IMPLEMENTATION INTENTIONS AND FACILITATION OF PROSPECTIVE MEMORY

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Abstract—Forming detailed implementation intentions for a future behavior can increase the probability that the behavior is actually completed. We investigated whether this intention effect could be used to improve prospective memory in older adults. As expected, participants who formed an implementation intention were more than twice as likely to self-initiate the intended behavior (writing down the day of the week on every sheet of paper received during the experiment) compared with participants who either were merely instructed to do so or actively rehearsed the instruction. Forming an implementation intention, however, did not improve performance on a task that required a response to salient cues. We conclude that detailed implementation intentions facilitate prospective memory on tasks that lack salient cues and require self-initiation.

Mentally rehearsing a detailed implementation plan can greatly increase the likelihood of achieving future goals or objectives through processes that are automatically activated (Gollwitzer, 1999; Gollwitzer & Brandstätter, 1997). The mental rehearsal of a detailed plan can create a set of situational cues that, when encountered later, may elicit the desired behavior, thus reducing the necessity to keep the goal in mind. The effectiveness of this strategy has been demonstrated across a variety of tasks, from breast self-examination (Orbell, Hodgkins, & Sheeran, 1997) to eating healthy foods (Verplanken & Faes, 1999; for a review, see Gollwitzer, 1999). Because the facilitative effect of implementation intentions is assumed to reflect automatic processes, this strategy may hold great promise for improving the performance of older adults. Whereas controlled memory processes show pronounced age-related declines, automatic processes are less age-dependent and remain largely intact (Jacoby, Jennings, & Hay, 1996; Park, 1999).

One domain in which older adults may experience memory deficits is prospective memory tasks that rely on controlled processes (Einstein, McDaniel, Richardson, Guynn, & Cunfer, 1995; Einstein, Smith, McDaniel, & Shaw, 1997; Kidder, Park, Hertzog, & Morrell, 1997; Mantylä, 1993; Park, Hertzog, Kidder, Morrell, & Mayhorn, 1997). Prospective memory refers to remembering to perform intended future actions, such as taking a medication or picking up a child after school. To the extent that implementation intentions can recruit automatic processes in the service of prospective memory, the techniques developed by Gollwitzer and his colleagues may improve older adults’ prospective memory performance.

Although prospective memory has been a component in some of the tasks studied with implementation instructions (see Gollwitzer, 1999), explicit investigations of prospective memory have so far not been reported. The present research fills this gap and also explores whether this technique might be a useful one for improving the memory performance of older adults. Because prospective memory deficits have been shown to be a greater problem for older than younger adults, and because we were particularly interested in whether Gollwitzer’s techniques are useful for strengthening memory in older adults, only elderly participants were included in the present experiments.

EXPERIMENT 1

Two different tasks were used in Experiment 1. A computerized background-pattern (BP) task required respondents to keep words presented to them in working memory and to press a response key whenever a certain background pattern appeared on the screen. In addition, respondents were asked at the beginning of the experiment to write the day of the week (DOW) at the upper right corner of each sheet of paper they received. These tasks differed in important ways. Pressing the response key was focal to the BP task, and the appearance of the background pattern was highly salient. In contrast, the DOW task was introduced casually at the beginning of the experiment and was not a focal part of what participants worked on at any time. Accordingly, we expected that performance would be poorer on the DOW than the BP task and that the former task would benefit more from implementation intentions than the latter.

Method

Participants and design

Participants were 68 community-dwelling older adults (mean age = 71.35 years, mean education = 15.40 years) from the greater Ann Arbor, Michigan, area who received $15 for their participation. The study was a single-factor, between-subjects design with three conditions: control, background intention, and DOW intention.

Tasks

BP task. This task (adapted from Park et al., 1997) consisted of a working memory and a prospective memory component. In the working memory component, high-frequency words were presented every 3 s in the center of the computer screen. Participants were instructed to retain the last three words shown in memory, and to say them out loud whenever the cue “RECALL” appeared. This cue occurred at unpredictable intervals. The words were presented in a blue font against one of six black-and-white background patterns. With each word change, the background pattern changed. Participants completed an initial 4-min span of practice trials, including seven recall trials.

