

The influence of partial-match cues on event-based prospective memory

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In event-based prospective memory tasks people form an intention to respond when an environmental cue signals that conditions are appropriate to fulfil an intended activity. In the ongoing activity the authors embedded partial-match cues that only partially, but not completely, satisfied the conditions required to make a prospective response. The consequence of encountering these partial-match cues was to increase responses to appropriate prospective memory cues encountered later. This outcome occurred both with semantic and orthographic cues, but only the former led to longer processing latencies of the partial-match cues. This asymmetry suggests that partial-match cues may not need to be processed consciously in order to benefit event-based prospective memory. A parametric manipulation of the number of partial-match cues resulted in numerically but not statistically better prospective memory. Consequently, partial-match cues may function as overt reminders of the intention to respond or they may serve to engage participants in self-initiated reminders of the intention.

When the current conditions are not conducive to performing an activity immediately, people generally form an intention to complete it at a later time. This need to retain an intention in long-term memory over longer retention intervals distinguishes “delayed intentions” from “intentions in action” (e.g., Ellis & Milne, 1996). If a decision is made to carry out an activity at the moment it occurs, such as deciding to retrieve a beverage from the refrigerator, then this activity constitutes an “intention in action” (Dalla Barba, 1993). In the case of delayed intentions, people must either engage in self-initiated retrieval of the intended action or the environment must cue them to

accomplish it at an appropriate opportunity. In this article we are concerned with one particular type of delayed intention, namely, event-based prospective memory. In this type of memory, people form the intention to perform an activity when environmental cues remind them to do so (e.g., Einstein & McDaniel, 1990; McDaniel & Einstein, 1993). For example, an individual may have the intention to retrieve dry cleaning when passing the shop where it was taken last week. In this case, seeing the shop may serve as a cue to fulfilling the intention.

The question we address in this article concerns whether encountering partial-match cues will

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We wish to thank Austin Evans, Carrie Shipley, Amy Morris, and Denise Zelikov for their dedicated help in collecting the data. We are also deeply indebted to Judi Ellis, Timothy Perfect, and an anonymous reviewer for their suggestions.

influence performance when an appropriate cue is encountered later. For example, will encountering different dry cleaning shops across town affect whether the shop containing one's clothes serves as an effective reminder on a subsequent occasion? We believe that it might, because our intuition is that the status of a delayed intention does not remain static over a retention interval. Rather, intentions are probably subject to substantial change by the cognitive activity of daily life. For example, intentions are often postponed, cancelled, or their priority increased (Marsh, Hicks, & Landau, 1998). Intentions that are re-planned, reformulated, or otherwise elaborated may have a higher probability of being carried out (Chasteen, Park, & Schwarz, 2001; Mäntylä, 1993). In the dry cleaning example, the realisation that the clothes are to be worn at a special event the following day increases the importance of performing the action and is likely to increase the probability of carrying out the task (Kliegel, Martin, McDaniel, & Einstein, 2001; Kvavilashvili, 1992). In a similar vein, encountering the wrong dry cleaning shops could change the effectiveness of seeing the correct cue.

In laboratory paradigms of event-based memory, participants are engaged in an ongoing task such as rating the pleasantness of words (Marsh, Hicks, & Hancock, 2000), naming famous faces (Maylor, 1993, 1996), judging the sensibleness of sentences (Ellis, Kvavilashvili, & Milne, 1999), or remembering words for a short-term memory test (Einstein, Holland, McDaniel, & Gynn, 1992; Einstein, McDaniel, Richardson, Gynn, & Cunfer, 1995; Park, Hertzog, Kidder, Morrell, & Mayhorn, 1997). This ongoing task is intended to mimic real-world conditions in which people are busily engaged in some activity when a prospective memory cues presents itself. Prior to commencing that ongoing task, people are told to perform an additional task whenever a prospective cue appears such as an animal word, a face with glasses, the word *prefect*, or when the background on the computer monitor becomes a certain colour. The proportion of times that participants notice and respond to the cue(s) is a measure of successful event-based performance.

