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GENDER DIFFERENCES IN PROSPECTIVE MEMORY IN YOUNG AND OLDER ADULTS

The main purpose of the present study was to investigate the relation between gender and prospective memory performance with respect to participants' age and the specific requirements of prospective memory tasks. Prospective memory performance was better for women compared to men in the older adult group. In the entire sample, women performed better than men on prospective memory tasks with an external cue. The possible influence of factors related to the gender role, personality, and perception on prospective memory performance is discussed.

Keyword: prospective memory; gender differences; Virtual Week.

The main objective of the present study was to investigate the relation between gender and prospective memory performance. Prospective memory, defined as remembering to perform the intended action at a specific time in the future, is an important determinant of the quality of functioning in everyday life. The execution of delayed intentions is difficult because it requires effective cognitive control (Niedźwieńska, Barzykowski, Leszczyńska, & Janik, 2015).

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Two divisions of prospective memory tasks are usually present in the literature. The first one is associated with the frequency of performing tasks. There are regular tasks that are performed routinely and repeatedly, such as taking medication during breakfast, and episodic tasks, performed rarely or irregularly, such as going to the post office in the afternoon (Rendell & Craik, 2000). Both the analysis of the mechanisms underlying these two types of tasks (regular repetition of a particular task consolidates its content and strengthens the relation between the action and the circumstances in which it is to be performed) and the results of empirical studies (Aberle, Rendell, Rose, McDaniel, & Kliegel, 2010; Rendell & Craik, 2000) indicate that regular tasks are remembered better.

The second division is related to the manner in which intention execution is triggered. Einstein and McDaniel (1990) distinguished event-based and time-based tasks. The former have to be recalled when the target event occurs (e.g., asking the boss for a few days off when meeting him). The latter have to be performed when the right time comes (e.g., calling the doctor at 9 a.m.). Time-based tasks are considered to be more difficult because they cannot be linked to an external event that might remind of the intention. In this kind of tasks, the challenge is to capture the moment of intention execution (Niedźwieńska & Albiński, 2010). Monitoring the time is crucial for performing time-based tasks in the right moment (cf. Niedźwieńska review, 2013).

In analyses of individual differences in prospective memory, research to date has focused primarily on age, consistently showing that older adults exhibit deficits in performing laboratory prospective memory tasks (cf. meta-analysis by Henry, MacLeod, Phillips, & Crawford, 2004), and that these deficits are larger for irregular tasks than for regular ones (Aberle et al., 2010; Rendell & Craik, 2000). In the study by Albiński, Sędek, and Kliegel (2012), older adults performed worse on time-based tasks compared to younger and middle-aged adults. However, there are only few studies on gender differences in prospective memory, and their results are not conclusive. In two studies, one experimental study (Hering, Cortez, Kliegel, & Altgassen, 2014) and one large-scale study (Huppert, Johnson, & Nickson, 2000), where various prospective memory tasks were used, women performed significantly better than men. What is interesting, this difference was observed only in older adults. A large-sample Internet study (Maylor & Logie, 2010) revealed better performance of women on event-based tasks. The effect was larger in older children and young adults than in middle age. By contrast, in an experimental study in which older adults performed time-based tasks (Bahrainian, Bashkar, Sohrabi, Azad, & Majd, 2013), men did signif-

icantly better. Men were also found to perform better in a study using the *Rivermead Behavioral Memory Test* (Efklides et al., 2002).

In summary, the results of research on gender differences in prospective memory are not consistent, but in many of them women performed significantly better than men. It is possible that the ambiguity of the existing results stems from the fact that the pattern of gender differences may be affected by age and by the type of cognitive requirements involved in various prospective memory tasks. As mentioned earlier, event-based tasks can be, at least to some extent, carried out automatically in response to a cue in the environment (an event reminds about the intention), while the time-based tasks require resource-consuming time monitoring.

If gender differences in the performance of prospective memory tasks are a result of gender differences in the cognitive abilities that are required to perform these tasks, then they should be expected to occur in different age groups. But if the differences are due to social roles and, more specifically, due to a varied training in prospective memory tasks associated with the accepted social role, then gender differences should be larger in older adults compared to younger adults. As suggested by Huppert and colleagues (2000), in the traditional society, the role of a woman, wife, and mother consists, among other things, in organizing the daily life of family members, which includes not only remembering about her own prospective memory tasks but also reminding family members about their assignments and upcoming deadlines. Such training may lead to a better functioning of prospective memory in older women than in older men.

