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Personality and cognitive variables as predictors of prospective memory tasks performance

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Several studies have tried to analyse the relationship between prospective memory and other personality variables: state-action orientation (Goschke & Kuhl, 1996); type A personality, self-actualization (Searleman, 1996); depression (Rude, Hertel, Jarrold, Covich & Hedlund, 1999); anxiety (Harris & Menzies, 1999; Nigro & Cicogna, 1999); locus of control (Nigro & Cicogna, 1999); and extraversion (Hefferman & Ling, 2001). However, research about those topics is partial and not conclusive. We have run several regression analysis to determine how some cognitive variables (sustained attention, verbal fluency, interference, retrospective memory, selective attention) and personality factors (tested using 16-PF-5, Cattell, Cattell, & Cattell, 2003) contribute to explain the variance of prospective memory tasks performance. Our results show that the contribution of personality predictor variables is moderate and smaller than cognitive variables. Other additional results are also commented.

Working memory processes in encoding intentions

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Although the effects of encoding have been studied extensively in traditional retrospective memory research of already learned things, the encoding of intentions has yet to be studied in great detail. The primary interest of this investigation concerned working memory functioning and cue/act discrimination during encoding of intentions. Stemming from ideas first set forth by the Automatic Associative Activation framework proposed by Guynn, McDaniel, & Einstein (2001), three experiments are presented that involve different working memory distraction tasks (corresponding to Baddeley's tripartite model of working memory) at the time of encoding the prospective memory (PM) intentions, as well as varying numbers of cues and actions. Initial hypotheses proposed two main concepts: that binding the cue to the act was an important part of the encoding process, and that the central executive would most likely be involved in this process. The pattern of performance across experiments, coupled with the cue and act recall findings (particularly those of Experiment 3), not only gave credibility to some of the initial hypotheses, but also allowed for speculation about the specifics of how the other components of working memory are involved. In the experiments, participants were required to perform one of three tasks designed to primarily utilize either the central executive (CE), the phonological loop (PL), or the visiospatial sketchpad (VS). While performing this task, participants were presented with instructions to perform a subject-performed task (SPT) when a specific cue word was presented in a subsequent task. Finally, participants were required to first recall all of the PM cues and SPT's then to complete a recognition test for the cues and SPT's. The number of PM cues and SPT's were varied across the three experiments. Differences were found among the working memory conditions, though these differences were not constant across experiments. In Experiment 1 which had three cues and one action, the VS condition showed higher performance than the CE and PL conditions. A similar pattern of results were found in Experiment 2, which had one cue and three actions. In Experiment 3 with three cues and actions, the VS group showed a dramatic decline in PM performance and was significantly lower than the CE and PL groups. With respect to the recall results, the CE task seemed to result in difficulty with cue/act discrimination, the PL task appeared to cause problems with encoding of the cues, and the VS task caused a detriment for encoding of actions (especially when differentiation of cues and acts was required). Overall, results suggested that the central executive is involved in binding a cue to an action, and that this operation is central to PM success. Furthermore, the phonological loop seems to be primarily involved with processing of cues and the visuospatial sketchpad with actions. It was concluded that the processes of the phonological loop and visuospatial sketchpad must be successful before the central executive can bind the cues and acts together, which is possibly the most important part in the encoding of intention.

Is Prospective Memory impairment an index of hepatic encephalopathy?

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Introduction: The ability to remember a delayed intention is very important in every day life. The term Prospective Memory (PM) refers to this function. Hepatic encephalopathy (HE) is a neuropsychiatric complication that can be detected in patients with liver cirrhosis even in absence of clear signs of mental deterioration. Even if everyday life activities are often considerably compromise in cirrhotic patients, PM was never investigated. Aim of this study was to evaluate PM in a group of patients with liver cirrhosis without overt HE. Methods: Cirrhotic patients without HE were enrolled in the study. They were assessed with a standard neuropsychological battery and matched for age and education with healthy controls. Both patients and controls performed a computerized PM task. Subjects underwent 288 trials divided in 8 blocks. In each trial a string of 5 letters was displayed for 2000 ms. Subjects primary task was to judge if the letters in 2nd and 4th positions were equal or not. When at least one of the letters in 2nd and 4th positions was a "B" (PM condition), after the primary judgment task, subjects were instructed to press the spacebar of the keyboard (PM task). In the other case it was an "ongoing" condition. The flanker letters were considered "Distracters" when they were Bs. Reaction times (RTs) and accuracy both for the primary and the PM task were recorded. Data Analysis: Analysis of variance (ANOVA), with Group (Cirrhotics vs. Controls) as between-subjects factor and task conditions (Ongoing, PM, Distracter) as within-subjects factor, was performed to test the effect of PM instructions on primary task RTs. A second ANOVA was performed excluding the trials with errors in the PM task. A third ANOVA was performed to measure patients' ability to remember the delayed intention associated with PM stimuli. Percentage of correct response to PM task was used as independent variable for this analysis. Results: Cirrhotic patients were found to be slower than controls considering all conditions [1223 ms. vs. 1043 ms., respectively; $F(1,14)= 4.8237$; $p<0.05$]. Reaction times were found to be slower in the PM compared to both the Ongoing and the Distracter conditions [$F(1,14)=34.23$; $p<0.0001$]. No interaction was found between the two factors. However, considering only RTs of trials without errors to the PM task, no difference was found between the two groups. The effect of PM demand on Primary task was found again significant: i.e. slower RTs in the PM condition than in the Ongoing and Distracter conditions [$F(1,13)=26.9$; $p<0.0001$]. Considering the PM task it was found that patients were less accurate than controls only in the PM condition [56% vs. 91%, respectively; $F(1,13)=12.6$; $p<0.00001$]. Conclusion: Cirrhotic patients without HE showed a specific deficit in the ability to remember a delayed intention. They showed a clear tendency to omit response to the PM task even if they correctly remembered instructions at the end of the task. These findings are discussed in the light of a multi-componential model of PM.

Modulation of attentional resources in prospective memory: an ERP study

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Introduction: Prospective memory (PM) tasks imply vigilance and divided attentional resources, in order to monitoring intention over time. Typically, in PM paradigms subjects are engaged for a long time in an ongoing activity and exposed to rare prospective stimuli. In the present study different target probability was used to modulate attentional demands in a PM task. Method: Two experimental groups of subjects underwent a PM task. In each trial a string of 5 letters was centrally presented on a computer screen. Subjects were invited to press one of two keys when the letters in the 2nd and 4th positions were equal, and the other when they were different (e.g. DFDFD = same; DFDGD = different). They were instructed to press the space bar whenever a "B" appeared in one or both the target positions (2nd and 4th) (e.g. SBSBS, SBSDS) after performing the primary task. In the low frequency PM task prospective target "B" was presented 5% of times. In the high frequency PM task the "B" had a probability of occurrence of 50%. The "B" distracters ("B" presented in 1st, 3rd, and 5th position) were equally probable, irrespective of condition. Two other groups of subjects performed the primary task without prospective instructions (Baseline tasks). Subjects were randomly assigned to one of four tasks. The experimental session consisted on eight blocks of 61 trials of letters. The aim of our study was to test the influence of attentional demand on baseline and PM tasks. Our hypothesis was that variations in "B" occurrence modulate different components of attention only in PM tasks. Data on accuracy, reaction times (RTs), and event related potentials (ERPs) were analysed. Results: The control groups (performing only the primary task) showed no effects of the target frequency on RTs. RTs in the primary task were systematically higher in the experimental than in baseline groups ($t70= 3.030$; $p< .003$). Furthermore, B distracter RTs increased at the presence of PM task ($t51= 8,316$; $p< .001$). The target trials differed significantly according to the frequency ($t53= 8,621$; $p< .001$): namely, RTs in the low frequency condition were slower than RTs in the high frequency condition. ERPs data revealed enhanced N100/P200 and N400 amplitudes in frontal and central sites for PM targets compared to baseline and ongoing tasks. The probability of the PM target modulates these components; specifically their amplitudes were enhanced in the rare target condition. Furthermore, compared to the baseline group, prospective trials produced late ERPs components, starting from 500 to 600 msec in frontal sites. Conclusions: Data show a global increase of RTs in the prospective memory condition (low frequency), as result of a dual-task and monitoring costs. Slow waves ERPs might provide evidences for a specific prospective memory component. Furthermore, target probability affects RTs and ERPs only in PM tasks, probably due to an increase in monitoring demand.

A multinomial model for consent and attendance to an experimentally arranged laboratory appointment

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In real world applications the nonexecution of a prospective memory task need not indicate that a participant did not remember. She may have agreed in order to appear compliant, or external factors could have impeded that she performed as agreed. If nonexecution cannot be taken at its face value it becomes necessary to disentangle the factors of intention, prospective memory, response bias and the likelihood of unforseen intervention. In two studies, experimenters asked students in a campus cafeteria if they would attend to a laboratory experiment. The candidates were asked to choose a date from one randomly determined range that varied from short at the next day to very long up to eight weeks later. The conditions of recruitment differed among the two experiments. Dependent variables consisted of the consent and attendance rates. Also, half of the participants that had agreed to collaborate were reminded one day before the actual session by giving them a phone call. For Experiment 1, 242 persons were contacted. One half were recruited by experimenters that wore loose outfit (jeans and sweaters), and the other half with the experimenters dressed up more formally, carrying suits. Experiment 2 relied on 78 persons. Half the candidates had been exposed to a short paper-and-pencil pretest at the recruitment. They were told that this was to properly assign them to a fitting psychological study. In fact however all participants were treated the same. The results show a strong memory effect. In Experiment 1, 57% of the contacted students that had agreed to show up on next day (or were reminded at that lag) actually attended. Following that five weeks intervened unreminded attendance dropped to 32%. Regarding Experiment 2, the procedure of mock diagnostic pretesting significantly raised the consent rates from 29% to 48%. A multinomial model relied on the following main assumptions and parameters: First, the observed agreement quotas are based on candidates that had formed an effective intention to participate (i) and others that without having that intention falsely agreed to participate (f). Second, unreminded participants with proper intentions were assumed to show up if only they remembered the date (b(t)) and if the appearance at the laboratory was not interfered with by unforseen events (e). The general model fit the data from both experiments ($p>.78$) and parameter values were interpretable. Prospective retention, b(t), following intermediate lags of two weeks was estimated to 68%, and following five weeks, to 53%. The likelihood of unforseen events proved statistically significant above zero, while likelihood of false agreements did not. Further, different estimates are needed to reflect the degree of intention formation in all conditions. Mocked testing and dressing style significantly fostered intentions, i(control)=24%, i(dressed up)=38%, and i(pretest)=58%. As far as we are aware, this is the first time a model served to quantify the otherwise confounded processes of intention formation, prospective retention, response bias and intruding events. Further results suggest that mock pretesting, while surprisingly effective, does not aid memory itself but rather contributes to the intention formation at the recruitment.

The role of rostral prefrontal cortex (Area 10) in prospective memory

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Findings from both human lesion studies and functional neuroimaging implicate the rostral prefrontal cortex (Area 10) in prospective memory. Recent findings from our lab elucidate the role that this region is playing, with five key findings: (i) Haemodynamic changes in Area 10 provoked by prospective memory situations are unrelated to the difficulty of these situations, but are related to maintenance of an intention over a delay period. (ii) There is specialisation within brain area 10 in event-based PM situations, with lateral areas showing increased activation and medial regions showing a concomitant decrease. (iii) These lateral Area 10 increases occur equally when either retrieval or cue detection demands are high. Furthermore, a processing distinction between time- and event-based prospective memory is suggested by both lesion and imaging studies: (iv) In humans, lesions to the right rostral prefrontal region (i.e. Area 10) cause prospective memory deficits on multitasking tests which use time-based switching cues, whereas left rostral lesions cause impairments in the use of event-based cues (including arbitrary rules). (v) Time-based PM tasks where a clock is available provokes medial Area 10 activation because of the additional low-level attentional demand. Four additional lesion and imaging studies from this lab support the 'Gateway Hypothesis' of the role of Area 10: that it supports the biasing of attentional modes between stimulus-oriented thought (required for ongoing task performance) and stimulus-independent thought (required for maintenance of the intention), with medial aspects supporting the former, and lateral regions the latter.

The fractionation of executive functioning in prospective memory: The effect of task complexity

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Prospective memory involves planning, monitoring, inhibition, response selection... and is therefore assumed to rely on central executive functioning. However, since few theoretical concepts specify which executive functions contribute to prospective memory performance, we investigated to which degree executive functioning predicts realising delayed intentions, and which executive measures are the best predictors of prospective memory. We will report results of a study in which 180 young adults (17-25 years) completed a new computer-based driving task ('Space Racers') designed to assess both time-based and event-based prospective memory. The time-based prospective memory task involved monitoring the level of available fuel, and to refuel on time. For the event-based prospective memory task, participants were instructed to refill the oil by hitting a keyboard button whenever a yellow light on the screen was lit. Task complexity was introduced as a between-subjects independent variable, by manipulating the cognitive load of the ongoing task but holding constant the prospective memory instructions. In addition to the prospective memory tasks, three tests of executive functioning were administered: Wisconsin Card Sorting Task (WCST), Controlled Oral Word Association Test (COWAT), and Tower of London (TOL). Given the highly integrated aspect of these complex and multicompound tasks, we also collected pure measures of the executive component processes separated at a cognitive level by Miyake et al. (2000): mental shift, updating, and inhibition. Additionally, measures of sustained attention (Continuous Performance Test) and of prospective time production were gathered. Preliminary analyses show a significant correlation between time-based and event-based prospective memory. Correlations between the complex executive tests and the component tasks were generally low, consistent with the results from previous individual differences studies of central executive functioning. Results suggest that performance on time-based and event-based prospective memory is predicted by different executive functions. Performance on prospective memory tasks, executive tests, executive component tasks and cognitive tasks will also be discussed within the framework of a newly developed visuospatial working memory task, Tangrou. The advantages and disadvantages of the 'Space Racers' prospective memory game for clinical neuropsychological assessment, especially with children, will be considered.

A Comparison between Combination Span and Single-dimensional Span of Working Memory

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Working memory span refers to the amount of information that individual can maintain while simultaneously manipulating information. One deficiency of researches on working memory span at present is that most researchers only examined the single-dimensional spans like verbal span and spatial span, while researches on the storage and processing mechanisms of complex information integrated from multiple dimensions remain quite rare. In the framework of cognitive aging, two experiments were designed in this study to examine the storage and processing characteristics of integrated information, and the differences between combination span and single-dimensional span, e.g. digital span and spatial span. Experiment 1 explored the differences among combination span, digital span and spatial span when no concurrent processing load was imposed. A 3x3 mixed designed was used, with age group as the between-subjects factor and span type as the within-subjects factor. Three age groups participated in the experiment: the young adults group (19 - 24 years old), the older adults group 1 (58 - 65 years old) and the older adults group 2 (74 - 83 years old). The three types of spans are digital span, spatial span and combination span. The digital span task required participants to report loudly the digits in the order that they had been presented in a series. The spatial span task asked the participants to mark the locations of the target in sequence. In combination span task, they were required to report both the names and the locations of target digits in the order that they appeared. The results showed that the combination span of all age groups was less than half of the sum of digital span and spatial span. The combination span of older adults group 1 was inferior to that of the young adults group, but the no significant difference was found in the other two spans between the two groups. However, all three spans of the older adults group 2 were significantly poorer than those of the young adults group. Experiment 2 was conducted to compare the differences of the three spans when various processing loads were imposed. A 3x3x2 mixed designed was used, with age group as between-subjects factor, span type and processing load type as within-subjects factors. There were two types of processing loads: verbal processing and spatial processing. A color naming task was used as verbal secondary task, requiring participants to say loudly the color of each item as it was presented using the color names red, green or blue. A spatial discrimination task was used as spatial secondary task, in which participants were instructed to point to the color of each item as it was presented using color palette. The results showed that for young adults group, digital span was poorer when including verbal secondary task, and spatial span was significantly impaired when including spatial secondary task, but no substantial difference was observed in combination span between the two processing load conditions. For older adults group 1, digital span in verbal processing load was inferior to that in spatial load condition, but there was no significant difference in the other two spans And for older adults group 2, no processing load effect was found in all three spans. Results above suggested that the combination span task involved some kind of processing component that was not tapped by single-dimensional span task, such as integration, coordination or something else. The processing in digital span and verbal span for young adults was domain-specific, while processing involved in combination span task might be domain-general. But as age increased, domain-specific processing might decay and become gradually sensitive to any type of processing load.

Interference and facilitation effect on time-based prospective remembering: the role of ongoing activity.

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When people must fulfil two different time-based intentions, for which the retention intervals partially overlap, a facilitation or interference effect on prospective tasks may occur. According to Cicogna et al. (2005), the administration of an interpolated time-based task improves prospective memory performance on a main time-based task, while performance on the interpolated task appears to be negatively affected by proactive interference due to the previous encoding of the main task. This effect becomes stronger when the deadlines for the execution of the two planned time-based actions are closer to each other.
The aim of the present study was to analyse whether facilitation and/or interference effects also depends on the continuous or discontinuous nature of the ongoing activity. Two hundred and forty university students took part in the study. Participants were randomly assigned to six different experimental conditions (40 each). Half of the participants were administered a continuous ongoing activity (COA), while the other half were administered a discontinuous one (DOA). Two groups of participants had to execute a time-based task 20 minutes after beginning the computer task, and two groups had to execute a 20 minute time-based task, as well as an interpolated time-based task, which was administered 14 minutes after trial commencement. Both PM tasks required that participants pressed a specific key on the computer keyboard. Participants could keep track of the passing of time by pressing another key. Two control groups completed the ongoing activity (continuous or discontinuous) only. The ongoing activities were of the same nature (reasoning tasks). However, participants in condition COA had to solve only one problem, while participants in condition DOA had a set of different problems to solve. The degree of difficulty of the reasoning problems was comparable. The instructions for the execution of the ongoing activity and of the PM task(s) were given via the computer screen. A post experimental interview ended the session. Preliminary results showed that the temporal organization of ongoing activity did not affect performance on the main task. However, performances on the interpolated PM task were worse where the ongoing activity was discontinuous (.37 of correct PM performances), rather than continuous (.60 of correct responses). In other words, the facilitation effect of the interpolated time-based task on the main task is more evident when the ongoing activity is continuous, while the interference effect appears stronger when the ongoing activity is discontinuous. Furthermore, results showed that the correct execution of both PM tasks is less frequent when the ongoing activity is discontinuous (.27), rather than continuous (.50). It seems that the fragmentation of ongoing activity negatively affects prospective remembering. It may be that attentional resources absorbed by the execution of multiple tasks impair PM performances.