Subsequently, participants performed this working memory task and an additional prospective memory task concurrently for 12 min. For the prospective memory task, participants were told to press the zero key on the number pad whenever a particular background pattern appeared. The target pattern appeared once randomly in each 2-min interval across the 12-min block of the working memory task, for a total of six target presentations. The working memory task consisted of 23 recall trials (one recall event in the first minute and two in each subsequent minute).

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DOW task. At the beginning of the experiment, participants were casually asked to write the day of the week at the top right corner of each response sheet they used for the written tasks that would come later. After they completed the BP task, they received six additional tasks (DOW trials), each on a separate sheet of paper. These were, in order of presentation, a BP-task questionnaire, a free-recall list, the Digit Symbol task (Wechsler, 1981), a reading-span task (Saltzhouse & Babcock, 1990), a vocabulary task (Shipley, 1986), and a demographics questionnaire. The time between the DOW instruction and the first DOW trial was approximately 22 min. After each DOW trial, the sheet was removed so that the participant could not see the previous sheets.

Procedure

Participants were tested individually and were told that they would be performing some computerized tasks and some written tasks. For the DOW task, all participants were asked to write the day of the week on the top right corner on every sheet of paper so that the experimenter could organize the data and maintain participants’ anonymity. In addition, participants in the DOW-intention condition formed an intention to write the day of the week by picturing themselves writing the day of the week and by stating out loud that they intended to write the day of the week on every sheet of paper they received (e.g., “I intend to write ‘Tuesday’ on the top right corner of every sheet of paper I receive.”). All participants then completed the practice trials for the working memory portion of the BP task and proceeded to the actual BP task. At this point, participants in the background-intention condition formed a specific intention to respond to the target pattern by first picturing the target pattern and then stating the specific intention (“I intend to press the zero key whenever the target pattern appears on the screen.”). After completing the BP task, all participants completed the six written tasks that served as the DOW trials.

Results and Discussion

Table 1 shows the relevant means as a function of experimental condition. As expected, older adults’ performance on the prospective BP task far exceeded their performance on the DOW task. In the control condition, participants provided correct responses on 88% of the trials for the prospective BP task, but only 22% of the trials for the DOW task. The difference in correct responding presumably reflects the fact that in the BP task, the target background pattern was highly integrated visually with the word the participant held in working memory and thus the task was largely a recognition task, indicated by a key press. In the DOW task, however, the completion of the six different tasks on six sheets of paper was not perceptually integrated with writing the day of the week on the top of each sheet. Further, the DOW task also required a recall response (writing a specific word) as opposed to passively pressing a key. Thus, the DOW task required a higher degree of self-initiation and lacked a salient task cue. We now turn to the effects of the experimental manipulations on performance of these tasks.

BP task

Separate one-way analyses of variance (ANOVAs) revealed no effect of condition for the proportion of trials on which respondents correctly recalled all three words, $F(2, 54) = 1.08, p > .34$, nor for the proportion of trials on which participants correctly responded to the background pattern, $F(2, 54) = 1.77, p > .18$. An analysis of the response times to the target background pattern also revealed no effect of condition, $F(2, 54) < 1$, suggesting that implementation intentions for the BP task failed to improve either response accuracy or speed of responding to the target pattern.

In sum, forming an implementation intention did not affect participants’ performance on the BP task, presumably because the task characteristics were sufficiently salient to initiate the proper response.

DOW task

A correct response on this task was defined as writing the day in the correct place (right of the center of the page, at the top). The proportion of correct trials was submitted to a one-way ANOVA, which revealed a significant effect for condition, $F(2, 65) = 5.43, p < .01$. As shown in Table 1, participants who formed an intention to write the day of the week remembered to do so more than twice as often as participants who had not formed an intention. A post hoc Tukey’s test revealed that the DOW-intention condition was significantly different ($p < .05$) from both the control and the BP-intention conditions.