Our goal in this study was to examine the consequences to event-based performance of participants encountering partial-match cues that were related to the intention but did not constitute appropriate conditions to respond. In the current experiments, participants formed the intention to respond to animals that began with the letter L

(e.g., *lion*, *lamb*). During the course of the ongoing activity they encountered words that only partially matched the necessary conditions for fulfilling the intention. Examples of partial-match cues include encountering either the word *lake* or the word *horse*. West and Craik (1999) have referred to such partial-match cues as prospective memory lures. Encountering a partial match to a prospective cue should not result in the intended activity being carried out because the conditions set forth in the intention have not been entirely met. However, noticing and inhibiting a response in the presence of a partial cue may change the mental representation of the intention. As mentioned before, passing a dry cleaning shop that is not the one where laundry was left may have some consequence on later event-based performance. In fact, West and Craik found that older adults will false alarm to partial-match cues whereas younger adults will not. One question of interest is how encounters with the partial-match cues will affect younger adults when they later experience the actual prospective memory cues. In other words, our interest in studying partial-match cues emanates from understanding how an intention might change from its original formation as a consequence of encountering these partial-match cues.

Theoretically, several outcomes could occur. First, if the intention is not retrieved when a partial-match cue is encountered, then later prospective memory may not be affected at all. The effectiveness of prospective memory cues in bringing the intention to mind may be a function of the type (or degree) of overlap with valid prospective cues. For example, passing the wrong dry cleaning shop may be a more effective partial-match cue than passing a clothing or a tailoring shop. For this reason, two different types of partial-match cues will be tested in Experiment 1. Second, a partial-match cue may not consciously bring the intention to mind but may still serve as some sort of unconscious priming of the intention. Priming could occur through a mechanism such as spreading activation or heightened retrieval sensitivity (Mäntylä, 1993). In this case, later performance to the valid prospective cues might be improved. Admittedly, there is no easy way of measuring whether such an unconscious mechanism is operative. Nevertheless, it is a viable theoretical mechanism (e.g., Einstein & McDaniel, 1996; McDaniel & Einstein, 1993). Consistent with this alternative, Ellis, Burkes, and Milne (1997) reported that participants who had been

asked to respond to the word *boat* did so more often if they had been primed with a synonym of boat several trials earlier.

A third possibility is that the partial-match cue might be noticed and the intention retrieved consciously. One reason that the partial cue might be noticed is that intention-related material may be perceptually more available (Goschke & Kuhl, 1996). If such conscious noticing occurred, then the partial cue would serve as something akin to a self-initiated reminder about the prospective task. Such an outcome might increase the likelihood of responding to subsequent event-based cues. However, not all reminders are equally effective at increasing event-based performance (Gynn, McDaniel, & Einstein, 1998). For example, reminders just about the cues or just about the action to be performed are inferior to reminders that refer to both the cue and the action together. One significant differences between the reminders that have been studied and those that might come in the form of a partial-match cue is that the former is an external reminder whereas the latter constitutes a self-reminder. One well known fact from the retrieval practice literature is that retrieving material serves as a far more potent study trial than merely re-experiencing the same material again (Bjork, 1988). By this account, if partial-match cues serve as a form of retrieval practice, they should increase later performance to actual event-based cues.

A fourth and final possibility is that encountering partial-match cues might decrease subsequent prospective memory. Anderson and Green (2001) had participants learn cue–target word pairs. For some pairs they had to retrieve the target when given the cues (practice) and for others they were asked to inhibit retrieving the targets. Subsequent ability to retrieve the targets was worse for the items that had earlier been inhibited. Therefore, if partial-match cues result in having to inhibit the intention, then their occurrence in the ongoing task might decrease event-based performance. However, this outcome would only occur if the partial-match cues cause active inhibition of the type being studied in Anderson and Green's suppression paradigm.

Therefore, the theoretical alternatives do not clearly delineate whether performance will increase, decrease, or remain the same as a consequence of encountering partial-match cues (or even the type of partial-match cue). Although it may represent a challenge to specify by which account performance would increase (i.e., con-

sciously, unconsciously, or both), our investigation is nevertheless an initial attempt to understand how encountering material partially related to an intention affects event-based performance (cf. Ellis et al., 1997; West & Craik, 1999).

