Prospective Memory

Theory and Applications

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Varieties of Intention: Some Distinctions and Classifications

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Mook (1989) recently noted that "the explosion of interest in everyday memory has enormously enriched the field. Entire areas of investigation that were unknown a few years ago—prospective memory, for instance,—are boiling with ideas and findings" (p. 25). It is, of course, encouraging to hear that an ardent defender of artificial laboratory experiments (see Mook, 1983) holds such an enthusiastic view about the accomplishments of everyday memory research (cf. Banaji & Crowder, 1989). In our opinion, however, this view tends to be slightly exaggerated, at least with respect to prospective memory. It is difficult to describe an area of research as boiling with ideas and findings when approximately only 45 papers were published over the past 20 years (see Fig. 2.1). This means two papers are published on average per year, or if one takes into account only experimental work, this figure drops to about one paper per year. However, this is great progress compared to a 40-year period preceding the early 1970s[1] when, to our knowledge, only three relevant studies appeared, one experimental (Birenbaum, 1930) and two theoretical (Lewin, 1926/1951; Miller, Galanter, & Pribram, 1960). An enhanced interest toward this important but unjustly neglected area of research is also reflected in the fact that recent and forthcoming conferences on memory have started to devote one symposium, among many others, solely to prospective memory. Finally, the publication of the present volume can be said to mark an important milestone in prospective memory research.

[1] Although the term *prospective* was not in use until 1975 (Meacham & Leiman), the first study of prospective memory by a cognitive psychologist was conducted by Loftus in 1971.

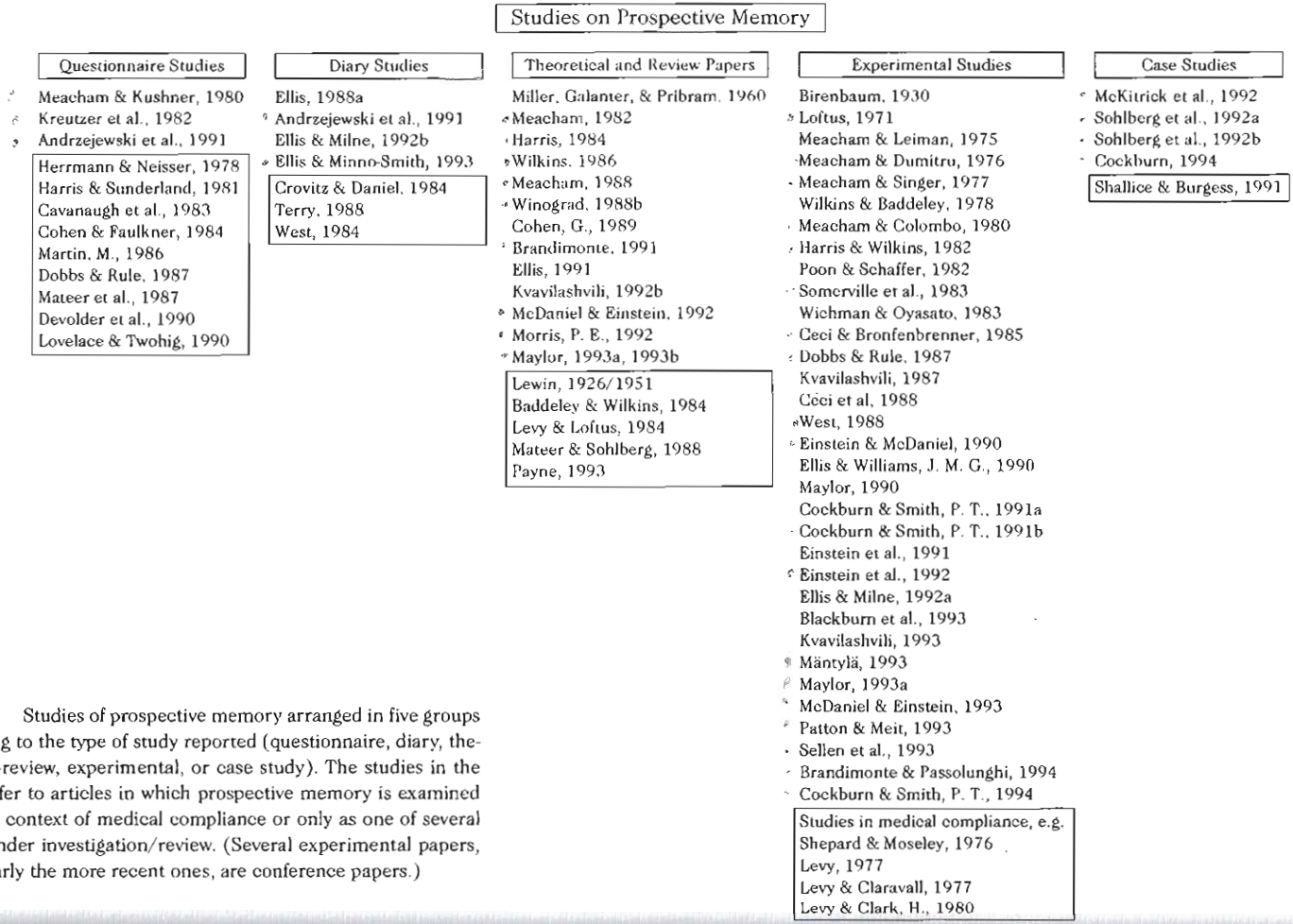

FIG. 2.1. Studies of prospective memory arranged in five groups according to the type of study reported (questionnaire, diary, theoretical–review, experimental, or case study). The studies in the boxes refer to articles in which prospective memory is examined either in context of medical compliance or only as one of several topics under investigation/review. (Several experimental papers, particularly the more recent ones, are conference papers.)

When one starts to investigate a new and unexplored phenomenon, its proper description and measurement is of paramount importance. Although various aspects of these issues are addressed in previous papers and throughout this volume, there is still much more to be said on the topic. For example, it is now well acknowledged that prospective memory is always embedded in people's everyday actions and activities (see, e.g., Baddeley & Wilkins, 1984; Cohen, 1989; Ellis, this volume; Harris, 1984; Meacham, 1982; Morris, 1992). People, however, often commit a variety of errors and mistakes while performing these actions (see, e.g., Norman, 1981; Reason, 1979, 1984). It seems necessary, therefore, to develop a taxonomy that will allow us to differentiate instances of prospective memory failure from other forms of error. Second, there appears to be agreement that a variety of intentions occur in everyday life. This is stressed in a number of papers and some potentially important distinctions have been drawn (see, e.g., Einstein & McDaniel, 1990; Ellis, 1988a; Harris, 1984). The observation and analysis of naturally occurring intentions, however, indicate that further distinctions are possible. The classificatory scheme we propose attempts to identify the more important of these distinctions for research and to capture the relationships between the potentially different types of intentions that emerge from this analysis. Finally, a number of different research methods and paradigms are employed by prospective memory researchers. It is important, therefore, to consider the appropriateness of a particular method in relation to a particular type of intention. In addressing these three questions, this chapter aims to demonstrate the complex nature of prospective memory, the difficulties of its investigation, and the possibilities for studying a wide variety of intentions despite these difficulties.