We further examined whether participants wrote the day of the week at least once ($1 = yes, 0 = no$). A chi-square analysis replicated the significant effect for condition, $\chi^2(2, N = 68) = 6.32, p < .05$. Participants in the DOW-intention condition ($P = .65, SD = .49$) remembered to write the day of the week at least once about twice as often as participants in the control ($P = .35, SD = .49$) and BP-intention ($P = .32, SD = .48$) conditions.

In sum, forming an implementation intention improved participants’ performance on the DOW task by a factor greater than 2, but did not affect their performance on the BP task. The instruction to write the day of the week on every response sheet was provided casually at the beginning of the experiment and required more explicit recall and self-initiation, because of limited environmental support, compared with recognizing a salient background pattern and responding with a key press. The implementation intentions presumably resulted in automatic activation of the intention to write the day of the week, bypassing the need for explicit recall, an area in which older adults are particularly deficient. Next, we conducted an additional study to rule out some alternative explanations for the intention effect observed for the DOW task.

EXPERIMENT 2

Although the improvement in prospective performance for the DOW-intention condition was striking, some alternative explanations for this effect need to be addressed. In this condition, participants formed an intention by picturing themselves writing the day of the week and by stating out loud their intention. Since participants were not required to write the day of the week on the top right corner of every sheet of paper, one might argue that forming an intention to write the day of the week made no difference but that they were, in fact, allowed to write the day of the week. This possibility was examined in Experiment 2.

1. Participants who did not correctly identify the target background pattern on the BP questionnaire were excluded from these analyses. On this basis, 11 participants were excluded from Experiment 1 and 12 participants were excluded from Experiment 2.

2. An examination of the types of errors participants made revealed that 94.56% were omissions in Experiment 1 and 99.52% were omissions in Experiment 2. These data are consistent with the assertion that participants were experiencing prospective memory failures (i.e., forgetting they were supposed to do something in the future) rather than retrospective memory failures (i.e., remembering they were supposed to do something, but failing to recall the instructions).
week and by stating out loud that they intended to do so (e.g., “I intend to write ‘Tuesday’ on the top right corner of every sheet of paper I receive.”). This procedure explicitly specified the day of the week, whereas participants who formed a BP intention or no intention at all were instead simply instructed to write the day of the week on their sheets, without the specific day being mentioned. Previous work by Einstein et al. (1997) found that cues with specificity (i.e., respond to specific exemplars like “lion,” “tiger,” or “leopard” vs. respond to “animal” words) significantly improved prospective memory performance. Although the study by Einstein et al. addressed the specificity of a stimulus cue and our concerns pertain to the specificity of an action (i.e., “write the day of the week” vs. “write ‘Tuesday’”), it is possible that specifying the action more narrowly could also make a difference. To address whether the explicit specification of the day would improve performance relative to the general instruction to write the day of the week, we ran a control condition in which participants were given the same DOW instruction as in the control condition of Experiment 1, except that the actual day of the week (e.g., “Tuesday”) was specified in the instructions.

We also included another condition to determine whether the mere amount of time that subjects in the DOW-intention condition had to think about writing the day of the week might have produced the effect. It might be that merely repeating or elaborating the initial instructions, rather than forming a specific intention, was sufficient to improve performance. To examine this possibility, we gave participants in this condition the same amount of time to rehearse the initial instruction as participants in the DOW-intention condition were given to form an intention. To increase motivation to do the DOW task, we told participants in the elaboration condition that research has shown that attention to instructions improves task performance. The participants were then given the same DOW instructions as in the control condition of Experiment 1 and were asked to repeat those instructions out loud until the experimenter told them to stop.

### Results and Discussion

As in Experiment 1, the proportion correct was used to analyze performance on all three tasks. The data from the DOW-intention condition in Experiment 1 were included in order to make the necessary comparisons between the two new control conditions and the DOW-intention condition.

