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Naturalistic assessment of everyday memory performance among older adults

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Abstract

Memory performance in everyday life (EDL) and its change by aging is still unclear, since laboratory results are often not transferable to real life situations. Therefore, a naturalistic memory task was designed to investigate memory performance in older adults in a representative task design. The memory performance of 23 older (70.28 ±4.65 years) and 20 younger adults (24.89 ±3.16 years) was assessed by using four established tasks of Short-Term and Working Memory (Digit Simple Span, Digit Complex Span, Grid Simple Span, and Grid Complex Span), which differed in complexity and domain (verbal vs. visual-spatial). To simulate an EDL context, a “Supermarket” was constructed within the laboratory. The results showed that memory performance presents alterations in older adults. This was especially true for the “Supermarket” task, in which the younger adults showed benefits in the common environment as opposed to older adults. A factor analysis showed that the four memory laboratory tasks measured different memory processes as compared to the EDL task. Our findings suggest that memory performance in EDL is a different construct than when it is measured in the laboratory and that memory alterations in older adults are especially pronounced in EDL tasks. Following these findings, we recommend an EDL approach to measure memory performance further to the well-established laboratory approaches.

Keywords: Ecological validity, Naturalistic task, Memory, Aging, Item-manipulation

Naturalistic assessment of everyday memory performance among older adults

One of the most common complaints among older people is that their "memory is not as good as it used to be". This becomes apparent in the following everyday examples: forgetting names or forgetting the shopping bag or the recent shopping list when going to a supermarket, as well as leaving their belongings such as a purse or products after paying . To prove, disprove and explain age-related alterations in memory performance has been one of the most focused topics in psychological research for the last decades (Reuter-Lorenz & Park, 2010). However, sharp distinctions could be observed between the age-related difference in basic and complex cognitive abilities in the laboratory and observations of cognitive performance in real life (Blanchard-Fields, 2007; Hertzog, Kramer, Wilson, & Lindenberger, 2008). Circumstantial evidence for this view is provided by Verhaeghen, Martin, and Sędek (2012), who compared two meta-analyses, the first one examining cognitive abilities by using typical laboratory tests and the second one examining indices of job performance. They found an age-related difference in the cognitive abilities such as perceptual speed, working memory, spatial ability, episodic memory, and reasoning, as well as an age-related stability in everyday life (EDL) performance (job performance). One explanation for this stable or superior performance at old age could be the usage of acquired knowledge, strategies, or an individually developed retrieval structure for information stored in the long-term memory (Ericsson & Kintsch, 1995), which could especially compensate age-related deficits in short term memory performance (Elliott et al., 2011; Hale et al., 2011). However, the dissociation between simple laboratory measures and real life performance as a function of age is sparsely investigated except for the work of Rendell and colleagues (Rendell & Craik, 2000; Rendell & Thompson, 1999; Rose et al. 2010; Schnitzspahn et al. 2011) on the 'age-prospective memory-paradox'. This paradox describes that older adults outperform younger adults in everyday prospective memory tasks, but perform worse than younger adults in laboratory prospective memory tasks. Based on all these indications, the purpose of this present article is to compare memory performance in a naturalistic setup as a function age and how representative this performance is in comparison to basic laboratory memory performance.

Age-related differences in memory performance

Memory has been divided by the temporal dimension into short-term (STM) and long-term (LTM) memory (Atkinson & Shiffrin, 1968). When reviewing the literature on memory performance and aging, one thing that becomes apparent is the substantial variability of memory performance. This variability is especially pronounced if the tasks are assumed to tax different memory components (STM and LTM). These two components and their subcomponents are differentially affected by aging (Hoyer & Verhaeghen, 2006).

On the one hand, performance on tasks relying on semantic memory, the part of LTM responsible for an individual's cumulative knowledge is seen as stable at old age or even superior than for younger adults (Park et al., 1996, Park et al., 2002, Verhaeghen, 2003). On the other hand, older adults show a considerable alteration in LTM tasks involving retrieval of specific events located in time and place and/ or context of experienced events (Bäckman et al., 2001; Light et al., 2000; Zacks et al., 2000). This LTM component is referred to as episodic memory and is mostly tested by asking people to learn information explicitly (e.g., a list or story) and recall it after a delayed period. The three aspects of episodic memory include the encoding phase, the storage phase, and the retrieval of the encoded and stored information. These three phases show differential aging effects. Whereas the storage of information is seen as relatively stable, encoding and retrieval are seen as age-sensitive (Castel & Craik, 2003). If we apply this to the example of not remembering names, it is possible that older adults have the name to be remembered in mind but are not able to retrieve it.