PROSPECTIVE REMEMBERING AND INTENTIONS

Prospective memory is defined either as remembering to do something at a particular moment in the future or as the timely execution of a previously formed intention. Because prospective memory refers to remembering *intentions*, we should pause to briefly consider the nature of intentions. For example, it is important to know what kind of phenomenon an intention is, how it is related to human behavior and the types of intention people usually form and carry out in their everyday lives. Answers to these questions may substantially enhance our understanding of prospective memory and its underlying mechanisms.

The most important feature of intentions is their intrinsic relation to the actions and activities that we perform in our everyday lives. Indeed, some philosophers define human behavior as events caused by intentions (Brand, 1984; Harré, 1982). Gauld and Shotter (1977), however, suggested that it is almost impossible to provide a single definition of an intention that could encompass

the great variety of naturally occurring intentions people usually carry out. Although this is true to some extent, in general, an intention can be defined as a person's readiness to act in a certain way in the future, where *what* has to be done and *when* it has to be done are defined with more or less clarity. This readiness to act in a certain way in the future can be described as the *that* aspect of an intention (see Ellis, this volume; Gauld & Shotter, 1977). Of course, there are other aspects of intentions, such as who, where, and how (see, e.g., Cohen, 1989; Fishbein & Ajzen, 1975; I. James, 1990, cited in Morris, 1992). In many respects, however, the latter are not as central to the realization of an intention as are the *what* and *when* aspects. For example, how an action is effected (its *component action sequence*) can be regarded as a further specification of the what aspect. Similarly, who (i.e. to, with, or for whom) and where are often closely connected with a specification of the when aspect (for further discussion see Ellis, this volume).

Searle (1983) distinguished two broad types of intentions, namely, *prior intentions* and *intentions-in-action*. A prior intention is one in which the intention is formed prior to action, whereas an intention-in-action is not associated with a prior intention. (One example of an intention-in-action would be a spontaneous action, such as picking up an umbrella you see on your way out of the house). An important feature of a prior intention is that it always occurs as a result of a conscious decision to act in a certain way (see, e.g., Brand, 1984; Heckhausen & Kuhl, 1985; Nuttin, 1987). If no such decision has been made, then no relevant prior intention can exist.

On many occasions, people begin to carry out their prior intentions immediately after a decision has been made. We can call these *immediate intentions* and distinguish them from *delayed intentions* (cf. Gauld & Shotter, 1977). The fulfilment of a delayed intention is, by definition, always postponed and it is possible to realize the intention only at some designated moment in the future. The term *prospective memory* appears to be used to describe the processes associated with the retrieval and satisfaction of these delayed intentions. Moreover the difficulty of prospective remembering—the timely retrieval of an intention—arises only with these delayed intentions. For any one of a variety of reasons, one may miss this prearranged moment and thus fail to satisfy an intention.

PROSPECTIVE MEMORY FAILURES, ABSENT-MINDED ERRORS AND OTHER MEMORY LAPSES

Prospective memory failures are common in everyday life (see, e.g., Crovitz & Daniel, 1984; Einstein & McDaniel, this volume; Terry, 1988; West, 1984). However, they are not the only source of failures that occur during the performance of our everyday activities. It is important, therefore, to try to distinguish prospective memory failures from other forms of action errors.

Absent-Minded Errors

A distinction should be drawn between *prospective memory failures* and *absent-minded errors* (see Cohen, 1989). The latter constitute a broad class of different failures and lapses, and are usually described as *action-slips* (Heckhausen & Beckmann, 1990; Norman, 1981), *actions-not-as-planned* (Reason, 1979), or *strong habit intrusions* (James, 1890). Although these errors take a variety of forms, they all describe failures that occur during the execution or performance of an intended action. Prospective memory errors, in contrast, take the form of a failure to retrieve an intended action at all, at an appropriate moment (cf. Cohen, 1989). The most typical absent-minded errors are ones in which a person carries out an unintended action instead of the intended one. For example, we may start to remove some tomatoes from the refrigerator instead of the eggs or tidy up a room instead of fetching a book we had left there. Because these errors occur when an unintended action is substituted for an intended one, we refer to them here as *action substitution* errors.

Another type of absent-minded error includes occasions when we start to carry out an intended action but suddenly realize (usually within a few seconds or minutes) that we no longer know what we had set out to accomplish. This type of error occurs when, for example, someone opens the refrigerator or enters a bedroom only to discover that he or she cannot recall what was needed (a *what am I doing here* experience; Reason, 1984). This form of forgetting cannot be characterized as a prospective memory failure (but see, for an alternate view, Einstein & McDaniel, this volume). Rather, it refers to the loss of the contents—the action or what aspect—of an immediate intention during the performance of the intended activity.

Finally, there is a class of absent-minded errors[2] that appears to result from an incorrect assessment of one's current place in a sequence of actions. These errors, sometimes referred to as *place-losing* ones (Reason, 1984), usually take the form of either omissions or repetitions of a particular action in the sequence. A failure to switch the kettle on after filling it, for example, would be classified as an omission error, whereas an attempt to fill an already filled kettle would be an example of a repetition error. In both instances, the error occurs during the performance of an intended action and its occurrence is not connected with a failure to retrieve the intention to carry out that action. It cannot, therefore, be regarded as a failure of prospective remembering.

A crucial difference between absent-minded slips or errors and prospective memory failures is that the former occur in relation to either immediate intentions whose performance has been initiated or to intentions-in-action, and

[2]There are, of course, many other types of absent-minded errors that have been documented by, for example, Heckhausen and Beckmann (1990), Norman (1981), Reason (1979, 1984). However, the ones considered here are thought to be most vulnerable to be misattributed as failures of prospective memory.

the latter in relation to delayed intentions. Once a delayed intention is initiated, however, it is transformed into an immediate one and any of the different types of absent-minded errors outlined previously may be committed. If these errors are not corrected, they may contribute to the overall failure of the prospective memory *task*, but they are not attributable to a failure to retrieve the delayed intention. For example, if you forgot to telephone a friend at 8:00 p.m., as arranged, this would be an example of a prospective memory failure. If, however, you recalled the intention at this time and had even started to carry it out (e.g., moved toward the hall) the delayed intention would be transformed into an immediate one and would be potentially vulnerable to any one of the absent-minded errors outlined. For example, you may either dial the number of a different friend (substitution error), enter the hall but forget why you wanted to go there (loss of action content), dial only part of the telephone number (omission), or dial the number twice in succession (repetition error).