Working memory load and self-regulatory strategies modulate the cost of remembering to remember

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Recently, there is growing interest in the effect that an embedded intention has on ongoing task performance (e.g., Marsh, Hicks, Cook, Hanson, & Pallos, 2003; Marsh, Hicks, & Cook, 2005; Smith 2003). Smith (2003) showed that reaction time performance on an ongoing task was significantly increased by the presence of an embedded intention. More interestingly, these increased reaction times occurred even on neutral trials where no prospective memory (PM) target was present. In our experiments, we assessed the role of working memory load and self-regulatory strategy on the costs to ongoing task performance. In one experiment, we examined the role of working memory load by varying cognitive load across seven conditions in which participants received no intention (control condition) or 1, 2, 3, 4, 5, and 6 target cue words. In Marsh et al. (2003), they varied cue set size (4 versus 8 targets) and observed a difference such that there was significantly more interference for 8 unrelated target items versus 4. In contrast, we were interested in examining more specifically at what point working memory load begins to interfere with ongoing task performance. Our results showed that there was little or no cost to responses on an ongoing lexical decision task (LDT) in the control condition and the 1-word. Significant costs to reaction time responding were observed in the 2-word condition and increased in magnitude to the 6-word condition. Our results show that working memory load influences the way attention is allocated over the course of the task. In the next experiment, we investigated the role that self-regulatory strategies play in alleviating interference associated with the working memory cost of holding an intention in mind. Specifically, we used implementation intentions which are effective self-regulatory tools that are expected to facilitate goal attainment on the basis of psychological processes that relate to both the anticipated situation and the specified behavior. In an implementation intention, a mental link is created between a specified future situation and the anticipated goal-directed response (Gollwitzer, 1999). Marsh et al. (2003) found that cues and responses that were highly associated (e.g., photo-album) showed less interference than cues and responses that were unassociated (e.g., dog-album). Therefore, we predicted that implementation intentions (by creating an association between the cue and response) lead to a decrease in ongoing task interference. In our study, we compared three conditions: a control condition (no intention), an intention only condition, and an intention + implementation intention condition. Results showed a pattern in which performance in the implementation intentions exhibited less costs to ongoing task performance compared to the intention only condition. Furthermore, this benefit was not at a cost to propective memory performance as detection of prospective memory cues was marginally higher in the implementation intention condition versus the intention only condition. The present studies identified important variables that serve to extend understanding of the relationship between prospective memory and ongoing task performance.

Prospective memory in patients with Parkinson's disease

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Background. Prospective memory (PM) is the ability to perform action in the future when some external event occurs (event-based) or at a certain time (time-based). Einstein and McDaniel (1996) pointed out that PM contains a retrospective component and a prospective component. The former referring to remembering what action and when the action has to be performed is retained to rely on episodic memory system; the latter refers to the remembering to perform an action when the appropriate event or time occurs and is retained to be more associated to executive processes. PM deficits have been observed in patients with Alzheimer's disease, with frontal brain damage, with closed-head injury and in elderly subjects without medical disease. Poor interest has been directed to the investigation of PM in Parkinson's disease (PD) and available data appear inconclusive. In a recent study, Katai et al. (2003) found pathological performances of patients with PD compared to control subjects on PM event-based but not on PM time-based. These results are of difficult interpretation in the context of the deficits in executive functions and in the ability to estimate correctly time intervals that are described in PD patients. Moreover, it would be interesting to evaluate in these patients the possible dissociation between the retrospective and prospective components of PM. The present study was aimed at investigating PM and its relationship with neuropsychological deficits in PD patients. Material and methods. 25 PD patients without dementia and 25 healthy subjects (HC) matched for age, sex and years of formal education participated in the study. In the experimental task, subjects were asked to execute three uncorrelated actions after 20' (time-based condition) or after a timer ring (event-based condition). For each task three trials were performed. A score for the correct recall of the intention to perform the actions (prospective component, PC) and a score for the correct execution of the actions (retrospective component, RC) have been computed. Moreover, for the time-based task, time monitoring (i.e. number of watch observations during the retention interval) was also evaluated. Finally, PD patients also received a neuropsychological test battery investigating episodic memory and executive functions. Results. PD patients obtained significantly lower PC score on Time-based ($Z=2.42$; $p=0.01$) but not on event-based ($Z=1.48$;$p>0.10$) tasks. Moreover, number of time monitoring in the 5 minutes immediately preceding the target time in the time-based condition was significantly lower in PD patients compared to HC ($Z=2.36$; $p=0.02$). As regards RC, PD patients performances were worse than the HC's in both tasks ($Z=4.31$;$p<0.001$). Finally, significant correlations were found between scores obtained on PC and RC and number of categories achieved (TI: $R=0.45$; $p=0.03$, e TE: $R=0.47$; $p=0.02$, respectively) and perseverative errors committed (TI: $R=-0.45$; $p=0.03$, e TE: $R=-0.39$; $p=0.05$, respectively) on Wisconsin Card Sorting Test. Conclusions. The results of the present study show that the difficulty in the prospective component of the time-based condition is associated in PD patients with a deficit in the strategic time monitoring and with executive functions impairment. Moreover, also the impairment in the retrieval of the specific action to carry out appears to be associated to executive functions alterations and not to an episodic memory deficit.

Prospective memory and obsessive compulsive disorder

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Obsessive-Compulsive Disorder (OCD) is an anxiety disorder characterized by persistent and distressing ruminations that are temporarily relieved by the execution of some compulsion, such as, checking, washing or organizing. In two studies we explored whether individuals with OCD/OCD tendencies are impaired on prospective memory (ProM) tasks. In our first investigation, 25 OCD patients, including a variety of subtypes, and 33 healthy control participants were administered the Rivermead Behavioral Memory Test which contains three measures of ProM. We found no performance differences between OCD patients and controls on any of the three measures of ProM. In our second investigation we examined the more specific hypothesis that only individuals with the checking subtype of OCD are impaired on ProM tasks. A recent meta-analysis supports the memory bias hypothesis (Woods et al., 2002), suggesting that OCD checking is a compensation for impairments in retrospective memory (RetM) and for diminished confidence in RetM. That is, it appears that affected individuals feel compelled to check and re-check because they have difficulty remembering whether they carried out a particular action and in general don't trust their RetM. Ours is the first study to attempt to extend this memory hypothesis to the domain of ProM. Individuals high in the tendency to repeatedly check (high checkers), tend to check such things as whether the door was properly locked, the stove was turned off or the water was turned off -- all of which are ProM tasks. Thus, extending the memory hypothesis to the domain of ProM is a logical next step. If individuals prone to check have objective impairments in ProM or in some of the processes underlying successful ProM then checking would be a reasonable compensatory strategy. On the other hand, checking may just be a response to the belief that they have an unreliable ProM, without there being any true objective impairment. Our second investigation explored these hypotheses. Over 100 undergraduate students participated in this study. Participants completed the Padua (a measure of OCD tendencies), the Prospective Memory Questionnaire and the Prospective Retrospective Memory Questionnaire. They were also assigned two lab-based ProM tasks: they were asked to request for the return of a personal belonging (e.g. a watch) at the end of the session and to remind the experimenter to make a phone call in exactly 30 minutes. Participants were required to make confidence ratings about their anticipated performance on the ProM tasks. Further, time-monitoring in response to the time-based task was measured. Using the results from the questionnaires we explore whether high checkers reported more frequent ProM failures than people low in such tendencies (low checkers). Using the confidence ratings we explored whether high checkers had lower confidence in their ability to successfully perform the ProM tasks than low checkers. Using the results from the lab-based ProM tasks we explored whether high checkers showed a different rate of ProM failures than low checkers. We also observed whether high checkers monitored the time in response to the time-based task differently than low checkers.

Personality and cognitive ability underlie age-related differences in prospective memory

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Prospective memory (ProM) is the ability to formulate intentions, retain them, recollect them, and carry them out at the appropriate time or in the appropriate context. A recent meta-analysis showed that older adults perform worse than younger adults on ProM tasks that require execution in the laboratory (lab tasks), but they outperform their younger counterparts on real-life tasks (field tasks) (Henry et al., 2004). Older adults' impaired ProM performance in the lab has previously been attributed to their declining processing/cognitive resources while their superior performance in the field has been attributed to a variety of non cognitive factors. Our research has shown that ProM performance on lab and field tasks is related to a variety of personality traits that vary across the lifespan, including, conscientiousness, agreeableness and neuroticism (Cuttler & Graf, in prep). The present research was designed to explore how personality and cognitive factors contribute to age-related changes in the performance of lab and field ProM tasks. Participants were community-dwelling healthy individuals (n = 141) between 18 and 81 years of age. Participants completed three different ProM tasks (two lab tasks and one field task) as well as various indicators of personality and cognitive ability. Our results replicate previous research showing that compared to younger adults, older adults perform worse on ProM lab tasks and better on ProM field tasks. More importantly, the interplay between personality and cognitive ability varied across tasks. On one ProM lab task age-related differences in personality interacted with older adults' declining cognitive resources to impair ProM performance. On the other lab task, age-related differences in personality acted to partially buffer the impairment caused by declining cognitive resources. On the field ProM task, age-related differences in personality acted as a complete buffer against the older adults' declining cognitive resources. Our results suggest that a complex interplay between personality and cognitive ability underlies age-related differences in ProM performance. These results highlight the importance of considering age-related differences in personality when exploring ProM across the lifespan.

Brain regions associated with retention and retrieval in event-based prospective memory: Evidence from functional magnetic resonance imaging

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Event-based prospective memory (PM) involves remembering to perform a planned activity when an external event occurs in the future (e.g., remembering to post a letter upon passing a postbox). The crucial issue in performing an event-based PM task is that an intention has to be retained over time, typically while one is engaged in an ongoing activity. This implies affinities with processing demands in dual task or divided attention situations. Similarly, event-based PM bears resemblance to sustained attention tasks or 'vigilance' situations, in that it requires detecting environmental cues to interrupt ongoing activities and carry out the intention. We used event-related fMRI to disentangle common and distinctive neural correlates of PM, vigilance, and dual task processing. Furthermore, the event-related nature of the experimental design allowed to separately study patterns of neural activity during ongoing task items in the PM condition and at the presentation of the PM cues. This corresponds to neural activity associated with the retention of an intended activity and the retrieval/execution component of PM, respectively. Results show increased neural activity bilaterally in occipital cortex during the retention phase of the PM task, suggesting an early visual attention system directed at identifying the relevant PM cue (i.e., an abstract visual stimulus). Upon detection of the cue, increased left inferior frontal cortex (BA 10/46) activity was found uniquely in the PM condition, differentiating PM from sustained attention (vigilance) and divided attention (dual task). The left inferior frontal activity possibly reflects successful memory retrieval, or a task switching and/or inhibition component involved in interrupting the ongoing activity in favour of intention execution. Surprisingly, and in contradiction with previous studies, no neural activity related to the retention phase was found outside the visual cortex. Two possible explanations are given: First, the event-related nature of our experiment does not allow to detect neural activity associated with sustained cognitive processes, such as maintenance of an intention in memory. Second, we used null events (fixation stimuli) as a baseline to which neural activity during ongoing task items was compared. Since these null events also occur during the retention phase of the PM task, some relevant retention-related information may have been filtered out. Therefore, we carried out a second fMRI study, this time applying a mixed blocked and event-related design, in which blocks of a PM condition were alternated with blocks of an ongoing task only condition. This experimental setup allows to study sustained (block-related) neural activity during the retention phase of a PM task (e.g., intention maintenance) by subtracting neural activity of ongoing task only blocks from PM blocks. At the same time, the sustained neural activity can be differentiated from transient (item-related) neural activity (e.g., target-checking), by directly comparing neural activity during ongoing task items in the PM condition with the items of the ongoing task only condition, thus avoiding the use of null events as a baseline. Implications of the results for theories of prospective remembering will be discussed.

Prospective memory - a forgotten element of patient safety. Results from a pilot study in acute care medicine

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Background: Even though Prospective Memory (PM) failures are a potential threat to patient safety (Dieckmann et al., submitted; Rall & Gaba, 2005), the problem was never studied in acute care medicine before. There is ample evidence for the relevance of PM-failures in other industries (Dismukes et al., 2001) and a high face validity in medicine where interruptions and delays of tasks are very common. Results from laboratory research on PM-failures are not readily applicable to the more complex medical settings. For this we conducted a first pilot study in anaesthesiology and acute care medicine investigating the relevance of PM-failures and influencing factors. By investigating this safety relevant human factor in more detail we strive to finally develop effective countermeasures. Methods: A questionnaire was developed and distributed amongst 680 anaesthesiologists and acute care physicians working in university hospitals, community hospitals or private practice all over Germany. Respondents estimated the relevance of PM-failures to patient safety and the incidence of PM-failures in 24 different error prone situations which were identified in workshops with eight anaesthesiologists (consultants and residents). An experimental study was conducted using a modern high fidelity patient simulator. Ten simulations contained between 1 and 5 PM-tasks each. Independent variables were subjective importance of the encoded intentions (high and low) and type of intention (educational, internal simulation related and external setting related). Dependent variables were percentages of (missed) executions of intentions. Results: Despite the fact that PM-failures were never addressed in medicine before 66% of the 112 respondents of the questionnaire (response rate 16%) estimated the influence of PM-failures on patient safety as 'very big', 'big' or 'somewhat big'. The estimated incidence of PM-failures in error prone situations ranged between 7% and 42%. The simulator study showed that around one third of 73 valid intentions were missed. 80% of the 'important' and 64% of the 'unimportant' intentions were executed. 71% of the 'internal', 67% of the 'external' and 79% of the 'educational' intentions were executed. There were clear tendencies, but the hypothesised effects of the factors (importance and type of intention) on the dependent variables did not reach statistical significance. Conclusion: Despite some methodological problems, our pilot study clearly demonstrates the high impact of PM-failures as a potential threat to patient safety. Questionnaire results emphasised the high relevance of PM-failures as judged by medical experts. It also allowed for some first hints on PM-failure prone situations in acute care medicine and possible countermeasures. The patient simulator setting proved to be suitable to further investigate PM-failures in complex research settings.

Evidence for spontaneous retrieval processes in prospective memory

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Following from our multiprocess model (McDaniel & Einstein, 2000), prospective memory retrieval can be accomplished either by controlled monitoring of the environment for a target event or by a more reflexive process that spontaneously responds to the presence of a target event. Smith's (2003) recent theoretical position argues that prospective memory retrieval cannot occur without preparatory attentional processes and questions the existence of spontaneous retrieval processes. The purpose of this research was to examine whether the presence of target events associated with prospective memory intentions can trigger spontaneous retrieval processes. In the first experiment, we discouraged monitoring by strongly emphasizing the speed of performing the ongoing task. Despite finding virtually no costs of performing a prospective memory task on the ongoing task, prospective memory performance was high. A second experiment revealed individual differences in adopting strategic versus spontaneous retrieval approaches to a prospective memory demand. Interestingly, those participants who showed no costs on the cover task still demonstrated high prospective memory. In the third experiment, participants were given the prospective memory task of pressing a key whenever any of two target events occurred. They were then told to suspend this intention during an intervening task. Slowed responding to the target items appearing in the intervening task suggested spontaneous retrieval. Taken together, these experiments provide converging evidence for the existence of spontaneous retrieval processes in prospective remembering.

The automaticity of Implementation Intentions: Implications for prospective remembering

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Interest has developed recently in exploring the relationship between implementation intentions and prospective memory tasks. One important theoretical difference between these two phenomena is the degree to which they rely on attentional resources. While most researchers agree that, for prospective remembering, the demand for these resources varies with the characteristics of the prospective memory task (cf. McDaniel & Einstein, 2000), it is claimed that implementation intentions are retrieved and performed automatically (e.g., Brandstätter, Lengfelder & Gollwitzer, 2001). We report findings from two experiments designed to explore further the proposed automaticity of implementation intention realisation. Using a paradigm designed by Brandstätter et al. (Experiment 3), we compare performance under conditions of full attention and divided attention, using secondary tasks that have been demonstrated to make high or low attentional demands. In a second experiment we explore the role of covert and overt commitment on attentional resource recruitment. The findings allow us the identify similarities and differences between implementation intentions and prospective memory tasks.

Suppressing or expressing thoughts about future intentions does not enhance event-based prospective memory

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Wegner, et al. (1987) demonstrated that thought suppression can lead to later preoccupation with the very same thought, the so called 'rebound effect'. Since then, a widespread assumption is that the effects of thought suppression are negative and undesirable. However, if thought suppression results in enhanced accessibility of thoughts later on this could be beneficial for memory tasks involving remembering future intentions. Very little is also known about the effects of deliberately thinking about one`s upcoming intention prior to enactment (i.e., rehearsal). Therefore, three experiments were conducted to examine the effects of thought suppression and expression on event-based prospective memory. In all experiments participants were given standard prospective memory instructions to remember to carry out an action (e.g., pressing the space bar) every time a target event appeared in the ongoing task (e.g., sentence verification or word association task). Immediately after the prospective memory instructions, and prior to the onset of the ongoing activity, participants were engaged for 5 minutes in a standard think aloud procedure. Half of the participants had to think aloud and suppress a certain thought, and the other half had to express this thought. Within each of these groups, half of the participants were manipulating (suppressing or expressing) the prospective memory target or intention and half were manipulating an irrelevant target or intention. After this period all participants were introduced to the ongoing task with no mention of the prospective memory task. Prospective memory was assessed by the proportion of times participants remembered to carry out the designated action. Experiment 1 demonstrated that suppression of the prospective memory target (white bear) during the retention interval resulted in no better prospective memory performance than suppression of an irrelevant construct (brown sugar). Surprisingly, thinking about the target `white bear` did not result in better performance either. However, results from Guynn et al. (1998) suggest that for rehearsal to prove effective it needs to contain both the prospective memory target and the associated action. Study 1 had participants manipulate the prospective memory target alone. Therefore, in Experiment 2 participants had to suppress or express the whole intention (target plus action). Results indicated that suppression or expression of the relevant intention (press the bar when seeing an animal word) resulted in no better prospective memory performance than suppression or expression of a completely irrelevant intention (to eat later on). A failure to replicate Guynn et al. (1998) in those participants who were deliberately thinking about the whole intention was unexpected. One important methodological difference between the studies is that in the Guynn et al (1998) paradigm participants were asked to think about the intention during the ongoing task, whereas in Experiment 2 participants suppressed or expressed their thoughts about the intention during a 5-minute retention interval. In Experiment 3, in addition to suppressing/expressing the intention during the retention interval, like in Experiment 2, participants also had to suppress or express their intention 3 times during the ongoing task (for 1-minute periods). Nevertheless, no effects of suppression/expression or intention (relevant vs. irrelevant) were found. The theoretical and practical implications of these findings for prospective memory research and thought suppression will be discussed.