EXPERIMENT 1

In Experiment 1 we embedded two event-based cues in a series of 100 pleasantness rating trials on words. We embedded a number of partial-match cues leading up to the occurrence of each of the animal words starting with L. In order to determine if the type of partial-match cue affected event-based performance, some participants received semantic cues (an animal word starting with another letter, *horse*) and others received orthographic cues (a word starting with L, *lake*). If partial-match cues do not change the memorial status of an event-based intention, then performance in the orthographic or semantic condition will be equivalent to a control group that does not encounter any partial-match cues. Alternatively, perhaps orthographic versus semantic partial matches may affect performance differently, and in turn, such a difference might provide one handle on the theoretical mechanism by which they can change the status of the intention.

Method

Participants. A total of 108 University of Georgia undergraduates volunteered in exchange for partial credit towards a course research requirement. Each participant was tested individually in sessions that lasted approximately 25 minutes. As described shortly, 36 volunteers were assigned to each of three different between-subjects conditions, namely, a control group, an orthographic partial-match group, and a semantic partial-match group.

Materials and procedure. The basic procedures are ones that we have used on several previous occasions (Hicks, Marsh, & Russell, 2000; Marsh et al., 2000). Participants rated 100 words for how pleasant they were on a 1–5 Likert scale by pressing one of the number keys along the top row of the keyboard. Two prospective memory cues occurred at trials 48 and 96. The two cues were randomly drawn from a pool of four animals that began with the letter L (*leopard*, *lamb*, *lion*, and *lizard*) and randomly assigned to one of the

two prospective trials by the software controlling the experiment. The remaining 98 items were medium to high frequency items selected from the Kučera and Francis (1967) compendium. None of these items were related to animals and none started with the letter L. These items were assigned randomly to trials in the experimental sequence. All randomisation was performed anew for each participant. An additional 18 animal words were selected from the Battig and Montague (1969) norms for use in the semantic partial-match condition. Nine of these items randomly replaced words in the sequence before the first prospective cue, and the remaining nine animals replaced words between the first and second prospective cues. Each prospective cue was buffered by a minimum of three unrelated words prior to its occurrence. In the orthographic condition, rather than animals, words beginning with the letter L were inserted into the sequence in an identical manner to the semantic condition.

When participants arrived they read instructions from the computer monitor concerning the pleasantness rating task. This ongoing task was verbally explained again by the experimenter who informed participants that we were also interested in their ability to remember to perform an action in the future. The experimenter went on to explain that if they ever encountered an animal beginning with the letter L that they should press the / key *before* making their pleasantness rating. The experimenter also provided an example of a prospective cue (but not one that they would encounter later, for example, llama). Once the experimenter was convinced that the participant understood both tasks, a distractor activity was initiated for 5 minutes to ensure that the prospective task was not a vigilance task (for a discussion of retention intervals see Hicks et al., 2000). After the distractor period, the experimenter initiated the pleasantness rating task without reference to the prospective task. On each trial of the experimental sequence, a short warning tone and the query *Pleasantness?* appeared two lines beneath the word to be rated. The computer recorded all prospective key presses and the reaction times to make pleasantness ratings.

Results and discussion

Unless specified otherwise by a *p* value, statistical significance does not exceed chance by the conventional 5% throughout this article. We begin by

addressing two analytic issues. First, participants could have made a late prospective response on a subsequent trial, but this occurred very rarely (less than 2%) and the results do not hinge on the way these responses were counted. We have traditionally classified these as missed responses and have done so here. However, if a participant responded after making their pleasantness rating judgement and before the next trial began, this was counted as a successful prospective response. Second, participants in the semantic or orthographic conditions could have false alarmed to the partial-match cues and issued an erroneous response. Like West and Craik's (1999) younger adults, the participants in this study rarely did so (less than 1%) and such responses were too rare to analyse in any meaningful way.

