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Is working memory necessary for implementation intentions to enhance prospective memory in older adults with cognitive problems?

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ABSTRACT

Implementation intentions are an effective strategy for improving prospective memory in older adults. However, their efficacy has never been assessed in older individuals with cognitive problems (i.e., individuals with subjective memory complaints or objective memory impairments). Furthermore, although most authors consider implementation intentions to depend on automatic processes, some studies have shown the necessity of residual preserved controlled processes for implementation intentions to be efficient. We examined the efficacy of implementation intentions in prospective memory in 45 older participants consulting a memory clinic. Half of the participants were instructed to form an implementation intention, the other half receiving standard instructions. Analyses showed that working memory moderated the efficacy of implementation intentions, which were efficient only in individuals with better working memory. These results corroborate the claim that a minimal level of cognitive resources is required for the technique, although implementation intentions might depend principally on automatic processes.

1. Introduction

Numerous studies have shown that the execution of goal-directed behaviors can be enhanced by the use of implementation intentions (II). II are a planning strategy, consisting of specifying when, where, and how one will perform a specific action (Gollwitzer, 1993). Such a plan is formulated in the form of an if–then contingency by using the structure "If situation *x* arises, then I will perform behavior *y*," for example, "If I get home from shopping, then I will call my sister for her birthday."

The formation of II has been shown to be effective in improving prospective memory (PM; i.e., the ability to remember to perform an intended action at the appropriate moment), inhibition (of a prepotent response or of distractors), and, more generally, goal-directed behaviors (Gollwitzer & Sheeran, 2006). Although most studies were conducted in samples of young adults, a few studies also examined the efficacy of II in older participants, more specifically in PM tasks. These studies assessed the efficacy of II in laboratory tasks (Burkard et al., 2013; Chasteen, Park, & Schwarz, 2001; McFarland & Glisky, 2011; Schnitzspahn & Kliegel, 2009; Zimmermann & Meier, 2009) and in more ecological tasks, which consisted of participants remembering to monitor their glucose four times a day for 3 weeks (Liu & Park, 2004), or remembering to measure their blood pressure three times a day for 5 days (Brom et al., in press). In these studies, II were effective in improving performance in comparison with standard instructions, in particular for participants aged 60–75 or 80 years (the technique was inefficient, however, when administered in a group setting in participants aged 75–90, Schnitzspahn & Kliegel, 2009). In general, large size effects were found: For example, in the study by Brom et al. (in press), the participants of the experimental group forgot to test their blood pressure five times less often than the participants of the control group did.

To date, II have seemed to be a generally effective strategy in improving PM in "normal aging," as samples of previously mentioned studies consisted of older community-dwelling

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individuals. Only one study (Burkard et al., 2013) included—besides community-dwelling older adults—older adults who consulted a memory clinic. Interestingly, in this study, II improved not only PM, but also inhibition performance, independently of working memory abilities. Individuals who more frequently used visual strategies in everyday life particularly benefited from this technique. Although this study included patients of a memory clinic, none of them fulfilled the criteria of dementia.

However, the need of older adults with cognitive deficits for a supporting strategy is even higher than that of community-dwelling older adults. Therefore, the main aim of the present study was to test the efficacy of II in a sample of older adults who consulted a memory clinic and who received a diagnosis of dementia, a diagnosis of mild cognitive impairment (MCI), or no diagnosis.

Our sample was thus composed of individuals with a variety of cognitive abilities and constituted an interesting context to explore the current debate regarding whether or not II require cognitive resources to be efficient. Indeed, on the one hand, different arguments support the view that the efficacy of II does not rely on controlled processes, but depends on automatic cognitive processes, which are preserved in individuals diagnosed with MCI or early dementia (e.g., Adam, Van der Linden, Collette, Lemauvais, & Salmon, 2005). According to Gollwitzer (1999), II foster high activation of the specified situational cue (by perceptual, attentional and mnemonic processes) and create a link between the situation and the behavior, so that when the situation occurs, the behavior is automatically initiated. The arguments for automatic II are as follows:

1. The effect of II is not diminished by the presence of an interfering cognitive load (Brandstätter, Lengfelder, & Gollwitzer, 2001; McDaniel, Howard, & Butler, 2008).
2. The effect of II is high for patients known to have reduced cognitive resources, as is the case in individuals who have been diagnosed with schizophrenia, opiate addicts under withdrawal (Brandstätter et al., 2001), or individuals who have had a brain injury (Lengfelder & Gollwitzer, 2001).
3. In aging, some studies find no relation between executive functions/working memory and the effectiveness of II (Burkard et al., 2013; McFarland & Glisky, 2011), while others suggest that participants with low cognitive resources profit the most (Brom et al., in press).