Functional magnetic resonance imaging (fMRI) of encoding of delayed intentions

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Prospective memory has been defined as the fulfilment of delayed intentions. Recall for delayed intentions is normally excellent, probably due to their inherent characteristic that they contain actions that have to be enacted at a later time. Several researchers (Goschke & Kuhl, 1993; Marsh, Hicks & Bink, 1998) found that action words encoded for later enactment are more accessible from memory than action words encoded for later verbal report. As this effect is absent when the actions have to be enacted during encoding, or when a motor interference task is initiated after encoding, Freeman and Ellis (2003) suggested that the advantage of to-be-enacted actions is due to additional preparatory motor operations during encoding. Accordingly, in a fMRI study, was investigated whether motor brain regions are differentially activated during verbal encoding of to-be-enacted actions in contrast to verbal encoding of to-be-reported actions and to-be-reported abstract verbs.

The influence of matched and mismatched processing focus on prospective remembering

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The influence and attentional demands of conceptual and perceptual processing during prospective remembering are examined in three experiments. In Experiment 1 processing focus (conceptual, perceptual) was either matched or mismatched across study (encoding) and test phases (retrieval). The findings suggest that transfer appropriate processing occurs with perceptual as well as conceptually driven processing, although the former may be restricted in certain situations, possibly due to a levels of processing effect. The data also indicate that study-test processing discrepancies may induce lower levels of accuracy in mismatched processing conditions (cf. Whittlesea & William, 2001a, 2001b), although conceptually-focused processing at either encoding or retrieval would appear to benefit prospective remembering. In a second experiment we investigated the use of automatic and controlled processes during matched and mismatched conceptual and perceptual processing focus. Further studies use ERPs to specify further the cognitive processes involved in prospective memory, adapting the design employed in Experiment 1 in line with West and Ross-Munroe (2000, see West et al. 2000). In particular, they focus on examining how the neurocognitive mechanisms underlying prospective memory are related to perceptual and conceptual task and target characteristics and their reliance on attentional resources.

Cueing event-based episodic prospective memory retrieval

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According to one theory, event-based prospective memory task retrieval involves a discrepancy-attribution mechanism. It is assumed that planning phase activities prime the sensory/perceptual representation of the retrieval cues involved in a task. Therefore, when those cues are subsequently encountered - during the retrieval phase of a task, their processing is facilitated, and this facilitation is perceived as oddly fluent, as discrepant with expectations. Previous work has shown that subjects interpret this processing discrepancy in a flexible manner, for example, as familiarity in a retrospective recognition memory experiment. The main goal of the present study was to investigate the role of discrepancy-attribution in event-based episodic prospective memory (ProM) tasks under conditions where the ongoing task focused either on performance speed or on performance accuracy. We conducted a series of experiments in which the ProM task required subjects to press a key on the keyboard when they noticed ProM cue words. To produce and manipulate the discrepancy experience, half of the ProM cue words in each experiment were primed (i.e. preceded by the masked presentation of the same word) and the others were shown without primes. The ProM cues were shown either as part of a lexical decision task, which focused on speed, or in the course of an anagram-solving task, which focused on accuracy. The results showed the priming manipulation facilitated ProM task performance in all experiments. However, in the experiment where the ongoing task required making lexical decision, subliminally priming ProM cues benefited only the speed of ProM responses, but not their accuracy. By contrast, in the anagram-solving task, the accuracy driven task, subliminally priming ProM cues facilitated the accuracy of the ProM responses, but not the speed of those responses. These findings are consistent with a discrepancy-attribution mechanism, as well as with prior evidence that discrepant experiences tend to be interpreted flexibly, in line with the demands of the ongoing or dominant task.

Time-based prospective memory: effects of cognitive load, time-estimation and time-management

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Since in time-based prospective memory (TBPM) tasks there are no external cues for remembering the intention, successful performance requires an internal sense of passing time. We examined the degree to which the sensation of time affects performance and time-monitoring strategies adopted in TBPM tasks and whether they are influenced by individual differences in time-management style and in time-estimation ability. Cognitive load of ongoing task and clock speed were manipulated in order to modify the sensation of passing time. Time-management style was measured with the time-management behavior scale (Macan et al., 1990) and a time-production task was used to assess time-estimation. High cognitive load increased clock checking frequency but hindered accuracy. Accelerating the clock also induced more clock checks but its effect on accuracy depended on cognitive load: with high cognitive load accelerating the clock reduced accuracy, but with low cognitive load a fast clock improved performance accuracy. Accurate time estimators looked more at the clock and performed the TBPM task more accurately. In contrast, time-management skills improved accuracy but did not affect time-monitoring strategies. Successful performance in TBPM tasks involves two independent factors: clock monitoring strategy and managing available resources.

Faulty Brain; Flaky Person

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According to Munsat (1967), "If a person makes memory claims about what he did in the past, and they are frequently wrong, we say his memory is unreliable. [However], if the person forgets to do things he said he would do... it is he we brand as unreliable" (p. 18). The main goal of the present study was to test this hypothesis, the claim that retrospective and prospective memory failures are interpreted differently, the former due to a faulty system and the latter reflective of a flaky, unreliable person. The study also explored the more specific claim that Munsat's hypothesis might apply to episodic but not primary memory, or that it might be relevant to social, interpersonal memories but not to personal, asocial memories. We created brief 5-sentence vignettes to illustrate different types of memory failures. Some of the failure vignettes were about primary memory and the others were about episodic memory, some involved another person (social/interpersonal failures) whereas the others did not (asocial/personal failures), and some focused on prospective memory whereas others concerned retrospective memory. The subject read each vignette and then rated it on 12 different scales, the most relevant of which focused on whether the failure was due to internal controllable causes, such as a lack of motivation, internal uncontrollable causes, such as poor memory, and external uncontrollable causes, such as distraction. The subjects were 60 community-living healthy volunteers between 20 and 80 years of age. The overall results showed that all memory failures, whether retrospective or prospective, were most likely rated as caused by a faulty memory system and next most likely as reflecting confusion or distraction; the failures were not likely to be rated as caused by a lack of motivation or reliability. Importantly, the overall data showed no significant differences in the interpretation of pro- and retro-spective failures. However, the results were more supportive about the more limited claim that the Munsat hypothesis applies to episodic but not primary memory failures and is relevant to social but not asocial memory failures. For the episodic social memory failures, participants gave significantly higher ratings on the lack of motivation and reliability scales for failures that were prospective rather than retrospective.

An experimental study on the schizophrenes' prospective memory

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More and more attention has been brought to prospective memory (ProM) research these years. But a few are concerned on the schizophrenes' ProM. This study tried to test the ProM performance of the schizophrenes and made a comparison with normal adults. The experimental group consisted of 28 schizophrenes (all their course of diseases is within 5 years), and the normal control group involved 30 volunteer undergraduates. In the experiment, we chose a soundless cartoon film as the experimental material in which the ProM target cue was embedded, and number-dictation was dubbed as an ongoing task. The participants had to finish the ongoing task and the ProM task (give a mark on the certain place when the ProM target cue appears) synchronously. After that, they were asked to complete several questions about the content of the film (which can be thought as an interference task) and finish a self-estimation questionnaire about ProM performance in one's daily life. The results showed that: (1) The performance of the experimental group (the schizophrenes) was significantly poorer (at 0.01 level in the Independent-Sample T Test) than the control group in both the ProM task and the interference task, however their ongoing task performance had no significant difference. (2) The experimental group has approximate self-estimation score (mean) to the control group, and they had no significant difference in the Independent-Sample T Test. (3) In the experimental group, the ProM performance had no significant correlation with neither their familiarity nor preference on the experimental material. Otherwise, the ProM performance of the control group had significant correlation with their preference (at 0.01 level) but no significant correlation with their familiarity on the experimental material.

A theory of strategic monitoring: Instantiating a retrieval mode and checking for targets

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Prospective memory can be mediated by strategic monitoring for targets that indicate when to perform an intended action. A dual-process theory proposes that strategic monitoring involves instantiating a retrieval mode and checking for targets. If a check occurs and a target is present, a response can be made. A retrieval mode may be described as a task set to treat stimuli as cues to execute an intention. If a check does not occur but a target is present, a response can be made if an appropriate task set (i.e., a retrieval mode) has been instantiated. Four experiments provide evidence for the theory. In all experiments, a prospective memory task was embedded in a short-term memory task, and the prospective memory task was to press a key if a target word (i.e., a fruit) appeared in a short-term memory trial. A 4-choice reaction time task was used to index the resource demands of the prospective memory task on the non-target trials (i.e., to index strategic monitoring). In all experiments, reaction time task costs on experimental trials (where there was a goal to execute an intention) versus control trials (where there was not a goal to execute an intention) provided evidence of strategic monitoring. In the first experiment (Guynn, 2001), participants were instructed to check for the targets on either 3 of 6 trials or 6 of 6 trials. Participants in the two conditions reported different frequencies of checking for the targets, but the cost to the reaction time task did not vary across conditions. The results suggest that participants differed in the extent of checking for the targets but not in the extent of instantiating a retrieval mode. In a second experiment (Guynn, 2003), experimental and control trials alternated or were blocked by trial type. Performance was worst on experimental trials, suggesting that participants monitored on these trials and that monitoring involves two strategic processes. Performance was best on blocked control trials, suggesting that participants did not monitor on these trials. Performance was intermediate on alternating control trials, suggesting that participants instantiated a retrieval mode but did not check for targets on these trials. In two final experiments (Guynn, 2004), participants performed worse on experimental trials when a target could appear in any one of five possible locations than when a target could appear in just one possible location, providing evidence for checking. Participants performed worse on control trials when they had already been instructed about the prospective memory task than when they had not yet been instructed about the prospective memory task, providing evidence for instantiating a retrieval mode. Performance on these control trials was not affected by the possible location of the targets, indicating that the control trial cost reflected instantiating a retrieval mode, not checking for targets.

Output monitoring in prospective memory: Attentional resources and executive skills

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Output monitoring in prospective memory, correct or incorrect recall of a prior action, is a relatively neglected component of prospective remembering. This lacuna was addressed recently by Marsh, Hicks, Hancock, & Munsayac (2002), who identified some of the conditions under which output monitoring errors occur in young adults. We report findings from three experiments, based on the paradigm designed by Marsh et al. (Experiment 4), that explore the attentional demands of output monitoring. In Experiment 1 older adults were observed to make more output monitoring errors than younger adults while the findings of Experiment 2 revealed an increase in errors from young adults under divided attention conditions. Thus, output monitoring errors appear to rely on intact executive processing. Consistent with this hypothesis, older adults with relatively low functioning executive skills were observed to make more output monitoring errors than older adults with relative high functioning executive skills (Experiment 3). The specific nature of the executive skills underlying accurate and inaccurate output monitoring was also explored in these studies.

Associating intentions to well-specified retrieval contexts is helpful in some cases but harmful in others

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Prospective memory, or memory for delayed intentions, is affected by the context in which an intention must be fulfilled. For example, prospective memory is generally better when aspects of intention-related retrieval cues overlap with processes required by an ongoing task (i.e., task appropriate processing; see Marsh et al., 2000; and Maylor, 1996, 1998; Meier & Graf, 2000, for examples). Thus, the ongoing task context interacts with properties of the intention-related cue to affect performance. We report experiments that further explore the interaction between established intentions and an expected retrieval context. We asked participants to establish time-based intentions to press a key on a computer keyboard during a one-minute window of time. In the first experiment, some participants were given the expectation that this time window would occur during a third phase of ongoing task activity. Others were given no such context expectation. We also manipulated whether the window of opportunity appeared in the third phase or in the first phase. Those given the context expectation performed much better (72% correct) when the time window appeared in the third phase. However, others with the same expectation performed markedly worse (28% correct) when the time window occurred in the unexpected context of the first phase. Participants given no such expectation performed at an intermediate level, averaging 52% correct time-based performance. Clock-checking behavior was also affected by the context expectation variable. For those with a context expectation that the time window would occur in phase three and for whom the time window occurred appropriately in phase three, the rate of clock checks during phase one was negligible but in phase three was more numerous. Clock checking by those with a context expectation but for whom the time window occurred inappropriately in phase one was not numerous enough in phase one to benefit time-based performance. In addition, those without a context expectation and whose time window occurred in phase one checked the clock more often during phase one - twice as often as compared to participants with a context expectation. A second experiment tested only participants with a context expectation and when the time window occurred inappropriately in phase one. One condition replicated the analogous condition from Experiment 1. Two other reminder conditions were tested - some obtained a reminder about when to fulfill the time-based key press after 1 minute of phase one had elapsed, whereas others received a similar reminder after 5 minutes of phase one had elapsed. Time-based performance in the no-reminder condition was 25%, whereas performance in the reminder conditions was better (52% after 1 minute; 54% after 5 minutes). The reminders also caused increased clock checking relative to the no-reminder condition. Our results suggest that associating the completion of an intention with a specific environmental or temporal context alters the normal monitoring of the passage of time. More generally, such intention-to-context associations may alter how people allocate attention to the mixture of ongoing tasks and established intentions during retention intervals versus during performance intervals.

How important is prospective memory?

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Most research on everyday memory problems is based on the reported frequency of occurrence of specified problems. We have recently taken an approach to assessing memory concerns that is different from how often the memory problems occur - measuring which memory problems people most want to overcome. The present research continues this approach, with the focus on the importance of problems with prospective memory (a) relative to other kinds of everyday memory problems, and (b) for different kinds of people (elderly adults vs. young adults, males vs. females, and United States vs. New Zealand). The participants were general audiences of people attending two public lectures on memory skills, taught by the first author. The United States (US) audience consisted of 154 people (77 males, 77 females) ages 18-82 (M = 51.3), and the New Zealand (NZ) audience consisted of 103 people (55 males, 48 females) ages 16-68 (M = 35.1). At the beginning of each lecture, all participants completed the Memory Improvement Questionnaire (MIQ), which was developed from the answers given by people in memory skills classes who were asked what memory questions or problems they most wanted to have answered or solved. The MIQ consists of 12 items that describe different aspects of memory - e.g., "remembering people's names", "remembering places (like locations or directions)" and "remembering everyday actions (like where I put something or whether I did something)". Participants rated each of the 12 items on a 10-point scale for how important that aspect of memory is to them. This research focuses on the only prospective-memory item on the MIQ - "remembering everyday tasks (like errands, things to do, or appointments)" to investigate the extent to which people consider prospective memory to be of value to them personally. The importance ratings of this item will be used for several comparisons: (a) Prospective memory will be compared with the ratings of the other 11 MIQ items for each group (US and NZ); (b) older adults will be compared with younger adults for each group; (c) males will be compared with females for each group; and, (d) the US group will be compared with the NZ group, omitting the US participants over age 68 (the oldest NZ participant) to make the two groups more equivalent. In addition, the number of participants age 65 and over in the US group (n = 52) is sufficient to make two comparisons just among the elderly - prospective memory vs. the other 11 items, and males vs. females. We will draw conclusions regarding the importance of prospective memory relative to other kinds of everyday memory problems, and for different kinds of people varying in age, gender, and cultural setting.

Do intentions linger after a prospective memory task has been performed?

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The Intention Superiority Effect (ISE) is demonstrated when words associated with a delayed intention are more highly activated than neutral words (Goeshke & Kuhl, 1993), whereas words associated with completed or cancelled intentions are not (Marsh et al., 1998, 1999). The ISE has been assumed to be associated with successful prospective memory performance or recall of delayed intentions, though only a few studies have attempted to explore a direct relationship between the two (e.g., Marsh, Hicks & Watson, 2002). We investigated whether prospective memory performance could be predicted from the pattern of results achieved with the ISE. In particular, we asked, 'does a target used in a prospective memory experiment show the same immediate drop in activation level following completion of a task as do the task words tested in ISE experiments?' We asked participants to perform a typical event-based prospective memory experiment in which they were required to make a response upon seeing a target word (lemon) during a semantic matching task. On completion of this task participants were told that the first experiment was over and that they would now be starting a second experiment. This 'second experiment' involved only rating the pleasantness of a series of words. The target word from the prospective memory task was presented twice during this 'second experiment.' Fifteen percent of participants made the prospective memory response (incorrectly) upon seeing the target word during the pleasantness rating task. Post-experiment questionnaires confirmed that the remaining 27 participants understood that they were not required to respond to the word lemon during the pleasantness rating. However, reaction time data from these participants suggested that, although they had consciously dropped the intention to respond to the word lemon, activation of the intention did not immediately return to baseline. Reaction times for pleasantness ratings on target trials were longer than those for neutral trials. Further, reaction times for trials immediately following the presentation of the target were also elevated. These data, along with post-experiment reports by all but one of the participants that they did notice that the target appeared in the second experiment, suggest that the intention associated with a prior prospective memory target is at least partially retrieved when that target is encountered during a subsequent task, and this retrieval may slow responding to the target. Limitations of the study as well as implications for automatic activation and monitoring theories of prospective memory performance are discussed.

Interruptions as Prospective Memory: A New Paradigm

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Our field studies and observations of prospective memory failures in everyday and aviation domains suggest that most laboratory paradigms capture only a small portion of the variance in real-world prospective memory performance. For example, most laboratory paradigms provide participants with an explicit intention and clearly define target cues that determine when that intention should be executed. We present data from field studies suggesting that these conditions often do not occur in everyday situations. For example, real-world interruptions rarely afford individuals an opportunity to explicitly or elaborately encode an intention to return to the interrupted task. If an explicit intention is encoded at all, the individual may specify only a general condition for resumption (e.g., I will return to writing this letter when I finish meeting with my colleague) that may not closely match the specific cues actually encountered at retrieval (e.g., my desk, my computer, the absence of my colleague - all of which may have many other associations or may not be salient cues). Contrast this with a typical laboratory prospective memory paradigm, in which participants create an intention to respond when they see a specific target, such as the word 'zebra.' In this case, the cue encountered at retrieval very closely matches the encoded representation of the cue. Furthermore, in a real world setting, completion of one task often leads into another task, and so on, such that at the completion of an interrupting task, there may be more environmental support for initiating a third task rather than returning to an unfinished interrupted task. We developed a laboratory paradigm designed to capture these aspects of real-world interruptions, and to empirically investigate the contribution of these factors to the variance in remembering to return to interrupted tasks. Participants performed a series of naturalistic tasks that were occasionally interrupted by other tasks, requiring participants to remember to resume the uncompleted task after the interruption. In three experiments we investigated the effects of the following manipulations on remembering to return to an interrupted task: 1) opportunity to encode the intention prior to beginning the interrupting task, 2) match between the encoded representation and conditions encountered at retrieval, and 3) opportunity to retrieve the intention at the end of the interrupting task. Remembering to resume the interrupted task was improved by providing opportunities to encode a specific intention to resume, increasing the match between the encoded representation and cues available at retrieval, and providing a short pause after each block rather than cues associated with continuing on to the next block of trials. These findings will be discussed within the context of other potentially important sources of variance in prospective memory performance - identified in a field study of both everyday and aviation environments - that have not yet been systematically explored in laboratory settings.

