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# Prospective Memory in 2000: Past, Present, and Future Directions

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SUMMARY

During the past four years there has been an explosion of interest in prospective memory research, culminating recently in the success of the First International Conference on Prospective Memory (July, 2000). In this paper we take the opportunity to review progress in the area by identifying some key themes and issues that arose during the conference and that are exemplified in the papers contained in this special issue. Finally, we consider future directions for research and some of the key questions that we believe all researchers in this area will need to address. Copyright © 2000 John Wiley & Sons, Ltd.

Successful prospective remembering enables us to shape and direct our cognitive resources in the pursuit of future actions and plans. As such, it is a critical element in the coordination and control of cognitive skills that underlie our ability to complete many real-world activities. It should, therefore, no longer be regarded as an aspect of memory that lies on the fringes of cognitive psychology but as one that is central to developing our understanding of how intentions are translated into action.

Prospective remembering describes the process and skills required to support the fulfilment of an intention to perform a specific action in the future. Moreover, these are intentions that we cannot, for a variety of reasons (social, logistic, etc.) put into effect at the time that we form them. Thus a critical aspect of success on a prospective memory task is not only recall of the content of that task but also its retrieval at an appropriate moment for action. If, for example, we have to ask our neighbour to feed the cat while we are on holiday, it is of little comfort to the cat if we recall this intention half-way across the Atlantic! In everyday life, moreover, these intentions vary considerably on a number of potentially important dimensions (Kvavilashvili and Ellis, 1996).

Although the first experimental study on prospective memory within cognitive psychology was conducted nearly 30 years ago (Loftus, 1971), subsequent research in this new field grew steadily but somewhat slowly due to the efforts of only a handful of researchers. An important milestone was the publication of the first book on this topic in 1996 that not only summarized the main developments in the field but also identified important avenues for future research (Brandimonte, Einstein, and McDaniel, 1996). Even at that time, however, it was clear that research was progressing at a relatively slow

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rate – only 45 papers had been published on the topic during the previous 20 years (Kvavilashvili and Ellis, 1996). In contrast, in the past four years we have witnessed an explosion of interest in prospective memory research; almost 100 articles have been published on this topic during this period. This heightened level of activity and interest allowed us to convene the First International Conference on Prospective Memory in July of this year, with over 50 paper and poster presentations and more than 80 delegates from North America, Australia, Japan, and Europe, including former states of the Soviet Union. The enthusiasm and commitment of these researchers, together with the quality of debate that took place during the conference was a source of delight to us and to the other contributors. Clearly the field is developing rapidly in the quality, quantity, and diversity of approaches to the topic as evidenced by the papers reported in this special issue.

The aims of this editorial are threefold. The first is to identify and consider the most important themes and issues that arose during the conference, thereby providing a summary of current concerns. We then indicate how these are addressed in the papers contained in this special issue, drawing the reader's attention to key aspects of these papers. Finally, we attempt to predict future developments by identifying those areas of research that we believe will develop most rapidly in the next few years and those that have been broadly neglected and merit attention.

## THEMES AND ISSUES

The two main themes of research reported at the conference reflected continued interest in the effects of ageing and a more recent focus on contributions from neuropsychology. The remaining papers examined a diverse range of topics including the attentional demands of retrieval, developmental issues, and the effects of both cognitive and non-cognitive factors. One very noticeable outcome of increased productivity in the area is the move from a situation in which individual researchers pursued relatively independent work on a particular aspect of prospective memory to one in which similar or complementary investigations are often conducted in parallel in different laboratories. This is reflected in the inclusion of two papers on the same topic, task appropriate processing, in this special issue. Inevitably, this situation has produced apparently contradictory findings in some areas such as the effects of ageing on performance. Although this situation may appear confusing we regard it as a positive development that will foster the investigation of variables that may be responsible for such discrepancies (see also McDaniel and Einstein, this issue).