One of the main problems concerning memory performance amongst the elderly seems to be uploading the required information for the task at hand from LTM into STM

(Verhaeghen, 2012). This also involves age-related changes in STM capacity. Performances decrements of older adults are especially evident in STM tasks in which information has to be manipulated or kept in mind while processing further information (Elliott et al., 2011; Hale et al., 2011). Memory tasks, which require an individual to simultaneously store and actively transform information (Baddeley, 2000), tap a memory system that is called working memory. Laboratory measures of Working memory (WM) such as the reading span, the listening span, or the operation span reveal reliable and large age-related deficits (Bopp & Verhaeghen, 2005). In contrast, simple STM tasks, such as digit span tasks or recall of the last few items of longer lists that do not need further processing only show small or no effects of aging (see Zacks et al., 2000).

To sum up, there seem to be two main factors that are accountable for an age-related difference in memory performance: First, memory performance of older adults is worse when information has to be manipulated before recall in comparison to a serial recall of items. Second, performance decreases when information stored in LTM needs to be uploaded into STM for further processing and usage on an on-going task.

Memory performance in naturalistic setups

The laboratory-everyday-life paradox is well established in terms of LTM, especially prospective memory (Henry et al., 2004). Ihle and colleagues (2012) could show that older adults outperformed younger ones in EDL by comparing the performance on matched laboratory and a naturalistic prospective memory task. Further, the better performances of the older adults could be partly explained by covariance analysis as the performance differences between younger and older adults were no longer significant when taking the effect of less EDL stress, higher motivation in fulfilling the task and the usage of memory strategies into account.

This comparison of performance in laboratory and naturalistic tasks has so far not been drawn for STM and WM. An indication of the effect on memory by presenting common items was given by Hambrick and Oswald (2005). They could show a benefit in the WM performance within a baseball memory task. Participants showed a 100% higher WM span in the baseball condition even for participants with low baseball knowledge in comparison to pure laboratory tasks.

Possible explanations of differences in STM and WM capacity measured in the laboratory and performance in EDL can be drawn by the theory of expert performance (for an overview, Ericsson, Charness, Feltovich, & Hoffman, 2006). In consequence, there are theoretical assumptions that acquired knowledge (expertise), strategies, and skills stored in LTM help to increase STM performance (Ericsson & Delaney, 1999). This was shown by a number of studies using the expert performance approach across a number of different domains such as piano playing (Meinz & Hambrick, 2010), piloting tasks (Morrow, Leirer, Altiteri, & Fitzsimmons, 1994), and Texas Hold'em poker (Meinz et al., 2012). In all of these studies it was shown on younger adults, that domain-specific knowledge and WM capacity are both relevant predictors for memory tasks. Further achieved knowledge seems to alleviate age-related deficits in WM in piloting tasks (Sohn & Doane, 2003) and reading tasks (Soederberg & Miller, 2009). With regards to these findings, Sohn and Doane (2003) assumed that stored skills and knowledge can decrease the influence of WM capacity on complex task performance. Although the benefit of a well-known context has been investigated in various studies on WM tasks, no study has answered the question if this is helpful for older adults' memory performance yet.

Besides the effect of EDL context, it is conceivable that the nature of everyday activities has an influence on memory processes. EDL activities mostly combine motor and cognitive tasks. The influence of the motor element in causing a limitation in storage and WM processes was found by Rose, Myerson, Sommers, and Hale (2009). While performing a finger tapping task, the participants had to either solve a simple memory span or a WM span task. Tapping caused a significant interference in both tasks but surprisingly this effect was not sensitive for age. On the contrary, an age effect was found between young and older adults in the movement parameters and storage performance while walking on a treadmill and keeping a wordlist in mind (Lindenberger, Marsiske, & Baltes, 2000). Nevertheless, memory performance appears to be better while walking as opposed to sitting (Schaefer, Lövdén, Wieckhorst, & Lindenberger, 2010). To summarize, an EDL environment as well as movements common in EDL seem to highly influence memory performance. EDL scenarios could identify new aspects in terms of performance alterations of older adults.

