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The Impact of Absolute Importance and Processing Overlaps on Prospective Memory Performance

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Summary: Prospective memory is the ability to remember an intention at an appropriate moment in the future. Prospective memory tasks can be more or less important. Previously, importance was manipulated by emphasizing the importance of the prospective memory task relative to the ongoing task it was embedded in. This resulted in better prospective memory performance but also ongoing task costs. In the present study, we simply instructed one group of participants that the prospective memory task was important (i.e., absolute importance instruction) and compared them with a group with relative importance instructions and a control group. The results showed that absolute importance leads to an increase in prospective memory performance without enhancing ongoing task costs, whereas relative importance resulted in both increased prospective memory performance and ongoing task costs. Thus, prospective memory can be enhanced without ongoing task costs, which is particularly crucial for safety-work contexts. Copyright © 2015 John Wiley & Sons, Ltd.

Prospective memory (ProM) is the ability to plan and carry out an intention in the future. In everyday life, a ProM task can be more or less important. Important intentions are often prioritized over an ongoing activity in order to be successfully remembered. However, sometimes, it is not possible to neglect the ongoing task even if the ProM task is important. In many safety-critical work contexts, it is crucial that adding a ProM task does not affect ongoing task performance. For example, a surgeon has to keep track of the surgery while remembering to remove the surgical instruments before finishing the surgery. Similarly, when preparing an airplane for takeoff, a pilot has to keep in mind to set the wing flaps into takeoff position, without allocating his cognitive resources to only this task (cf. Dismukes, 2012).

To investigate ProM in the laboratory, a ProM task is typically embedded in an *ongoing* task, and thus, processing requirements of the two tasks can either overlap or not. So far, task importance was mainly manipulated by emphasizing the importance of the ProM task relative to the ongoing task or vice versa (i.e., relative importance manipulation; cf. Kliegel, Martin, McDaniel, & Einstein, 2004; Walter & Meier, 2014). The results have shown that ProM performance can be increased by the manipulation of task importance, at least when the overlap of processing requirements was low. However, in most of these studies, the advantage of ProM task importance came at a cost in the ongoing task, indicating a change in resource allocation policies. In contrast, in the present study, we investigated whether simply instructing participants that the ProM task was important (i.e., an *absolute* importance manipulation) can enhance ProM performance without increasing the cost in the ongoing task. We compared performance with a control group who did not receive an importance instruction. We also tested a group with relative importance instructions in which the ProM task was emphasized relative to the ongoing task. We expected substantially higher ongoing task costs for the latter group compared with the other conditions.

In previous studies, importance enhanced ProM performance when the overlap between processing requirements of the ProM task and the ongoing task was low (cf. Einstein *et al*., 2005; Kliegel, Martin, McDaniel, & Einstein, 2001; Kliegel *et al*., 2004; Smith & Bayen, 2004). Einstein *et al*. (2005) suggested that in these conditions, resource allocation policies are changed, and *strategic monitoring* for target events is increased (Smith, 2003). In contrast, in situations where the overlap between processing requirements of the ProM task and the ongoing task is high, the intention may be retrieved *automatically* (cf. McDaniel & Einstein, 2000). However, in the latter situation, often performance was high from the beginning, and importance may not have affected performance because of ceiling effects.

Studies investigating the effect of relative importance on ProM and ongoing task performance support the assumptions about changes in resource allocation policies. For example, a study by Kliegel *et al*. (2004; Experiment 2) showed that the instruction to prioritize the ProM task over the ongoing task boosted ProM task performance but only when task processing overlaps were low. This increase was accompanied by monitoring costs in the ongoing task, suggesting a reallocation of attentional resources to the ProM task because of the relative importance manipulation.

However, Nowinski and Dismukes (2005) noted that in everyday life, there are situations in which strategic monitoring is not possible, specifically in situations where cognitive capacities are limited because of resource-taking ongoing tasks or when it is not possible to neglect or postpone an ongoing activity. This is consistent with the *associative-activation model* by Nowinski and Dismukes (2005), according to which a ProM task can be performed successfully without a change in resource allocation policy (see also McDaniel, Guynn, Einstein, & Breneiser, 2004).