The accumulation of new research and, to some extent, discrepant findings emphasizes the complexity and multi-faceted nature of prospective remembering (cf. Marsh, Hicks, and Hancock, this issue). It is possibly not surprising then to note that, despite nearly three decades of research, definitional issues formed a main topic of debate at the conference. Most researchers would agree that prospective memory tasks display the following three characteristics. The first is a delay between formation of the intention and an opportunity for carrying it out. The other two are the (frequent) absence of an explicit reminder to carry it out at an appropriate moment and the need to interrupt one's activity in order to carry out the intention. Current laboratory simulations attempt to mimic these core aspects of naturally occurring intentions by (a) introducing a filled delay between encoding and retrieval (to preclude rehearsal of the task), (b) not providing an explicit prompt when an

 

opportunity for performance arises, and (c) ensuring that participants are engaged in a separate activity that has to be interrupted in order to perform the task (see also Meier and Graf, this issue). Despite this degree of agreement there are areas of dispute or debate. One source of confusion, for example, is the use of different terms to describe these core aspects. For example, as Burgess (2000, presentation at the First International Conference on Prospective Memory, University of Hertfordshire, July) pointed out, the activity that participants are engaged in when retrieval should occur has been described as the background, ongoing, or cover task/activity. One positive outcome of the conference was an agreement to use the term 'ongoing' in future publications (including this issue)!

A more serious disagreement centres on another important characteristic of prospective memory, namely that it consists of two components: prospective (remembering that something needs to be done when the opportunity arrives) and retrospective (recalling the content of the task). Investigators have usually simplified the latter component in order to ensure that failure to recall content does not underlie failure to carry out the prospective memory task, thereby allowing one to focus on variables that influence the prospective component. Increasingly, however, there are experimental situations in which the distinction between these components is blurred or in which one appears to be studying performance on the retrospective rather than the prospective component. Examples of the latter are provided by two papers in this issue, one by Maylor, Darby, and Della Salla and the other from Schaefer and Laing. Interestingly these authors provide compelling reasons for including the study of the retrospective component.

However, it was clear from debate during the conference that not all researchers would regard these as legitimate studies of prospective memory. On the one hand, some believe that the term 'prospective memory' is an umbrella term for a collection of processes that includes the study of both components (Burgess, 2000; Ellis, 1996; Schaefer, personal communication). Others, however, wish to retain the more narrow definition in the belief that failure to do so could cause confusion (e.g. on a distinction between retrospective and prospective memory) among researchers not well acquainted with the field (e.g. Maylor, personal communication). This is an important issue that merits further consideration. One practical outcome of the debate, however, was recognition of the importance of assessing post-study recall of the prospective memory task in order to identify the component responsible for failures.

A further concern expressed at the conference was the necessity of maintaining a distinction between a prospective memory task and monitoring or vigilance tasks. Some experimental designs that provide prospective memory event cue as frequently as once every 10–15 seconds may compromise a key aspect of prospective remembering, namely that the intention is not continually maintained in working memory. In such a situation it seems highly unlikely that we are measuring prospective remembering but rather consciously controlled monitoring processes. It is perhaps unsurprising, therefore, to note that very high performance is obtained in some of the tasks employing this design feature. Meier and Graf (this issue) address these concerns in more detail.

## REVIEW OF PAPERS

The laboratory offers many opportunities for studying variables that are directly relevant to remembering naturally occurring intentions in real life. One such variable is the correspondence or overlap in cognitive processing between one's current activity and the

 

encoded features (or retrieval criteria) of a prospective memory event cue (cf. Ellis, 1996). The potential importance of this relationship, particularly for older adults, has been described in Maylor's (1996, 1998) task-appropriate-processing framework. This framework suggests that when cognitive processing is oriented towards features of the prospective memory (cue) event performance should be enhanced relative to conditions in which there is a mismatch between cue features and current processing focus.

Maylor's framework has stimulated recent research, as evidenced by the inclusion of two papers in the current issue that investigate some of the predictions that follow. Marsh, Hicks, and Hancock present findings from three experiments that reveal not only the beneficial effects of task appropriate processing but also possible boundary conditions for these effects. Thus they demonstrate that a match between the cognitive processes required for one's ongoing activity when a cue appears and encoded features of that cue results in better performance than a mismatch between the two. Interestingly, however, this pattern of results was not observed when the cues were particularly salient; in this instance salience was afforded by the contrast between the perceptual appearance of the cue relative to other events in the ongoing activity. As the authors suggest, it would appear that when a cue is salient, little additional advantage is conferred by a processing match between the ongoing task and features of the cue. Marsh *et al.*, moreover, explore not only the theoretical but also the practical implications of their findings. Their discussion implicates the potential importance of the general context in which ongoing activity takes place and draws attention not only to the processing resources that this activity requires but also specific components that might interact with a particular intention.