Effects of sad mood on time-based prospective memory

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Very little is known about the influence of emotional factors on prospective memory performance. Applying a mood induction with half the participants in a neutral mood condition and half in a sad mood condition, the present study examines the effects of sad mood on time-based prospective memory performance. Based on Ellis and Ashbrook's (1988) resource allocation model, we hypothesized an adverse effect of sad mood on prospective memory. Results revealed that participants who responded to a sad mood induction procedure showed reduced prospective memory performance, but only in the first half of the task. Mood effects on prospective memory could be explained in terms of reduced monitoring. Implications for concepts of prospective memory and the assessment of emotional aftereffects are discussed.

Moderating Prospective Memory: Do Theory of Planned Behaviour Variables Moderate Cue Response?

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This naturalistic study attempted to manipulate increased perceptual saliency and association strength, examining the effect upon cue response. Following instruction to respond to a future email, participants completed a series of measures relating to motivation and past behaviour. The theory of planned behaviour was used to investigate possible moderating effects of motivation upon cue response. All participants indicated intent to respond to a future email cue, with 100% of participants above the midpoint of a bipolar scale. Manipulations of perceptual saliency and association strength were not associated with improved cue response. However, a series of chi-squared tests indicated that higher levels of intention, self-efficacy, and attitude were associated with increased cue-response, whereas neither perceived control or subjective norms were significantly related to it. Furthermore, neither self-reported reliance upon or expertise with computers, were associated with cue-response. Moreover, whilst perceived control was significantly correlated with reliance and expertise, intention, attitude and self-efficacy were not. These results suggest that motivational or internal volitional factors associated with improved cue response may provide additional explanation of cue response beyond environmental factors in naturalistic settings. Potential for future research into both the antecedents of these motivational factors and their effects upon cue response are discussed in relation to implementation intentions.

Role of meta-memory and demography in prospective and retrospective memory

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A questionnaire study was conducted on 395 adult participants (206 males; 189 females) to investigate the role of metamemory and two demographic variables (gender and place of residence: rural/urban near Kanpur, India) in prospective and retrospective memory (paradigm). Cuing (self or environmental) and term (short-term and long-term) were also involved as independent variables. The mean age of the participants was 18.7 years (SD= 1.7). Among the participants, 210 were from urban and 185 from rural background. Out of 395 pariticipants, 193 were low while 202 were high on metamemory. The present study employed two questionnaires which were Hindi translations of "Prospective and Retrospective Memory Questionnaire" (PRMQ) developed by Smith, Della Sala, Logie and Maylor (2000) and "Everday Memory Questionnaire" (Martin, 1986). PRMQ consists of 16 self-report items which tap minor memory mistakes that everyone makes from time to time. It contains equal number of items for measuring prospective memory and retrospective memory. It also measures self-cued and environmentally-cued short- and long-term memory. The questionnaire uses a 5-point scale: Very Often, Quite Often, Sometimes, Rarely, and Never. Ratings were assigned numerical values of 5 (Very Often) to 1 (Never) respectively. Everyday Memory Questionnaire consists of 37 items which measure self-reported meta-memory. Participants were asked to answer each item on a 5-point scale: Very Poor, Poor, Do Not Know, Good, Very Good. Ratings were assigned numerical values from 1 (Very Poor) to 5 (Very Good). Analysis of variance (2×2×2×2×2×2 mix factorial design) and correlational analysis were used to analyse the data. In all the analyses, metamemory (high vs low), gender (male vs female) and residence (urban vs rural) were employed as between subject factors. On the other hand, paradigm (prospective vs retrospective), cue (self vs environment) and term (short-term vs long-term) were utilized as within subject factors. All the main effects except residence were significant. Some interactions were also found to be significant. Significant differential effects were obtained between males and females for paradigm, cuing, term and various interactions between these variables. Further, prospective as well as retrospective memory were found to increase with metamemory as revealed by significant correlation coefficient (r) between metamemory and prospective memory as also that between metamemory and retrospective memory. Analysis of variance as well as the correlational analysis revealed that metamemory is a better indicator of prospective memory than that of retrospective memory.

Children`s prospective memory skills: Developing the ability to remember to remember

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The effective early development of PM skills is thought to be crucial for coping with the cognitive demands of learning encountered in a primary school environment. Despite this only a few studies have examined PM development in young children (e.g. Kvavilashvili, Messer & Ebdon, 2001) and as yet no unitary, coherent theory of PM development exists. Previous research (e.g. Einstein & McDaniel, 1996; Kvavilashvili et al, 2001) has identified two types of PM (event-based and time-based), however previous research had neither examined time-based PM development; nor investigated the relationship between time-based and event-based PM development. Further, it remains unclear whether or not a relationship exists between retrospective and prospective memory performance and/or development. This study sought to further current understanding of PM development, building on previous methodologies (Guarjardo & Best, 2000; Kvavilashvili et al, 2001) and adapting the computer based paradigm (Einstein & McDaniel, 1990) successfully used with adults. A quasi-experimental mixed-measures design was used with 104 participants (aged 4 - 8yrs). Event-based PM was assessed using a computer based picture-naming task (ongoing task), which had to be interrupted to respond to target pictures using a key-press technique. Time-based PM was assessed by asking the children to remember to ask for a sticker to affix to a certificate (incentive condition), and to remember to close the door (no-incentive condition), after the picture-naming task. An incidental retrospective memory test was used to generate recall scores for comparison and correlation with event-based PM response scores. Analysis of event-based PM performances revealed a significant effect of ($p<0.0005$); planned comparisons indicated a fairly steady progression with age. Retrospective memory performance was also affected by age ($p<0.0005$), however, planned comparisons suggested a different rate of progression to that of PM. There was a significant positive correlation between retrospective and prospective memory scores ($p<0.0005$). However, separate correlations for each year group, showed only Year 2 (mean age 6yrs 7mths) children's scores to be significantly correlated ($p=0.011$). With the effects of age partialled out, no significant correlation was found ($p=0.191$). Analysis of time-based PM revealed significant relationships between performance and age in both incentive conditions ($p<0.0005$). The association between incentive and performance was also significant ($p<0.0005$). Comparison of event-based and time-based tasks indicated a significant relationship between the two types of PM task in both the incentive condition ($p=0.001$), and the no-incentive condition ($p<0.0005$). All analyses had high levels of power and medium or large effect sizes. The findings show that whilst both prospective and retrospective memory performances show progression with age, the developmental trajectories are not the same; are not related to each other; and thus may be suggested to be largely distinct. Further, both time-based and event-based PM performances were affected by age: despite the potentially different task demands, the tasks were not sufficiently disparate as to be unrelated in terms of performance. The developmental path of PM is discussed in terms of theoretical explanations including the development of other cognitive functions such as planning skills, script understanding, rehearsal and strategy use. Further, practical applications including the design and implementation of learning activities for both 'normal' and 'atypical' populations; and potential diagnostic uses for ADHD and Autism Spectrum Disorders are discussed. Finally, suggestions are made for future research including longitudinal research; larger scale studies extending the age range; and studies of atypical populations, to allow comparisons of developmental trajectories.

Differential effects of ongoing cognitive task demands on event- and time-based prospective remembering

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Objectives: To explore the effect of ongoing cognitive demands, on both event- and time-based prospective remembering task performance, in an experiment conducted within the Einstein & McDaniel (1990) paradigm. Design: 2 (prospective task: event-based vs. time-based) x 4 (ongoing task: low vs. low/mod vs. mod/high vs. high cognitive load) within subjects factorial design was used. Methods: Thirty-six university students participated. During the computer based experiment, conducted over two sessions, the event-based prospective memory task required participants to respond orally each time a non-specified exemplar from the category 'animals' appeared on the screen in front of them. The time-based prospective memory task required participants to report at specified time intervals. Each prospective memory task was performed separately in one of the two experimental sessions, the order counterbalanced across participants. Cognitive demand was manipulated within an ongoing word task which required identification, from individually presented words (yes/no key press responses), of either single syllable words or words containing a long "Ee" sound or words containing another word sound or words to which a "d" or "ed" sound could be suffixed. In the low cognitive demand condition one of the four questions appeared each time for each word presentation. In the low/mod cognitive demand condition one of two questions was randomly presented for each word. In the mod/high condition one of three questions appeared randomly for each word and in the high cognitive demand condition one of four questions appeared randomly for each word presented. Results/Conclusions: As ongoing cognitive demands increased, different patterns of performance emerged for event- and time-based tasks. Event-based task performance followed a linear pattern, decreasing both in response accuracy and response latency with each increase in the ongoing cognitive demands. Time-based task performance showed an initial increase in response accuracy, which decreased once the ongoing task reached the high cognitive demand condition. Response latencies for the time-based task decreased with each additional increase in ongoing cognitive demand. This outcome suggests that the optimum level of cognitive activation required for successful prospective remembering differs as a function of the type of prospective remembering task.

Elaborated spaced-retrieval intervention for prospective memory in early Alzheimer`s disease

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Rationale: Early Alzheimer's disease (AD) is characterised by significant episodic memory impairment and dysfunctional executive attention skills. These cognitive impairments form a substrate for major difficulties in prospective memory although memory performance in early AD has rarely been evaluated within a prospective memory framework. In response to memory difficulties in everyday life, neuropsychological interventions with demonstrated efficacy are increasingly needed in the early-stages of the disease as patients and families are seeking practical advice to prolong independent functioning. Aims: To evaluate whether a strategy of supporting new learning, elaborated encoding combined with spaced retrieval, could substantially improve performance of persons with AD on a task of prospective memory. Design: A preliminary study compared base-line prospective memory performance between participants with mild AD (n=14, MMSE >19) and healthy older controls (N=14), matched by age and years of education. A subsequent intervention study compared performance of participants with mild AD (n=16; MMSE >19) and healthy older adults (n=16) on a prospective memory task under two learning conditions - spaced-retrieval or elaborated encoding combined with spaced-retrieval. Methods: The Text-Reading Task (adapted from Ellis, Kvavilashvili, & Milne, 1999; Kvavilashvili, 1998) provided a simple dual-task paradigm to determine ability to perform a prospective memory task. The demands of the task were simple and naturalistic which is of consideration when assessing participants with dementia. Participants read aloud a short 6-page story (ongoing task) within which a target word (cue) was embedded on multiple occasions, and participants were requested to make a word substitution (prospective memory) whenever the target word was encountered. The target word appeared once every page. Participants were trained to remember and perform the prospective memory task by using a spaced-retrieval technique alone (Camp, 2001) or spaced-retrieval combined with elaborated encoding of task. Each participant undertook the text-reading task (two versions of stories and substitutions) under both learning conditions, which were counterbalanced in administration. Results: (i) In the preliminary study we demonstrated a large and significant effect that participants with early-stage AD as compared to healthy older adults were impaired in base-line performance of prospective memory even though the episodic memory load was minimal (1 target word to remember). (ii) In the subsequent intervention study there was a significant interaction between group and task, and participants in the AD group demonstrated a moderate and significant effect of benefit in prospective memory in the combined training condition as compared to spaced-retrieval alone. Discussion: The results are discussed in relation to interventions for prospective memory impairments in early-stage AD and the support for using combined implicit memory and residual explicit memory skills to ameliorate everyday memory difficulties of prospective memory.

Prospective memory and executive functions in children with school difficulties and/or ADHD, compared to normally developing children

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Prospective memory in children develops between 2 and 14 years, with important differences whether this memory is measured by event-based or time-based tasks. Young children from about two year-old can perform event-based prospective memory tasks, especially when this task is considered interesting (e.g., buy candies at the supermarket). Performance on time-based prospective memory task develops only later, between 7 and 12 years; this coincides with the age in which the children become more and more successful in the use of strategies for control and estimation of time. However, until now no research has applied the same ongoing task to measure prospective memory in children in a time-based manner as well as in an event based one. Furthermore, research has demonstrated a link between prospective memory and executive functions exists, but only a few studies have been executed with children. In our research, an experimental task developed by Kliegel and Imhofen (2003) has been applied to measure event-based and time-based prospective memory. Furthermore, the Stroop and the Trial Making Test have been presented to evaluate executive functions. Additionally, two short-term memory tasks have been administered. A significant relation between prospective memory and executive functions is postulated as well as a more or less parallel developmental trend. The three tasks were administered to children with learning difficulties, ADHD children and normally developing children. Differences in prospective memory as well as correlation between prospective memory and executive functions in the three groups of children have been explored. Lower performances in the prospective memory task are expected in children with learning difficulties as well as in ADHD children because of their well known deficit in executive functions. First results did confirm differences in time-based prospective memory as well partially in executive functions, but differences in event-based prospective memory could not be found. Furthermore, the developmental hypothesis could be confirmed only for children with learning difficulties. These data will be discussed and compared to results found in two short-term memory tasks.

Age differences in delayed-execute prospective memory: It depends on how old!

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The present study follows the novel delayed-execute prospective memory paradigm, which involves briefly delaying the execution of an intended action. Investigating 127 participants (27 young and 100 older adults), the following issues were addressed: In contrast to previous studies using older participants taken from a very broadly defined age range, we examined development of delayed-execute prospective memory more accurately by dividing older adults into three age cohorts. We investigated the dependence of (age-related) delayed-execute prospective memory performance on working memory capacities by disrupting the phonological loop during the delay period. In addition, the role of interindividual differences in executive functioning in age-related delayed-execute prospective memory performance was examined. The results show that (1) delayed-execute prospective memory particularly declineswithin the group of older participants, that (2) delayed-execute prospective memory is diminished when working memory load is high during the delay period, and that (3) age-related performance in delayed-execute prospective memory may be mediated by executive functioning.

Planning and realization of complex intentions in parkinson patients

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Background: There is initial evidence that patients with Parkinson's disease might be impaired in prospective memory performance (i.e., planning and self-initiated realization of delayed intentions). Little is known about the effect of Parkinson's disease on distinct phases of prospective memory and potential mechanisms underlying these effects. Objective: To investigate intention formation, intention retention, intention initiation, and intention execution of patients with Parkinson's disease and test for the mediating influence of working memory, inhibition, short-term retrospective memory, and divided attention. Methods: Sixteen Parkinson's disease patients and 16 age and education matched normal controls were given a complex event-based prospective memory task that allows differentiating the four phases of prospective remembering. In addition, participants were tested on the operation span test, the colour-word stroop task, the digit span forward subscale of the WAIS, and the divided attention test of the TAP. Results: The results show that Parkinson's patients were impaired in the intention formation phase and showed a trend towards impairment regarding the intention initiation and in the self-initiated switching components of intention execution. In contrast, there were no impairments with regard to the retrospective intention retention as well as the fidelity with which the patients executed their previously developed plan. The group effects were revealed to be related to interindividual differences in working memory span. Conclusions: The results suggest that specifically the planning phase of prospective remembering is impaired in Parkinson's patients, presumably related to working memory impairments in Parkinson's disease. In contrast, even when complex intentions have to be remembered, the retrospective storage of intentions to be performed is not impaired.

Automatic or controlled? Rehearsal and retrieval processes in everyday time- and event-based prospective memory tasks

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The question about the nature of prospective memory retrieval (automatic or controlled) is becoming increasingly popular. However, research on this topic has primarily concentrated on event-based tasks using various laboratory paradigms. This research has resulted in several different models of event-based prospective memory. However, very little is known about the processes underlying the retrieval of time-based tasks. The prevailing theoretical assumption first stipulated by Harris and Wilkins (1982) is that they are supported by the self-initiated rehearsals and/or periodic monitoring of elapsed time (the Test-Wait-Test-Operate model). In contrast, Wilkins` (1976) Random Walking Model assumes that the rehearsal and retrieval of time-based tasks is entirely mediated by chance encounters with accidental external or internal cues. The aim of the present research was to examine the nature of rehearsal in naturalistic time-based tasks (Study 1 and Study 2) and to compare it to the rehearsal processes occurring in the naturalistic event-based task (Study 3). The general method used in all three studies consisted of participants remembering to give a single phone call to the experimenter (a prospective memory task). In addition, participants had to keep a diary in which they recorded the details of occasions when they thought about (i.e. rehearsed) this intention during the retention interval. For example, they had to indicate what they were thinking and doing at the time of rehearsal, whether there was any trigger that elicited their memory of future intention and if yes, what was the trigger. Participants in Study 1 and Study 2 had to remember to make a phone call at a pre-arranged time after seven days from an initial meeting with an experimenter (a time-based task). In Study 3, half of the participants had to carry out this time-based task and half an event-based task. The latter involved giving a phone call to the experimenter after receiving a text message from Lycos.com. The participants were told to expect this message within the next two weeks. However, all participants received it exactly after seven days. The results showed that in the time-based tasks only 9% to 14% of rehearsals were self-initiated, i.e., cued by thoughts about future plans and activities. The majority of rehearsals were triggered either by incidental external or internal cues or they simply popped into mind without any obvious triggers. The results of Study 3 showed that while participants in the event- and time-based conditions reported equal numbers of rehearsals triggered by incidental cues, those in the event-based condition were reliably less likely to report experiencing self-initiated rehearsals and rehearsals without any apparent triggers. In conclusion, the results suggest that the rehearsal and retrieval of naturalistic time-based tasks is less self-initiated and more reliant on automatic processes than previously thought. However, the results also show that processes underlying the rehearsal and retrieval of time-based tasks are fundamentally different from those involved in event-based tasks. It appears that the representation of event-based tasks is at relatively constant and low level of sub-threshold activation during the retention interval. This level of activation is sufficient to sensitise one towards the occurrence of target and/or related events in one`s environment. However, it is not enough for the task to pop periodically into one`s mind without any cue. In contrast, the activation levels of time-based tasks are generally higher and fluctuate over time resulting in periodic conscious thoughts about the task.

fMRI of responding to ambiguous cues: Endgame of a prospective memory task?