In a similar vein, several metacognitive strategies may boost ProM performance without increasing monitoring costs. These include *implementation intentions* (e.g., Gollwitzer, 1999; Rummel, Einstein, & Rampey, 2012; Zimmermann

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& Meier, 2010), *performance predictions* (Meier, von Wartburg, Matter, Rothen, & Reber, 2011), and *imagery* (e.g., Brewer, Knight, Meeks, & Marsh, 2011). In particular, implementation intentions are supposed to call on automatic processes whenever a plan has to be linked to goal-directed responses (cf. Gollwitzer, 1999; McDaniel *et al*., 2004). Thus, there seem to be mechanisms that enhance ProM performance in absence of strategic monitoring. In light of these considerations, absolute importance may operate by similar mechanisms, and these mechanisms may enhance the ProM performance without increasing strategic monitoring (see also Einstein & McDaniel, 1996). Moreover, in contrast to relative importance, absolute importance does not explicitly prompt participants to prioritize the ProM task over the ongoing task.

So far, only one study (Einstein *et al*., 2005; Experiment 1) investigated the impact of absolute importance instruction and processing overlaps on ProM performance and ongoing task costs. Participants were prompted to perform a word-categorization task as ongoing task. Moreover, the ProM task was to press a designated key whenever one of several specific words (*high* task processing overlap condition) or a word with a specific syllable (*low* task processing overlap condition) occurred. Critically, half of the participants were instructed that it would be very important to find each of the ProM targets. Consequently, the importance instructions increased ProM performance, and also monitoring costs. In addition, the results showed an interaction between the importance manipulation and processing overlaps indicating that the performance benefit was higher in the *low* overlap condition. At first glance, these results seem to support that resource allocation policies were changed. However, the importance instruction used in this study explicitly pushed participants to find each and every ProM target, and it is very likely that this, in fact, induced strategic monitoring. Besides, ProM performance in the high overlap condition was probably at ceiling.

The aim of the present study was to investigate the influence of *absolute* importance on ProM performance and ongoing task costs. We also manipulated the processing overlap between the ongoing task and the ProM task in order to test the hypothesis that absolute importance increases performance even in low processing overlap conditions without increasing monitoring costs. We used a paradigm initially introduced by Meier and Graf (2000) in which the ProM task was embedded in a complex short-term memory (STM) task. In addition, during encoding, participants had to rate each word on either a semantic or a perceptual dimension. To manipulate processing overlaps, the ProM task was also manipulated such that it was defined either semantically or perceptually. The importance of the ProM task was varied by instructing one-third of the participants that remembering to perform the ProM task was very important (i.e., absolute importance instruction condition), while one-third of participants were informed that performing the ProM task would be more important than the ongoing task (i.e., relative importance instruction), and the last third of participants did not get any additional instructions (i.e., standard ProM instruction condition). We hypothesized that absolute importance enhances ProM performance without affecting attention allocation policies, whereas the instruction to prioritize the ProM task (i.e., relative importance instruction) would affect attention allocation policies, resulting in higher ongoing task costs.

METHOD

Participants

The participants were 240 young adults ($M_{age}=24.58$, $SD_{age}=5.29$; 182 women and 58 men). The experiment consisted of 12 between-subject conditions that were defined by crossing two ongoing task conditions (semantic and perceptual) with two ProM task conditions (semantic and perceptual) and three instruction conditions (standard, absolute importance, and relative importance). Each participant was randomly assigned to one of these conditions.[1]

Materials

A set of 126 concrete German nouns were selected from the CELEX database (Baayen, Piepenbrock, & Gulikers, 1995). These words were between six and seven letters long and had approximately the same word-class frequency (derived from http://wortschatz.uni-leipzig.de). Half of the words belonged to the category of fabricated things (e.g., cigar), whereas the other half referred to natural things (e.g., diamond). In addition, one-half of the words contained more than two letters with enclosed spaces (e.g., diamond), whereas the other half had two or less letters with enclosed spaces (e.g., cigar). Letters with enclosed spaces are *a*, *b*, *d*, *e*, *g*, *o*, *p*, and *q* for lowercase letters and *A*, *B*, *D*, *O*, *P*, *Q*, and *R* for uppercase letters (i.e., capital letter at the beginning of a German noun). These words were used for the series of activities listed in Figure 1. Twelve additional words were required as ProM targets. Six of these words were *animal* words (German words *Hamster*, *Schwan*, *Ameise*, *Leopard*, *Grille*, and *Papagei*) that were used as *semantic* ProM targets. The other six words included three *e*'s (German words *Gewebe*, *Gehege*, *Tiefsee*, *Weberei*, *Geleise*, and *Seeweg*) that were used as the *perceptual* ProM targets. The average word-class frequency was equal for both groups of ProM targets. All the words were presented in Arial font, in black color on a white background (Meier & Graf, 2000).