Results reported by Meier and Graf both complement and extend those reported by Marsh *et al.* Meier and Graf, for example, draw parallels between the Task Appropriate Framework proposed by Maylor for prospective memory, on the one hand, and the Transfer Appropriate Framework developed to explain findings in retrospective memory research, on the other (Morris *et al.*, 1977). In so doing, they make an important distinction between sequential and concurrent processing overlaps in prospective memory tasks. Thus, sequential processing refers to a match or overlap of processing across encoding and test phases in both prospective and retrospective memory tasks. In contrast, concurrent processing is unique to prospective remembering and refers to the overlap between the processing required for the ongoing task and the detection of cues embedded in that task. As Meier and Graf point out, although a number of studies have examined the influence of sequential processing overlaps on prospective remembering, only recently has the effect of concurrent processing overlaps come under investigation. It is therefore encouraging to note that the studies conducted by Marsh *et al.*, and Meier and Graf have produced broadly converging findings despite using different procedures, ongoing tasks, and prospective memory cue events (see also Brunfaut *et al.*, 2000).

The study of ageing and prospective memory performance has long been a concern to researchers of both prospective remembering and healthy and dysfunctional ageing. This is an issue not only of theoretical importance but also of considerable practical concern, given the impact that prospective memory failures can have on normal everyday functioning. One interesting observation from this research is that while younger adults frequently outperform older ones on laboratory based tasks (see McDaniel and Einstein, this issue, for exceptions), this situation is often reversed when such tasks are undertaken in everyday life. Interestingly, the contrast or correspondence between performance of laboratory-based and everyday memory tasks provided an impetus for many early studies of prospective memory (e.g. Maylor, 1990; Einstein and McDaniel, 1990). While the work

 

reported by Rendell and Craik in the current issue continues this aspect of prospective memory research, it also provides a novel approach to the topic by introducing a laboratory-based task designed to mimic many features of prospective remembering in daily life.

Rendell and Craik examined young and older adults' performance on the 'Virtual Week', a novel board game played in the laboratory, and compared and contrasted this with their performance on similar tasks ('Actual Week') carried in participants' everyday life. This study represents the first published attempt to try to equate many of the dimensions on which laboratory and everyday prospective memory tasks vary. It thereby provides an important and novel means of not only examining the deficits that can result from ageing but also identifying strategies that older people may use to compensate for these problems.

By creating a laboratory task that simulates the times and events for prospective remembering that occur naturally in everyday life, Rendell and Craik expected to observe an age-related increase in prospective memory performance. Contrary to these predictions, however, young adults' performance was superior on this task while older adults continued to outperform their younger counterparts on the real-life version. The authors discuss a number of possible reasons for this pattern of results and are able to offer some important avenues for future research as the design of their study obviates many of the confounding variables that have plagued previous investigation of laboratory and real-life prospective memory task performance. Thus, for example, there may be variations in the structure of daily living that supports older adults prospective remembering that are not captured by the Virtual Week, suggesting the need for further research on this topic. It is also possible that the two tests may be highlighting differences between prospective memory tasks that are carried out in the short term (1–2 hours or less, as in the laboratory) and those that are have longer retention intervals (several days, as in everyday life).

The nature of the tasks that are carried out in everyday life may not be the only important factor in determining the presence or direction of age differences. Thus Huppert, Johnson, and Nickson argue forcibly that testing only volunteer samples of healthy community dwelling elderly people can lead to serious underestimation of the effects of ageing on prospective memory. Individuals in this group, they suggest, are likely to be healthier, more educated, and of higher economic status than the population as a whole. To address this possibility, Huppert *et al.*, examined performance on a simple event-based prospective memory task in a large population-based study of 11,956 people aged 65–90+ years, in a screening phase of the Medical Research Council Cognitive Function and Ageing Study (MRC-CFAS). In addition, they investigated the influence of both cognitive and non-cognitive factors on prospective memory as well as the performance of a sub-sample of 388 people with probable dementia.