Current Study

The goal of this study was to compare everyday memory performance of younger and older adults on a naturalistic task. The experimental protocol was designed to address three questions regarding the effect that an EDL context has on memory, especially STM, and its alteration in old age.

First, is there an age-related difference in everyday memory performance between younger and older adults? According to the model of LT-WM (Ericsson & Kintsch, 1995) and pertinent experimental findings (Henry et al., 2004; Park et al., 1999; Soederberg Miller, 2009), acquired knowledge and strategies of older persons may indeed help to overcome age-related memory deficits. To test this hypothesis, we compared the memory performance of younger and older adults in an EDL task. We used the idea of the representative task designs by Brunswik (1956) to perform an appropriate scenario. Following this construct, the scenario shall include the major constraints worked out above like body movement, visual-spatial distractions by the environment and a common context to benefit from acquired knowledge and strategies. Thus, we conducted a memory task within a “Supermarket”-environment that is well known for the usage of memory, including knowledge and strategies, and that is performed daily in EDL. Furthermore, it includes EDL constraints like walking and perceptual distractions by the environment. By doing this, our study collects a new kind of data that should represent memory performance in EDL.

Second, does the memory performance of older adults in EDL vary from basic laboratory measures? As pointed, participants show a different performance on a memory task in a common environment compared to pure laboratory based tasks (Hambrick & Oswald, 2005; Meinz & Hambrick, 2010; Meinz et al., 2012). However, those studies did not include the distraction of movements and high volume of visual-spatial information. It could be possible as well that memory tasks in EDL differ in principle regarding their underlining cognitive principles (Verhaeghen et al., 2012). To compare laboratory memory capacity with EDL memory performance, we conducted four established tasks to measure STM and WM capacity. Further, to investigate the influence of inhibiting irrelevant information on memory tasks in EDL, the Stroop test paradigm was performed, given its well-known influence of WM capacity in laboratory tasks (Long & Prat, 2002).

Third, do older and younger adults differ in their performance depending on whether the item recall is serial or requires manipulation? The answer to this question will clarify whether age related difference is caused by the need to manipulate items before recalling them in everyday life memory tasks. This age-related difference was found by several studies in the laboratory (for a meta-analysis, see Bopp & Verhaeghen, 2005) although a transfer of these finding to EDL tasks has not been made yet. To answer this question, participants had to complete the same memory task either with or without item manipulation in laboratory as well as in the representative task.

Methods

Participants

Twenty young (24.89 ± 3.16 years) and twenty-three older adults (70.28 ± 4.65 years) participated in this study. All participants had to fill in a custom made questionnaire, in which they reported a normal or corrected-to-normal vision and an independent living within the community. The study was approved by the local Ethics Committee, and all participants signed an informed consent statement before the testing started.

Apparatus, stimuli and procedure

The participants had to complete six memory tests and a Stroop test within two sessions of 1.5 h each. A delay of minimum two days and maximum one week between the sessions was set to reduce serial-order effects. STM tests included four established laboratory procedures - the verbal (Digit Span Test) and visio-spatial Span-Test (Grid Test) and the online-manipulation verbal (Digit Complex Span Test) and visio-spatial (Grid Complex Span Test) Span-Test designed by Hale et al. (2011). Item presentation time in all STM tests were set to 1.750 s as this was encountered as the minimal time older adults require for item manipulation (Emery, Myerson, & Hale, 2007). Because the encoding of words, especially for words with more than two syllables and with varying word length (Cowan, Baddeley, Elliott, & Norris, 2003) demands more recourses than the encoding of digits, the item presentation time for words was set to 3.5 s to enable online manipulation. Further, two naturalistic tasks (with and without online-manipulation) -"Supermarket Test"- were designed to be in parallel structure with the laboratory test in terms of items recognition.

