

Prospective Memory for Future Intentions

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Abstract

Prospective memory plays an important role in everyday life. Research methods, type of prospective memory, components of prospective memory and factors which influence on the prospective memory tasks are discussed. Frequency and priming are important factors in the encoding process, and familiarity and distinctiveness have influences on the retrieval process. Specificity is also important in both encoding and retrieval processes. Performance of prospective memory tasks is also influenced by motivation, time, external and internal cues and monitoring.

We have memories about the past, and the same time we have memories for the future. During daily life, we have many intentions that we want to realize in future. The ability to retain, recall and realize intentions is an important aspect of purposeful behaviour in our everyday lives. Prospective memory plays a predominant role in everyday living. Our lives are directed towards the future, with plans and actions forming a major component of this. Many of these plans and actions are governed by goals, and prospective memory is needed to carry out such goals (Brandimonte, Einstein & McDaniel 1996; Kobayashi 1996; Umeda & Koyazu 1998; Mizuno 1998a). Research in prospective memory has importance on a more practical level. For example, research has addressed the real life situation of why people fail to keep appointments with others.

Memory for future actions typically requires a great number of self-initiated retrieval operations to be performed successfully (Einstein & McDaniel 1995). In contrast to most retrospective memory tasks, there are no external agents that prompt the execution of planned actions in prospective memory tasks. Instead, the person has to identify the target event among other events at the time of retrieval. For example, remembering to leave a message for a friend requires that the person is recognized not only as a friend but also as a reminder of planned action (Mäntylä 1993).

(1) Methods

The methods used for studying prospective memory involve questionnaire,

naturalistic experiments and laboratory studies, each of which has its own methodological strengths and weaknesses. One widely used method for investigating prospective memory has been questionnaires. Questions such as "How often do you forget to keep appointments?" are often included and are thought to tap information about recall of future intentions. But subjects may not always be aware of failures in their prospective memory. In contrast to retrospective memory where it is obvious if one cannot remember a fact, in prospective memory it is only obvious when one has failed to carry out a plan if there are noticeable or important consequences (Quince 1996). Wilkins & Baddeley (1978) found that although subjects remembered when they had carried out intentions, they were not always aware of omissions.

Naturalistic experiments are aimed at simulations of real world situations and as such give high ecological validity to the results. However, one problem with these type of experiments is the lack of control over variables which could confound the results (Baddeley 1981, Baddeley, Sunderland & Harris 1982). The initial research involved having subjects return postcards from home (Meacham & Leiman 1982; Mizuno 1997b), telephone the experimenter, or press a button on a pill box four times daily. These paradigms have provided the field with descriptive data on prospective memory, but they do not allow for strict control of the behaviours and strategies used by subjects (McDaniel & Einstein 1993).

Laboratory studies offer more control on confounding variables, but can be problematic in cases where there is too much control, as the normal processes involved in prospective memory will not be activated and one cannot be sure that the results obtained would have occurred in real life. The remembering of intentions usually involves some interruption of ongoing activities, for example, remembering that one needs to buy bread can be triggered by seeing a supermarket while driving home from work. An additional challenge facing the researcher therefore, is to simulate this dual-task feature by combining the prospective memory task with a primary processing task. By embedding the prospective memory task within another task, the possibility that the task will simply be a vigilance task is reduced. In an important laboratory paradigm devised by Einstein & MacDaniel (1990), the prospective memory task is embedded in a short-term memory task. The primary processing task involves subjects being presented with a list of words which they are required to remember and recall. The prospective memory task requires subjects to press a response key whenever a target word appears. As the majority of the subject's attentional resources are focused on the primary processing task, the prospective memory component of the task is prevented from being a vigilance task. The target word, target event acts as a retrieval criterion for intent and action, pressing a key.

② Types of prospective memory

1. Time and activities in prospective memory

The realization of a delayed intention can be described in terms of the following phases (Brandimonte & Passolunghi, 1994; Ellis & Milne 1996).