The upper section of Table 1 contains the average proportion of trials that received a successful prospective response in each of the three conditions. The inclusion of partial-match cues significantly changed event-based performance, $F(2, 105) = 3.38$. Performance was significantly better when orthographic partial matches were encountered in the experimental sequence as compared with the control condition that contained none, $t(70) = 2.50$. The same was numerically true of the semantic condition except that the statistical test fell on the cusp of conventional significance, $t(70) = 1.84$, $p = .07$. The two condi-

TABLE 1
Average proportion of successful identifications of the event-based prospective memory cues in Experiments 1–3

<i>Experiment and condition</i>	<i>Mean</i>	<i>SE</i>
<i>Experiment 1</i>		
Control	.57	.07
Orthographic cues	.81	.07
Semantic cues	.74	.06
<i>Experiment 2</i>		
<i>Even spacing</i>		
Control	.54	.08
Four semantic cues	.73	.06
Eight semantic cues	.81	.07
<i>Randomly distributed</i>		
Control	.58	.08
Four semantic cues	.71	.06
Eight semantic cues	.81	.06
<i>Experiment 3</i>		
Control	.48	.06
Two reminders	.65	.06
Four reminders	.60	.07
Six reminders	.63	.06

tions with partial-match cues did not differ from one another, $t(70) < 1$, n.s. Therefore, the data indicate that encountering partial-match cues improves subsequent event-based prospective performance.

If the partial-match cues are receiving additional cognitive processing, then latencies to make a pleasantness rating on these items might be longer than latencies to the remaining (and unrelated) words in the ongoing activity. By contrast, if they are not noticed or otherwise do not attract any attention, the latencies might be equivalent to the other words. Processing latencies were not different for the orthographic partial-match trials (1876 ms, $SE = 119$) as compared to the remaining non-prospective words (1889 ms, $SE = 123$), $t(35) < 1.0$. However, processing latencies were indeed slower for the semantic partial-match trials (1876 ms, $SE = 90$) as compared with the remaining trials (1711 ms, $SE = 68$), $t(35) = 3.29$. The fact that both sorts of partial-match cues led to increased performance, but only the semantic cues evoked slowing, suggests that participants may be using different strategies in the two between-subjects conditions. In the semantic condition, the animal cue may prompt a verification check that the word does not begin with L. By contrast, words beginning with L in the orthographic condition may not prompt a check that the word fails to denote an animal (because the orthographic feature is not very salient). Therefore, in the semantic condition some amount of extra attention may be devoted to the partial-match cues whereas no extra attention is evident with orthographic partial-match cues. Given that event-based prospective memory was increased by both semantic and orthographic partial-match cues, but reaction time latencies were not uniformly slower to both types of cues, this outcome suggests that the mechanisms responsible for increased performance may be unconscious. Of the alternative mechanisms considered in the introduction section, spreading activation or priming are most consistent with the results from this experiment, and the conscious retrieval practice account would be least consistent.¹

¹ The reader should note that we asked participants to make their prospective response before the pleasantness rating; therefore, latencies on the prospective trials are meaningless because they reflect two overt responses.

EXPERIMENT 2

The results from Experiment 1 suggest that partial-match cues can change the representation of an event-based intention in memory. As compared to the control condition, these partial cues increased subsequent responding. The goal of Experiment 2 was to determine whether the number of partial-match cues might influence performance. If the mere presence of partial-match cues simply acts to increase the importance of the prospective task, then perhaps the number encountered does not affect subsequent performance. In other words, one or two partial-match cues could increase the perceived importance of the task and the remaining partial cues have no additional effect. Consistent with such an interpretation, Ellis (1988, 1996) has argued that it was the occurrence of recollecting an intention rather than the frequency of recollection that predicted successful prospective remembering. By contrast, if partial-match cues serve as episodes of retrieval practice for the intention or act to increase unconscious priming (i.e., the activation level of the intention), then event-based performance may increase with greater numbers of them. We also took the opportunity to administer a brief post-experimental questionnaire concerning participants' retrospective intuitions about their noticing the partial-match cues. Admittedly, such data are fraught with interpretative issues, and so we will use this information cautiously and conservatively.