For the STM practice, three sets of four-, five-, six-, seven-, eight-, or nine-word lists were used, for a total of 18 lists. To create each list, words were randomly sampled from the pool of 126 nouns without replacement. For practicing the semantic and perceptual decision-making tasks, 80 words were randomly drawn from the initial pool. Sampling was without replacement. For practicing the combined STM and

[1] We thank two anonymous reviewers for the suggestion to include a relative importance instruction condition as a complement for the standard and the absolute importance condition. As a result, however, overall participants could not be assigned randomly to each experimental condition. Nevertheless, participants were also assigned randomly to the overlap conditions in the relative importance condition.

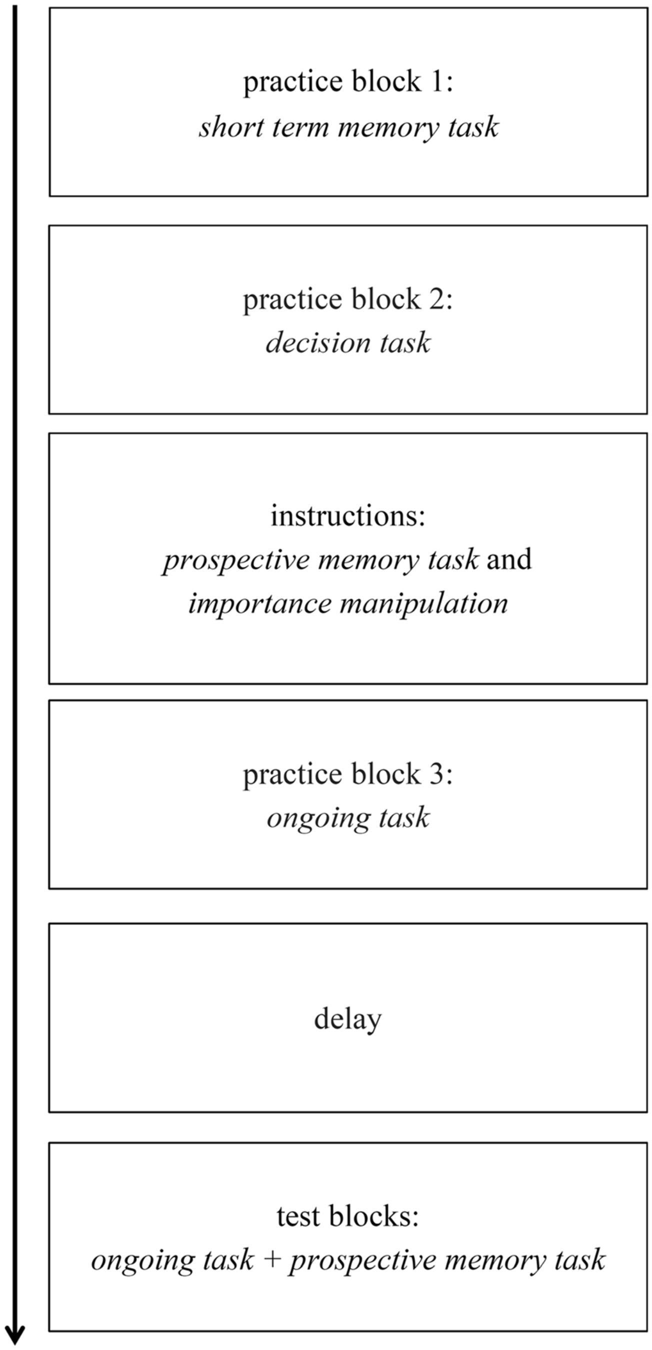

Figure 1. Sequence of practice and test blocks including prospective memory task and importance manipulation instructions

decision-making task, 39 words were randomly selected to create one four-, five-, six-, seven-, eight-, and nine-word list.

For the six test blocks, the words were again sampled from the initial pool, separately for blocks 1 and 2, 3, and 4 as well as 5 and 6. Thus, each word could not appear more than three times over the six test blocks. The number of yes/no responses was approximately equal for both the semantic and the perceptual decision task. The word order was fixed for each participant.