<Encoding>

- a. formation of an intention
- b. remembering what to do; retrospective component
- c. remembering when to do the action; the prospective component

<Delay, Performance interval>

- d. remembering to actually perform the action

<Execution>

- e. performing the action at the time, in the place, and in the way prescribed

<Evaluation>

- f. remembering having performed the action, so as not to repeat it; cancellation stage

2. Classes of prospective memory tasks

Einstein and McDaniel (1990) distinguished between two general classes of prospective memory tasks.

<Time-based> One class, termed time-based, requires that the person perform an action at a certain time (e.g. meet somebody at an appointed time) or after a period of time has elapsed (e.g. take food out of the oven in 10 minutes).

<Event-based> The other class, termed event-based, requires that the person perform an action when some external event occurs (e.g. give him a message when you see him). Delayed intentions should be recalled whenever a particular target-event occurs in an ongoing activity. In the event-based prospective memory tasks, a particular message has to be given to a friend, i.e. the message has to be associated with the friend. Successful remembering requires that the target event and the prospective memory task be associated, and further that aspects of that association be reinstated at retrieval.

<Activity-based> After finishing the present ongoing activity, they will execute the prospective memory task. For example, we ask a child to please go shopping after he has finished his homework (Kvavilashvili & Ellis 1996).

③ Components of prospective memory

1. Retrospective component

The distinction between prospective and retrospective memory is not absolutely clear-cut, since prospective memory necessarily includes some elements of ret-

rospective memory (Baddeley & Wilkins 1984). In this analysis, one component of prospective memory is that the person must remember what has to be done, which would include remembering the action to be performed and the proper target event. This might be termed the retrospective component of a prospective memory task. Recognizing a word as being a target-event is different from simple recognition of a word: the latter has to do with past events, whereas the former implies the activation of the prospective component of the task. That is, once the event has been recognized as a target-event, it almost automatically prompts the general feeling that something has to be done (Brandimonte & Passolunghi 1994).

2. Prospective component

The other component is that the person must remember to perform the action in response to the appropriate target event or at the appropriate time in the case of a time-based prospective memory task. Post-experimental questioning also revealed that most of the subjects who showed prospective memory forgetting simply could not think of what they were supposed to do when the target event appeared. Subjects indicated that they remembered they had to do something when the target event appeared, but had forgotten what it was that they were supposed to do. (Kvavilashvili 1987; McDaniel & Einstein 1993).

3. Distinction between prospective and retrospective memory

An important difference between prospective and retrospective memory rests on the presence and absence of explicit prompting for remembering. Memory for future intentions was compared with memory for past activities by asking members of a film society to retrieve names of films they intended to see later on in a season and films they had seen earlier. Memory for films that had been seen showed the usual recency effect, while retrieval of films to be seen showed an analogous proximity effect in that films to be seen sooner were more accessible (Hitch & Ferguson 1991). On the contrary, no correlations have been found in a study where a single task was employed to measure prospective and retrospective memory. In addition to the lack of correlation found between prospective and retrospective memory, the divergent characteristics of these two types of memory indicated that they have potentially different processes (Meacham 1988). In a dual task experiment, a prospective memory task should make minimal demands on the retrospective component (e.g. remembering a simple task associated with one target event).

The social consequences are different for the two types of memory and this has been claimed to be the main difference between prospective and retrospective remembering (Meacham 1988). Enmeshing of prospective memory with the needs and wishes of other people makes it important socially as forgetting can be

embarrassing (Morris 1992). A further social aspect is the tendency to say that the person is unreliable if his prospective memory fails, yet if retrospective memory fails, one tends to say that this is due to poor memory (Munsat 1966, cited in Winograd, 1988).

(4) Characteristics of prospective memory performance

Unlike a retrospective memory task in which some agent prompts the person to try to recall or recognize target information, a prospective task requires the person to spontaneously recognize the event or time as the stimulus for producing a response (Einstein & McDaniel 1995). Successful prospective remembering involves not only remembering to perform the action, but also the motivation to carry it out. Self-generated motivation may have a stronger effect on successful prospective remembering (Mizuno 1997a). The critical factor determining prospective memory performance seems to be the degree to which the target event triggers or evokes the memory for the action that is to be performed. From this point of view, prospective memory performance will depend on properties of the prospective memory target event (Einstein & McDaniel 1990).