Method

Participants. A total of 156 University of Georgia undergraduates volunteered in exchange for partial credit towards a course requirement. Each participant was tested individually in sessions that lasted approximately 25 minutes. Similar to Experiment 1, three between-subjects conditions were tested: a control condition contained no partial cues, another condition contained four semantic partial matches preceding each prospective cue, and the third condition had eight semantic partial matches preceding each cue. As described shortly, the spacing of the partial-match cues was also manipulated. Therefore, there were six between-subjects conditions with 26 volunteers tested in each.²

² Obviously, manipulation of spacing is irrelevant in a control condition. However, half of this experiment was conducted in response to the review process, and therefore we thought it prudent to re-collect a control condition as well.

Procedure. The procedure was virtually to Experiment 1. The control condition contained no partial-match cues. The remaining two conditions used only the semantic partial-match cues from Experiment 1. In one condition, four semantic partial cues were randomly inserted in the trials leading up to each prospective memory cue (for a total of eight partial cues). In the other condition, eight semantic partial cues were randomly inserted in the trials leading up to each cue (for a total of 16 partial cues). Because we evenly spaced explicit reminders in Experiment 3, and we wanted to facilitate any cross-experimental comparisons to this experiment, three conditions were tested in which the partial-match cues were evenly spaced throughout the ongoing task. In the four-cue condition, the partial matches occurred every 10 trials starting at trials 10 and 60. In the eight-cue condition, partial-match cues occurred every five trials starting at trials 5 and 55. Thus, spacing by numbers of partial matches yields a 2×3 between-subjects design (cf. footnote 2). At the conclusion of the experimental sequence, the experimenter asked the participant three questions that are described later.

Results and discussion

The data are summarised in the middle of Table 1. We conducted a 2 (spacing: random vs even) by 3 (condition: control, four, eight) ANOVA model to initially analyse the data. Only the effect of condition was statistically significant, $F(2, 150) = 6.85$. There was neither an effect of spacing, $F(1, 150) < 1.0$, nor an interaction, $F(2, 150) < 1.0$. Therefore, how the partial-match cues occur during the ongoing task (i.e., spacing) does not appear to influence performance. All that does appear to matter is that they do occur because their presence increased subsequent event-based prospective performance. As is obvious from the means, the magnitude of the increase from zero to four partial matches is about twice as great as the magnitude of the increase from four to eight partial matches. Owing to the large variability in these sorts of experiments, even pooling over the spacing conditions to obtain 52 observations in each of the four-cue and eight-cue conditions does not result in a statistically significant difference between them, $t(102) = 1.43$, n.s.

On the one hand, that outcome is consistent with Ellis's (1988) observation that *any* conscious occurrence of recollecting an intention may be

more important than the frequency with which those recollections occur. If the recollections are conscious and if the partial-match cues serve as retrieval practice, then the outcomes from this experiment are consistent with the idea that there are diminishing returns to additional practice (Anderson, 1983). On the other hand, the non-significant rise from four to eight partial matches is also consistent with an unconscious priming account. Given that orthographic partial matches did not attract attention in Experiment 1 but did increase event-based performance, the priming account appears to be supported by these data, whereas more conscious mechanisms did not receive any compelling additional support.

Next we turn to the latency analyses of the ongoing task for partial-match trials versus other nonprospective trials. Again spacing was not a significant factor and we used only one type of partial-match cue (animals), therefore we pooled over the four conditions in which partial cues were presented. Latencies were longer on those trials containing a partial-match cue (2187 ms, $SE = 88$) as compared with the remaining nonprospective trials (2050 ms, $SE = 87$), $t(103) = 3.00$. That result replicated Experiment 1 and suggests that the partial-match cues may be receiving some sort of extra cognitive processing. As speculated earlier, these outcomes may indicate that the intention is being retrieved when a semantic partial-match cue is encountered and the incomplete match is recognised. Of course, the same might not have been true in the orthographic condition of Experiment 1, a point we return to in the General Discussion section.