Supermarket Test. Nine shelves and two desks were arranged such as to create a scenario reminiscent of a corner shop (Figure 1). The shelves were filled with 108 different products, which were ordered in different categories (for example milk products or canned food). To create familiarity with the setup, each participant was introduced to the scenario and the products for about 15 minutes. In the actual test, the participants had to perform two shopping tasks in counterbalanced order. In each, they saw a shopping list with twelve products. Each item was presented for 3.5 s on a computer screen, followed by a black screen for .750 s. The products on the list were arranged either in a random order (manipulation condition, EDC), or in the order as encountered when passing through the supermarket (non-manipulation condition, EDS). Following the presentation, the participants were asked to walk through the supermarket and to collect all products they remembered into a shopping basket. They were instructed to pick the products in the order they walk by them, which was not necessarily the order they appeared on the list. To force the participants to reorder the items before entering the supermarket, they were told that they are not allowed to go back if they passed a shelf.

To measure the EDL memory span (everyday serial and everyday complex memory), all products in the basket were counted, whether they were part of the shopping list and if they were put into the basket at the right order. Each participant completed the tasks twice with different lists for both conditions (EDC and EDS). The average values of both lists were calculated for EDC-M and EDS-M-Score (maximal possibility of 12 points). Furthermore, we calculated average scores for the last four items seen on every single trial as pure EDL-STM score (EDC-STM and EDS-STM, with maximal possibility of 4 points). The time required for every trail was hand stopped with a stopwatch.

Verbal Simple Span (VS). The items were presented sequentially in a black-outline on a grey background in the centre of a computer screen. Each item appeared for 1.750 s and was followed by a black screen for .750 s. The items were randomly chosen from a set of nine digits (1–9) and nine letters (B, F, J, K, L, M, Q, R, and T). The participants had to mark the memorized items with the mouse on a screen in the presented order. Each participant started with a list length of two items. Different lists with the same list length were presented three times. If the participant answered at least one list correctly, the list length was increased by one item and the testing resumed; otherwise, the testing stopped. The numbers of the items in the last completed list were set as a digit span score.

Verbal Complex Span (VC). The item presentation, scoring and procedure were equal to VS. However, the participants had to recall the items in a rearranged order, starting with the numbers in an ascending order and afterwards the letters in an alphabetic order.

Spatial Simple Span (SS). The mark ‘X’ was presented in a 4 x 4 grid for 1.750 s on a grey background, followed by a black screen for .750 s. For recall, the participants marked the positions of the X´s in the presented order in an empty grid. Scoring and procedure were equal to VS.

Spatial Complex Span (SC). The item presentation, scoring and procedure were equal to SS. However, the participants had to recall the items in the presented order and to shift them one position to the right in the empty grid.

Stroop-Test. In order to test the participant's ability on inhibition, we conducted a modified Stroop-Test (Bock & Beurskens, 2011). In two test conditions, the words “gelb” (yellow) and “grün” (green) were presented on a screen. The subjects were asked to respond to these stimuli by either pressing a yellow button with their right hand or a green button with their left hand as fast as possible. To keep this instruction in mind, a yellow bar was presented on the left side of the screen and a green one the right side. The colour and meaning of the words were congruent in the first and incongruent in the second condition. In the latter condition, the participants had to respond in accordance to the colour if the word was presented on a black background, but in accordance to the meaning if it was presented on a light grey background. We calculated the mean reaction time of all 55 trials in either condition excluding wrong responses, and used the difference between means for further analyses.

Data analysis

For statistical analysis of group differences we used a 2 x 2 (Group [old, young] x Task difficulty [simple, complex]) analysis of variance (ANOVA) with repeated measures on the last factor for each task domain (verbal, spatial, everyday life) separately. Further, we used a 2 x 2 (Group [old, young] x Task difficulty [simple, complex]) ANOVA for the pure EDL STM scores and a 2 x 2 (Group [old, young] x Task difficulty [simple, complex]) ANOVA for the duration times of the everyday life memory trails. The reaction times of young and older adults in the Stroop-Test were compared by a t-test to examine their ability to inhibit irrelevant information.