A central question in research on delayed intentions concerns how and when an event in an ongoing activity triggers the retrieval of such an intention. Previous research has identified an important role for both encoding-related factors, such as priming or activation prior to encoding (Mäntylä 1993) and retrieval-related ones, such as familiarity and distinctiveness (Einstein & McDaniel 1990; McDaniel & Einstein 1993; Brandimonte & Passolunghi 1994). Ellis & Milne (1996) extended this research by examining the effects of variations in instructions provided at encoding and the interdependence of both encoding and retrieval-related factors. One important assumption is that event-based prospective memory tasks are similar to cued retrospective memory tasks, in that they both require that particular information be associated with a particular event (McDaniel & Einstein 1993). From this perspective, successful performance in prospective memory tasks depends on the triggering of the action by the target event.

1. Encoding related factors; priming, frequency

In a repeated-instance design, successful recall of the delayed intention on one occasion should increase the activation level of the intention, thus increasing the likelihood of successful recall in subsequent re-presentations of the target word.

Priming effects were manipulated by giving subjects a category fluency task for half of the target categories used in the subsequent prospective memory task. In this task, younger and older adults performed an action whenever an instance of a given semantic category occurred in the context of a free association task. Reliable priming

effects were observed for both age groups (Mäntylä 1993). Ellis, Kvavilashvili & Milne (1999) investigated the effects of event-cue frequency on prospective memory task performance during an ongoing activity in a repeated-instance design, but the results revealed that the variations in the event-cue frequencies explored did not influence overall performance.

2. Retrieval related factors; familiarity, distinctiveness

A range of factors linked to the target event have been found to have a marked influence on whether the target event will be recognized as a retrieval criterion and hence whether successful prospective remembering will occur (Einstein & McDaniel, 1990; McDaniel & Einstein 1993; Ellis & Milne 1996). Results from these studies have shown that target event familiarity has an effect, with more familiar target events less likely to produce successful prospective remembering (Einstein & McDaniel, 1990; Brandimonte & Passolunghi, 1994).

Distinctiveness was not a function of the target event, but instead was defined in terms of the background list in which a particular event was presented. More distinct targets also benefit prospective memory performance (Brandimonte & Passolunghi 1994). A beneficial effect of distinctiveness was found when perceptual rather than semantic distinctiveness was tested.

Two interpretations have been advanced to account for this pattern of results. According to the first, which follows directly from past research in the retrospective memory literature, unfamiliar events may have fewer ideas associated with them and fewer competing associations that might interfere with prospective memory. Presentation of any stimulus item always produces activation of that item's node in an associative network (Anderson 1983). Activation then passively spreads to associated items, thereby increasing the resting activation levels of those associated items. An assumption in this model is that the amount of activation for any particular associated item is a negative function of the number of associations emanating from the presented target. Accordingly, as an unfamiliar item would have fewer connected items, then there would be higher probability that the to-be-performed action associated with it in memory would be sufficiently activated to exceed the threshold necessary to bring the action into awareness (McDaniel & Einstein 1993). The second explanation takes into account the local distinctiveness of an unfamiliar target event, as when an unfamiliar item is included in a set of familiar items (Schmidt 1991). Such a situation may alert the subject to the particular role of the target event, hence triggering his memory for the action (Brandimonte & Passolunghi 1994).

3. Encoding and retrieval-related factors; specificity effect

Ellis & Milne (1996) manipulated ease of recognition by providing, at encoding,

either the particular target events (category exemplars) that subsequently appeared during the test phase, or the name of the category from which these targets were drawn---specific or general encoding instructions, respectively. For instance, one may be asked to carry out a particular action whenever a word naming a particular animal (e.g. giraffe occurs during a performance or test phase; specific encoding instructions) or when a word naming an exemplar of the category of animals appears at test; general encoding instructions. The task of recognizing a test item as a retrieval cue should be simpler when the encoded and presented cue are identical: specificity effect (Einstein & McDaniel 1995, Ellis & Milne 1996). The results indicate the importance of the semantic relations among target events and between target events and the category from which they are drawn in determining the superiority of specific over general instructions. There is a large body of evidence to suggest that recognition and recall are influenced not only by retrieval operations and conditions, but also by the degree of overlap between the latter and those that operate at encoding (Tulving & Thomson 1971).