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The dynamic network involved in prospective memory (ProM) is excessively complex, dynamic, and confounded by diverse and overlapping cognitive and noncognitive processes (e.g., planning, storing goals, cue-symbol interpretation, avoiding distracting cues and inhibiting undesirable motor responses, tagging goals to social information, monitoring errors, reward and attention, and, finally, providing a decisive impulse to implement a plan). A design that incorporates planning through to its completion with an action inadvertently exposes this tide of processes, each one overlapping with the next. Therefore, when designing a complex ProM task that required a timed response we decided to isolate, for functional magnetic resonance imaging (fMRI) purposes, the two most common final components of this chain of events: guesswork over the timing (and/or cue relevance) and a commitment to a motor response based on conjecture. Six right-handed healthy males (20 to 36 yrs old) with normal hearing and normal or corrected-to-normal vision participated in the fMRI experiment (BOLD contrast method; GE Signa 1.5T, TR/TE/flip 3000/40/90°). Subjects had to identify the side of louder pinging noises by pressing the hand-held button on that side. In reality, they had to execute an impossible perceptual task. The sound was always the bilaterally symmetric acoustic noise produced by the normal switching of the gradient electromagnets during echoplanar scanning. In the first session they pressed the button to communicate that they concurred that the louder sound was coming from the side (left or right) indicated by an arrow displayed on a viewing screen ("guided task"). The arrow remained on the screen for 15 seconds and was followed by the 15-second presentation of a diamond signifying that sound balance had been restored. This served as the baseline condition. The visual cues were thus akin to positive feedback (reward) that was valid at least at chance level. In the second session they had to identify the imbalanced sound without the aid of an arrow ("blind task"). Instead, they saw a filled circle for 15 seconds that was also followed by the baseline diamond stimulus. Compared to the baseline periods, the "guided task" displayed activations in parietal and temporal regions on the right side and in the lingual gyrus on the left. These regions were likely activated by sensory cue processing operations. The "blind task" was associated with activations in the lateral inferior orbitofrontal cortex (OFC), the supplementary motor area (SMA) and, anterior cingulate (AC) on the right. None of these regions were activated by the "guided task". We infer that SMA and AC activity was associated with response conflict and prompts for actions based on cognitively generated impulses. By contrast, OFC is likely to be involved in the suppression of responses that were previously rewarded in the "guided task". Both this task and other ProM tasks share the feature that a response is evoked in the absence of an external stimulus. The present strategy therefore helps to fragment a complex and redundantly represented systems implicated in ProM tasks.

Age-related differences in prospective memory performance: Behavioral and electrophysiologcal evidence

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Especially in old age people increasingly complain about memory problems. When asked to give examples, they mention for instance difficulties in remembering to pay a bill, to keep an appointment in mind, or even to turn off the oven after usage. Actually, these kinds of tasks ask for the ability to form an intention and postpone its execution to a later point in time. Cognitive psychology refers to this process as prospective memory performance. Besides memory functions it is closely related to executive abilities such as planning, anticipating, and self-initiating. Research has made great progress in recent years to explore the conditions of age-related deficits in prospective memory performance. Nevertheless, only little is known about the neural processes that underlie successful prospective remembering. Therefore, electroencephalography is currently discussed as an important tool for prospective memory research (West, Jakubek, & Wymbs, 2002). Event-related potentials (ERPs) allow for 'online' measurement with high temporal resolution and can reveal distinct modulations in the time-course of electrophysiological brain activity associated with prospective memory performance. The purpose of the present study was to determine age-related differences in the course of prospective memory performance according to correctness and timing of responses. Moreover, we assessed age effects in neural processing at the different phases of prospective memory using ERP recordings. The event-based prospective memory task was embedded in an ongoing task of semantic categorization and used a color cue. Due to a retrieve-delay specification in the paradigm the execution of the intention had to be additionally postponed (cf. Einstein, McDaniel, Manzi, Cochran, & Baker, 2000). Two groups of 14 younger adults (Age: 20 - 25 years old) and 14 older adults (Age: 65 - 80 years) were examined. EEG was recorded from 32 electrodes. Behavioral data confirm better prospective memory performance for the younger compared to the older group. ERPs show specific modulations for the cognitive processes of intention formation, intention retention, and retrieval of memory cues. Multiple group comparisons reveal age-related differences in the amplitudes of ERPs. Our preliminary results support age-related differences in the neural processes of intention formation and delayed memory retrieval. Findings will be discussed with regard to cognitive and neural mechanisms of efficient prospective memory performance in old age.

Work experience and prospective memory: Self-comment and the influence of increased difficulties at work memory

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The study used a test material which includes prospective memory and work memory tasks and was read out by a recorder, and in the material, self-comment inquiry of prospective memory are imbedded. The participants of the study are 55 office clerks and 152 college students. In the study, we explored the impacts of work memory on ProM scores by changing the difficulty levels of the tasks. Our final conclusions include: (1) the ProM scores of college students decrease but office clerks not when WM tasks become more complex; (2) college students have better self-comment of prospective memory than that of office clerks. Further implications of the findings were discussed.

Effects of depression on prospective and retrospective memory functioning among elderly adults

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Depression is a concept that describes a wide range of states, and can be viewed as a continuum ranging from dysphoria to severe clinical states. Depression is common in old age, and associated with retrospective memory (RM) impairment. Whether prospective memory (PM) is similarly impaired in depression remains unknown. Therefore, the major aim of the present study was to compare the effects of depression on PM and RM. Method: The study is based on data from the Kungsholmen Project, which is a longitudinal, population-based study of persons 75 years and older. The present study included 317 participants, who completed medical examinations and cognitive tests. 11 persons were diagnosed with major depression and 5 with dysthymia. Among those who were not clinically depressed, many still had depressive symptoms according to the Comprehensive Psychopathological Rating Scale (CPRS). All participants were free from other disorders known to affect cognitive functioning. At the beginning of the test session, participants were instructed to remind the test leader to make an important phone call after completion of all tests. If the participants failed to do so, the test leader asked: "What were you supposed to remind me to do" The RM task consisted of a word list with nouns from different taxonomic categories (e.g., clothes and furniture). After a free recall test, a cued recall test was given, in which participants were provided with the category names as retrieval cues. Results: Regression analyses, controlling for age, sex, education, and retention interval for the PM task, were performed. As stated earlier, depression was treated as a continuum, with number and severity of symptoms taken into account. The analyses revealed a negative impact of depressive symptoms on RM, indicating a general impairment across encoding, consolidation, and retrieval of episodic information. However, the only effect on PM was seen on the retrospective component of the task. The prospective component was not affected by depression. Thus, in the present task situation, PM was not as sensitive to the effects of depression as RM. Discussion: The results supports the view that PM and RM involve different cognitive processes. RM depends heavily on regions in the medial temporal lobe, whereas PM often places higher demands on self-initialized retrieval processes and is thought to depend mainly on frontal areas. Brain imaging studies show decreased hippocampal volume among depressed persons, which could partly explain their RM impairment. Previous studies have established that both RM and PM is impaired in the early stages of Alzheimers disease (AD). Because medial-temporal regions are affected also in AD, it may appear counterintuitive that PM is impaired in AD but not in depression. This pattern could possibly reflect the fact that multiple brain regions and functions are affected in early AD, including frontal areas. To obtain more knowledge of the cognitive processes behind PM may also improve the possibilities to differentiate between early dementia and other disorders.

Factors that influence the cost of event-based prospective memory

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Preparatory Attentional and Memory Processes (PAM) theory proposes that event-based prospective memory requires the allocation of preparatory attention to monitor the environment for target events, as evidenced by response costs to ongoing tasks (Smith & Bayen, 2004). In contrast, other theories propose that intentions can be retrieved automatically, and do not predict response costs to ongoing tasks (Guynn et al. 2001). Across three experiments, we examined response costs and prospective memory performance under conditions of high association, where the recognition of targets and retrieval of intentions are proposed to be relatively automatic; and under conditions of low association, where prospective memory is thought to rely on more strategic processing (Multiprocess View; McDaniel et al. 2004). A prospective memory task was embedded in a lexical decision task. Under high association conditions, target words were associatively related to response words (document-paper). Under low association conditions, there was no obvious relation (document-wash). Control participants performed the lexical decision task only. Both low and high association conditions were slower to respond to lexical decision trials than controls. There were no significant differences in response costs or prospective memory performance between the low and high association conditions. Previous studies indicate that manipulations of task importance influence the degree to which individuals monitor for prospective memory targets (e.g., Kliegel et al. 2004). Instructions in Experiment 2 emphasized either the importance of the prospective memory task or the importance of the lexical decision task. Both low and high association conditions demonstrated smaller response costs, and were less likely to make prospective memory responses, when instructions emphasized the importance of the lexical decision task. In Experiment 3, we predicted a reduction in response costs when targets were presented less frequently. This manipulation was inspired by a recently proposed theoretical sub domain known as ProM proper (Graf & Uttl, 2001). Targets were either presented every 33 trials (frequent) or every 90 trials (infrequent). Two control conditions matched in length to either the frequent or infrequent experimental conditions provided appropriate baselines. Both low and high association conditions demonstrated smaller response costs when targets were presented less frequently. Furthermore, declines in prospective memory performance when targets were presented less frequently were comparable across low and high association conditions. The response costs data indicate that participants under conditions of low and high association were directing similar amounts of preparatory attention toward monitoring for targets. However, analyses of trials proceeding prospective memory hits versus trials proceeding prospective memory misses indicated that these response costs were only functionally related to prospective memory performance under conditions of low association. This suggests that prospective memory under conditions of high association was immune to variations in the allocation of cognitive resources prior to attending targets. On the other hand, comparable declines in prospective memory resulting from task importance and target frequency manipulations challenge the proposal that intentions can be retrieved relatively automatically under conditions were targets and responses are highly associated.

Complex relationships between prospective memory, retrospective memory and executive functions in traumatic brain injury

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The aim of the present study is to investigate complex relationships between event-based and time-based prospective memory, retrospective memory and executive functions in patients with traumatic brain injury (TBI) and lesions in various brain regions. Recent research has shown relations between prospective memory and executive functions like planning, monitoring of the environment and inhibiting ongoing activities. It is assumed that both prospective memory and executive functions depend to a great extent on frontal lobe functioning. The role of retrospective memory in prospective memory tasks is not clearly specified. However, at least a minimum of retrospective memory abilities is required to remember the content of the intention in prospective memory tasks. Retrospective memory is usually thought to be mediated by the temporal lobes (especially the hippocampal formation). To explore the importance of different brain regions in prospective memory performance we are examining patients with TBI who have focal lesions in various brain regions. Measures of prospective and retrospective memory and of executive functioning are utilized in TBI patients and well-matched controls. Prospective memory is assessed with four time-based and four event-based tasks. We are interested in the comparison of these two task types and their specific correlations with other variables (e.g. location of the brain lesion). We parallelised event- and time-based tasks in terms of a) content of the intention, b) length of retention interval and c) type of ongoing task during which the retrieval and execution of the delayed intention have to be performed.Thus a confundation of the type of task with the mentioned variables is avoided and a direct comparison of the indexes of time- and event-based prospective memory performance will be possible.

Time and event-based prospective memory in children

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Prospective Memory (PM) is a form of memory we use every day and refers to memory for things we still have to do, i.e. for intentions/intended actions. At least two types of PM have been identified: Event-Based PM (EBPM) and Time-Based PM (TBPM). Despite its importance in day-to-day life, surprisingly few investigations have focused on the development of PM in children. Age effects have been observed in tests of EBPM which involve an ongoing task (e.g. picture sorting), where the cue to perform an intended action appears as part of this ongoing task - i.e., when a particular picture is presented participants must make a different response. Younger children typically perform these tasks less well than older children. However, age-effects are somewhat more variable in real-life EBPM tests when children are required to remember a single prospective event. Similarly, in studies of TBPM in children, developmental differences have been reported in performance on a computer task, but are less clear in a single episode real-life task. Only one study has directly compared EBPM and TBPM in children, although results indicate that EBPM develops earlier than TBPM, this conclusion is limited by the between-subjects design. The adult literature indicates a number of predictors of PM including working memory, processing speed and executive functions such as planning, inhibition and cognitive flexibility. Few developmental studies have sought to measure such 'predictor variables.' Furthermore, children's performance on PM tasks has not been compared to their PM abilities in everyday life. Investigate the development of EBPM and TBPM in children aged 7-12 years using various tasks. Compare the development of EBPM and TBPM in children using comparable computer tasks and a within-subjects design. Investigate the predictor variables most associated with EBPM and TBPM. Assess the incidence of everyday PM skills in children using a parent questionnaire and compare this to cognitive test performance. Participants: 3 age groups of children are currently being assessed, aged 7-8 years (N=20), 9-10 years (N=20) and 11-12 years (N=20). Participants perform a test battery: General Intelligence IQ is prorated from two subtests of the HAWIK IQ scales: Vocabulary and Block Design. EBPM: Three tests of EBPM are included, 2 involve a single to-be-remembered event over a 10-minute delay, e.g., saying 'red pencil' upon presentation of a red pencil. The newly developed 'N-Back EBPM Test' is a computer task. Participants perform an ongoing N-back picture judgement task, the PM task is to press a yellow key when a picture of an animal is presented. TBPM: There are three tests of TBPM, 2 involve a single to-be-remembered event over a 10-minute delay, e.g., remind experimenter at time X to take a break. The 'N-Back TBPM Test' forms a parallel version of the event-based computer task. During the ongoing N-back picture judgement task, participants must press a yellow key every 2 minutes, access to a computer clock is provided. Predictor Variables: HAWIK Digit Span (working memory), HAWIK Digit Symbol (processing speed), the Zoo Map test (planning), the TAP Go-NoGo test (inhibition) and the TAP Flexibility test (cognitive flexibility).

Time Perception: Children's ability to perceive time is assessed in 2 prospective and 2 retrospective time perception tasks. PM in Everyday Life: An adult self-assessment PM questionnaire was adapted for use by parents about their child. Results and Discussion: Assessment is in progress and results are pending.

Time monitoring and executive functions in children and adults

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Most goal-directed activities require temporal integration and monitoring of action sequences. In general terms, monitoring is the process by which agents assess their environments, and involves activities such as checking the progress of initiated plans, finding out what time it is, and looking for obstacles. Although often taken for granted, monitoring is a necessary task for any agent, be it a child or a robot. For example, a prospective memory task involves a monitoring phase following the formulation of an intention. During that monitoring phase, the individual has to pay attention to the target event among other background events. Because most everyday activities, including memory for future intentions, involve multiple goal-directed tasks efficient monitoring requires a strategy, or a scheme, for scheduling actions (i.e., when and how to monitor). In this study, we examined individual and developmental differences in time monitoring, temporal judgment, and executive control functions. Extending earlier work (Ceci & Bronfenbrenner, 1985; Harris & Wilkins, 1982), we examined regularities in monitoring strategies by studying how school-aged children, younger adults, and elderly adults monitor temporally defined target events, while carrying out a variety of background activities. In our study, time monitoring was based on computerized task in which participants indicated the passing of time, while watching a movie or completing more demanding cognitive tasks. Specifically, participants were instructed to press a (red) button when the clock on the computer monitor showed a target time. During the waiting period they could check the clock by pressing another (green) button. We also examined each participant's sense of time by using a time reproduction task, in which a simple stimulus picture (a 'smiley') appeared on the computer screen for an interval varying between 4 to 32 s. Another aim of our study was to examine time monitoring and time judgment in relation to individual differences in executive control functions. We assessed executive functioning by focusing on three basic constructs that were assumed to reflect central aspects of cognitive control, namely, mental set shifting, updating, and inhibition of prepotent responses (see also Miyake et al., 2000; Salthouse, et al., in press). Each of these three constructs was measured by multiple tasks that were assumed to tap a specific target function. We will discuss our findings in terms of individual and developmental differences in strategic monitoring, sense of time, and cognitive control functions. We will also consider our findings in relation to the assessment of temporal functioning in individuals with attentional disorders.

Factors in elementary school children's completion of assigned work

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Prospective memory is utilized in completion of assigned work in school situations. In this study, we examined the relationship between a number of cognitive and personality factors and elementary school children's completion of their assigned school work. Participants were 24 children (11 girls), between 6 and 11 years recruited from an elementary class of a Montessori school. In a school work planning task, children planned a week's work using a chart similar to those used in the classroom. (Work for the week is assigned by their teachers on the first school day in the week on a 'dot chart' and students place a dot on the chart when they complete each task to the teacher's satisfaction.) To assess school work completion, classroom dot charts from the first 10 weeks of the school year were collected daily and mean percentages of weekly school work completed by the end of the third day of the week were computed for each child. A realism score for school work time estimation was computed as the proportion of dots children said they could do in a morning out of the average number of dots actually done, added to the proportion of dots they said they could do if they worked really hard out of the highest number of dots ever actually done. Finally, the head teacher rated classroom behavior for each of the participants, using the Comprehensive Behavior Rating Scale for Children (CBRSC) (Neeper, Lahey, & Frick, 1990), a standardized scale with 9 subscales: inattention-disorganization, reading problems, cognitive deficits, oppositional conduct disorders, motor hyperactivity, anxiety, sluggish tempo, daydreaming, and social competence. Partial correlations were performed to examine the relationship between school work measures, realism and inattention/disorganization when age, years of schooling, cognitive deficits, and reading problems are controlled. School work completion was significantly ($p < .05$) correlated with school work planning ($r = 0.57$), realism ($r = 0.55$), and inattention/disorganization ($r = -0.59$). A new measure was computed based on items from the CBRSC which are most likely related to difficulty with prospective memory. Partial correlations were also computed between the prospective memory item scores, school work measures, and realism, controlling for age, years of schooling, cognitive deficits, and reading problems. Difficulty with prospective memory was negatively correlated with school work completion ($r = -0.59$, $p < 0.01$) and realism of the estimate of school work duration ($r = -0.45$, $p < 0.05$), suggesting that the ability to realistically estimate how much work one can do is also related to prospective memory.