Output Monitoring

Some omission and repetition errors differ from their absent-minded counterparts in that they usually occur in relation to delayed intentions; they are, therefore, more closely related to failures of prospective remembering. These errors constitute a broad and interesting class that Koriat and his colleagues refer to as *failures in output monitoring* (see Koriat & Ben-Zur, 1988; Koriat, Ben-Zur, & Sheffer, 1988). Suppose, for example, that someone has formed the intention to take a pill after breakfast. Errors of output monitoring could occur if one either subsequently forgets that a pill has already been taken and takes an additional pill (repetition error), or falsely remembers having taken it and thus ends up taking no pill at all (omission error). In both of these cases, the intention to take a pill is not forgotten. In the former, it is actually remembered twice, and in the latter, it is remembered but not carried out. Although repetition errors tend to result in inefficient behaviors (the risk of overdose, for example), omission errors are likely to contribute to failure on prospective memory *tasks* (taking no pill at all). Neither of these errors, however, are prospective memory failures because they do not result from the failure to remember an intention at an appropriate moment. Rather, they arise from the faulty encoding or retrieval of an actual (repetition error) or imagined (omission error) action.

Forgetting the Content of Delayed Intention

Some errors occur during the course of remembering a delayed intention and are therefore closely related to failures of prospective remembering. Nonetheless, they should not be regarded as prospective memory failures because they refer only to the partial loss of the what or when aspects of the content of

a delayed intention. Suppose, for example, that one had decided to buy some food, such as eggs, cheese, and bread from a shop on the way home. Returning home without stopping at the shop would be a clear and typical example of a prospective memory failure. Omitting to buy one of the food items, however, could be regarded as a failure to retrieve part of the what aspect of the delayed intention and thus would be classified as a failure of retrospective memory (see, for further discussion, Einstein & McDaniel, this volume).[3] Similarly, one may remember the what aspect of intention (like having an appointment with a friend on that day) but no longer remember accurately or completely the when aspect or exact time when this intention should be carried out (e.g., whether it is 1:00 p.m. or 2:00 p.m.).

Finally, there are paradoxical cases of successful prospective remembering that are accompanied by a complete loss of the what aspect of a delayed intention. These are occasions on which we have a feeling of something to do in response to a particular place, time, and so on, but are unable to recall what it is that we should be doing (see, for further discussion, Einstein & McDaniel, this volume; Ellis, this volume). Although a delayed intention may be remembered at an appropriate moment (retrieval of *when* aspect) it is clearly impossible to complete a prospective memory task unless the action (*what* aspect) is also recalled. Phenomenologically, however, the experience that accompanies such an occasion may be similar to ones associated with the temporary loss of an immediate intention—a what am I doing here experience, described earlier in the section on absent-minded errors.

Additional Sources of Error

As the previous discussion illustrates, it would be erroneous to assume that all failures to carry out an intention are errors of prospective memory. Failures of output monitoring or forgetting the contents (what and when) of a delayed intention are not, however, the only reasons why a delayed intention may be remembered but not performed. One obvious reason for nonperformance is that a person may simply decide that they no longer wish to carry out the intention. In these cases, the intention may be either postponed, with revised *when* and possibly *what* conditions, or cancelled (cf. Ellis, this volume).

Other instances of action failure, which might mistakenly be categorized as prospective memory failures, highlight the importance of the presence or absence of an initial decision to act in a certain way (the *that* aspect of an intention). For example, many failures to carry out a clearly necessary action or

[3]Classification depends on the nature of the original encoding—whether one or more intentions were formed. In other words, was the original intention to go to a particular shop to buy food, with some passing consideration of possible items, or were separate intentions formed to buy cheese, bread, and eggs? Caution is advisable without knowledge of the initial decision(s) or, in a laboratory study, the experimental instructions.

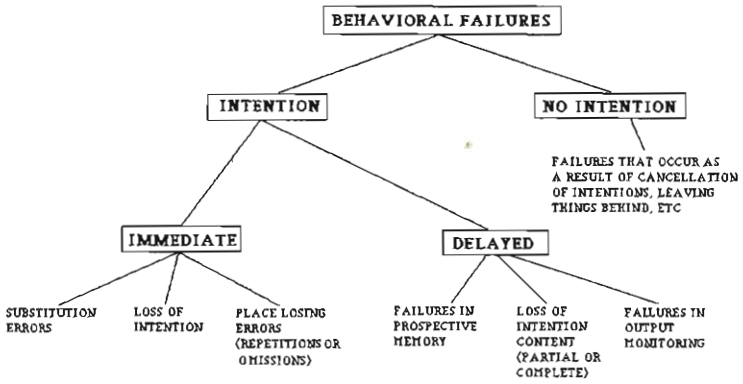

FIG. 2.2. . A classification of behavioral failures according to the presence or absence of an intention and the type of to-be-performed intention (immediate or delayed).

activity in a particular situation are not associated with such a decision and, as a result, no relevant delayed intention can be said to have been formed. A common example of this kind of failure is leaving behind objects, and occasionally even animals or children; for example, leaving an umbrella in a post office. It is unlikely that people in these situations typically make a conscious decision not to leave the umbrella or jacket behind. Rather, we assume that there will be sufficient situational cues available at an appropriate moment to support the performance of these actions. Repeated failures, however, may lead to the formation of a positive decision and thus to the encoding of a delayed intention.

In summary, people tend to perform a variety of errors in their everyday lives (see Fig. 2.2). Some occur as a result of making decisions and forming intentions (immediate or delayed) whereas others occur in the absence of these prior intentions (e.g., leaving things behind). For immediate intentions, different kinds of absent-minded errors are possible (e.g., substitution errors, temporary loss of intention, and place-losing errors). For delayed intentions, these errors may be due to either prospective memory failures, partial or complete loss of the content of an intention, or failures of output monitoring.

A VARIETY OF INTENTIONS

A great variety of delayed intentions can be classified in relation to the following four main phases of information processing—encoding, retention, retrieval, and performance. Although successful retrieval in most retrospective memory tasks almost always results in performance (production of the re-

trieved event) this is not necessarily true in prospective memory. For example, an intention may be retrieved at an appropriate moment but not be carried out. For this reason, we consider the retrieval and performance phases separately; cf. Brandimonte and Passolunghi, 1994; Ellis, 1991; Ellis, this volume.

Encoding

The following distinctions can be drawn in relation to the processes that operate during the initial encoding phase of prospective memory—simple or difficult decision, self- or other-generated, important or unimportant, and pleasant, neutral, or unpleasant.

Intentions Based on Simple or Difficult Decisions. The first refers to the type of decision that precedes the formation of an intention. Intentions may be formed as a result of either a simple, often momentary decision or a difficult, often time-consuming one (cf. Kvavilashvili, 1992a). Suppose, for example, that a friend asks you to go to the cinema with him or her this evening. If you have no particular plans for the evening, then you may agree almost immediately. On the other hand, if you wanted to complete a particular task then it may take some time and thought before you decide to postpone the task and watch the movie. Although in both cases the resulting intention is to go to the cinema, these intentions may be psychologically different. Several factors suggest that, other things being equal, the likelihood of forgetting an intention preceded by a simple decision may be higher than that of forgetting one preceded by a difficult decision. For instance, as the examples provided here illustrate, simple decisions are often less time-consuming than difficult ones. A difficult decision may require, for example, the reorganization of one's activities, prioritization of these activities, and/or the examination of future opportunities for performing alternate actions. The planning processes evoked by such considerations are likely to result in more elaborate and distinctive processing for intentions preceded by difficult decisions than for those preceded by simple decisions.