To explore the overall and age-sensitive connections between the laboratory and the shopping tasks, we completed correlation analyses separately for each age group and a factor analysis with standardized Varimax rotation that included the eight memory measures and the Stroop test. Data of the different tests was z-transformed to explore coherences between the laboratory measures and the novel naturalistic measures for both age groups. To explore an overall link between the different tasks, we conducted a correlation analysis with age partial led out. An exploratory factor analysis was completed based on the resulting correlation matrix.We were limiting the number of extracted factors such that all eigenvalues were above unity (Kaiser, 1960) as well as above the breaking point of the screen plot (Cattell, 1966). We used this conjunction of two criteria since the former, more common criterion, is thought to be too liberal (Horn, 1965) and thus may yield inconsistent factors.

Results

In the first step, the analysis of age differences in memory descriptive statistics showed that young adults memorized more items than older ones in all memory tasks (see Table 1). Within the shopping task, younger participants needed less time to collect the memorized items and showed shorter reaction times in the Stroop test in comparison to the older ones. All of the measured variables revealed a large effect of age, with the exception of EDC-M-Time (see Table 1 for effect sizes, based on Cohen, 1988).

An ANOVA with repeated measures for the verbal domain revealed a significant main effect of Age (F (1, 41) = 22.27, p < .001, η_p^2 = .36), but not for Task Difficulty. The spatial domain showed a significant effect of Age (F (1, 41) = 58.28, p < .001, η_p^2 =. 59), as well as of Task (F (1, 41) = 73.73, p < .001, η_p^2 = .64). The everyday life domain showed a significant effect of Age (F (1, 41) = 104.62, p < .001, η_p^2 = .72), but no significant effect of Task Difficulty. There was no significant interaction effect of Age x Task in any of the three domains.

The analysis of the STM scoring of the EDL memory tasks by an ANOVA with repeated measures confirmed the significant main effect of age (F (1, 41) = 67.68, $p < .001$, $\eta_p^2 = .62$). In line to the normal scoring, there was no effect of Difficulty and no interaction of Age x Difficulty. The time needed to fulfil the supermarket tasks was significantly lower for younger participants (F (1, 41) = 9.29, $p < .01$, $\eta_p^2 = .19$). But no significant effect of task or an effect of Age x Task could be observed. Furthermore, Fischer LSD post-hoc analysis showed that older adults needed significantly more time in the EDS-M then in the EDC-M task, but there was no such effect for younger adults. A t-test of reaction time differences in the Stroop test confirmed the advantage of young subjects over older ones (t (41) = 4.84; $p < .001$; d = 1.62).

In a second step, correlation analyses were conducted for both age groups to determine the influence of cognitive aging on the connection between laboratory and the naturalistic tasks (see Table 2). For older adults, as expected, the laboratory memory tasks correlated with each other in a range from r = .57 to .65. In the younger age group just the verbal tasks significantly correlated with each other (r = .50), but there was no connection between the two spatial difficulties or between the verbal and the spatial tasks. In case of the naturalistic tasks, EDS-M and EDC-M did correlate significantly with each other for older (r = .42) and for younger (r = .45) adults. Additionally, EDS-STM and EDC-STM were associated with each other in both age groups. Naturalistic tasks within the same task difficulty (serial vs. complex) correlated as well in both age groups. Further EDC-STM correlated with VC for older (r = -.43) and with SC (r = -.51) for younger adults. No other connection could be revealed between the laboratory and naturalistic tasks. The Stroop-Test did not show any connection with other tasks in the older group, but with EDS-M (r = -.55) and EDS-STM (r = -.47) in the younger group. In addition, the time measures for the naturalistic tasks correlated with each other (r = .87) but neither with the performance in task nor with the performance in the laboratory measures.

Because the correlation analysis did not provide a firm conclusion on the divergence of laboratory and real life tasks in relation to cognitive aging, we conducted a factor analysis to substantiate our findings. Both age groups were included in this analysis to see if the disconnection of the laboratory and the naturalistic task might be an overlapping issue. The factor loadings are presented in Table 3. Two orthogonal factors emerged (Factor F1 is related to laboratory tasks and F2 to real life tasks), explaining 54.7% of total variance. Stroop task is not loading on either factor.