5) Factors which affect prospective remembering

The factors which affect the processes of remembering intentions were investigated. The range of factors identified include motivation, time factors and reminders.

1. Motivation

Successful prospective remembering involves not only remembering to perform the action, but also the motivation to carry it out. It is difficult, however, to manipulate motivation in a task, and therefore efforts include using cash incentives as a means of increasing motivation. The results indicate that the effects of monetary incentive on prospective remembering were not very strong (Meacham & Singer 1977, Mizuno 1997b). Self-generated motivation did not have a strong effect on successful prospective remembering (Mizuno 1997b). Somerville, Wellman & Cultrice 1983 (cited in Winograd, 1988) also studied motivation, in addition to delay of carrying out the planned intentions in young children. The task for the children was to remind their primary caretakers to carry out an action at a specific time. The results showed that children were better at remembering tasks of high interest and short delay. The authors proposed that prospective memory is required earlier than retrospective memory. Often there are rewards for children when they remember to carry out planned intentions, e.g. washing their hands before meal, and it is this aspect that the authors' proposal is important in stimulating children to develop prospective remembering skills (Quince 1996).

2. Time

Time factors including retention interval and the time of day when the planned action is to be carried out have also been identified as affecting prospective remembering. Wilkins & Baddeley (1978) manipulated the time of day in their pill-taking study. The results indicated that early times in the morning of day were more successful in inducing the prospective memory task than later times in the evening.

Retrospective memory has been found to decline as retention interval increases. Some studies have shown that retention interval has no effect on prospective remembering (Hitch & Ferguson 1991, Einstein, Holland, McDaniel & Guynn, 1992), while other studies have shown that a delay negatively affects prospective remembering (Meacham & Leiman 1982, Brandimonte & Passolunghi 1994). At first these results seem contradictory, until the nature of the intervening tasks is taken into account. Prospective forgetting occurs during a delay if the intervening tasks interfere with more general mental activities or require repetitive motoric responses from the subjects. Studies have shown that most prospective forgetting occurs in the first three minutes of the time between instructions and task, with very little occurring thereafter (Brandimonte & Passolunghi 1994). If the subjects are told that the intervening task is different from the prospective memory task, then delay appears to have no effect on prospective remembering. It appears that if the intervening task is of the same nature as the prospective memory task, then the expectancy of the prospective memory event occurring and subsequent non-appearance of such an event is enough to negatively affect prospective remembering. Brandimonte & Passolunghi (1994) concluded that it was not delay as such that negatively affected prospective memory, but it was the habituation to the non-appearance of the prospective memory event.

3. Retrieval cues, reminders

Retrieval cues are effective means of remembering and can be either external or internal. External aids include shopping lists, calendars, notes and anything which disturbs the regular stream of events, for example, leaving books by the front door as a reminder to take them to school. External aids are even commercially available. Internal cues involve linking tasks with routine activity, e.g. taking books back to a friend on the way from work or mentally rehearsing the list of items one intends to buy. Meacham and Leiman (1982) showed that there was a significant positive effect of external memory aids (coloured tags on key chains) on remembering to mail post cards back to the experimenters at specified times. Subjects used external reminders rather than cognitive activities. It has been suggested that there is a reliance on external memory aids when there is a lengthy time interval between encoding of the

prospective memory task and carrying out the task and in situations where internal aids cannot be trusted. External cues are more reliable and easier to use than internal aids. External cues need to be visible at the time of remembering to carry out the task, to be of most benefit for prospective memory (Quince 1996). One interview study investigated the extent to which people use memory aids by asking children what strategies they would use to remember to bring their skates to school. It was found that the majority said they would rely on external retrieval cues rather than cognitive strategies (Krentzer, Leonard & Flavell 1982).

4. Monitoring

Prospective memory tasks are often important and anything that acts as a reminder can be useful. Morita (1998) showed that higher motivation and less cognitive load led to higher time-monitoring frequency and better performance in prospective memory tasks. Monitoring plays an important role in retrieval of prospective memory (Mizuno 1998b).

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