Self- or Other-Generated Intentions. At an encoding phase, intentions can be divided further into ones that are formed as a result of a personal need to do something and ones that are formed as a result of a request from someone else. The former can be described as *self-generated intentions* and the latter as *other-generated intentions* (Cohen, 1989; Ellis & Nimmo-Smith, 1993; Kvavilashvili, 1992b). Self- and other-generated intentions differ mainly in terms of the needs that they satisfy or that they originate from. Other-generated intentions are based on extrinsic needs (e.g., to comply with certain norms, obligations, etc.). Self-generated intentions, on the other hand, are based on intrinsic needs (see, e.g., Tuomela, 1977, on the distinction between extrinsic

and intrinsic needs). Thus far, experimental tasks have studied only other-generated intentions, formed as a result of a request from an experimenter. In contrast, diary studies of naturally occurring intentions are likely to include examples of both self- and other-generated intentions. Unfortunately, these studies have not examined possible variations in retrieval between these two types of intentions (Andrzejewski, Moore, Corvette, & Herrmann, 1991; Ellis, 1988a; Ellis & Nimmo-Smith, 1993).

To what extent might the origin of an intention influence the encoding and likely outcome of that intention? Certainly, research on the generation effect in retrospective memory indicates that self-generated intentions should be better retained and recalled than other-generated ones (e.g., Slamecka & Graf, 1978). McDaniel, Waddill, and Einstein (1988) suggested that a generation task induces consistent relational or distinctive processing (or both) of the material to be remembered. If retrieval requires the use of either or both of these processes, then a positive generation effect should be observed. However, it may not be possible to draw a direct parallel between self- and other-generated intentions and self- and other-generated information to be learned. In the case of the former, a request from another person has to induce an extrinsic need to comply with that request. Only after such a need has been formed can it be transformed into a delayed intention.[4] This, however, requires some degree of personal commitment to the performance of that intention, and thus, processing and transformation of the requested material has to occur. This would not necessarily differ from the processing that occurs with self-generated intentions. Relational and elaborate encoding of the what, when, and that aspects is equally likely for both types of intention—irrespective of the type of need from which they originate.

We would therefore not expect to observe a "prospective generation effect"—that is, a difference in the probability of retrieving self- as opposed to other-generated intentions. Some preliminary support for this conjecture comes from the results of a questionnaire study we conducted as part of a larger scale study on individual differences in prospective remembering. Subjects in this study were asked to rate how frequently they forget to pass a message (other-generated intention) and to tell someone something (self-generated intention). There was no significant difference in the forgetting rate of these intentions. If anything, subjects reported to forget self-generated intentions slightly more often than other-generated intentions ($t[59] = -1.90$, $p = .06$, two-tailed). Moreover, those who performed well on self-generated tasks tended to perform well on other-generated tasks, and vice versa ($r[58] = .45$, $p < .001$).

Important or Unimportant Intentions. As suggested, delayed intentions

[4]If there is no desire to pass on a message, for example, then no relevant intention is formed even if one formally agrees to comply with that request.

can also be distinguished with reference to their importance. Having formed an intention we can usually state whether or not it is important for us to carry it out. Clearly, the information that enables us to make this assessment can be derived from several sources, such as the consequences of failure or the benefits of success for oneself or for another person, associated with an intention.

A distinction between important and unimportant intentions was drawn by Freud (1901), who suggested that people are highly unlikely to forget genuinely important intentions unless they suffer from a serious psychological or psychiatric problem. If correct, this observation suggests that the phenomenon of forgetting intentions is more likely to occur with relatively unimportant intentions than with relatively important ones. Empirical support for this conjecture has been demonstrated in a wide variety of situations (real-world and laboratory), in both adults and children (Ellis, 1988a, 1988b; Kvavilashvili, 1987; Meacham & Singer, 1977; Somerville, Wellman, & Cultice, 1983).

The level of importance that is attributed to a delayed intention is probably derived from the links between that intention and other intentions, and more general goals, aims, desires, and so on (see, e.g., Baars & Mattson, 1981). The encoding of a relatively important intention, therefore, is likely to attract more integrative and organizational processing with respect to these other intentions than a less important one. The resultant associations may also provide additional cues for the retrieval of a particular delayed intention by, for example, the retrieval or performance of these other, associated intentions. Attributions of importance, however, are likely to cut across the self- versus other-generated distinction. Self-generated intentions are not necessarily more personally important than other-generated ones. The critical feature is likely to be the strength and character of the associative links between a particular delayed intention (self or other-generated) and other intentions, aims, and so on. The importance of a delayed intention, therefore, may have a more critical influence on its outcome than does the origin of that intention.

Pleasant, Neutral, or Unpleasant Intentions. Another potentially interesting distinction was also drawn a long time ago, and refers to the emotional tone of a to-be-remembered intention: *pleasant, unpleasant,* or *neutral* (Birenbaum, 1930). Unpleasant intentions, for example arranging a visit to the dentist, may be remembered as often as pleasant ones, but tend to be either cancelled or postponed more often. The postponement of a dental appointment, for example, may provide a temporary resolution of a conflict between a perceived need to satisfy that intention and a basic desire to avoid painful experiences (see, e.g., Oatley & Johnson-Laird, 1987). Alternatively, the construct of Freudian repression would predict that unpleasant intentions may be more likely to be forgotten (not recalled) than pleasant ones (see, for further discussion, Meacham & Kushner, 1980).

Experimental studies have thus far investigated only the remembering of neutral intentions. However, a questionnaire study conducted by Meacham and Kushner (1980) suggests that intentions reported as remembered but not executed (i.e., postponed or cancelled) were described as more uncomfortable to carry out than those either remembered and satisfied or not remembered at all. A more extensive investigation of the outcome of pleasant and unpleasant intentions may prove to be a fruitful line of inquiry.

In summary, we can draw at least four distinctions between delayed intentions with reference to processes that operate during an encoding phase. So far, only one of these—the importance of an intention—has been investigated. One reason for this might be that self-generated, pleasant–unpleasant intentions based on difficult decisions are not easy to experimentally manipulate, either in the laboratory or in the field. This is especially true of self-generated intentions, although a distinction between self- and other-generated intentions may not be as functionally important as, for example, the corresponding distinction in retrospective memory. The distinctions between pleasant and unpleasant intentions and between intentions based on either simple or difficult decisions are then theoretically more interesting. One possibility is that the ease with which a decision is made is dependent not only on circumstantial constraints (e.g., time, competing tasks) but also on individual differences in decision-making strategies or style (e.g., action- vs. state-orientation; see Goschke & Kuhl, 1993; Kuhl, 1985).[5] Another possibility is that factors shown to influence the retention and recall of pleasant and unpleasant information in retrospective memory research (e.g., positive and negative mood effects), may exert comparable influences on the recall of pleasant and unpleasant intentions. At present, however, the only means of exploring the theoretical importance of these distinctions is to study naturally occurring intentions, using either a questionnaire or a structured diary (see, e.g., Andrzejewski et al., 1991; Ellis, 1988a, 1988b; Ellis & Nimmo-Smith, 1993).