Age invariance in prospective memory performance: The role of focal cues and resource allocation

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Two experiments demonstrated that age-related deficits in event-based prospective memory tasks are not inevitable. Experiment 1 used an ongoing task typically associated with age-related deficits, Maylor`s (1996) famous faces task. In order to vary how focal the prospective memory cue was to the ongoing task, we modified the famous faces task such that participants were required to specify the occupation of the person whose face was presented. The focal prospective memory cue was a particular occupation (politician), and the non-focal cue was eyeglasses being worn. We found no age differences in prospective memory. For focal cues, neither young nor old demonstrated costs to the ongoing task. In contrast, for non-focal cues, older adults maintained levels of prospective performance comparable to young adults but at a cost to ongoing task performance (reduced accuracy). Experiment 2 replicated these patterns with a more sensitive cost measure and a different ongoing task. The ongoing task was to judge whether a word was a member of a specified category judgment. The focal prospective memory cue was a particular word, and the non-focal cue was a particular syllable. Once again, there were no age differences in prospective memory. Further, response latencies when the ongoing task was presented alone were not faster than the latencies when the ongoing task was presented in the presence of a focal-cue prospective memory task, and this pattern held equally for young and for older adults. By contrast, response latencies were significantly slower in the presence of the non-focal cue prospective memory task, and this cost was significantly exaggerated for older adults. These data provide the strongest support to date for the idea that when the prospective memory cue is focal to the ongoing task, prospective memory retrieval is typically spontaneous and accordingly, is not likely to produce age-related decline. Second, older adults` resource allocation policies with nonfocal target events clearly can support prospective memory at levels comparable to those of younger adults, albeit at a price to ongoing activity. One possible implication here is that in naturalistic settings, older adults can maintain prospective memory performance equivalent to that of younger adults, but doing so may involve some sacrifice in the speed or accuracy of the ongoing activity.

Prospective memory in children: The effects of age and target salience

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In a special issue of Applied Cognitive Psychology on prospective memory following the First International Conference on Prospective Memory, Kvavilashvili and Ellis (2000) noted that research on developmental aspects of prospective memory in children has received relatively little attention. In the following two studies, the effects of age and target salience on prospective remembering in 4-, 5- and 7-year old children were examined. The first was conducted in the context of a computer-based picture naming task. Children were asked to name aloud individually-presented pictures for Rosie the rag-doll and remember to press a response key whenever they encountered an item of food that she could put in her lunch-box. They were presented with four blocks of 20 trials and each block included 4 larger pictures and 1 prospective memory target item. Target salience was manipulated between-subjects by presenting the food item as either the same size as or larger than the majority of non-targets. The second study used a card-sorting task which required children to name and sort picture cards into the categories of clothing, transport, or other; and remember to place a card in the lunchbox placed behind them if it depicted a food item. Salience was manipulated in the same manner as the first study. Assuming that executive functioning in older children is more developed, it is predicted that, in each experiment, target salience will be more beneficial for the younger children. Data are still being collected and will be discussed in the context of the multiprocess framework of prospective memory (McDaniel & Einstein, 2000).

Retrieval experience as a meaningful measure of prospective memory processes: 'Pop up' and 'search' experiences vary systematically with experimental conditions

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Retrieval of an intention can be accompanied by the experience that the intention 'pops into one's mind' or as a result of a strategic search for the prospective memory cue. In this study we investigated whether the distinction between 'pop up' and 'search' experiences is meaningful to participants and whether these judgements vary systematically across experimental conditions. Towards this goal the retrieval experience was assessed immediately after each correct prospective memory response. The prospective memory task was embedded within a complex short-term memory task during which participants had to simultaneously process words and drawings of pictures. It consisted of describing the particular music instrument, whenever an instance of a musical instrument was presented. In Experiment 1 (N=96 undergraduate students), experimental conditions were varied within an associative priming paradigm, in which the prospective memory target cue was or was not preceded by an associated prime. The hypothesis was that priming prospective memory cues enhances performance and that this performance benefit is accompanied by an increase of pop up experiences. The results confirmed this hypothesis. In Experiment 2 (N=240 undergraduate students), experimental conditions were varied by manipulating the specificity of the retrieval situation and the length of retention interval in a sample of 240 students. Specificity was manipulated by informing one half of the participants in which task of the test procedure the prospective memory task was embedded while the other half of the participants did not receive this specific information. The retention interval was either 5 min, 15 min, or 45 min. The results showed that both, specificity of retrieval situation and length of retention interval influenced prospective remembering with higher performance for the more specific situation and the short retention interval. The results also indicated an interaction between specificity of retrieval situation and length of retention interval with a larger decrease in prospective memory performance when no specific information about the retrieval context were available. An analysis of the reported retrieval experience revealed that this interaction was due to a decrease in strategic search experiences in the unspecific retrieval context condition, but not in the specific context condition. These results suggest that the distinction between pop up and search experiences is indeed meaningful, that participants can make corresponding judgements about their memory performance, and that these judgements vary systematically with conditions under which prospective remembering takes place. These findings highlight the usefulness of experiential reports for prospective memory research.

Prospective memory and ageing: Can implementation intentions make up for the intention-inferiority effect?

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Recently, it has been suggested that older adults` impaired prospective memory performance may be due to the absence of an intention-superiority effect (Maylor, Darby & Della Sala, 2000). However, in an everyday prospective memory study, older adults have been found to outperform younger adults despite reduced intention accessibility (Freeman & Ellis, 2003). It remains unclear whether intention accessibility plays a role when older adults` prospective memory performance is actually impaired. In this study, we use a modified version of an event-based laboratory paradigm developed by Marsh, Hicks and Watson (2002), with a lexical decision as the ongoing task and reacting to instances of a category (e.g., pieces of clothing) as the prospective task. Our expectations are that compared to younger adults, older adults will perform worse on the prospective memory task and show a reduced or no intention-superiority effect. In addition, we explore whether forming an implementation intention benefits prospective memory performance. So far, there is evidence that implementations help prospective remembering in older adults (Chasteen, Park, & Schwarz, 2001; Liu & Park, 2004). One possibility is that implementation intentions help keeping an intention at a higher activation level in memory. Another possibility is that implementation intentions compensate for reduced intention accessibility by linking cue and intention such that once the cue is encountered, the prospective response occurs highly automatic. Data collection has not been completed yet. Preliminary results will be reported.

Psychosocial stress enhances time-based prospective memory

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Prospective memory describes the processes underlying the self-initiated and delayed execution of an intended action. Stress is known to interfere with a variety of cognitive tasks including memory tasks. However, no study so far has looked into the possible consequences stress might exert on prospective remembering. In the present project, in two studies, the effects of acute psychosocial stress on prospective memory performance were examined. In study 1, 20 healthy young male adults were exposed to a psychosocial stress test (i.e., a simulated job interview plus a mental arithmetic task) and a non-stress condition. After a delay, a time- and event-based prospective memory task was administered during the peak of cortisol concentrations elicited by the stressor. Results show that subjects performed significantly better in the time-based memory task after stress in comparison to the non-stress condition. In contrast, there was no effect on event-based prospective memory. In the second study, we extended this line of research examining whether the cognitive worries associated with the stress situation rather than the glucocorticoid peak might be responsible for the obtained effect. Again, 20 subjects took part in a similar study protocol. This time, a time-based prospective memory task was performed immediately after introducing the constraints of the stress test before the preparation time for the simulated job interview. Results revealed no differences in prospective memory performance between the stress and the non-stress conditions. The results demonstrate that prospective memory might be enhanced when subjects are exposed to stress prior to the memory task. These findings bear important implications for a variety of every day life relevant areas.

Target probability effects in prospective memory: a trade-off between ongoing- and target-related activities as revealed by functional magnetic resonance imaging

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Introduction: The probability that a particular retrieval context will occur has been thought to affect prospective remembering. Temporal patterns, or histories, of such retrieval contexts may therefore modulate cognitive and neural processes involved in prospective memory. The present study examined the effects of recent target frequency on prospective remembering, both behaviourally and in terms of ongoing- and target-related neural activity, as indexed by functional magnetic resonance imaging (fMRI). Methods: Sixteen healthy volunteers participated in a task paradigm in which the number of non-prospective memory (ongoing) trials between two successive prospective memory (target) trials periodically increased (expanding-interval phase) then decreased (contracting-interval phase). Thus, during expanding-interval phases, targets occurred less frequently than would be predicted from recent experience; during contracting-interval phases targets occurred more frequently. Subjects performed two separate tasks. In one task they classified two-digit numbers as being greater or less than 50 (ongoing response). However, if the number contained a repeating digit (11, 22, and so on; target stimuli) they were required to respond with a different key (prospective memory response). In the other task they were presented with three dots, and made the ongoing response according to whether there were more dots on the left or right of the screen. The prospective memory response was required if the three dots formed a diagonal line. The stimuli changed immediately after each response (i.e. the tasks were subject-paced), and each task lasted 20 minutes during which about 15 cycles of the expanding-interval (target-intervals: 8, 12, 16, and 20) and contracting-interval (target-intervals: 16, 12, 8, and 4) phases were repeated. Brain activity was scanned using 3T-MRI (Siemens Allegra), and analysed using SPM2 software. Results: Post-scan debriefing revealed that no subject was aware of systematic variation in target frequency. Accuracy of the ongoing responses was greater than 95% and the miss rate of prospective memory responses was around 10-20% in each task. Reaction times for the ongoing and prospective memory responses showed a striking dissociation between the two phases: the prospective memory response was approximately 60 ms faster in the expanding-interval phases than in the contracting-interval phases, whereas the ongoing response showed an opposite effect (approximately 20 ms slower in the expanding-interval phases). Consistent with this behavioural effect, fMRI activation in bilateral medial prefrontal cortex (peak: -18,39,-6 and 18,42,-6) showed a significant interaction between the phase and response (uncorrected $p < 0.0001$, Z-score 4.2): target-related activity was greater in the expanding-interval phases than in the contracting-interval phases, while ongoing-related activity showed an opposite pattern. These effects were consistently observed across the two tasks.

Discussion: The faster prospective memory responses and slower ongoing responses in the expanding-interval phase may reflect anticipation of an expected target. We suggest that the balance between stimulus-oriented processes related to the ongoing task and stimulus-independent processes related to target anticipation may be a critical determinant of the efficiency of prospective remembering. Furthermore, we suggest that this balance may be dependent on activity in medial prefrontal cortex, thus explaining the role of this brain region in controlling delayed intentions.

Strategy differences for remembering important and less important real-life intentions

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The main purpose of this study was to investigate whether people use different strategies for important vs. less important real-life intentions. There is some evidence to suggest that certain types of strategies are superior for remembering to perform an intention. Specifically, Maylor (1990) found that conjunction strategies (such as tying the intention to another event) were superior to external strategies, which were superior to internal strategies. West (1988) found external strategies to be superior to internal strategies. One study has examined strategies for different types of intentions. Ellis (1988) found that "pulses" (intentions with smaller performance windows) were rated as more important and were associated with more memory aids. The present study expanded on those findings by directly assessing strategy use, and perceived effectiveness, for important and less important intentions. Also, although several researchers have speculated on the importance of prospective remembering for social relations (e.g., Meacham, 1988), social attributions for forgetting have not been empirically assessed. In the present study, attributions for forgetting (by "oneself" vs. "others") were also measured. Two predictions concerned general strategy use. Participants were predicted to use external and conjunction aids more than internal aids. Also, external and conjunction aids were predicted to be rated as more effective than internal aids. For important intentions, people were expected to favor more effective strategies. Finally, forgetting was predicted to more often be attributed to low importance for others' forgetting than for one's own forgetting. Method: Participants (197 undergraduate students) completed an on-line questionnaire. Items assessed frequency of use and judged effectiveness for 12 strategies (for important and less important intentions). Most items were adapted from Intons-Peterson and Fournier (1986, (from Harris (1980)). The frequency scale ranged from 1 (never) to 7 (11 or more times in past two weeks). The effectiveness scale ranged from 1 (never) to 7 (always). The main independent variables were intention importance (very important vs. less important) and strategy type (external, internal, and conjunction). External aids included: timers, writing on hand, placing in view, asking to remind you, notes, calendars, and other external. Internal aids included mental rehearsal, imagery, and stating aloud. Conjunction aids included planning/rearranging the day and tying intention to events. Two items assessed social attributions by asking how often forgetting intentions was blamed on lack of importance for "yourself" vs."others" (1=never to 5=always). Results: In general, participants used external aids more than internal or conjunction aids, and both external and conjunction aids were judged more effective than internal aids. For important (vs. less important) intentions, participants reported more frequently using all strategies (M=3.42 vs. M=3.28), t(196)=2.82, external strategies (M=3.53 vs. M=3.37), t(196)=2.89, and (marginally) conjunction strategies (M=3.31 vs. M=3.18), t(196)=1.65. Internal strategy use did not differ. People more often assumed low importance caused another person's forgetting (M=2.94) than their own (M=2.62), t(196)=5.22. Conclusions: Results support the conclusion that people use different, and better, strategies for more important intentions. Also, people are more likely to attribute prospective memory forgetting to insufficient importance when judging others than when judging themselves.

The intention superiority effect: activation patterns for state vs. action orientation and different cue types

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The main purpose was to examine differences between state and action-oriented individuals in activation of completed and uncompleted intentions. Previous research has shown group differences in the intention superiority effect, or ISE (higher activation of to-be-performed intentions relative to other memories). In 1993, Goschke and Kuhl introduced a postponed-intention paradigm to measure activation of uncompleted intentions. Participants memorized two action scripts and then were told which to perform (the PM (prospective memory) script). Activation for script words was assessed with response times in a recognition task. They found an ISE for state-oriented participants, for both the experimenter-cued and no-cue conditions. However, action-oriented participants only showed an ISE with no cue. Marsh, Hicks, and Bink (1998) replicated the general finding of an ISE and showed a reversal in activation levels after intention completion, an inhibition effect. However, they did not assess state/action orientation or cue type. The present study replicated Marsh et al.'s procedures, but added two variables predicted to have moderating effects: state/action orientation and cue type. Method: Participants (191 undergraduates) completed the postponed-intention paradigm, but with activation measured both before and after intention completion. Activation was assessed with RT for script words in a LDT (lexical decision task). For each participant, activation was measured both before performance (uncompleted intentions), in one block, and after performance (completed intentions), in another block. An ISE would be demonstrated as faster RTs for PM than neutral scripts, and an inhibition effect would be demonstrated as slower RTs for PM than neutral scripts. In addition, participants were randomly assigned to cue conditions, self-cued (time-based) and experimenter-cued (event-based). Finally, participants were categorized as action or state-oriented (ACS-90). A 2(script: PM-neutral) X 2(completion status: uncompleted-completed) x 2(state-action) x 2(cue type: self- vs. experimenter-cued) design was used with script and completion status measured within-subjects. The dependent variable was RT for script words. Results and Discussion: In a mixed 4-way ANOVA, the only significant main effect was for script, $F(1,187)=15.78$, $p<.001$. There was an overall ISE with faster RTs for PM scripts (M=532) than neutral scripts (M=542). Unexpectedly, there was no interaction between script and completion status. That is, the inhibition effect Marsh et al. found for completed intentions was not replicated. None of the other 2-way or 3-way interactions were significant. However, there was a 4-way interaction, $F(1, 187)=3.85$, $p = .05$. Post-hoc comparisons showed differences in activation patterns for state vs. action-orientation before intention completion. These groups showed opposite patterns of the ISE depending on cue type. The state-oriented group showed the ISE when self-cued (PM RT (531) < neutral RT (554)), $t(44)=2.60$, $p=.013$, but no ISE when experimenter-cued. The action-oriented group showed the ISE when experimenter-cued (PM (538) < neutral RT (556)), $t(58)=2.78$, $p=.007$, but no ISE when self-cued. One interpretation of these results is that the ISE occurs under different conditions for state and action-oriented individuals. If self-cuing is more cognitively demanding, then state-orientation shows an ISE under higher demands, but not lower demands, and action-orientation only shows an ISE under lower demands.

The role of ecological validity in age differences in planning and prospective memory.

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Older adults perform worse than young on laboratory based measures of planning and prospective memory (PM) . In contrast, there is either no age effect or indeed an age-related benefit in performance in PM and planning measures which have higher levels of ecological validity. In this paper I will outline results from three recent studies. Study 1 (N = 40) revealed that despite declines in executive functioning, middle-aged adults have intact errand planning in real settings. No evidence of age-related decline in the ability to schedule or execute a plan of action were found when this was tested in a real shopping centre. However, no data was collected in that study on the effects of age on lab-based measures of planning. Study 2 (N = 78) investigated aging effects on both abstract and more ecologically valid measures of planning ability. Older adults performed worse on the novel planning measure (the Tower of London task), but there was no age effect on a more realistic Plan-A-Day task. However, the abstract and realistic planning tasks differed on many dimensions, making it difficult to conclude which factors were critical in the pattern of age effects. In Study 3 (N = 104) planning tasks were designed which were matched for difficulty and structure. The only difference between the planning tasks was that one involved more familiar and ecologically valid materials while the other did not. Results indicated that age differences were only found on the abstract planning task, with no age effects where more naturalistic materials were used. Further, there was evidence to indicate that older adults may be able to compensate for some aspects of cognitive decline by focussing on the most salient information in realistic planning tasks. These studies will be discussed in relation to recent meta-analytic evidence of similar-sized age benefits in naturalistic PM tasks and age deficits in laboratory-based PM tasks. A number of explanations for this pattern of differential age effects on abstract versus naturalistic planning are considered, including motivational factors and compensatory mechanisms.

Why procrastination is not an efficient strategy

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Prospective memory entails that the intention to perform a task is delayed until it can be performed in an appropriate time and context. An important characteristic of the prospective task is that the intention is maintained concurrently with other tasks. One of the key theoretical issues in prospective memory is whether, or the extent to which, a prospective memory task necessitates strategic resources. In other words, what are the processes that distinguish a prospective memory task from a vigilance task? These experiments address this question by exploring the relationship between the prospective task and the ongoing tasks. Moreover, the intention to perform an action has been found to be maintained at a heightened and more sustained level of activation that facilitates the implementation of the intended task (Goschke & Kuhl, 1993, 2001). It is proposed that this facilitation may occur by attracting resources in order to increase the probability of enactment. The specific aim of these experiments is to investigate whether the maintenance of an intention entails a cost on secondary tasks. Previous research (d`Ydewalle, Luwel & Brunfaut, 1999; Marsh, Hancock & Hicks, 2002) indicates that increasing the demands of ongoing activities effects performance on the prospective task. However, the effect of maintaining an intention on ongoing activity has predominantly been overlooked (cf. Smith, 2003). The first experiment examines whether retaining an intention induces a cost on a secondary task. Importantly, the secondary task is not embedded within the PM task but occurs whilst the intention is being maintained. This allows us to ascertain that the cost, if present, is a result of the actual prospective component of the task. The results of the first experiment show that the presence of an intention tag facilitates memory for the intended task. However, this facilitation comes at a cost on the secondary task measured by an increase in response latency. In a second experiment, we extend these findings and explore the source of the cost effect. One hypothesis is that the observed cost occurs as a result of motoric preparatory processes that are activated and cause an incongruency effect between the intended action and the intervening actions. The second experiment tests this hypothesis by looking at latencies for items that are prospective but not motoric in nature. Under these conditions, the cost effect is still present but attenuated. These findings provide evidence that maintaining an intention to perform an activity at a later stage requires strategic resources that impinge on the performance of other secondary activities. Finally, further research is requires to explore whether the cost of superiority persists until implementation.