Better coping with prospective memory tasks in women is also suggested by gender differences on those dimensions of personality that are strongly related to prospective memory. As follows from Niedźwieńska's review (2013), conscientiousness and agreeableness are those dimensions of personality included in the Big Five model that are positively correlated with the level of performance on prospective memory tasks. The links between prospective memory and these dimensions stem from the fact that, by performing prospective memory tasks in everyday life, one often fulfills obligations, meets the requests of other people, and does favors for them (cf. Niedźwieńska review, 2013). Studies on personality indicate that women score higher than men on both conscientiousness and agreeableness (Kaiser, Sackett, Kuncel, & Bröthen, 2016; Soto, John, Gosling, & Potter, 2010).

The aim of the present study was to analyze gender differences in prospective memory performance. Taking into account the subjects' age and various types of prospective memory tasks, which impose diverse cognitive require-

ments, we sought to explain the inconsistencies in the existing results in this area. Based on the results of the available studies, we expected that women would perform significantly better than men on prospective memory tasks. There was insufficient evidence to formulate specific hypotheses about the influence of age and type of task on gender differences. We also expected that, irrespective of gender differences, we would obtain results confirming previous reports on age-related changes in prospective memory – namely, that significant deficits would occur in older adults, especially with respect to irregular prospective memory tasks.

METHOD

Participants

The participants in the study were 61 young adults (age range: 19-24, $M = 21.51$, $SD = 1.39$) and 54 older adults (age range: 64-84, $M = 70.19$, $SD = 4.10$). All seniors were screened for dementia using MINIMENTAL and scored within the norm (≥ 27). The groups did not differ significantly in the proportions of men and women (31.15% and 33.33% men for young and older adults, respectively), $\chi^2(1) = 0.63$, $p = .80$. Men and women did not differ significantly in age, self-assessed health, or years of formal education either in the group of young adults or in the group of older adults (all p values were at least .25). We used two measures of cognitive abilities that are usually taken into account in research on cognitive aging. Speed of processing was tested by means of the *Digit Symbol* test and verbal ability was measured by means of the synonym subtest measuring verbal fluency which is a part of the APIS-Z battery. Younger and older participants differed in the way that is representative for these groups: young adults outperformed older adults in the test of processing speed, $t(113) = -15.35$, $p < .001$, but they performed worse than older adults on verbal ability, $t(113) = 2.91$, $p < .05$. We found no significant differences between women and men in cognitive abilities in either of the two age groups (all p values were at least .20, except $p = .08$ for processing speed in the case of young adults).

Materials and procedure

Virtual Week. In the main part of the study, we used a Polish adaptation of the computerized board game called *Virtual Week* (VW; Rendell & Craik, 2000). VW is a laboratory measure of prospective memory. Participants move around

the board on the screen with the roll of a die. Each circuit of the board represents one virtual day. As participants move around the board, they must pick up event cards. There are 10 event cards per virtual day, with each card presenting a brief description of an activity relevant to a particular moment during the virtual day (e.g., a meal or shopping) and a decision to make with three options to choose from (e.g., what to eat or what to buy). In addition, participants have to remember to carry out intentions (prospective memory tasks). Each day of the VW includes eight prospective memory tasks (four regular and four irregular). To perform those tasks, participants click on the *Perform Task* button when they feel the moment is appropriate and select the task from a list of options (prospective memory tasks and distracters). The four regular prospective memory tasks are the same each day and are supposed to simulate the kinds of regular tasks performed as one does everyday duties (such as taking medication), two of them are event-based (cued by specific event cards: breakfast and dinner event cards), and the other two are time-based (cued by specific times on the virtual time clock of the day: 11 a.m. and 9 p.m.). The time-based tasks require monitoring the virtual clock located in the center of the board. The four irregular prospective memory tasks simulate the kinds of tasks that occur occasionally in everyday life (such as phoning the plumber or picking up dry-cleaning). Again, the four irregular tasks consisted of two event-based and two time-based tasks (e.g., picking up dry-cleaning cued by an event card depicting shopping; and phoning the plumber at 5 p.m. cued by the virtual clock). Participants perform five circuits on the board, which corresponds to five virtual days.