#### BP task

A one-way ANOVA revealed a significant effect of condition for the working memory component, $F(2, 50) = 3.57, p < .05$ (see Table 1). Post hoc Tukey’s tests indicated that participants in the elaboration condition performed more poorly than those in the DOW-intention condition ($p < .01$), which suggests that participants in the elaboration condition might have been devoting more of their cognitive resources to remembering to write the day of the week than to the working memory component. However, this notion is not supported because the performance of subjects in the elaboration condition did not differ from that of subjects in the other conditions for the proportion of correct responses on the prospective component, $F(2, 50) < 1$ (see Table 1). Further, there was no effect of condition on participants’ response times to the target background pattern, $F(2, 50) < 1$. Participants in the elaboration condition performed as well as participants in the DOW-intention condition on all aspects of the prospective BP component.

#### DOW task

A one-way ANOVA of the proportion of correct trials revealed a significant effect for condition, $F(2, 63) = 6.85, p < .01$. Post hoc

<table>
<thead>
<tr>
<th>Condition</th>
<th>BP working memory</th>
<th>BP prospective</th>
<th>DOW prospective</th>
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<tbody>
<tr>
<td>Experiment 1</td>
<td></td>
<td></td>
<td></td>
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<tr>
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<td>.55 (.27)</td>
<td>.88 (.15)</td>
<td>.22 (.35)</td>
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<tr>
<td>Background intention</td>
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<td>.24 (.38)</td>
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<td>DOW intention</td>
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<td>.78 (.19)</td>
<td>.57 (.45)</td>
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<tr>
<td>Experiment 2</td>
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<td></td>
<td></td>
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<tr>
<td>Control, specific day</td>
<td>.52 (.23)</td>
<td>.82 (.24)</td>
<td>.18 (.35)</td>
</tr>
<tr>
<td>Control, elaboration</td>
<td>.46 (.26)</td>
<td>.77 (.26)</td>
<td>.20 (.36)</td>
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**Note.** Standard deviations are in parentheses. BP = background pattern; DOW = day of the week.

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### Table 1. Proportion correct by condition and task for Experiments 1 and 2

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**Method**

**Participants and design**

Participants were 43 older adults (mean age = 71.65 years, mean education = 15.05 years) from the greater Ann Arbor, Michigan, area who received $15 for their participation. The study had a single-factor (condition: specific day or elaboration) between-subjects design.

**Stimuli and procedure**

The same stimuli and procedures were used as in Experiment 1, except for the initial DOW instruction. In the specific-day condition, participants were given the original DOW task instruction used for participants in the control and BP-intention conditions, but the actual day of the week was used (e.g., “Please write ‘Tuesday’ on the top right corner of any sheet of paper you receive.”). In the elaboration condition, participants were given as much time (45 s) to think about the DOW instructions as participants in the DOW-intention condition were given to form an intention. To increase motivation to do the DOW task, we told participants in the elaboration condition that instructions to write 'Tuesday' on the top right corner of every sheet of paper I receive."

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**Results and Discussion**

As in Experiment 1, the proportion correct was used to analyze performance on all three tasks. The data from the DOW-intention condition in Experiment 1 were included in order to make the necessary comparisons between the two new control conditions and the DOW-intention condition.

**BP task**

A one-way ANOVA revealed a significant effect of condition for the working memory component, $F(2, 50) = 3.57, p < .05$ (see Table 1). Post hoc Tukey’s tests indicated that participants in the elaboration condition performed more poorly than those in the DOW-intention condition ($p < .01$), which suggests that participants in the elaboration condition might have been devoting more of their cognitive resources to remembering to write the day of the week than to the working memory component. However, this notion is not supported because the performance of subjects in the elaboration condition did not differ from that of subjects in the other conditions for the proportion of correct responses on the prospective component, $F(2, 50) < 1$ (see Table 1). Further, there was no effect of condition on participants’ response times to the target background pattern, $F(2, 50) < 1$. Participants in the elaboration condition performed as well as participants in the DOW-intention condition on all aspects of the prospective BP component.

**DOW task**

A one-way ANOVA of the proportion of correct trials revealed a significant effect for condition, $F(2, 63) = 6.85, p < .01$. Post hoc
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Tukey’s tests revealed that performance in the DOW-intention condition was significantly higher (p < .01) than performance in the specific-day or the elaboration condition (see Table 1). Moreover, participants who formed an intention (P = .65, SD = .49) were twice as likely to write down the day of the week at least once as were participants in the specific-day (P = .29, SD = .46) and elaboration (P = .27, SD = .46) conditions, χ²(2, N = 66) = 8.64, p < .05.