Retention

All delayed intentions, however they are differentiated at encoding, can be distinguished during a retention phase only in terms of the delay between their formation and the designated moment for retrieving and carrying out the intended action. As Baddeley and Wilkins (1984) suggested, they can be divided into short and long term intentions. Such a distinction is central to research on retrospective memory, and Baddeley and Wilkins argued that it may be appropriately applied to prospective memory. The processing necessary to sup-

[5] For example, it may be the case that action-oriented subjects tend to form their future intentions mostly on the basis of simple decisions, whereas state-oriented participants are more likely to form their intentions on the basis of difficult decisions.

port the timely retrieval of, for example, an intention to telephone someone in 5 min may be qualitatively different from that required to support an intention to telephone the person in 5 days (see Ellis, this volume, for further discussion). Laboratory studies of prospective memory have examined only the remembering of shorter term delayed intentions. Longer term intentions have been investigated in a natural context, using either diary studies or field experiments. To our knowledge, there are no reported studies that directly compared performance on short and long term delayed intentions that are equivalent in all major respects other than the extent of their retention intervals.[6]

The importance of considering also the nature of one's activities during this interval was highlighted in a study on shorter term intentions by Brandimonte and Passolunghi (1994). Their findings suggest that prospective memory failures occur because of interference from interpolated activities (see also, Ellis & Nimmo-Smith, 1993; Wichman & Oyasato, 1983). These effects, moreover, may be moderated by the importance of the delayed intention. Kvavilashvili (1987), for example, observed a reliable effect of the character of an intervening period (either unfilled or filled with an interesting–uninteresting activity) on the performance of a relatively unimportant intention, whereas no such effect was present for an important intention.

Retrieval

It is during this phase that an appropriate opportunity for carrying out an intention occurs. The retrieval phase is a critical one, therefore, in that it is here that an intention is either recalled or forgotten. All delayed intentions have to be remembered and carried out in response to particular occasions (defined by the when aspect). The nature of these occasions, however, varies in a number of different ways.

Event-, Time-, or Activity-Based Intentions. If we consider the basic nature of a retrieval occasion, several potentially different types can be identified—activities, locations, persons, objects, events, times, or time periods. We might wish to describe delayed intentions, therefore, as either time-based or activity-based or object-based, and so on. Kvavilashvili (1990), however, described three distinct types of prospective remembering based on the differences between events, times, and activities. Einstein and McDaniel (1990; this volume), on the other hand, draw a distinction between time- and event-based intentions only, whereas Harris (1984) differentiated between *appointment-*

[6]Einstein, Holland, McDaniel, and Guynn (1992) examined the effects of 15- and 30-minute delays on prospective remembering. Although no reliable differences in performance were observed, this manipulation does not really capture the difference between the shorter (minutes) and longer term (hours) delays under consideration here.

keeping intentions (time-based) and intentions to *do one thing before or after another* (activity-based).

To what extent can these different types of retrieval occasions be subsumed under the more general descriptions of time- versus event-based or time- versus activity-based intentions? An event is an occurrence relatively independent of a particular person. We speak, for example, of "attending an event," "an event happening," and so on. In this sense, persons, locations, and objects could all be classed as different types of event-based intentions—for example, when you see John, when you are in the kitchen, when you see a telephone. Activities, however, usually refer to something in which the individual engages. (Although one may observe another person's activity, a retrieval occasion that is defined with respect to that person's activity could be described as an event; for example, Mary has finished photocopying). An activity-defined retrieval occasion (such as taking a pill before or after dinner) requires the identification of our own actions rather than something that is independent of those actions. Finally, time-defined retrieval occasions (e.g., turn the oven off at 5:00 p.m.) appear to be different from both activity- and event-defined ones because time is a process independent of our activity and events.

A distinction between time-, activity- and event-based intentions may represent a reasonably coherent classification of different types of retrieval occasions. However, are these distinctions psychologically important? Are these different types of intentions, for example, associated with different processing requirements? Einstein and McDaniel (1990) suggested that whereas, in event-based intentions, the event provides an external cue for remembering those intentions, the same is not true of time-based intentions; the latter, they suggested, are more reliant on self-initiated retrieval processes. Thus, following Craik (1986), they argued that time-based intentions are more difficult for elderly persons to retrieve than are event-based ones and presented evidence in support of this conjecture (see Einstein and McDaniel, this volume).

With regard to the presence or absence of external cues, event- and activity-based intentions seem to be broadly similar to one another. After all, finishing an activity (e.g., a meal) may be regarded as an external cue in the same way that seeing a friend is a cue in an event-based task. Thus, both Brandimonte and McDaniel (personal communication, January, 1994) have argued that there is no need to distinguish activity-based intentions from event-based ones. However, there is another important dimension along which these intentions may differ. The retrieval of both event- and time-based intentions usually requires the interruption of an ongoing activity. For example, in order to buy some food on the way home, we have to interrupt a journey, and in order to keep an appointment, we have to interrupt writing an essay. The interruption of an ongoing activity is likely to place particular demands on current attentional resources. Retrieval of an activity-based intention, on the other hand, does not require such an interruption. In the latter case, we have to do some-

thing after finishing or before starting another activity—to do something during the gap between two consecutive activities.

If we take account of the presence–absence of an external cue and the interruption–noninterruption of an ongoing activity, then a three-way distinction between activity-, event-, and time-based delayed intentions is a theoretically valid proposal. The following predictions follow from this analysis. First, activity-based intentions are probably the easiest to remember at an appropriate moment, as they do not require the interruption of an ongoing activity and they benefit from the presence of external cues. (These cues, however, may be less distinctive than those associated with event-based intentions). Second, time-based intentions are probably the most difficult to remember because no obvious external cues are necessarily associated with the various times and our current activity must be interrupted in order to carry out an intention. Event-based intentions are likely to occupy an intermediate position in terms of ease of recall, because they share some features with both time- and activity-based ones; both event- and time-based intentions require interruption of an ongoing activity, whereas both event- and activity-based ones benefit from the presence of an external cue. These predictions, however, are based on an assumption that the presence or absence of an external cue and the necessity to interrupt our activity are of equal importance in determining the effects of different retrieval occasions on the outcome of delayed intentions. This assumption clearly requires empirical examination.

