Everyday Descriptions Task (Dritschel, B. (1991). The role of autobiographical memory in describing how to perform everyday activities. In *Paper presented at the European Cognitive Society Conference*.), in which they were asked to describe how they would plan eight common unstructured activities, i.e. activities that could be solved in a variety of ways. Group 1 was then asked to describe how to plan a second set of eight unstructured activities. Prior to completing their second set of eight activities, Group 2 underwent training in a procedure aimed at prompting the retrieval of specific memories to support planning. The results suggested that the intervention was effective at increasing the number of specific memories recalled, with a corresponding increase in the effectiveness of the plan and number of relevant steps in the plan. Potential applications of the technique are discussed.

Keywords: Traumatic brain injury; Rehabilitation; Executive dysfunction; Planning; Problem solving

1. Introduction

The term 'dysexecutive syndrome' was coined by Baddeley (1986) to characterise the wide range of deficits commonly arising after damage to the frontal lobes and including difficulties in problem-solving (Baddeley & Wilson, 1988). Baddeley (1986) suggested that the dysexecutive syndrome arises from impairment in the central executive component of working memory. The concept of a central executive has been equated with the concept of a 'supervisory attention system' (SAS; Shallice, 1982) because the SAS regulates conscious attentional processes required to control behaviour. Shallice and Burgess (1996) expanded the model of the SAS, focusing on the function of the SAS in dealing with novelty or problem solving. They suggested that a number of different processes operate together as a supervisory system. These processes (they describe eight) operate in three stages: the first can be thought of as a planning stage (devising a solution to a problem, or plan of action to achieve a specified goal), the second involves the processes required to implement the plan, and the third involves the monitoring of progress towards achieving the goals (and hence solving the original problem), triggering, if necessary, a revision of the plan. One of the processes considered to be important in the planning stage is episodic memory retrieval. Put simply, finding solutions

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to novel problems may benefit from recollection of previous experiences of solving similar, if not identical, problems (see Dritschel, Kogan, Burton, Burton, and Goddard (1998)). This argument is supported by Ross (1984) who found that 'reminding', the memory retrieval of earlier learning episodes, influenced subsequent learning of a cognitive skill. Seifert (1994) has also argued that retrieving past experiences can improve performance on many reasoning tasks. Thus one reason that the process of problem solving may break down might be failure to retrieve relevant information from autobiographical memory during the planning stage.

Conway and Rubin (1993) referred to three levels of structure in the construction of memories in one's life; lifetime periods, general events, and event specific knowledge. The term 'lifetime periods' was used by Conway and Bekerian (1987) to refer to extended periods in a person's autobiography such as 'when I lived with X'. In contrast to lifetime periods, general events constitute a more specific level of autobiographical knowledge. General events take the form of summaries of repeated events such as 'evening hikes in meadows' (Barsalou, 1988) and extended events such as 'holidays in Italy' (Conway & Bekerian, 1987). The third layer of autobiographical knowledge (i.e. event specific knowledge) contains specific self-referenced information relating to events that occurred at a particular time and place, e.g. 'playing with my nephew in the snow last Christmas'.

The notion that autobiographical memory is important for problem solving has been supported by research in the area of problem-solving and autobiographical memory in depressed participants (Evans, Williams, O'Loughlin, & Howells, 1992; Goddard, Dritschel, & Burton, 1996; Marx, Williams, & Claridge, 1992). It has also been shown that head-injured participants with frontal lobe lesions have difficulties with problem-solving tasks (Shallice, 1982) as well as impaired retrieval of specific autobiographical memories (Baddeley & Wilson, 1986).

Dritschel and colleagues (Dritschel, 1991; Dritschel et al., 1998) investigated this relationship further using the Everyday Descriptions Task (EDT). The EDT consists of a set of questions asking participants to describe how they would plan certain activities. Dritschel (1991) showed that healthy controls used more general event autobiographical knowledge to plan structured activities (e.g. brushing one's teeth) and more event specific knowledge to plan how they would go about less structured and less frequently occurring activities (e.g. buying a new car). In a subsequent study (Dritschel et al., 1998), the performance on the EDT of twelve participants suffering from TBI was compared to that of a matched control group. Dritschel et al. (1998) compared the verbal protocols of the descriptions given by participants in response to the planning tasks. Participants' verbal protocols were transcribed and rated by two judges independently in terms of the effectiveness of the description (using a seven point scale), the number of relevant steps provided, the coherence of the plan (a measure of how well the steps listed in the response fitted together in a logical sequence using a three point scale) and the number of specific memories.

Analysis of the protocols examined the extent to which retrieval of autobiographical memories during the task related to overall task performance. TBI participants reported fewer steps for the activities and their responses were judged to be less effective and less coherent than the controls. For the control participants there was a positive correlation between the retrieval of event specific memories and both the effectiveness rating and the number of relevant steps in the plan, but not for the coherence rating. Dritschel et al. (1998) concluded that accessing specific memories was helpful in planning and that the TBI participants in their study failed to use specific autobiographical memories as a result of executive impairments arising from frontal lobe damage.

Dritschel et al. (1998) speculated that participants with TBI would be able to plan future activities more easily if they first tried to retrieve specific memories of when they had executed similar activities in the past and described step by step what they did. The question arises as to whether this process could be facilitated in rehabilitation and, if so, whether it would make the participant's planning more effective. Improved planning of course may not be sufficient to bring about improved problem solving overall because an individual may also have problems implementing a plan or monitoring progress. Nevertheless, improving planning may be a necessary (if not always sufficient) element in improving problem solving. The main aim of the present study was to examine this possibility. It was hypothesised that a group of head-injured participants who underwent a brief training in the retrieval of specific memories would improve on a planning task significantly more than a group given no training (Hypothesis 1). Consistent with the Shallice and Burgess (1996) model of executive functioning, in which use of autobiographical episodic memory is viewed as an important step in the problem solving process, it was also hypothesised that there would be a significant correlation between problem-solving ability and the number of specific memories recalled for the trained group post-intervention (Hypothesis 2).

There are several reasons why a brain-injured person may fail to use specific memories to help solve problems. The individual may fail to recognise that it would be helpful to consider previous experiences, or act impulsively and fail to implement the strategy, even if recognised. This form of strategy application deficit is central to the concept of dysexecutive syndrome. In this situation, it might be said that the person could use previous memories, but does not. The intervention used in this study aimed to prompt autobiographical memory retrieval. However, another possibility exists, which is that the brain injury may have caused impairment in the ability to access autobiographical memories. Damage to the temporal lobes, in particular medial structures such as the hippocampus, produces memory impairment, with a particular difficulty in recollecting autobiographical episodic information. This is typically associated with anterograde memories, but also affects retrograde episodic recall (Nadel & Moscovitch, 1997). It was, therefore, predicted that those people with the most severe memory impairment would benefit less from the intervention than those with less severe memory impairment (but equally or more severe executive impairment). It was, therefore, hypothesised that there would be a significant correlation between performance on a general test of anterograde memory, the Rivermead Behavioural Memory Test (RBMT) and the improvement in the number of