Discussion

The present study was designed to determine memory performance of older adults in an EDL task. Therefore, we recreated a shopping scenario to address three questions: 1) is there an age-related difference in everyday memory performance between younger and older adults?, 2) Does the memory performance of older adults in EDL vary from basic laboratory measures?, and 3) Do older and younger adults differ in their performance depending on whether the item recall is serial or requires manipulation?

Consistent with the literature on cognitive aging, older adults performed worse than younger adults in all of the executed tasks. More specifically, the observed age-related difference in the laboratory memory tasks is in line with previous studies on STM measures (Elliot et al. 2011, Hale et al, 2011). A significant age-related difference was also shown in the EDL tasks (for both scorings). This was especially unexpected for EDS-STM and EDC-STM as similar laboratory tasks previously showed no age effects (Zacks et al., 2000).

When comparing the different tasks, the effect of age was most pronounced in the EDL tasks. This contradicts our hypothesis that older people would benefit from their acquired knowledge and strategies in the shopping task, following the expert performance approach (Soederberg & Miller, 2009; Sohn & Doane, 2003). A possible explanation for this unexpected result is that other age-related alterations like visual distraction might be responsible for this increased age effect in comparison to the laboratory. The ability to inhibit irrelevant information is seen as one of the most important WM capacity limiting factors (e.g., Long & Prat, 2002). Although older participants performed worse in the Stroop-Test no relation between Stroop and everyday memory performance could be observed. Reaction times in the Stroop-Test did not correlate with any of the EDL-task nor did they load as a factor in the factor analysis. Therefore, the ability to inhibit unnecessary information does not seem to influence the performance in our everyday memory task. The fact that older adults need about 30 seconds longer than younger ones to complete the naturalistic task points in another direction. It indicates that the process to search and find the items was much harder for older adults and therefore required additional cognitive resources, which is in line with findings of age-related deficits in visual search paradigms (Kosnik, Winslow, Kline, Rasinski, & Sekuler, 1988; Sloane, Ball, Owsley, Bruni, & Roenker, 1992). Another aspect to explain the larger age-effect in the shopping scenario is the simultaneously performed motor task. An age-related decrease of memory performance while walking has been shown before (Lindenberger et al., 2000). Therefore, we could speculate that the motor component of walking and grasping in the shopping scenario might cause similar deficits.

In opposition to this argumentation, it is possible to argue that older adults did not benefit from naturalistic task, because they were not able to use their expertise. The representation of the supermarket they usually visited for over a decade might interfere with the new setup. Therefore, it might be easier for younger adults to adapt to this “new” setting and use the common context and cues more appropriate. This objection cannot be ignored and could partly explain our findings as well. However, younger and older participants affirmed after the introduction of fifteen minutes that they were familiar with the products and with the setup. After the task they confirmed as well that the products they were ask to memorize are common to them and on their usual shopping list.

Regarding our second question, we could state that older adults seem to perform equally in EDL and laboratory. Based on the aging literature (Rendell & Craik, 2000; Rendell & Thompson, 1999; Rose et al. 2010; Schnitzspahn et al. 2011), we expected that older adults should memorize more items in the EDL-task than they did in the laboratory tasks. This pattern could be observed for the younger adults who could memorize two items more than their basic laboratory capacity. These results are in line with the observations of Blanchard-Fields (2007) and Hertzog et al. (2008) which show that there is an overt distinction between memory in the laboratory and EDL. This is also consistent with previous research concerning prospective memory showing differences in memory performance in laboratory and real life context (Henry et al., 2004). Younger adults seemed to benefit from the common context of the shopping scenario, which supports the findings of Hambrick and Oswald (2005), who found that young adults performed up to 100% better when remembering items with a common context. On contrary, older participants showed nearly equal performance for both VS and the EDS-M. In fact, they memorized slightly more items but not in a significant manner. That means that older adults performed the same in EDL memory tasks as they were supposed to by their laboratory memory capacity.