Measurement of prospective memory in traumatic brain injury

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Failures of prospective memory, or memory for intentions, are one of the most frequent sequelae of brain injury. Although interest in prospective memory has increased substantially in the last several years, there is no clinical assessment tool available to measure prospective memory performance after brain injury. We have developed a screening measure, the Memory for Intentions Screening Test (MIST). The test takes approximately thirty minutes to administer. It contains items that require a 2 minute or 10 minute delay. There are two different tasks to perform during the intervening delay, one that is more difficult than the other. The tasks are cued either by time (e.g., 'in two minutes please stop working') or by an event (e.g., 'when the tape stops, please turn it over and listen to the other side.') Responses are either verbal or an action. Scoring is available for a variety of error types, so that a differentiation can be made between true prospective memory errors and retrospective memory errors for the content of the task. Normative data is available for ages 18-70 on a sample of 500 subjects. There are four versions of the task to ease in retesting. The validity is high (compared to prospective items on the Rivermead Behavioral Memory Test) (.80) and measures of prospective memory in daily life (.92). Internal reliability mean Cronbach alpha of .87. Alternate form reliability between Form 1 and the other three forms is .85, .89, and .90 respectively. Data on 50 subjects with brain injury yields a number of important findings. Individuals with brain injury are perform significantly worse than control subjects only on prospective memory errors and not on the other error types. There is a significant interaction for response type x group such that individuals with brain injury do not show a superiority for action responses compared to verbal responses, but such an effect is demonstrated by control subjects. Not surprisingly, both groups are significantly better at event-based tasks than at time-based tasks.

Examining the pharmacology of prospective memory: Implications for psychological models

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Human memory and information processing is mediated neurochemically by activity in the cholinergic system. Cholinergic stimulation improves performance and cholinergic blockade impairs performance. Nicotine is a well-tolerated cholinergic agonist that has been shown to modulate working memory in healthy young volunteers. In a series of experiments, we explored the effects of nicotine on performance of a prospective memory task. We administered nicotine via smoking or via nicotine nasal spray, in the latter series, testing volunteers from both smoking and non-smoking populations. In the first three studies, we manipulated instructions, task, and task priority. The results are consistent with the view that relatively small changes in instruction and in task variables engage strategic processing in a prospective task. Employing both direct and indirect manipulations of strategic engagement, we demonstrated nicotine-induced enhancement of performance on the ProM task. In the second series of studies, we replicated the effects of nicotine on ProM performance in both smoking and non-smoking populations. In addition, we demonstrated that these effects are more likely to be mediated by nicotine's effects on attention than effects on enhanced encoding or recall of the delayed intention. The work has implications for models of prospective memory that refer to both automatic and strategic processes in the efficient execution of delayed intentions.

Prospective memory and implicit memory: the role of unaware processing on performance

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In recent years, prospective memory (PM) research has focused primarily on the nature of the processes involved in the execution of the planned intention (McDaniel,Einstein, 2000; McGann, Ellis, Milne, 2003). According to Einstein and McDaniel Multiprocess Framework Model, both strategic and automatic processes are activated in prospective memory behaviour. McGann et al. (2003), analysing the action of conceptual and perceptual processes in event-based tasks, have shown that both types of processes contribute to fully explained accurate PM performances. Although the results of these studies have helped shed light on the role of cues directly associated with planned intentions, this area of research has not cleared up the question of the role of cues that are not directly associated with the prospective task (which we can call 'goal free cues'); one possible exception is perhaps the recent contribution of Graf and Cuttler (2003), which analysed the role of perceptual context, semantic context, and environmental (physical) context in the PM performance (see also McDaniel et al., 1998, Exp. 2, in this regard). If we extend McDaniel and Einstein's (2000) proposal, we can hypothesise that if a 'goal free' cue interacts with the memory trace associated with the prospective intention, then the solicited memory system (which, in this case is associative, automatic, and involuntary) should rapidly bring to consciousness the information associated with a previously planned action (Guynn, McDaniel, Einstein, 2001) by means of spreading activation (Anderson, 1983). Thus, if it is true that the processes that are responsible for reactivating an intention are also perceptual in nature (Brandimonte, Bisiacchi, Pelizzon, 2000, Exp. 6; Graf , Cuttler, 2003; Marsh, Hicks, Hancock, 2000; McDaniel e Einstein, 2000; McDaniel, Robinson-Reigler, Einstein, 1998, Exp. 2; McGann et al., 2003), we can hypothesise that any perceptual element, which for some reason is associated with an intention during encoding, i.e., any element defining the 'perceptual context of the prospective action', can reactivate the intention itself, if re-presented (Moscovitch, 1994) at any time, from encoding to performance interval. The aim of our study was to verify wether and to what extent a visual stimulus presented at encoding and represented subliminally during the performance interval helps reactivate an intention. Sixty participants took part in the experiment. They had to execute a time-based task at the 20th min. from the beginning of a computer task, and were randomly assigned to three experimental conditions, namely: a) Primed (P) (the stimulus presented at encoding was subliminally re-presented six times during the performance interval); Not primed (NP) (during the performance interval was presented a different stimulus); Control (C) (no stimulus was presented during the performance interval). Results showed that participants in condition P performed better than participants in conditions NP and C, respectively. Our finding seems to indicate that implicit memory systems play an important role in reactivating intentions in time-based PM task.

Age-related changes in event-cued prospective memory proper vs. vigilance

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We rely upon prospective memory proper (ProMP) to bring back to awareness previously-formed plans and intentions at the right place and time, and to enable us to act upon those plans and intentions; ProMP is distinguished from other subdomains of ProM such as vigilance and habitual ProM. We investigated ProMP in a large sample of healthy adult participants ranging from 18 to 80 years of age. Each participant was tested on a battery of cognitive and neuropsychological tests including measures of processing speed, working memory, vigilance, ProMP, retrospective memory, and both crystallized and fluid intelligence, in two 90-minute sessions spaced one week apart. Our main results showed substantial age-related declines in ProMP but only minimal age-related declines in vigilance. Moreover, age-related declines in ProMP were not explained by age-related declines in RetM. We discuss the contribution of processing resources, working memory, and intelligence to performance on ProMP vs. vigilance.

Plans for success: improving prospective memory task performance

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Prospective memory (ProM) is the ability we use for making and carrying out future intentions and actions. Although much research has been directed at describing various aspects of ProM and how this ability varies between individuals and across the lifespan, very little prior research has examined strategies for improving performance on ProM tasks. Successful prospective remembering is dependent on many cognitive activities, one of which is planning. Planning includes the generation, selection and execution of various strategies. The current research examined the range of planning strategies that exist for ProM tasks, and the frequency and likelihood of their use. In a semi-structured interview setting, undergraduate psychology students (n = 24) were encouraged to talk about how they would plan to successfully perform a variety of time and event based ProM tasks. They were given 6 different ProM scenarios (e.g., a promise to pick up a friend at the airport at 11 pm Saturday night) and were asked to describe the strategies they would use to ensure that they would remember to do the task as promised. Responses were tape recorded and transcribed for data analysis. Analysis of the interview data revealed a number of unique strategies for supporting ProM tasks. The most important of these are strategies for time allocation, for organizing and collecting task-relevant resources, and for recording and remembering task-relevant information. Independent raters were used to establish scoring reliability.

Parkinson's disease and failures in everyday memory

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Selective attention deficits are frequently reported in Parkinson's disease (PD) and it has been suggested that these problems arise from impairments in inhibitory processes (e.g., Downes et al., 1993). PD patients are also impaired at internally generating information (Brown & Marsden, 1988), especially in the context of memory (e.g., Cooper et al., 1991), and have problems with executive functioning (e.g., Owen et al., 1992). Outside the laboratory setting, failure to inhibit irrelevant information may result in heightened distractibility, whilst problems with memory and executive functioning may lead to a more general susceptibility to everyday cognitive failures and memory lapses. Whilst there have been some anecdotal reports of an increased proneness to such problems in PD patients, no systematic investigation of this source of everyday error has been undertaken to date. To address this oversight, the self-report responses of a PD group on a battery of everyday memory questionnaires were compared to those of a group of healthy controls, matched for age and gender. In addition, the groups did not differ significantly on measures of IQ, working memory span, level of activity in daily living, and depression. All the participants were screened for dementia and were included in the analyses only if they scored in the normal range. The PD patients were selected at Hoehn and Yahr stage III or less (Hoehn & Yahr, 1967), with minimal on/off fluctuations and dyskinesias. They were tested under their normal dopaminergic medication regime, during a stable 'on' period. Several measures of working memory were administered and then the participants were asked to verbally report the frequency of occurrence of various types of cognitive error assessed by the Cognitive Failures Questionnaire (CFQ; Broadbent, Cooper, FitzGerald, & Parkes, 1982), the Everyday Memory Questionnaire (EMQ; Sunderland, Harris, & Baddeley, 1983) and a selection of questions (numbers 13-18) from the Everyday Attention Questionnaire (EAQ; Martin, 1986). The PD group scored significantly higher on both the CFQ and the EMQ, indicating that they were more prone to cognitive and memory failures than the control group overall. On the EAQ, the PD patients also rated themselves as being less able to do more than one thing at the same time and this difference was most pronounced when the concurrent tasks were deemed to be 'easy' rather than 'hard'. This finding is consistent with the idea that PD patients find it more difficult to carry out tasks that healthy controls are able to do automatically (Cooper & Shallice, 2000). However, the PD patients did not rate themselves as being any worse at general selective or divided attention than the controls. The implications for attentional accounts of PD are discussed.

Evaluation of MEMOS, an interactive memory aid system for brain injured patients: Personal Memory Assistant vs. palm organizer

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Introduction: MEMOS is an interactive memory aid system tailored to the special needs of brain injured patients. A portable Personal Memory Assistant (PMA) reminds patients of future intentions at the appropriate time. Online contact via mobile phone and internet between PMA and a service centre allows a caregiver to monitor patient's responses to the PMA and makes interactive guidance through activities possible. Critical aspects for the development of the system were derived from of our evaluation of two commercially available electronic aids (palm organizer, mobile phone; Thöne-Otto et al., 2003) and theoretical considerations on the basis of the model of prospective remembering by Kvavilashvili & Ellis (1996). The aim of this study was to compare the MEMOS-System with a commercial organizer (Palm) concerning their efficiency in improving performance on prospective memory tasks. Subjects: 13 subjects (11 males, 2 females) with a mean age of 46 years (Range 24 - 71 years) participated in the study. Patients suffered from different kinds of brain injuries. All patients were in a chronic state (time post injury range 9 months to 8 years) and reported difficulties in remembering future intentions. Procedure: The study based on an experimental AB-AC-A-Design. In a baseline condition (phase A, two weeks) patients had to carry out four experimental tasks each week (call a mailbox three times, send a letter) without an electronic memory aid. At the same time each patient was individually trained in handling one of the two devices. The order was counterbalanced across subjects. In the intervention condition (phase B) subjects used the electronic memory aid for three weeks and were reminded of executing the same experimental tasks. All experimental tasks, as well as private intentions of the patients, were entered into the devices during training sessions. At the end of Phase B, the memory aid was removed, followed by a break of minimally one week. Subsequently the same procedure was started with the second baseline and intervention condition (phases AC). The completion of the experimental tasks was monitored again for two weeks (Post-phase) after withdrawal of the second device. Results: The mean rate of experimental tasks successfully executed was 57% during baselines, 71% with the Palm, and 84% with the PMA. Improvement for the electronic memory aids compared to baseline was significant for the Palm ($p=.017$), as well as for the PMA ($p=.002$). In addition, performance with PMA was better than with Palm ($p=.041$). Asked for the preference, 8 subjects favored the PMA compared to 5 subjects, who preferred the palm. Conclusion: Performance on prospective memory tasks was significantly improved by using electronic memory aids. Improvement, as well as patients' satisfaction was higher when using the system MEMOS, which was especially tailored to brain injured patients' needs compared to a commercially available palm organizer. The results confirm the assumption that the consideration of the clients' needs is important for the success and acceptance of an electronic memory aid. Advantages and disadvantages of the devices will be discussed at the conference.

Benefits of contextual support on prospective memory under working memory load

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Contextual support and working memory load in two experiments were varied to determine the extent to which context can maintain prospective memory in attentionally demanding situations. In the first experiment a sentence verification task was used to vary the semantic context of the target cue from study-to-test. Changes in the semantic context of the target had a negative effect on prospective memory performance as expected. However, results indicated that a cue presented in a similar semantic context is uninfluenced by increased working memory demands. The aim of the second experiment was to replicate this benefit of contextual reinstatement using more ecologically valid stimuli. Using recall of items viewed in video footage of a library as the ongoing task stimuli, successful prospective memory retrieval of embedded target cues was only independent of working memory demand for participants familiar with the location. Findings are interpreted within the multiprocess framework, and appear consistent with the notion that familiarity with the context in which the target cues are likely to occur make the prospective memory task less vulnerable to disruption from withdrawal of resources. The result has significant real life implications.

Inattentional blindness and prospective memory: a useful hybrid experimental design?

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A critical issue in prospective memory (ProM) research concerns to what extent it is automatic or employs strategic attentional search processes (McDaniel & Einstein, 2000). Attentional need is inferred by the cost of completing the ProM task successfully while maintaining one or more ongoing working memory tasks. This issue of strategic or automatic cue detection is not apparent in inattentional blindness research. The term 'inattentional blindness' (IB) refers to the observation that our conscious viewing of visual scenes can completely fail to notice unexpected objects or events even when they traverse centrally fixated areas of the visual field (Mack & Rock, 1998). What makes the IB paradigm so interesting from a prospective memory (ProM) perspective is that the participant is not told about the 'unexpected' stimulus (the effect disappears when they do), and therefore does not allocate resources from the ongoing task to strategically search for the unexpected stimuli. Therefore, whenever the stimulus is noticed it is presumably an automatic process. If the IB paradigm could be adapted to incorporate a ProM component then this might offer an index of automatic cue detection exclusive of any conscious search processes. In this exploratory study, 160 participants took part in an adapted IB/ProM paradigm, which required them to watch a short video of two basketball teams and count how many ball passes the white team made to each other (see Simons & Chabris, 1999). Ongoing task demand was varied by asking participants to keep a silent mental count of the total number of passes made (Easy condition) or separate silent mental counts of the number of bounce and aerial passes made by the white team (Hard condition). Prior to the presentation of the short video film, all participants were given instructions to respond to a target cue in a second experiment after the basketball video. In the prime group, this target cue also appeared unexpectedly in the basketball video (woman with umbrella). Participants in the hard condition were more likely to notice this unexpected event if they had made an earlier intention to respond to that cue in the subsequent phase. These results suggest that visual information associated with an earlier intention has a lower threshold for attentional capture. This novel approach may offer an alternative to typical dual-task designs for specific areas where resource demands of cue detection are questioned (e.g., the recent discussion on the automaticity of task-appropriate processing (Marsh, Hicks, and Cook, 2005)).

Are conceptual confusions and faulty measurement leading ProM research astray?

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Prospective memory proper (ProMP) is required to bring back to awareness previously-formed plans and intentions at the right place and time, and to enable us to act upon those plans and intentions; ProMP is distinguished from other subdomains of prospective memory (ProM) such as vigilance/monitoring and habitual prospective memory. A quantitative review of over 200 age contrasts on various ProM measures in over 50 published studies revealed that both ProMP and vigilance show substantial declines with aging, that age-declines in ProMP are larger than in vigilance/monitoring, and that these age declines have been underestimated in previous studies due to methodological shortcomings such as ceiling-limited scores, age confounds in research design, and use of inappropriate effect size measures. These combined results highlight the need to recognize that ProM, like RetM, is composed of multiple subdomains, which must be properly distinguished to avoid literary confusion and theoretical quagmire. Moreover, these results underscore the urgent need to assign more resources to developing valid and reliable measures of ProM. Otherwise, the entire field risks becoming known for its most significant and reliable finding to date: the size of observed age declines on ProM tasks is directly related to the degree to which researchers are able to avoid ceiling effects, r-squared > .40, $p < 0.0001$.

Concurrent processing overlap between ongoing task and prospective memory task in young and old adults

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In this study we investigated whether the impact of a processing overlap between an ongoing task and a prospective memory task differs across age. We also investigated whether retrieval experience differed across age groups and experimental conditions. Processing overlap was manipulated by systematically varying type of ongoing task and type of prospective memory task. The prospective memory task was embedded in a simple decision task. A word pair was presented on a computer screen and the participants had to indicate which word named the bigger object (a semantic task) or which word contained more vowels (a perceptual task). The prospective memory task was to perform an action (notify the experimenter) when specific cues were presented. In one condition, the cues were objects bigger than a car (a semantic cue), in the other condition the cues were words containing three e's (perceptual cues). In all conditions, two prospective memory cues were presented. If the prospective memory cue was recognized, the participant was subsequently asked about his retrieval experience. Specifically we assessed whether the prospective memory task was performed as a consequence of an active search or whether it just popped into mind (i.e., 'search' vs. 'pop-up' experience). By combining the two ongoing tasks with the two prospective memory tasks, we created four conditions: semantic-semantic, perceptual-semantic, semantic-perceptual and perceptual-perceptual. In each condition 20 student participants and 20 older adults were tested. We expected higher test performance in the conditions with greater concurrent processing overlaps, that is, where the ongoing task and the prospective memory task required the same kind of processing (e.g., semantic-semantic, perceptual-perceptual) rather than different kinds of processing (e.g., perceptual-semantic, semantic-perceptual). Overall, the results confirmed this expectation. In addition, we found an age effect, but no age x overlap interaction. Interestingly, in the group of older adults, only few participants reported that the prospective memory task popped into their minds (< 10% in all conditions). Rather they reported to have actively searched for the prospective memory task; this pattern did not vary across experimental conditions. In contrast, in the group of young adults, prospective memory performance in the overlap conditions was accompanied by an increase in 'pop up' experiences. These results demonstrate the robustness of concurrent overlap effects across age. However, they also indicate that different mechanism may underlie overlap effects in older adults than in young adults.