Each test block consisted of one four-, five-, six-, eight-, and nine-word list and two seven-word lists each. In one of these seven-word lists, the fifth word was replaced by a ProM target. ProM targets were randomly sampled without replacement and for each participant separately.

Procedure

Participants were tested individually. First, they were informed that the experiment involved a series of tasks to test their memory and their decision-making abilities. After giving consent, they were seated in front of a computer, and they were asked to perform a sequence of activities (Figure 1). Practice trials of the STM task and the decision task were used to familiarize participants with the experimental procedure; that is, they practiced both tasks separately before having to perform them concurrently.

The STM-task block consisted of 18 trials. On each trial, a different list was presented, one word at time, at a rate of one word per second. At the end of each list, participants were instructed to recall the words in any order. After 10 seconds, the instruction 'press spacebar for the next list' appeared on the monitor. Pressing the spacebar initiated the next trial. The four-word lists were used for the first three trials; the five-word lists were used for the next three trials, and so on, in order to expose participants to increasingly longer lists across trials.

The decision task block immediately followed the STM-task practice. Depending on experimental conditions, the instructions for the decision task were different. For the semantic task, participants were instructed to decide if a word referred to a fabricated or to a natural object. For the perceptual task, participants were instructed to decide if a word includes two or fewer enclosed spaces versus more than two enclosed spaces. They were instructed to work as fast and as accurate as possible. Responses were given by pressing a designated key (*b* or *m*; counterbalanced across participants), and each key-press initiated the display of the next word. The block consisted of one 80-word list that was shown once to each participant.

After the decision-task practice block, the ProM task and importance manipulation instructions were given. Participants were informed that they would now perform the STM task and decision task in combination. For the semantic ongoing task, they had to decide for each word whether it represented a natural or fabricated object, and after each list, they had to recall the words. For the perceptual ongoing task, they had to decide for each word whether it consisted of two of fewer versus more than two letters with enclosed spaces, and after each list, they had to recall the words. For the ProM task, half of the participants were instructed that they had to press the *A* key whenever an animal word was displayed (*semantic* ProM task). The other half of the participants were instructed that they had to press the *A* key whenever a word that included three *e*'s was displayed (*perceptual* ProM task). In each condition, they were instructed to press the *A* key at the end of the list in which they saw a target word, following the method used by Meier and Graf (2000). To exclude the possibility that STM task would interfere with remembering to press the *A* key, participants were not required to recall any lists that contained a ProM target (even though the recall instruction appeared at the end of every list). After pressing the *A* key, the instruction 'press spacebar for the next list' appeared on the screen. One-third of the participants in each condition received the absolute importance instructions. Specifically, they were informed that 'it is important to remember to press the *A* key whenever a critical word occurs (i.e., an animal or a word including three *e*'s)'. Another third of the participants received the relative importance instruction. Specifically, they were informed that 'it is more important to remember to press the *A* key whenever a critical word occurs (i.e., an animal or a word including three *e*'s) than to remember word of the STM task'. Finally, the last third of participant did not receive any additional instructions (i.e., standard instruction group). In all conditions, participants were asked to repeat the instructions in their own words.

For the phase with the combined STM and decision task, a total of 48 word lists arranged into 7 blocks were presented; the first block with six word lists and the remaining blocks with seven word lists. As practiced previously, participants made either semantic or perceptual decisions, and they had to recall each list when prompted to do so. The word lists were sampled pseudo-randomly. That is, each block had another wordlist order, but the different orders were the same for each participant.

Between the first and the remaining blocks, participants had to answer a paper/pencil questionnaire that lasted about 10 minutes. The purpose of this task was to create a filled retention interval before assessing ProM test performance (Einstein & McDaniel, 1990). After the questionnaire, participants returned to the computer for the remaining tasks. The ProM task was not mentioned again.

Finally, after finishing the experiment, participants were asked to rate the importance of the ongoing tasks and the ProM task. This rating was considered as a *manipulation check*. The whole experiment took approximately 1 hour.