The potential differences and similarities between the remembering of activity-, event-, and time-based intentions have not been studied systematically. To our knowledge, there are only two experiments that attempted to compare subjects' performance on event- and time-based tasks. In one, a field study conducted by Sellen, Louiel, Harris, and Wilkins (1993), participants were asked to press the button of electronic badges (carried with them for 2 weeks during working hours) during each of several 5-minute intervals spaced 2 hours apart (time-based task) and whenever they were in a particular room (event-based task). In the other, a 30-min computer-based laboratory task (Richardson, cited in Einstein & McDaniel, this volume), some participants were asked to press a designated key once every 5 min (time-based), whereas others were asked to press the same key whenever they saw a question about a president (event-based). Both studies, despite considerable variations in design, produced converging evidence in support of a distinction between event- and time-based intentions and thus point to the importance of this distinction. Unfortunately, however, there are no experiments in which the distinctions between activity- and time-based and, more importantly, between activity- and event-based intentions were directly compared.

Pure or Combined Intentions. Retrieval occasions in everyday life, can occur in either a relatively pure form (activity- or time-based, for example) or

in combination—pure and combined intentions (cf. Ellis, this volume). Although laboratory studies typically define and investigate only pure intentions, naturally occurring intentions often take a compound form. For example, they may be a combination of event and time (give a message to a partner when he or she comes home at 6:00 p.m.), event and activity (give a message to a partner when you have finished writing a letter), or time and activity (telephone someone at 8:00 p.m. when you have finished watching a television program). On the whole, combined intentions may be more easily remembered at an appropriate moment than pure ones because the former provide more cues for retrieval (cf. West, 1988). Some support for this conjecture comes from a study conducted by Loftus (1971) in which participants were asked to convey their place of birth at the end of a verbally administered questionnaire (pure, activity-based intention). However, half of the subjects were also informed about the content of the final question (combined, activity + event-based task). As expected, those in the combined intention condition were more likely to relate their birthplace at the correct moment than were those in the pure intention condition.

Episodic or Habitual Intentions. A further distinction refers to the frequency and regularity with which a retrieval occasion occurs and its associated intention should be remembered and executed. Meacham and Leiman's (1975/1982) distinction between episodic and habitual intentions was made with reference to these dimensions. They suggested that episodic intentions refer to actions that are performed either infrequently and/or on an irregular basis, such as buying bread on your way home from work, whereas habitual ones refer to actions that are carried out in a regular or routine manner, such as brushing teeth or buying a newspaper on the way to work. They argued that habitual intentions are easier to remember than episodic ones, as the former provide additional cues from both the environment and preceding activities (see Ellis, this volume, for further discussion).

Episodic intentions, if defined in terms of frequency, can be divided further into single and repeated intentions (Kvavilashvili, 1992b). A single intention is one that has to be remembered on only one occasion in response to a single retrieval occasion (e.g., telephoning one's mother this evening). A repeated intention, on the other hand, is one that has to be remembered several times in response to a recurring occasion (e.g., telephoning one's mother every evening this week). Interestingly, repeated intentions seem to be a necessary intermediate stage in transforming a single episodic intention into a habitual one (e.g., telephoning one's mother every evening for the rest of the year). Like all habitual intentions, a repeated intention does not require one to make a new decision prior to each retrieval occasion. The intention is formed once only but, unlike a single intention, it has to be retrieved on more than one occasion. Although naturally occurring intentions are usually instances of either

single–episodic or habitual intentions, repeated intentions are useful and important in experimental research because they enable the collection of quantitative measures of prospective remembering (see, for further discussion, Kvavilashvili, 1992b).

Relatively few studies have attempted to investigate the distinction between episodic and habitual intentions, and one of these, an early field experiment by Meacham and Singer (1977), failed to reveal any reliable variation in the performance of the two types of intentions. However, as Harris (1984) pointed out, their experimental manipulation (participants had to post a card either every Wednesday or on a variable day each week) did not really capture the complexity of the distinction they described.[7] In contrast, a diary study conducted by Andrzejewski et al. (1991), reported findings in support of an episodic–habitual distinction—the likelihood of remembering to keep an appointment was positively related to the frequency of making such appointments. Some care, however, is clearly required in drawing a distinction between habitual and episodic intentions because it includes a possible confound between the regularity with which an action is carried out and the frequency with which it is carried out. An intention to attend a monthly seminar, for example, can be described as a regularly but infrequently performed action (see also Harris, 1984). Is this intention, therefore an episodic or a habitual one? Andrzejewski et al.'s study suggests that the frequency with which an intention has to be carried out may have a greater influence on performance than the regularity with which it is carried out. In fairness, Andrzejewski et al.'s study was not designed to clearly dissociate between regularity and frequency; moreover, in everyday life the two variables are likely to be correlated.

Pulse, Intermediate, or Step Intentions. Finally, retrieval occasions can be distinguished with regard to the temporal specification of a retrieval occasion (Ellis, 1988a; see also Harris and Wilkins' (1982) notion of a *window of opportunity*). Although some intentions have to be remembered within a very narrow time interval (such as a telephone call at 4:00 p.m.), others are associated with much longer time periods (such as a telephone call this evening). One of us introduced a broad classification scheme in which the former (narrow interval) intentions were described as *pulse intentions* and the latter as *step intentions;* intentions with temporal requirements that lie between are referred to as *intermediates* (see Ellis, 1988a, 1988b; Ellis and Nimmo-Smith, 1993). This scheme was constructed using information collected from a series of diary studies on naturally occurring intentions and refers primarily to time-based intentions. However, both event- and activity-based intentions may also

[7]It is extremely difficult to experiementally study habitual intentions. Indeed, Meacham and Singer (1977) were actually studying repeated intentions in both of their experimental conditions while varying only the regularity of to-be-performed action.

be described within the pulse–step classification scheme. For example, we may have to relay a message to a colleague whom we are likely to either meet briefly in the corridor (pulse, event-based), or see during a coffee break (intermediate) or attend a dinner with this evening (step). Similarly, we may need to take a medication either immediately (pulse, activity-based), within the next 15 min (intermediate) or any time after having our breakfast (step).

One obvious prediction that arises as a result of the pulse-step distinction is that step intentions may be easier to remember on time than are either pulses or intermediates; the relatively long time intervals associated with steps are likely to afford more opportunities for remembering. This is supported by a study conducted by Maylor (1990) who asked her subjects to telephone her either within a certain time interval each day (step) or at the same exact time each day (pulse). Maylor reported that those in the pulse condition performed worse than those in the step condition, both in terms of the number of calls they made and the number of errors or memory failures associated with those calls (e.g., calling outside the prescribed times). On the other hand, Ellis (1988a) reported a diary study on naturally occuring intentions in which pulses were less likely to be forgotten than were steps. Pulse intentions were rated as more important than steps, which could account for the discrepancy between the two sets of findings. However, further analyses of these data, together with the findings from a second diary study, suggest that both personal importance and the pulse–step distinction exert independent and reliable influences on the outcome of naturally occuring intentions (Ellis, 1988b; Ellis & Milne, 1992b).