Although their performance was the same in EDL like their STM capacity, no connection was found between the laboratory tasks and EDS-M or EDC-M. One could argue that EDS-M and EDC-M rely more on LTM components and therefore we verified the well-established distinction between LTM and STM. To control that issue we used the EDS-STM and EDC-STM scores. This analysis showed a connection between EDC-STM and VC in the older age group, as well as a connection of EDC-STM with SC in the younger one. Hence, a consistent interaction between laboratory and EDL tasks cannot be observed. Because of the indistinct picture drawn by these outcomes, we assumed that the distinction between laboratory and EDL task is apparent among both age groups. The outcomes of the factor analysis support this idea by separating the four laboratory and the four EDL measures. The high loadings that separate the two environments indicate that both conditions rely on separate cognitive resources, which is consistent with the interpretation of Verhaeghen et al. (2012).

Answering the third question, we found that to rearrange the presented items before recall had no significant influence on the memory performance of young and older participants. Particularly in both, the shopping tasks and the verbal domain conditions, values just differed slightly, however, in the visual-spatial domain the differences were much more pronounced but not significant. These findings are supported by Hale et al. (2011) who detected an age effect in several WM tasks but no effect caused by rearranging items. Surprisingly even the shopping scenario did not cause such an effect, although we expected this effect to be more remarkable in EDL. Especially as we thought that older adults could prefer the strategy to rearrange items before stepping into the supermarket. Because of their experience in shopping, we argued that it is more common to them to write a shopping list by daily needs and rearrange it in their mind while shopping. This would be in line with Emery et al. (2007), who find that older adults tend to rearrange items for easier recognition if enough time is given. Therefore, it might be possible that the given time was too short for item-manipulation or as state before they were not familiar enough with the setup.

Possible limitations of the present study comprise the sample size of the correlation analysis and the factor analysis, thus these findings have to remain exploratory. However, as the present study is an important preliminary work to explore memory performance of older adults in an EDL context, it can serve as initial empirical evidence for identifying the main variables for memory performance in EDL. Follow-up studies will be required to corroborate our results using experimentally controlled designs with higher power and including more control task of different memory components, for example episodic memory or complex span STM/ WM measures as introduced by Unsworth and Engle (2007). In addition, when investigating everyday memory, the degree of ecological validity needs to be manipulated carefully. Within our present study, we focused on everyday life item retrieval. Following the approach by Sinnott et al. (1992) the influence of an everyday life item presentation and the combinations of both should be investigated in future studies, using slight variations of the shopping task scenario.

In summary, age-related differences in everyday memory performance were found between younger and older adults. Based on the idea that superb knowledge or strategies to fulfil a task supports performance, one could argue that especially older participants could benefit in the shopping task, because of greater experience. Though younger participants actually benefited of the EDL task, while older participants did not. They were just able to memorize the same amount of items like they did in the verbal laboratory task. This could also indicate that older people need much more cognitive resources in an EDL activity than younger people do. They are much more conflicted by moving and searching the right product while keeping all the products in mind.

These findings show that the transfer of results made in the laboratory on memory performance to EDL activities should be taken carefully. Furthermore, our findings suggest that there are main differences in a memory task performed in a laboratory or an EDL environment. We think that the common approaches to measure memory performance (Ericsson & Delaney, 1999; Yuan et al., 2006) should be enhanced by using an EDL approach as complimentary measure. This approach would include expertise, like the expert approach, as well as the usage of acquired knowledge. Further research is needed to mediate between the findings made in a laboratory and in an EDL environment. Closing this gap could make it much easier for further research to recreate supportive strategies or interventions to help retain a high memory capacity up until old age.

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Figures

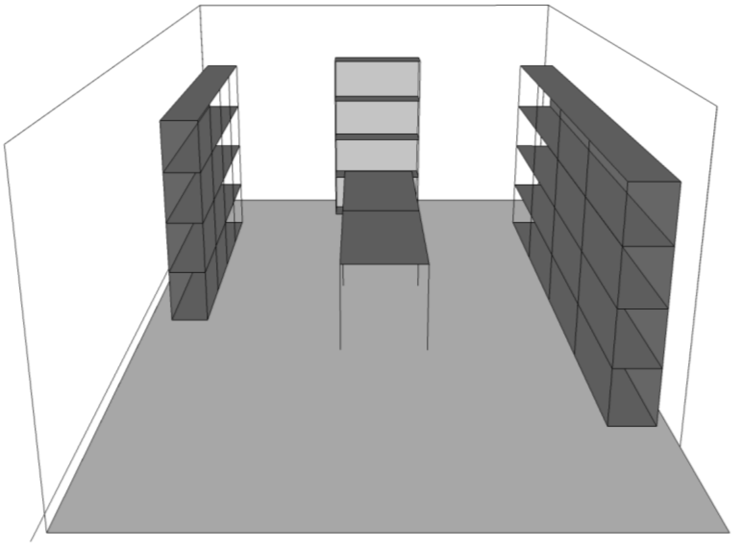

Figure 1. 3D-model of the shopping scenario.