Analysis

In order to ensure that the decision task was kept in the focus of the complex STM task, participants were excluded with below 75% ongoing decision task accuracy ($N = 1$ in the standard instruction, $N = 3$ in the absolute importance instruction, and $N = 3$ in the relative importance instruction group). For the main statistical analyses, we used analyses of variance (ANOVAs) with the factors ProM task (semantic and perceptual), ongoing task (semantic and perceptual), and instructions (standard, absolute importance, and relative importance). For decision task reaction times (RTs), correct responses were analyzed, and trials above or below 2.5 *SD* were excluded. An alpha level of 0.05 was used.

RESULTS

Prospective memory performance

Prospective memory test performance was calculated on the basis of correct ProM responses. A maximum of six correct ProM responses was possible, and proportion of correct responses was calculated for further analyses. For each ProM task, there was an overlap and a non-overlap condition (i.e., semantic–semantic and semantic–perceptual, and perceptual–perceptual and perceptual–semantic). ProM performance across conditions is shown in Figure 2. Overall, ProM performance was $M = 0.58$ ($SD = 0.34$), $M = 0.69$ ($SD = 0.29$), and $M = 0.68$ ($SD = 0.31$), for the standard instruction, absolute importance instruction, and relative importance instruction conditions, respectively. Thus, importance seemed to improve ProM performance. Moreover, ProM performance was $M = 0.77$ ($SD = 0.27$) and $M = 0.53$ ($SD = 0.33$), for high and low task processing overlap conditions, respectively, indicating an overlap effect.

A 2 × 2 × 3 ANOVA with the factors ProM task (semantic and perceptual), ongoing task (semantic and perceptual), and instructions (standard, absolute importance, and relative importance) showed a main effect of importance $F(2, 221) = 3.08$, $p < .05$, $\eta^2 = .02$. Post-hoc least significant difference (LSD) comparisons showed higher ProM performance for the absolute importance ($p < .05$) as well as for the relative importance group ($p < .05$) compared with the standard instruction group. There was also a main effect of ongoing

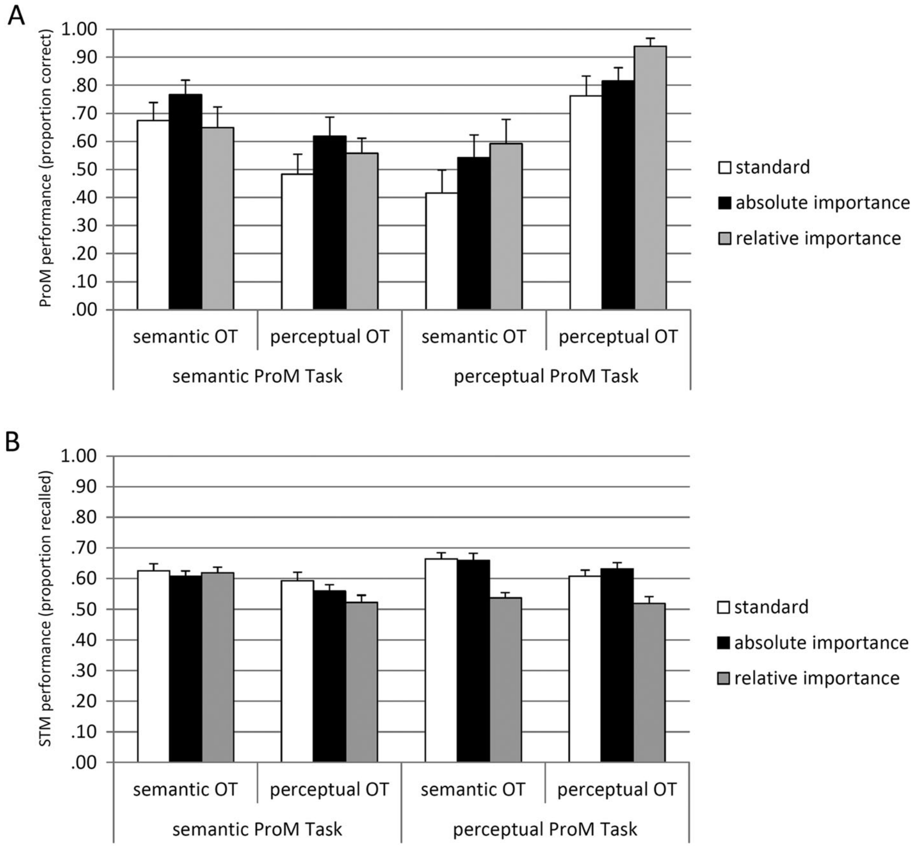

Figure 2. Prospective memory task (A) and STM task (B) performance across ProM task conditions (semantic and perceptual), ongoing task (OT) conditions (semantic and perceptual), and importance instructions. Bars are representing standard errors