One reason for the discrepancy between the field (Maylor) and diary (Ellis) investigations may arise from the type of mnemonic strategies that Maylor's participants claimed to have employed. Maylor reported that those in both the pulse and step conditions performed equally well if they used the same type of cue. Thus participants in both conditions who used conjunction cues (e.g., replanning the day for the call or tying it to a routine event) or external cues (e.g., external memory aid, such as a memo) performed better than those who used internal cues (i.e., reliance on memory alone). Those in the step condition who used conjunction cues might have been transforming a step into a pulse intention. Indeed, the operation of this strategy can be seen in naturally occuring intentions following a failure to carry out a step intention (Ellis, 1988b, this volume). Other differences between intentions in the two studies, such as single versus repeated, regular versus irregular intentions, may also be relevant to explanations of the observed variations in performance.

Finally, the results of Andrzejewski et al.'s (1991) diary study indicate that the effects of some pulse–step intentions may be mediated by the importance of these intentions. When participants have to keep important appointments, they report satisfying pulses slightly more often than steps, whereas for unimportant appointments more steps than pulses are successfully carried out (An-

drzejewski et al., 1991). Further investigation is necessary to study differences in pulse and step intentions. As we pointed out earlier, in everyday life retrieval occasions are often combined (e.g., time + event) rather than pure. It may be more appropriate, therefore, to study the possible effects of the pulse–step distinction in the laboratory where both pure and combined intentions are easier to define and where a greater degree of experimental control is possible (for further discussion, see Ellis, this volume).

In summary, a total of four distinctions can be drawn at a retrieval stage of prospective remembering. An important difference between these and the previous distinctions is that each of the former have been examined in at least one experimental study. This situation is probably due to a particular interest, from researchers, in the processes that operate during the retrieval phase of prospective remembering. Moreover, unlike most of the previous distinctions, these four are potentially amenable to experimental investigation. The only exception is probably the episodic–habitual distinction. As suggested earlier, it is almost impossible to simulate habitual intentions not only in the laboratory but also in a field experiment. At present, the only way to experimentally study this distinction is to define repeated intentions and to vary the frequency and regularity with which these intentions have to be carried out (Meacham & Singer, 1977; Wichman & Oyasato, 1983). An alternative is to study naturally occuring habitual intentions using diaries and questionnaires.

PERFORMANCE

In common with many researchers, we suggest that the primary characteristic of prospective remembering appears to be the retrieval of an intention at an appropriate moment (for further discussion, see Einstein & McDaniel, this volume). Although performance of the intended action does not seem as crucial for prospective remembering as the retrieval phase, it may have some impact on retrieval. Two aspects of the performance phase that might be relevant in this regard are discussed here:

Momentary, Short, or Long Intentions. Delayed intentions can be distinguished with reference to the amount of time that is required to carry out the intended action. Although some may be executed within a few seconds or minutes (e.g., conveying a message), others may occupy several hours (e.g., going shopping) . The former can be referred to as *momentary intentions,* and the latter as *long* or *time-consuming intentions,* whereas intentions that require more than few minutes but less than an hour (such as a phone call) can be classified as *short intentions.* It is clearly difficult to decide upon an exact criterion for distinguishing intended actions that lie between the two extremes (min vs. hours). However, it seems likely that intentions associated with ac-

tions that take either a few seconds, 20 min or several hours will have different processing demands. One possibility is that more time-consuming intentions will tend to elicit more elaborative processing at encoding. Satisfaction of these intentions is more likely to require, for example, greater reorganization of normal activities and thus the application of planning processes in order to accommodate them into a particular time period. Relatively time-consuming intentions may also be more likely to require the performance of other, enabling actions (e.g., checking the refrigerator and making a shopping list prior to going to the shops). Thus it is possible that, as a result of the effects of these variables on encoding, long or time-consuming intentions may be less vulnerable to failure than either short or momentary ones.

One- or Two-Stage Intentions. A second distinction refers to the number of times one has to remember an intention in order to complete a prospective memory task. Consider, for instance, one-stage and two-stage intentions (although there may be three- and even multi-stage ones). In the former, only one act of remembering is necessary (e.g., to convey a message to a colleague when you see her in the coffee room), whereas in the latter, two acts are necessary (e.g., to take a letter when setting out to work and to post it on your way to work). Theoretically, two opposite but equally plausible predictions can be made about the relative likelihood of completing one- and two-stage intentions. According to Lewin (1926/1951), for example, remembering the first step of a two-stage intention should result in the partial discharge of tension associated with that intention, and this may result in a failure to remember the second step. On the other hand, extrapolation from more recent models of action control (e.g., Norman, 1981; Reason, 1984) suggests that remembering the first step should enhance the activation level of action schemata associated with that intention and thus increase the probability of remembering the second step. The likelihood of this facilitation effect, however, will clearly depend on the degree to which the two action stages are integrated at encoding (for further discussion, see Ellis, this volume). Although it would be interesting to test these two hypotheses, it may be difficult to model two-stage intentions in the laboratory. Field experiments, diaries, and questionnaires may provide a more appropriate vehicle for examining a one- versus two-stage distinction.

In summary, two possible distinctions emerge at the final performance phase of prospective remembering. These distinctions are both practically and theoretically important. To our knowledge, however, no relevant research has been conducted on these distinctions, nor have they been identified as a potentially interesting area of prospective memory research. This is probably due to an insufficient emphasis on the role of performance phase in prospective remembering. However, carefully controlled field experiments, diaries, and questionnaires could provide us with important information on these distinctions.

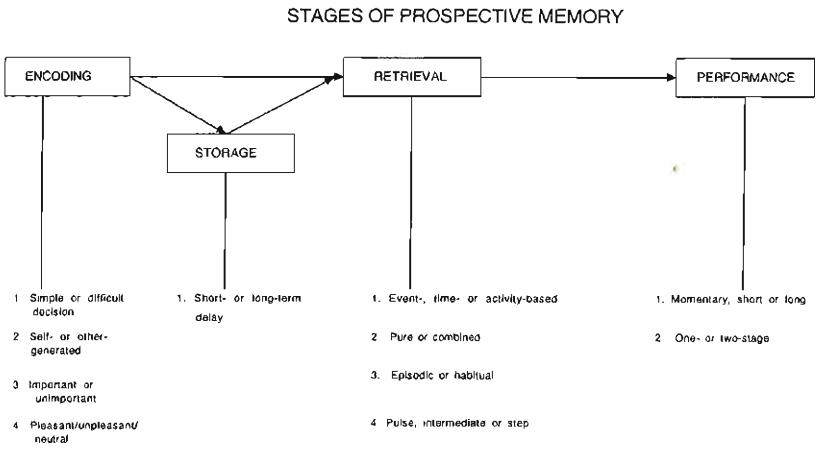

FIG. 2.3. Illustrating possible types of delayed intentions, classified according to variations at the encoding, storage, retrieval, and performance phases of prospective memory.

CLASSIFICATION OF EXISTING EXPERIMENTAL PARADIGMS

In this chapter, we try to show that the great variety of intentions people have to remember and carry out in their life can perhaps be best classified with regard to processing that occurs during each of the four main stages of prospective remembering. This classification scheme is summarized in Fig. 2.3. Naturally, this scheme is by no means exhaustive—one may easily continue to draw new and finer grained distinctions. However, the intention types outlined here seem to be the most obvious and potentially important for future prospective memory research. We also try to demonstrate that this research can actually be conducted using a variety of research methods. If a certain intention type does not render itself to experimental manipulations then it is always possible to employ a nonexperimental method, such as structured diaries or questionnaires.[8] Although the latter are popular in everyday memory research, few are used to directly investigate prospective remembering.