After the completion of the experiment, a brief post-experimental questionnaire was administered. The first question simply asked whether participants "noticed anything special" about the nonprospective words. No participants in the conditions with partial matches reported noticing other animal words that did not begin with L. When asked more directly if they remembered seeing animal words that did not begin with L, every participant (100%) in the four-cue partial-match condition responded affirmatively and everyone in the eight-cue condition responded likewise. Therefore, participants are reporting that they have memory for these partial-match cues, at least retrospectively. The third question concerned whether the other animal words "served as a reminder" about the intention to respond to animals beginning with L. In the four-cue partial-match condition 79% responded

affirmatively and 71% did likewise in the eight-cue partial-match condition. Although it is unclear if these reports contain demand characteristics to respond in the affirmative, participants are claiming that the partial match served to “remind” them of the prospective intention. Of course, the only way that the partial matches could remind participants of the intention is if they engaged in self-initiated retrieval of it. Retrieving the intention is needed in order to reject the word as not fully matching the appropriate conditions to respond.

EXPERIMENT 3

One unresolved issue concerns specifying the locus of the improvement associated with encountering partial-match cues in the ongoing activity. One possibility is that the partial-match cues simply serve as *external* reminders of the prospective memory task (Einstein et al., 1995; Vortac, Edwards, & Manning, 1995). If this were true, then a parametric increase in the number of external reminders might give rise to a linear increase in event-based performance. Consequently, the goal of Experiment 3 was to assess whether increasing the number of external reminders would increase event-based performance. As mentioned earlier, however, there could be a fundamental difference between externally presented reminders and internally generated reminders. The latter may have greater potency and significance. Guynn et al. (1998) found that only reminders containing both the cue and the action that was to be performed improved event-based memory. Although Guynn et al. used only a static number (three) of reminders, we used the same type of reminder that has already been demonstrated to be effective and we varied how frequently they occurred in four between-subjects conditions.

Method

Participants. A total of 96 University of Georgia undergraduates volunteered in exchange for partial credit towards a course research requirement. Each participant was tested individually in sessions that lasted approximately 25 minutes. Based on their arrival at the laboratory, 24 participants were randomly assigned to each of four conditions.

Procedure. No partial-match cues were used in any of the four conditions. In a no-reminder (control) condition participants merely performed the tasks as instructed in the control conditions of Experiments 1 and 2. In three other conditions, two, four, or six external reminders preceded each event-based cue. The reminders were all identical and they were evenly spaced in the trials leading up to the prospective cues (i.e., similar in format to the even spacing condition in Experiment 2). The reminders occurred in between trials and consisted of a unique sound and the following message presented in the centre of the computer monitor: “Remember to press the / key when you see an animal starting with L”. The reminder remained on the screen for 5 seconds and then the sequence of trials resumed automatically. We specifically chose fewer numbers of reminders in this experiment than we used partial-match cues in the last experiment because we were concerned about a potential ceiling effect with six explicit reminders preceding each cue. In all other respects, this experiment was conducted identically to the previous ones.

Results and discussion

The results are summarised in the bottom portion of Table 1. Visual inspection of the average proportion of times the prospective cues evoked a response suggests that reminders improved performance, but increasing numbers of them had no additional effect. These impressions were confirmed statistically, $F(1, 94) = 4.44$. In fact, none of the conditions with reminders differed from one another, all $t(46)s < 1$. This result suggests that increasing the number of external reminders that contain both cue and action does not add any incremental benefit to subsequent event-based prospective memory performance. In addition, the absence of any increase in event-based performance with increasing numbers of reminders in this experiment is similar to the outcome from Experiment 2 where there was no statistically significant rise in performance from increasing the number of (semantic) partial-match cues encountered from four to eight. To the extent that explicit reminders serve to heighten the activation of intentions in memory (e.g., Mäntylä, 1993), the partial-match cues used in Experiments 1 and 2 may be serving the identical function. Because the external reminders were processed consciously in this experiment, and because semantic partial-

match cues attracted extra attention in the ongoing task in Experiments 1 and 2, some partial-match cues may function as simple reminders. However, the fact that orthographic partial-match cues in Experiment 1 did not attract extra attention, but nevertheless led to increased event-based memory, suggests that the cognitive processing of different kinds of partial-match cues is likely to be different. In other words, not all partial-match cues behave like external reminders. We turn now to developing some of these ideas more fully.