The strength of this study undoubtedly lies in the sheer size and nature of the sample, together with the comprehensiveness of the information collected on these people. Thus it is interesting to observe, from a series of logistic regressions, that prospective remembering was positively related to female gender, higher occupational grade, and more years of education, as well as better performance on retrospective memory and other cognitive tests. Most importantly, however, there was a strong linear effect of age on prospective remembering with performance dropping substantially with increasing age. In addition, there was a marked, almost total impairment of prospective memory in the sample with probable dementia. Huppert *et al.*, recognize that there are problems in generalizing from performance on a simple event-based task to prospective memory performance

 

in everyday life (see Rendell and Craik, this issue). Nevertheless, they point out the practical implications of their findings for the majority of their sample, as well as for others in the population as a whole, who are expected to lead an independent life in the community.

Maylor *et al.*, extend research on ageing by exploring the dynamics of intention representation in healthy older adults and in people suffering from dementia, using a methodology that is not only novel but also offers an ecological valid means of investigating a long-term 'intention superiority effect'. (The intention superiority effect or ISE reflects the heightened accessibility or activation of information on intentions to act in the future, relative to other contents in memory; Goschke and Kuhl, 1993; Marsh *et al.*, 1998). Their simple technique, appropriate for use with the memory impaired, compares recall of performed and to-be-performed activities over the previous and coming few days in a speeded fluency test.

The results of two experiments revealed a reliable ISE in young adults who recalled more to-be-performed than performed tasks, indicating that the former are represented at a higher level of activation or are more accessible in long-term memory than performed actions. This finding replicates and extends the observation of a shorter-term ISE using a more conventional laboratory materials (Goschke and Kuhl; Marsh *et al.*, 1998). In contrast, an ISE was not observed in either healthy older participants or Alzheimer sufferers; indeed, there was some indication of an intention *inferiority* effect in the older group who recalled relatively more performed activities. Moreover, the results did not reveal any further deficits of the ISE in dementia patients, over and above the effects of normal ageing. Maylor *et al.*, suggest that the absence or reversal of the ISE in older people may contribute to prospective memory impairments that have been associated with normal and abnormal ageing. However, as these authors point out, the link between the ISE and prospective memory performance has yet to be investigated.

As Rendell and Craik's research reveals, there are many elements of prospective remembering in real life, both the context in which it is planned, recalled, and should take place as well as social and motivational factors, that may not be fully captured by current laboratory tasks. One such variable – the role of others in prospective remembering – is the subject of a paper by Schaefer and Laing. Moreover, in common with Maylor *et al.*, their research is focused more on the contents of the task than on its prospective component. Schaefer and Laing's participants were asked to remember to perform six simple tasks at the end of a 30-minute experiment. Allegedly, these tasks would help the experimenter to prepare the room for the next participant thereby disguising the fact that performance on these tasks was under investigation (cf. Kvavilashvili, 1992). In the experimental conditions participants were asked to remind another participant – a confederate – about these tasks at the end of the session, or told that they would be reminded by the confederate, or both. Interestingly, relying on others to remind one led to the performance of significantly fewer tasks whereas an obligation to provide a reminder led to a (marginal) increase in performance. The practical implications of these findings are self-evident and discussed by these authors, along with possible underlying mechanisms.

All researchers in this area now recognize that successful completion of our intentions relies on the operation of a number of different cognitive processes, including attention, action control, and memory (Dobbs and Reeves, 1996; Ellis, 1996). Indeed, Burgess (2000) has suggested that prospective memory task completion requires many of the skills that are commonly described as 'executive' processes. Thus it is not surprising that

 

one of the more recent developments in this area is the particular interest shown by neuropsychologists (e.g. Burgess and Shallice, 1997). Importantly, for constructive theoretical development in the area, there is a close correspondence between the techniques used to study prospective memory task performance and the theories that drive these studies in both cognitive psychology and cognitive neuroscience. Thus West, Hendon, and Munroe report the findings from a series of ERP studies that address current theories of prospective memory task retrieval and that further explicate the results of experimental research with young and older adults, conducted by West and his colleagues (West and Craik, 1999). In particular, they address an important debate on the attentional or strategic demands of prospective memory task retrieval, evaluating the notice + search (strategic component) and automatic activation models described by Einstein and McDaniel (1996; see also this issue).

Although West *et al.*'s data appear to conflict with the notice + search model of retrieval, they argue that it is possible and potentially beneficial to integrate ideas from the two models. This possibility is explored further in McDaniel and Einstein (this issue). The findings that West *et al.*, report also extend understanding of research conducted by Craik and his colleagues (e.g. Craik and Kerr, 1996) on momentary 'lapses of intention' or failures to notice a prospective memory cue. Older adults, for example, appear to be more prone to 'lapses of intention' (West and Craik, 1999) and are believed to suffer from attentional or executive deficits. Interestingly, West *et al.*'s ERP research indicates that these failures are associated with a transient change in neural activity in a region (frontal polar) thought to be responsible for the implementation of cognitive control (West and Alain, 2000).