Before starting the game, each participant is thoroughly instructed on how to play and performs one test circuit on the board. The game is designed so that it does not require proficiency in using the computer, and the introductory training is sufficient to freely pass through each virtual day.

The values of Spearman–Brown split-half reliability coefficients for VW adapted into Polish by Agnieszka Niedźwieńska are as follows: $\alpha = .95$ for regular tasks and $\alpha = .92$ for irregular ones (Niedźwieńska, 2013).

RESULTS

The data were analyzed using a $2 \times 2 \times 2 \times 2$ mixed ANOVA with two between-group variables: age group (young vs. older) and gender (women vs. men) and two within-group variables: prospective memory task (regular vs. irregular) and cue type (event-based vs. time-based). The dependent variable was

overall prospective memory performance measured as the proportion of prospective memory tasks completed in the appropriate time to all prospective memory tasks in a given category.

Table 1

Means and Standard Deviations (in Parentheses) for the Four Types of Prospective Tasks Performed by Men and Women in the Two Age Groups

		Event-based		Time-based	
		regular	irregular	regular	irregular
Young	women	.83 (.15)	.93 (.07)	.84 (.15)	.68 (.23)
	men	.86 (.12)	.91 (.10)	.91 (.09)	.76 (.18)
Older	women	.58 (.32)	.57 (.36)	.47 (.27)	.25 (.23)
	men	.37 (.34)	.38 (.36)	.39 (.29)	.21 (.22)

Note. Performance is the proportion of tasks performed in the right time to all tasks in a given category

All of the three main effects were significant and indicated that: younger participants outperformed older ones, $F(1, 111) = 140.74$, $p < .001$, $\eta_p^2 = .56$, regular tasks were performed better than irregular ones, $F(1, 111) = 24.16$, $p < .001$, $\eta_p^2 = .18$, and event-based tasks were performed better than time-based ones, $F(1, 111) = 35.24$, $p < .001$, $\eta_p^2 = .24$. Neither four-way nor three-way interactions were significant. However, the analysis revealed a number of significant two-way interactions, including those that indicated a relationship between gender and prospective memory performance.

Task type

The two-way interaction of task type (regular vs. irregular) and cue type (event-based vs. time-based) was statistically significant, $F(1, 111) = 45.02$, $p < .001$, $\eta_p^2 = .29$. A follow-up simple effects analysis of the interaction revealed that irregular time-based tasks were performed worse than irregular event-based ones, $F(1, 111) = 70.22$, $p < .001$, $\eta_p^2 = .39$. There was no significant difference within regular tasks with respect to the type of cue. Similarly, irregular tasks were performed worse than regular ones, but only if they were time-based, $F(1, 111) = 71.07$, $p < .001$, $\eta_p^2 = .39$. There was no significant difference in performance between regular and irregular event-based tasks.

Age group

The two-way interaction of age group and task type was significant, $F(1, 111) = 4.30$, $p < .05$, $\eta_p^2 = .04$. A follow-up simple effects analysis of the interaction revealed that older participants performed worse than younger on both types of tasks (regular and irregular), $F(1, 111) = 101.78$, $p < .01$, $\eta_p^2 = .48$, and $F(1, 111) = 126.72$, $p < .01$, $\eta_p^2 = .53$, respectively. The significant interaction was due to the fact that prospective memory deficit in older participants was notably greater in irregular tasks than in regular tasks.

Gender

There were two significant interactions connected with gender. Firstly, the two-way interaction of gender and age group was significant, $F(1, 111) = 5.29$, $p < .05$, $\eta_p^2 = .05$. The interaction resulted from the fact that gender differences occurred in older but not in younger adults: in the group of older participants, women performed significantly better than men, $F(1, 111) = 6.13$, $p < .01$, $\eta_p^2 = .05$. Secondly, the two-way interaction of gender and cue type was significant, $F(1, 111) = 7.27$, $p < .05$, $\eta_p^2 = .06$. Gender differences in the performance of prospective memory tasks were found for event-based tasks but not for time-based ones. In the case of event-based tasks, women performed significantly better than men, $F(1, 111) = 4.91$, $p < .05$, $\eta_p^2 = .04$.