GENERAL DISCUSSION

To our knowledge, there has been only one other published report that has used partial-match cues in an event-based prospective memory task (West & Craik, 1999). That report focused on age differences and did not compare conditions that did versus did not contain partial-match cues. In addition, we manipulated their type and frequency. The results from the present experiments suggest that their presence in the ongoing activity changes the memorial representation of the event-based intention. If the partial-match cues serve as either explicit reminders or episodes of retrieval practice, then the representation of the intention should be strengthened when a partial cue is identified as such. After all, self-initiated retrieval of the intention is likely to elaborate and to refine the intention, thereby increasing performance because of increased sensitivity (Mäntylä, 1993). The term “retrieval sensitivity” refers to how easily a cue is noticed as related to a previously established intention. Elaboration or refinement of the intention may come in the conscious realisation that partial-match cues share some of the necessary features of an actual cue but must be overtly rejected in order to avoid erroneous responses. In fact, the vast majority of the younger adults used in this study were able to avoid making a rogue response.

Increasing the number of partial-match cues numerically (but not statistically) increased performance. Perhaps greater numbers of cues increased the probability that participants engaged in self-initiated retrieval of the intention. If so, then such cues are to be distinguished from explicit, external reminders that are delivered without any need to engage in self-initiated recollection. Thus, external reminders and partial-match cues differ on the important dimension of whether intention-related information had to be

retrieved and reprocessed, or just reprocessed. Studying information repetitively may increase memory for that material as would be the case with external reminders, but it is less effective in strengthening the material’s representation in memory than engaging in the same number of successful retrieval episodes (Bjork, 1988). To the extent that a partial-match cue causes any recollection, then retrieval of the intention is almost guaranteed to be successful. This conclusion follows from the fact that the retrospective content of the intention (i.e., press the / key) is so simple that it is unlikely to ever be forgotten. It is for exactly this reason that researchers can be confident that failures of event-based prospective memory reflect the prospective component of the intention and not memory for the intended activity (i.e., the retrospective component). As a consequence, our manipulations of occurrence, type, and frequency of partial-match cues are probably affecting the prospective component of this form of memory.

Although partial-match cues may indeed be increasing retrieval sensitivity, they may also be increasing the strength of the association between the cue and the action. McDaniel and Einstein (2000) have demonstrated that when the association between the cue and action is high, event-based prospective memory becomes relatively automatic. By contrast, when the association is low, event-based memory requires more strategic control (see also Marsh, Hicks, Hansen, & Pallos, 2002). The data from Experiments 1 and 2 are largely consistent with this idea. Of course, heightened retrieval sensitivity from elaboration and strengthening the cue–action association may be highly similar mechanisms or both consequences may be occurring. Our point is that there are several theoretical mechanisms discussed in the event-based literature that would serve to explain the improvement that comes from encountering the partial-match cues.

Our attempt in Experiment 1 to manipulate the type of partial-match cue as semantic versus orthographic led to numerical (but not statistical) differences in subsequent event-based performance. One argument against the retrieval practice account concerns the lack of slowing on orthographic partial-match cues. If retrieval practice takes time, then slowing on these trials should have been found, just as we demonstrated for the semantic partial-match trials in both Experiments 1 and 2. If the lack of slowing for orthographic partial-match cues were to generalise to other sorts of partial-match cues, then

mechanisms positing conscious processing (such as retrieval practice or explicit reminders) may have to take a back seat to more unconscious forms of processing. For example, heightened retrieval sensitivity could occur either through priming or spreading activation which would not evidence any slowing when the partial-match cues were encountered.