Tables

Table 1. Mean Numbers and Standard Deviations are shown for the Memory-Spans of the four laboratory tasks and EDL tasks are shown by age-groups as well as the reaction times in the Stroop-Test.

	old		young		
	M	SD	M	SD	Effect size (Cohen´s *d)*
VS	5.9	1.21	7.7	1.45	1.39
SS	4.7	0.91	6.3	0.84	1.87
VC	5.6	1.77	7.8	1.67	1.31
SC	3.2	0.98	5.2	0.81	2.26
EDS-M	6.4	1.67	9.9	0.93	2.6
EDC-M	6.2	1.36	9.7	1.22	2.76
EDS-STM	1.63	0.89	3.0	0.63	1.8
EDC-STM	1.41	0.48	2.98	0.68	2.77
EDS-M Time	135.05	53.24	89.30	25.58	1.1
EDC-M Time	121.07	48.44	94.00	25.27	0.7
Stroop [ms]	1169.81	489.27	579.15	152.61	1.62

Note: Verbal Simple Span (VS), Spatial Simple Span (SS), Verbal Complex Span (VC), and Grid Working Memory Spans by age-group. Further WM-Spans of the EDL memory tasks, Everyday-Non Manipulated (EDS-M) and Everyday-Manipulated (EDC-M), and the scoring for the last four items as STM measure, Everyday-Non Manipulated (EDS-STM) and Everyday-Manipulated Short-Term-Memory (EDC-STM)

Table 2. Correlations among measures of both age groups with correlations of older adults above and of younger adults beyond the diagonal.

	Simple Span		Complex Span		Naturalistic Task						
	1	2	3	4	5	6	7	8	9	10	11
VS (1)		.57*	.59*	.57*	.15	-.25	.03	-.39	.08	-24	-.27
SS (2)	-.05		.65**	.62*	.03	-.26	-.14	-.16	.08	.08	.03
VC (3)	.51*	.27		.46*	-.001	-.38	-.09	-.43*	.11	.08	-.02
SC (4)	-.03	.13	.15		-.19	-.11	-.38	-.28	-.04	.10	-.12
EDS-M (5)	.-.02	-.15	-.08	-.37		.42*	.82***	.38	.04	.04	.05
EDC-M (6)	-.12	-.38	-.48*	-.24	.45*		.42*	.47*	-.01	.01	.05
EDS-STM (7)	-.11	-.05	-.17	-.15	.79***	.36		.43*	.01	.01	.05
EDC-STM (8)	-.29	-.51*	-.29	-.08	.59**	.81***	.44		-.04	-.02	-.12
Stroop (9)	.21	-.05	-.17	-.06	-.55*	-.16	-.47*	-.34		.16	.14
EDS-M Time (10)	.10	-.50*	-.31	.17	.05	.34	-.09	.35	-.13		.70***
EDC-M Time (11)	.09	-.32	-.25	.29	-.01	.25	-.01	.20	.01	.87***	

Note: n.s., *, ** and *** $p > 0.05$, $p < 0.05$, $p < 0.01$ and $p < 0.001$ respectively.

Table 3. Outcome of factor analysis.

	Factor 1- laboratory	Factor 2- everyday life
VS (1)	**.75**	.05
SS (2)	**.71**	-.11
VC (3)	**.90**	-.10
SC (4)	**.50**	-.28
EDS-M (5)	.13	**.92**
EDC-M (6)	-.44	**.62**
EDS-STM (7)	.01	**.90**
EDC-STM (8)	-.48	**.58**
Stroop (9)	-.12	.07
Proportion of variance	27.5 %	27.2 %