DISCUSSION

In the presented study, we compared the prospective memory of men and women with respect to age and the varied cognitive requirements of prospective memory tasks. The results confirm earlier reports on irregular and time-based tasks being more difficult and indicate that a decrease in prospective memory performance should be expected particularly when these two types of cognitive demands (the irregularity of the task and the need to monitor the time) are combined. The result can be interpreted in the context of the theory of schemas, according to which the encoding of information (in this case, prospective memory task contents) is more effective if there are knowledge structures to fit the information into (van Kesteren, Rijpkema, Ruiters, Morris, & Fernández, 2014). Event-based tasks contain a schema, e.g. a schema of a breakfast during which one should take antibiotics. By contrast, information about the time of performing an activity is not a schematic structure. Similarly, regular tasks, even if at

first they were not related to a scheme, could be adjusted to it with successive repetitions. The link between irregular tasks and schemas is not so obvious, as these tasks are performed occasionally or only once. The interpretation of disparities in the performance of different types of prospective memory tasks in the context of the theory of schemas requires verification in further studies.

Our findings also confirm significant age-related deficits in prospective memory (especially in irregular tasks), which have so far been found in laboratory studies (Henry et al., 2004). Above all, the study provided new data on gender differences in prospective memory and, for the first time, on the association of these differences with age and type of task.

As expected, the level of prospective memory performance was significantly higher in women than in men. This difference, however, was found only for older adults and event-based tasks. When explaining the influence of age on the observed gender differences, the social roles performed by men and women in different periods of life are worth mentioning. Firstly, the tasks performed by male and female students are similar. They are focused on science, completing formal duties at the university, etc. The tasks of older adults are more diverse, which results from the division of responsibilities in the family. The differences we found may therefore be a result of the distinct roles performed by men and women in adult life. According to Huppert and colleagues (2000), it is usually the woman who is responsible for reminding other members of the household about prospective memory tasks. Life experience (different for men and women) can lead to a better functioning of prospective memory in elderly women. It is also possible that gender differences in prospective memory tasks performance are related to the cohort effect. Hering and colleagues (2014) pointed out that in the older generation mainly women were responsible for the execution of prospective memory tasks related to the daily functioning of the family. The life experience of the generation may have caused variations in the results of the two age groups tested in our study. It is also possible that both of the above-described effects have an impact on the results. Finally, the relation between gender and prospective memory performance can also be interpreted in the light of the results of research on personality in men and women and its links with prospective memory. The results of the studies conducted so far do not allow for resolving which of these was the actual cause of the obtained gender differences.

It is also worth noting that, compared to older adults, the level of VW performance in young adults was high, which indicates that VW was relatively easy for them. Although their performance did not reach the ceiling effect, it was so

high that it may have hindered the manifestation of the differences between young men and women.

The obtained results for the first time suggest that the presence or magnitude of gender differences in prospective memory may depend on the cognitive requirements of prospective memory tasks. In our study these differences were revealed in the entire sample for event-based tasks but not for time-based tasks. This means that women did better than men on tasks where there was a definite external cue signaling the need to implement the intended action and the person could rely to a large extent on what happened in the environment. It is possible that the differences in the performance of event-based tasks are associated with gender differences in perception. In their study on rapid perception of the key elements of the situation, Wanmarcke and Vagemans (2014) asked participants to categorize objects and images. In all conditions – including the categorization of social situations – women achieved better results than men (both in reaction time and in accuracy). The ability to extract the important elements of the event in order to ascribe meaning to it is crucial to event-based tasks performance. It allows a person to notice the cue included in the event and link it to a prospective memory task. The observed influence of prospective memory task type on gender differences in prospective memory requires replication in further studies.

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The preparation of the English version of *Roczniki Psychologiczne (Annals of Psychology)* and its publication in electronic databases was financed under contract no. 723/P-DUN/2016 from the resources of the Minister of Science and Higher Education for the popularization of science.