The final paper from McDaniel and Einstein tackles many of the issues that have been raised by others in this volume and in recent publications. In their new, multiprocess framework of prospective memory retrieval they suggest that people use multiple approaches to achieve success on this task. Thus they intend to shift current debate away from examining whether or not prospective remembering *per se* is achieved by reliance on relatively automatic retrieval processes or is resource demanding and strategic. Instead, they argue that the issue of concern is one in which we investigate how the characteristics of the task, the individual, and the wider context in which the task is set, influence the probability that automatic processes alone will support prospective remembering.

McDaniel and Einstein's paper, therefore, takes the multi-componential view of a prospective memory task (e.g. Dobbs and Reeve, 1996; Ellis, 1996) an important step further by examining how variations in the demands on these different components might influence the requirement for strategic retrieval processes. For example, when target events are not particularly salient and the ongoing task focuses processing on encoded features of that event, then retrieval is likely to benefit from strategic processing. Therefore, performance on such tasks should be sensitive to the effects of dividing attention during ongoing task performance and age (cf. Maylor, 2000, presentation at the First International Conference on Prospective Memory, University of Hertfordshire, July). Moreover, variations in the characteristics of target events, ongoing tasks, etc. are likely to influence also the extent and nature of planning that takes place prior to and/or during ongoing task performance. McDaniel and Einstein point out also that an increased understanding of individual differences in personality and meta-cognitive processes relevant to prospective remembering may provide a means of explaining the variability in performance that most researchers in the area have observed.

 

## FUTURE DIRECTIONS

Neuropsychological research in the field, although still in its infancy, is likely to prove a valuable and major development. Advances in scanning techniques, alongside current research on executive functions, make prospective memory tasks a potentially useful tool for exploring interactions between executive functions. One example would be the relationship between response inhibition (of an ongoing task) and monitoring (for a future opportunity for action). Where this research maps onto and addresses current issues in experimental studies, advances in the field might benefit from convergent approach using both ERP and scanning measurements as well as case or group studies of neurologically impaired patients (cf. Burgess, 2000).

A second area ripe for development is the study of more complex prospective memory tasks (e.g. Kliegel *et al.*, 2000). This research builds on and develops work on planning in frontally impaired patients (e.g. Shallice and Burgess, 1991) and allows us to address issues such as how we prioritize, schedule, and recall multiple intentions during complex or structured ongoing tasks (e.g. Kliegel *et al.*, 2000; Rendell and Craik, this issue). Related issues include examining performance on routine and habitual intentions (Einstein *et al.*, 1998) and after longer and more variably filled delays between encoding and recall (Hicks *et al.*, 2000).

Finally, we anticipate that work on understanding changes in prospective remembering during old age will continue to grow, particularly in view of some of the discrepant findings that have emerged recently. One potentially useful avenue, revealed by findings presented at the conference, is the recent shift towards dividing older participants into specific age bands (see Huppert *et al.*, this issue). This finer-grained approach should provide a more accurate account of prospective memory as a function of age and perhaps contribute to the resolution of some current controversies.

In addition to the above we believe that there are several aspects of prospective remembering that merit more detailed or thorough examination than they currently receive. These include investigation of individual differences in the resources and expectations that people bring to the task (cf. McDaniel and Einstein, this issue) and thereby paying greater attention to the social aspects of prospective remembering (cf. Winograd, 1988). Moreover, it is surprising to observe that very few studies have examined the developmental course of prospective memory skill acquisition in young children. However, it is possible that the increasing body of research on executive functions – which develop gradually throughout childhood and adolescence – may provide the spur for further research on prospective memory development (e.g. see Kerns, 2000).

Research on prospective memory is proceeding at a rapidly increasing rate using a range of methods and participants to address important questions in cognitive psychology. Our knowledge of underlying processes and influential variables is likely to increase accordingly. Similarly, areas of debate and dispute are likely to emerge and it is important for these to be resolved constructively and not allowed to impede progress in the exciting endeavour to understand this theoretically and practically important topic.

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