Long-term usage of the interactive memory aid system MEMOS

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Introduction: MEMOS is an interactive memory aid system tailored to the special needs of brain injured patients. A portable Personal Memory Assistant (PMA) reminds patients of future intentions at the appropriate time. It can also be used as a mobile phone in order to send information about new tasks to a mailbox. The mailbox information is being entered into the system by the caregiver at the Service Centre (SC). The online contact between PMA and the SC via mobile phone and internet enables the caregiver to monitor the patient's responses, because the task execution always has to be confirmed by the client. This allows an interactive guidance through complex activities. Additionally, a data history of the PMA and SC activities can be used for a further analysis of the clients' reactions. The present study looks at long-term usage of MEMOS in two single cases and focuses on the following questions: - Do patients still use MEMOS six months after implementation? - Is there a difference over time in a) the number or b) the kind of activities, which are entered into the memory aid? - What happens, if MEMOS is partially withdrawn? - How much effort is required for the patients guidance by the caregiver? Subjects: Two male patients have been testing MEMOS since autumn of 2004. MS (35 years), with a history of traumatic brain injury, works at a garage and uses MEMOS to be reminded of different tasks on his job. HV (61 years) suffered a vascular insult and lives at home. He uses MEMOS to remind him of several tasks to do at home, as well as appointments such as visiting a physician or a physiotherapist. Procedure: The data histories of the two subjects were analyzed over a period of six months with respect to the number of successful tasks, the confirmation interval, and the type of entered tasks. Results: The mean percentage of successful tasks was 74% for MS and 88% for HV. In only a few weeks confirmation rate had to be dropped due to technical problems or in case of MS due to sickness and holidays. The number and kind of entered tasks was highly stable over time. This indicates that the patients accept the system. HV used the mail box to continually enter new tasks into his schedule, while MS only used the system for a fixed set of tasks defined during a task analysis at the beginning of the intervention. Conclusion: Once the memory aid system MEMOS has been successfully implemented, patients seem to get used to its regular support and they show a high acceptance over time. Online interaction between PMA and Service Center, as well as permanent data history, allow for the fast identification of critical situations or technical problems. The analysis of the data history offers detailed information about patients’ usage of the system. The time needed for support and supervision is minimal and limited to task entry and response check.

A study on the effect of distractor inhibition on the ProM retrieval

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In life, one of the important characters of most ProM tasks is to interrupt the onging tasks and activities. The inhibition mechanism is one of the crucial mechanisms of selective attention, and it is also directly related to cental executive system. The researches showed that the interrupt effect is low if the inhibition efficient is high. So, the study assumed that the inhibition mechanism affects the retrieval of ProM in the interferential conditions. The performance of high inhibition efficient participants will be better than low inhibition efficient participants. There are significant differences between them. The study was formed by two experiments. In the first experiment, 32 participants were selected from 80 college students with Stroop Program. Among them, 16 participants were chosen by percent 20 of top and low inhibition performances respectively. In the second experiment, the two groups will perform ProM task while undertaking ongoing tasks in two conditions. In the control condition, there are no interrupted tasks, and in the experimental condition, there being some interference tasks will disturb the performance.

The ProM of 4-6 years old children: ProM tasks and OT tasks load effects

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122 participants were chosen from the Kindergarten of Shanghai Normal University in the study, among them, 40 children are from Small class, 41 children are from Middle Class and the other 41 are from Big Class. The study adopted between-subjects design of 3 (small/middle/big class)x 2(ProM tasks load) x 2(OT load). The independent variances are ProM performance, Rt of ProM and RetroM performance. The materials included children basketballs and sticks. The experiment took dual tasks method. The ongoing tasks are that the participants verbally report the name of sticks on the basketballs, and the ProM tasks are, as soon as the participants see the target picture, not to verbally report, but throw the ball into a barrel. Analyzing the data of class factor, the results showed that the main effect of ProM performance, Rt of ProM and RetroM performance respectively, X2 = 17.17, (df=2, p<001 2-sided), F(2,100)=5.09, p<.001, F(2,119)=13.38, p<001. Took a multiple comparisons to evaluate the Rt of ProM with Post-hoc Scheffe tests. The results indicated that the differences are not significant between small and middle classes, t=.04, p>.05; the differences are significant between small and big classes, t=.65, p<.05; the differences are significant between middle and big classes, t=.69, p<.001, and the same method to be performed to evaluate the RetroM performance. The data displayed that the differences are significant between small and middle classes t=1.8, p<.001; the differences are significant between small and big classes t=1.90, p<.001; not significant between middle and big classes t=.10, p>.05. Besides, analyzed both the ProM and OT factors respectively, not found the main effects. Computed the between-subjects effects of RetroM and Rt of ProM performances, not detected the main effects, F(2, 119)=14.13, p<.001, F(2,100)=4.91, p<.001. Analyzed the between-subjects effects of 3x 2 x 2, discovered that the main effect of class, F(2,119)=13.72, p<.001 and not found any interaction. Besides, the data showed that the main effect of class of Rt F(2,100)=6.17, p<.001, moreover, the data displayed the significant interaction among class, ProM tasks and OT load F(2,100)=6.60, p<.001. Further analyzed the interaction among three factors, the data showed that there are significant interaction between the Rt of ProM tasks and OT load of middle and big class F(1,36)=6.79, p<.05, F(1,35)=7.47, p=.01. In the level of raised ProM task load, class effect is significant F(2, 46)=6.37, p<.001; and the interaction is significant too between class and OT load F(2,46)=4.51, p<.05; in the basic line level of ProM task load there isn`t any significant effect. In the basic line of OT load, the class effect is significant F(2, 49)=4.48, p<;.05; and the effect of ProM tasks load is significant F(1, 49)=5.15, p<;.05; the interaction between class and ProM tasks is significant F(2,49)=6.07, p<.001; besides, in the level of raised OT load, not found any significant effect.

Electrophysiological correlates of prospective memory

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The last decade has seen significant advances in our understanding of prospective memory. During this time a number of conceptual frameworks have been introduced into the literature that describe the cognitive processes underlying the realization of delayed intentions including the noticing plus search model, the automatic associative activation model, and the preparatory attentional processes and memory processes theory. Other work over the last several years has revealed some of the neural correlates associated with the various processes thought to support prospective memory. In this presentation I will review some of our recent findings wherein predictions derived from the various models of prospective memory have been used to examine the neural correlates of the encoding and realization of delayed intentions. One common feature of theories of prospective memory is that there are processes dedicated to the detection of event-based prospective memory cues when they are encountered in the environment. Evidence from a number of studies indicates that a phasic occipital-parietal negativity/medial frontal positivity (N300) is associated with the detection of prospective memory cues. The N300 differentiates prospective hits from prospective misses and is modulated by the working memory demands of the ongoing activity. These findings provide evidence for the idea that the recruitment of processing resources can facilitate the detection of prospective memory cues and do not support the idea that cue detection is relatively automatic. A second common feature of many theories of prospective memory is that processes similar to those that support recognition memory also facilitate the realization of delayed intentions. Consistent with this idea, data from a number of studies using ERPs reveals that prospective memory cues elicit an old-new effect over the parietal region of the scalp that is indistinguishable from that elicited by recognition hits. In addition, this work indicates that the old-new effect can be elicited by both prospective hits and misses indicating that in some instances an intention may be retrieved from memory but go unrealized. The realization of a delayed intention also elicits a positivity over the parietal region of the scalp that is more temporally extended than the old new effect. This modulation of the ERPs is not elicited by prospective misses, leading to the hypothesis that it may be associated with processes that serve to coordinate the prospective and ongoing components of the task once a cue is detected. Continuing work in this area of research is designed to further define the functional characteristics of the prospective positivity in order to gain a clear understanding of the exact processes that underlie the generation of the modulation of the ERPs.

Exploring the locus of a focal prospective memory deficit: A case study

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The present study was designed to examine the characteristics of what appears to be a focal prospective memory deficit in an individual with multiple sclerosis (MS). The study had two primary goals: 1) to examine the profile of the individual's psychometric, neuropsychological, and cognitive profile, 2) to examine the characteristics the prospective memory deficit across a variety of tasks. To examine the first goal the participant completed a number subtests from the WAIS-R, measures of episodic and autobiographical memory and executive functions, and a series of measures of prospective memory drawn from the literature. The psychometric, episodic memory and executive function measures revealed a profile that placed the individual at the upper range of the distribution for age-matched controls. The individual scored in the +90% percentile for measures from the WAIS (information, digit span, block design, arithmetic, digit symbol) revealing an exceptional level of general intelligence. On the list learning scale of the WMS the individual recalled 7/12 words of trial 1 and 12/12 word on trial 4 and recalled 11/12 words following a 30 minute delay. On the autobiographical memory interview the individual demonstrated extensive recall of episodic details from episodes sampled across the life span. Also, in a self-report measure of everyday retrospective memory failures the individual's data were nearly identical to those reported by age-matched subjects. Consistent with her performance on the tests of general intelligence and episodic memory the individual also demonstrated intact executive functions as assessed by the WCST and the conditional associative learning task. The individual also scored at the mean level of controls on the planning component of the complex prospective memory task. In contrast to her performance on the measures described in the previous paragraph the individual demonstrated a marked impairment on a variety of measures of prospective memory. On a self report measure of prospective memory errors the individual clearly difference from controls. In the breakfast task the individual's performance was intact relative to intact older adults when the prospective memory demands of the task were low (scenario's 1 and 2) and was impaired in scenario 3 where there is a significant prospective memory component to the task. The individual's poor performance on the breakfast task appears to have resulted from a failure to monitor the progress of meal preparation. Consistent with this finding the individual demonstrated a depressed level of monitoring in a time-based prospective memory task relative to what has been observed in prior studies for intact older adults. In the virtual week task the tended to be late on regular prospective cues more often than intact older adults (30% vs. 2%) and revealed a tendency to miss irregular prospective cues (60% vs. 38%). Together these data revealed a marked disruption of prospective memory in the presence of highly preserved general intelligence, episodic memory, and executive functions. A disruption of the frequency of monitoring for the appropriate time or occasion to realize an intention appears to be one significant source of the individual's prospective memory deficits.

The role of processing resources in prospective and retrospective memory within old age

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This study investigates the role of speed of processing and working memory in prospective and retrospective memory (i.e. free recall) performance within old age. The aim is to examine age-related differences in both memory systems within the age range of 65 to 80 years. Furthermore, following prominent theories on basic mechanisms of cognitive aging, speed and working memory are supposed to be involved in age-related prospective and retrospective memory performance. Particularly, as proposed by Craik (1986), we expected age effects and the influence of working memory to be higher for prospective memory than for free recall. The sample consists of 364 adults between the age of 65 to 80 years and was derived from wave 1 data of the Zurich Longitudinal Study on Aging (ZULU). Participants' prospective memory performance was assessed by two event-based single-tasks, free recall by a picture memory task and a word list task, working memory performance by three working memory span measures (operation span, reading span, counting span), and speed of processing by a digit-letter, a number comparison, and an identical pictures task. The results are in accordance with our hypotheses: Using structural equation modeling, age effects are found to be larger in prospective memory than in free recall. Furthermore, the influence of working memory shows a tendency of being higher for prospective memory than for free recall. The results are discussed within Craik's framework.

Prospective Memory in Emergency

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Background: Human error has become the main cause of most accidents and scientific evidence has suggested that stress will increase the rate of human error. In an emergency, the feeling of stress may have harmful effects on cognition and actions, which leads to higher error rate and more accidents. Through simulation of emergency, the knowledge and skill of emergency treatment can be mastered, but in the real emergent environment can this knowledge and skill be recalled effectively? In fact projects of emergency treatment have been established in most high-risk surroundings, therefore the successful retrieval of the memory becomes the key point. If in an emergency, those memorized projects can be recalled just like in the normal conditions, then many accidents caused by human errors will be prevented. To date, no research has explored the relationship between prospective memory - a type of memory for future events and emergency treatment. Prospective memory (PM) involves remembering to carry out specific tasks at some future point in time, typically without the use of some external aid. The present study therefore explored the new application of prospective memory in emergency treatment. Design: 2(fast vs. slow)x2(distracted vs. undistracted). Methods: The materials developed by ourselves were used to measure prospective memory. The procedure consisted of the ongoing task which required subjects to classify Chinese characters by structures and the prospective task which required the subjects to react to some typical Chinese characters. The speed of characters represented the level of stress. Calculating task was added up in the distracted group. Results and discussion: Overall, there are no significant effect of distraction but significant effect of speed, which means stress had significantly impaired the performance of prospective memory. But particular reduction was observed in the stress and distracted condition. These findings can be well explained by the retrieval mechanism of prospective memory. The retrieval of prospective memory involves dual-process: the strategic process which represents more conscious components and the automatic process which represents more unconscious components. The present study provides new insights into prospective memory application in emergency.

Age-related differences in prospective memory and the role of the prospective and the retrospective component

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The purpose of this study was to separately assess the speed, with which the prospective and the retrospective component of an event-based prospective memory task can be initiated across the life span. We used a paradigm that enabled the separate measurement of the speed with which the prospective and the retrospective component are initiated, and which enabled also to assess prospective memory performance. Such measures could prove to be more sensitive to age-related effects than conventional measures of success/failure. In addition, it is possible that the speed with which the prospective and the retrospective component of an intention can be initiated provides for insights into the underlying mechanisms of age effects in prospective memory across the life span. In this study we tested 40 kindergarten children, 40 young adults and 40 older adults. We found a significant difference in prospective memory performance between all three age groups, with higher performance for the young adults, compared to the children, who outperformed the older adults. In addition, an interaction between age and initiation speed for the prospective component and for the retrospective component materialized, which was expressed by significant age-related differences in the initiation speed for the retrospective component, but not for the prospective component. Moreover, a significant number of older adults failed to remember the contents of the retrospective component after having successfully initiated the prospective component. Thus, age-related decline in initiation speed and performance can be attributed particularly to the retrospective component. Our results also show an inverted u-curve for prospective memory across the lifespan - a finding similar to the lifespan trajectory of retrospective episodic memory.

Implementation intentions affect the prospective component but not the retrospective component of prospective memory

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Forming an implementation intention can facilitate the delayed realization of this intention. Typically an implementation intention involves the establishment of a highly specific 'if-then' rule in the form of 'if situation X occurs, I will perform Y'. It is assumed that forming such a rule leads to an increase in automatic processing, that is, a faster and more efficient implementation of the intention. However, it is not clear whether the performance benefit for implementation intentions is due to a more efficient triggering of the prospective memory task or due to a more efficient recall of the contents of the intention. In this study, we investigated whether forming an implementation intention - in contrast to simply forming a goal intention - influences the initiation speed of the prospective component or the retrieval speed of the retrospective component. In addition, in order to test whether the speed of these components can be influenced independently we manipulated the contents of implementation intentions by emphasizing either the fast initiation of the prospective component or the fast retrieval of the retrospective component. We tested a sample of 80 undergraduate students with a task that enables the separate measurement of the speed with which the prospective and the retrospective component of the intention are initiated which also allowed the assessment of conventional prospective memory performance. Results of prospective memory performance showed no benefit for the implementation intention groups compared to the goal intention group. However, forming an implementation intention resulted in faster initiation of the prospective component of the intention, whereas no such difference emerged for the retrospective component. Also, the two types of implementation intentions with focus on either the prospective component or the retrospective component showed no differences. These results indicate, that forming an implementation intention can speed up the realization of this intention. They also indicate that forming an implementation intention increases the readiness to respond to a prospective memory cue, but do not lead to a faster initiation of retrospective component of the prospective memory task even if the implementation intention emphasizes retrieval speed.

What do we know about neural and behavioral correlates of prospective memory in children?

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Prospective memory reflects the ability to form and later realize planned intentions. It is therefore mainly associated with executive functions such as planning, anticipation, self-initiation, and self-monitoring. It is well accepted that these components develop over time, with some aspects not maturing until late adolescence or even early adulthood. In fact, behavioral studies show an increase in the efficiency in prospective memory tasks from younger to older children. Nevertheless, only little is known about the involved neurophysiological processes. The purpose of the present study was to determine whether there is an age-related development in prospective memory performance across adolescence and to assess possible age-related differences in neural processing using EEG. The event-related prospective memory task used a retrieve-delay specification in which intention execution had to be additionally postponed after cue detection. This task was embedded in an ongoing activity using the semantic categorization task of West et al. (2003). Children (11-13 years) were compared to young adults (20 - 25 years). Behavioral data confirm age differences between the two groups, indicating better prospective memory performance with increasing age. Findings suggest furthermore that this poorer performance is at least partly due to an impairmed retrospective component of the prospective memory in children. Electrophysiological data show modulations of ERP-components, which could support age differences in the neural processes of intention formation and delayed retrieval.

The experiential basis for task appropriate processing in prospective memory

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In prospective memory a performance benefit may occur when the processing demands of the prospective memory task and the ongoing task in which the prospective memory task is embedded overlap sufficiently. Different hypotheses have been formulated as an explanation for this "task appropriate processing" effect. According to one hypothesis, the performance benefit is due to automatic processing, which is induced by the obligatory processing of the prospective memory cues. According to another hypothesis the performance benefit is due to strategic processing, which is a type of monitoring for the prospective memory cue. In this study the interplay between automatic and strategic processes was investigated by assessing the subjective experience of prospective remembering. Immediately after performing the prospective memory task participants were asked whether they performed the task because they were actively monitoring for the prospective memory cues or whether the prospective memory task just popped into their minds. The prospective memory task was embedded within a complex short-term memory task during which participants had to simultaneously process words and drawings of pictures. The prospective memory task consisted of describing a particular musical instrument, whenever an instance of a musical instrument was presented. Musical instruments were either presented as words or as pictures. When the instrument occurred as a picture we expected a performance benefit, since there is an overlap between the prospective memory task and the demands of the ongoing task. We also manipulated the attentional demands of the ongoing task by asking half of the participants to decide when there was a change between small and capital letters in the presented words. Our results revealed a transfer effect between the ongoing and prospective memory tasks, that is, a performance benefit when the processing demands of the prospective memory task and the ongoing task overlapped. However, the manipulation of the attentional demand had no significant effect on prospective memory performance. Yet, it had an impact on ongoing task performance: participants scored significantly higher in the ongoing task when there was no additional attention manipulation. The experiential reports revealed that the performance benefit in the task appropriate processing condition was due to an increase of both automatic (pop-up) and strategic (search) processes, independently of the attentional demands of the ongoing task.