These different results were interpreted to mean that II strengthened or relied on automatic processes. Nevertheless, on the other hand, three experiments by McDaniel and Scullin (2010) have shown that when a PM task was to be performed under high cognitive demands (i.e., while performing a word categorization task and a random number generation task), II were not more efficient than standard instructions. The results of these experiments hence suggest that although II may rely principally on automatic processes, they seem also to require the contribution of some controlled processes. In the context of this debate, we decided to test for a possible moderating role of working memory (as a measure of controlled processes) in the efficacy of II.

We examined II in a PM task, because of the relevance of PM in everyday life and its clinical pertinence in aging. Indeed, PM plays an important role in instrumental activities of daily living, health needs, and social relations by for example, helping people remember to take the cake out of the oven when it is baked, to take their medicine, and to go to appointments (McDaniel, Einstein, & Rendell, 2008). Furthermore, PM problems are frequently reported by older adults and appear early in the course of problematic cognitive aging. Thus, according to the results of Smith, Della Sala, Logie, and Maylor (2000), older individuals with and without a diagnosis of dementia report more failures in remembering tasks to be performed in the near future than in remembering past events. Corroborating these results, recent meta-analyses and reviews show that individuals diagnosed with MCI (Costa, Caltagirone, & Carlesimo, 2011), as well as individuals who have received a diagnosis of dementia (van den Berg, Kant, & Postma, 2012), frequently present PM difficulties.

In the current study, we aimed to assess the efficacy of II in older individuals with cognitive problems in PM tasks. To assess PM, we preferred close-to-real-life tasks to laboratory tasks in order to make the task more accessible to older adults (who are often not used to using a computer) and to ensure higher ecological validity. Indeed, naturalistic and laboratory tasks lead to different results in normal aging (Phillips, Henry, & Martin, 2008), with community-dwelling older adults performing better than their younger counterparts in naturalistic tasks, but worse on laboratory paradigms.

2. Method

2.1. Participants

Forty-five older individuals (range: 60–89 years, mean age: 78.0 years) consulting the local memory clinic were recruited. Participants came initially for a complete neuropsychological, neurological, and psychiatric evaluation in order to examine the nature (degree of impairment and cause) of their cognitive concerns. During the recruitment, all patients of the memory clinic who met the inclusion criteria were asked to participate. Inclusion criteria were age above 60 years, good mastery of the French language, and normal or corrected-to-normal vision and hearing. Exclusion criteria were comprehension difficulties impeding the understanding of the experimental tasks and institutionalization (living in a nursing home). All participants gave their written consent to participate, and the study was approved by the Ethics Committee of the University Hospital (to which the memory clinic belongs).

Our sample included eight individuals who received a diagnosis of MCI and 14 who received a diagnosis of dementia (Alzheimer's disease, vascular dementia, mixed Alzheimer's and vascular dementia; in some cases, the subtype could not be determined at the time of assessment). In the case of 22 individuals, no diagnosis was given or diagnosis was postponed (see Table 1 for distribution). Four participants were excluded after having entered the protocol, three because of missing Mini-Mental State Examination (MMSE) data, and one because of incomplete PM data.

2.2. Design

Participants were randomly allocated to one of two groups: II or standard instructions.

2.3. Measures

2.3.1. PM tasks

A set of four concrete, close-to-real-life PM tasks was used as experimental material. These tasks were embedded in the neuropsychological assessment for which the participants consulted the memory clinic. All four PM tasks were administered in a single session, lasting 60 or 90 min (the duration varied for organizational reasons) and were administered in the same order for all participants. Fig. 1 depicts how the tasks were embedded in the session. The neuropsychological assessment included several cognitive tests, depending on the specific difficulties of the individual (episodic/semantic/working memory, executive functions, language, etc.).

The instructions for the first PM task were given at the beginning of the assessment session. "Later on, I will dictate a sentence