Thus, it appears that the improved performance in the DOW-intention condition was not due to a more specific instruction regarding the day of the week, nor was it due to the opportunity to elaborate or rehearse the DOW instructions.

GENERAL DISCUSSION

The present experiments provide the first evidence that older adults’ prospective memory can be improved through techniques that are assumed to recruit automatic rather than controlled memory processes. Specifically, we observed that forming an implementation intention improved older adults’ performance on the DOW task by a factor greater than 2, from 22% correct responses without an implementation intention to 57% correct responses with an implementation intention. The results are consistent with Gollwitzer’s (1999) theorizing, in that rehearsing an explicit intention in a way that tied the intention to specific situational cues (here, receiving sheets of paper) increased the likelihood that these cues elicited the intended behavior at the appropriate time. As expected, our findings further suggest that implementation intentions are more likely to improve performance the more the task itself requires self-initiation.

In the present studies, implementation intentions improved older adults’ performance on the DOW task but did not improve performance on the BP task. The BP task is largely a recognition task in which the cue is highly integrated with the primary memory task. In contrast, for the DOW task, six different tasks were used, each of them focal, and none contained a powerful or integrative cue. Thus, the DOW task required a greater degree of self-initiation, which made it more likely older adults would perform poorly in the control condition (Einstein et al., 1995; Park et al., 1997). Further supporting the notion that the DOW and BP tasks involve different memory processes, performance on the two tasks was uncorrelated in the present studies (r = .05 and .15 for Experiments 1 and 2, respectively), a result consistent with the findings of Kidder et al. (1997; r = .08). We conclude from this pattern of results that implementation intentions are particularly beneficial for older adults when the cues for test completion are subtle and likely to engage a recall process that requires controlled processing, and less beneficial on a recognition task that has a strong automatic component associated with it. These results suggest that implementation intentions may be highly promising for many real-world applications.

The present findings also elaborate Einstein and McDaniel’s (1996) Noticing + Search model of prospective memory. This model proposes that there are two stages in a prospective remembering task. The first stage is the noticing stage, in which the target event or cue is noticed. Einstein and McDaniel suggested that the noticing stage is a relatively automatic process, as the target event or cue automatically elicits feelings of familiarity or perceptual fluency that cause the cue to be noticed. The second stage in the model is the directed search stage, in which memory is probed to determine what the cue signifies.

According to Einstein and McDaniel (1996), the Noticing + Search model posits not only that the usual encoding and rehearsal strengthen the association between the cue and target action, but also that types of rehearsal that increase the likelihood of noticing the target event or cue could be effective. In the case of the DOW task, the cue was sufficiently subtle that it required active recall to be noticed. Thus, we found that simple elaboration or rehearsal of the DOW instruction was insufficient for improving elderly people’s performance on the DOW task. In contrast, the implementation-intention condition appeared to strengthen the noticing function, doubling the number of times older adults correctly remembered to write the day of the week. The search function in the DOW task presumably was relatively minor because implementation intentions are supposed to create a direct, automatic link between noticing the cue and recollecting the action to be performed. Thus, our findings suggest that the noticing function might be more effortful than the search function. The noticing function might frequently require explicit memory or rehearsal to respond to a prospective cue, but once the cue is noticed, relatively little memory is needed for the search function to determine what to do.

In conclusion, we believe the use of implementation intentions holds great promise for improving older adults’ performance on prospective memory tasks that require self-initiated processing. In particular, this technique should be beneficial to very old adults, who have the greatest limits in cognitive resources required for self-initiated processing. Helping the old and very old improve their prospective memory performance can increase their chances for maintaining independent living. Future research should take at least three directions. It will be important to determine how implementation intentions can be used to (a) improve elders’ prospective memory performance on other tasks (e.g., time-based prospective memory), (b) improve other types of memory in laboratory-based tasks, and (c) improve important real-world behaviors that have low compliance rates, such as exercising, taking medication, or adhering to a nutrition plan.

REFERENCES


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