As Fig. 2.1 illustrates, most prospective memory studies have employed an experimental method. In some experiments participants are asked to perform an action during a laboratory task (e.g., pressing a key on a computer keyboard) whereas in others, they are asked to carry out an action in the course

[8]These methods are particularly relevant for studying intentions preceded by difficult decisions, self-generated intentions, pleasant–unpleasant intentions, two-stage intentions and long or time-consuming intentions.

of their everyday activities (e.g., post a letter)—laboratory and field experiments, respectively. Both types can be further divided according to the character of the task the participants have to remember at a designated moment. Tasks can either be artificial or similar to those encountered in everyday life—artificial and natural tasks. The advantages and limitations of the four experimental paradigms emerging from this alternative classification scheme proposed by one of us, were discussed elsewhere (Kvavilashvili, 1992b). A possible weakness of this classification is that it is not always easy to decide whether a certain prospective memory task is artificial or natural (cf. Winograd, 1988a). Moreover, a distinction between artificial and natural tasks may not be critical for empirical research. Kvavilashvili (1992b), for example, suggested that the problem of obtaining ceiling effects was more likely to occur when artificial tasks were prescribed. However, recent laboratory experiments using artificial tasks (e.g., pressing a response key when a certain target word occurs), consistently managed to avoid ceiling effects (see, e.g., Brandimonte & Passolunghi, 1994; Einstein & McDaniel, 1990; Mäntylä, 1993; McDaniel & Einstein, 1993). In contrast, the classificatory scheme presented in this chapter (see Fig. 2.3) captures a theoretically motivated set of distinctions. It enables us to focus both on the processes underlying prospective remembering and the appropriateness of different research methods in relation to a particular research question.

If we examine existing experimental studies of prospective remembering with respect to the distinctions illustrated in Fig. 2.3 then all have investigated the following—neutral, relatively unimportant, episodic, pure, pulse, mostly one-stage, momentary intentions, generated by other people (usually an experimenter), and formed as a result of simple decisions. Some experiments, however, have examined the remembering of short-term delayed intentions, and others have investigated longer term ones. These studies can be further divided according to the type of retrieval occasion—event-, time-, and activity-based intentions. If we focus only on these last two distinctions, then all existing experimental studies in prospective remembering easily fall within one of the six experimental paradigms that emerge (see Fig. 2.4). In Fig. 2.4, it can be seen that all experiments on short-term delayed intentions have taken place within the laboratory, whereas long-term delayed intentions have been investigated using field experiments. Event- and activity-based intentions have usually been studied in the laboratory, whereas time-based intentions have mainly been investigated in the field. (Diary studies and questionnaires tend to examine event-, time-, and activity-based, longer term delayed intentions).

This classificatory scheme reveals an interesting pattern with respect to the remaining distinctions we discuss in this chapter. For example, all short-term delayed intentions (whether event-, time-, or activity-based) studied in the laboratory are examples of pure, pulse, one-stage, momentary intentions,

whereas there is no such uniformity with long-term delayed intentions. Indeed, some of the latter (field) experiments investigated pulses (Levy & Clark, 1980; Maylor, 1990; Moscovitch & Minde, 1982 [cited in Moscovitch, 1982]; Poon & Schaffer, 1982; Wilkins & Baddeley, 1978), and others examined either intermediates (Levy, 1977; Maylor, 1990; Sellen et al., 1993) or steps (Meacham & Leiman, 1975/1982; Meacham & Singer 1977; West, 1988). Some of these experiments examined performance on momentary intentions (e.g., pressing the button of an electronic badge), whereas others required the execution of either short or more time-consuming intentions (e.g., making a telephone call or keeping an appointment, respectively). Finally, some field studies of longer

	Short-Term Delayed	Long-Term Delayed
Event-Based	Dobbs & Rule, 1987 Cockburn & Smith, P. T., 1991b Einstein & McDaniel, 1990 Einstein et al., 1992 Mäntylä, 1993 Maylor, 1993a McDaniel & Einstein, 1993 Brandimonte & Passolunghi, 1994	Somerville et al., 1983
Time-Based	Harris & Wilkins, 1982 Wichman & Oyasato, 1983 Ceci & Bronfenbrenner, 1985 Patton & Meit, 1993 (Exp. 1)	Meacham & Leiman, 1975 Meacham & Singer, 1977 Wilkins & Baddeley, 1978 Moscovitch & Mindes, 1982 (cited in Moscovitch, 1982) West, 1988 (Exp. 1) Maylor, 1990 Patton & Meit, 1993 (Exps. 1 & 3) And all studies in compliance (see Fig. 2.1)
Activity-Based	Birenbaum, 1930 Loftus, E., 1971 Meacham & Dumitru, 1976 Meacham & Colombo, 1980 Kvavilashvili, 1987 West, 1988 (Exp. 2) Cockburn & Smith, P. T., 1991b	Somerville et al., 1983 Dobbs & Rule, 1987

FIG. 2.4. Classification of published experimental studies into one of six categories defined by the length of the retention interval for an intention (short or long) and the type of retrieval occasion (event, time, or activity) on which the intention has to be recalled. (Some studies fall into more than one category because participants were asked to perform more than one type of intention.)

term intentions investigated pure time-based ones (e.g., Wilkins & Baddeley, 1978), and others probably combined ones (e.g., Meacham & Leiman, 1975/1982).

CONCLUSIONS

In this chapter, we draw attention to some of the distinctions and possible classificatory schemes that may be important for future prospective memory research. We show that a variety of everyday behavioral errors and failures can be classified in terms of the type of intention (immediate or delayed) that is formed, and that absent-minded slips and errors occur in relation to immediate intentions, whereas prospective memory failures are always associated with delayed intentions. We demonstrate also that the great variety of intentions people usually have to remember and carry out in their everyday lives can perhaps be best classified in relation to the encoding, storage, retrieval and performance phases of prospective memory.

A total of eleven distinctions are drawn with respect to these four phases (see Fig. 2.3). Some of these distinctions are theoretically more important than others. The four that refer to the retrieval phase of prospective remembering, for example, may be of paramount importance given the critical role of this phase in the successful completion of a prospective memory task. We also suggest that some of the distinctions outlined in the study can be easily investigated in the laboratory, whereas it may be appropriate to study others using either field experiments or diaries and questionnaires. Finally, the distinctions between short- and long-term delayed intentions and event-, time-, and activity-based intentions, and the six experimental paradigms that result from these distinctions, appear to provide a useful means of organizing existing experimental studies. The latter classification indicates that most published experiments on short-term delayed intentions actually studied event- and activity-based intentions only, in the laboratory, whereas experiments on longer-term delayed intentions examined mainly time-based intentions outside of the laboratory.

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