Unfortunately, a single explanation for why partial-match cues increase event-based prospective memory may not exist. The semantic processing of the ongoing task may highlight the relevance of the semantic partial-match cues and cause an explicit “reminding” effect. In this case, the improvement to event-based performance is a consequence of conscious cognitive processing upon encountering the partial matches. By contrast, with a semantic ongoing task, the relevance of the orthographic partial-match cues may go unnoticed at a conscious level, but unconscious processing such as priming may still serve to heighten the activation of the intention. Studies of how the cognitive processing of the ongoing task affect noticing of different types of cues have been called *task-appropriate processing* in this literature, but very little work has been reported on this important interaction (see Marsh et al., 2000; Maylor, 1996). One way to investigate these ideas would be to conduct Experiment 1 with an orthographic (or lexical) ongoing task. If the foregoing analysis is correct, then orthographic partial-match cues would demonstrate the slowing effect and the semantic partial matches would not.

In a similar vein, our search for different types of partial-match cues was hardly exhaustive. Perhaps if we had used a different paradigm, then different types of partial-match cues would be recognised at different rates and would lead to overall differences in subsequent performance. For example, Maylor’s (1993, 1996) face identification paradigm might be a fruitful one in which to explore the issues broached by our experiments. If one has an intention to respond to faces with a black beard, perhaps faces with various different types of facial hair of various colours would evoke different levels of responding (e.g., moustaches, goatees, etc.). Our intuition is that partial-match cues with greater overlap with the prospective cue in memory would result in better subsequent event-based performance. Obviously, the amount of overlap would have to be defined by the particular materials being used. In our paradigm, perhaps if we had used specific targets like the word BOAT and manipulated partial matches

that were orthographically similar (COAT) versus both orthographically and semantically similar (FLOAT), then we could have been successful in finding overall differences that depended on the type of partial-match cues that were encountered (cf. Ellis et al., 1997, who used synonyms).

In the introduction, we mentioned that partial-match cues could have reduced performance based on Anderson and Green’s (2001) suppression paradigm. In their work, participants had to actively inhibit the target item from cue–target word pairs on suppression trials. This suppression apparently led to worse later recall of such pairs. The fundamental difference between their paradigm and the one used here is that we did not attempt to manipulate how participants processed the partial-match cues. In order to reject the partial-match cue as invalid, retrieval of the intention (i.e., the target in Anderson and Green’s paradigm) had to be brought to mind. Thus, in the present case, there is no active suppression of the intention because event-based performance was not reduced.

The results from this study do have practical ramifications as well. In laboratory-based studies that use carefully controlled materials, partial-match cues have traditionally been avoided to prevent contamination of the phenomenon being studied. However, everyday cognition is hardly ever this pristine or highly controlled. We frequently encounter people, places, and things that remind us of previously established intentions. The present study suggests that there may be a benefit that accrues to processing partial-match cues. When the appropriate cue presents itself later we may be much more likely to respond correctly if we previously encountered “lures” in the course of everyday life. More importantly, we know that there are variables that dramatically reduce noticing an event-based cue such as divided attention (e.g., Einstein, McDaniel, Manzi, Cochran, & Baker, 2000; Marsh & Hicks, 1998; McDaniel & Einstein, 2000). All of these demonstrations of reduced performance occurred in the absence of experiencing any partial-match cues. If the association between cue and target is strengthened, leading to a more automatic response after processing several partial-match cues, then perhaps their occurrence will eliminate the deficits in event-based responding observed in the face of demanding retrieval conditions. This speculation might warrant investigation, but also suggests that experiencing partial cues could inoculate people from any of the other factors that

are known to reduce event-based performance, such as high cue familiarity, general as opposed to specific intentions, or lack of cue salience against a background context, to name just a few. The overarching point is that partial-match cues encountered in everyday cognition probably facilitate people's responding to actual cues that they encounter later. Just how potent such cues are and whether they protect populations known to have event-based deficiencies, such as older adults, remains to be determined. However, we are confident that partial-match cues could play a very important role in everyday event-based prospective memory.

Manuscript received 24 April 2001
 Manuscript accepted 2 October 2002
 PreView proof published online 30 July 2004

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