task, $F(1,\ 221) = 5.35$, $p < .05$, $\eta^2 = .02$, indicating higher ProM performance for the perceptual decision task. As expected, the interaction between ProM task and ongoing task was significant, $F(1,\ 221) = 36.40$, $p < .001$, $\eta^2 = .13$, indicating higher performance in the high processing overlap conditions compared with the low processing overlap conditions. However, the triple interaction was not significant, $F(2, 221) = .23$, $p = 80$, indicating that the effect of importance was comparable across overlap conditions. No other main effect or interaction reached significance, $F\text{s} < 2.03$, $p\text{s} > .13$.

Ongoing task performance

Ongoing task performance was assessed separately for the STM task and the decision task. For analysis, we used the overall proportion of recalled words. Ongoing decision performance was assessed as accuracy and median RT. For all analyses, the seven-word lists including ProM targets as well as word lists with an incorrect ProM response were excluded.[2]

Short-term memory task

STM performance for each experimental condition and for each list length separately is presented in Table 1. Overall, proportion of STM performance was $M = 0.62$ ($SD = 0.10$), $M = 0.62$ ($SD = 0.10$), and $M = 0.55$ ($SD = 0.10$), for the standard instruction, absolute importance instruction, and relative importance instruction conditions, respectively. This suggests lower STM performance in the relative importance instruction condition. The overall proportion of STM performance was $M = 0.60$ ($SD = 0.10$) and $M = 0.59$ ($SD = 0.11$), for high and low task processing overlap conditions, respectively.

The $2 \times 2 \times 3$ ANOVA with the factors ProM task (semantic and perceptual), ongoing task (semantic and perceptual), and instructions (standard, absolute importance, and relative importance) showed a main effect of importance, $F(2,\ 221) = 14.08$, $p < .001$, $\eta^2 = .10$. Post-hoc LSD comparisons revealed lower STM performance in the relative importance compared with the standard instruction ($p < .001$) and compared with the absolute importance condition ($p < .001$). STM performance between the standard instruction and the absolute importance condition did not differ ($p = .63$). Moreover, there was a significant interaction between importance and ProM task, $F(2,\ 221) = 6.13$, $p < .01$, $\eta^2 = .04$. Further analyses of importance effects for each ProM task separately indicated a significant main effect of importance for the perceptual ProM task, $F(2,\ 112) = 19.76$, $p < .001$, $\eta^2 = .26$, but not for the semantic ProM task, $F(2,\ 115) = 1.47$, $p = .24$, $\eta^2 = .02$. Post-hoc LSD comparisons for the perceptual ProM task showed higher STM performance for the standard and absolute importance conditions compared with the relative importance condition ($p\text{s} < .001$). These results are depicted in Figure 2.

There was an additional main effect of ongoing task, $F(1,\ 221) = 14.40$, $p < .001$, $\eta^2 = .05$. That is, STM performance was higher in the semantic than in the perceptual

[2] Less than 1% of all word lists contained a wrong ProM response. These errors were mainly due to misidentified words, and thus, these results will not be further discussed.

Table 1. Short-term memory task performance for each word list length, decision task type, ProM task type, and importance manipulation conditions

		List length											
Decision task type		4 words		5 words		6 words		7 words		8 words		9 words	
Semantic ProM target	Importance condition	*M*	*SD*	*M*	*SD*	*M*	*SD*	*M*	*SD*	*M*	*SD*	*M*	*SD*
Semantic	Standard	0.86	(0.12)	0.70	(0.12)	0.63	(0.12)	0.62	(0.13)	0.49	(0.11)	0.44	(0.10)
	Absolute	0.85	(0.13)	0.69	(0.11)	0.62	(0.11)	0.59	(0.08)	0.47	(0.08)	0.43	(0.07)
	Relative	0.84	(0.09)	0.72	(0.12)	0.62	(0.10)	0.60	(0.12)	0.49	(0.10)	0.44	(0.09)
Perceptual	Standard	0.81	(0.14)	0.66	(0.17)	0.62	(0.16)	0.56	(0.16)	0.48	(0.12)	0.43	(0.10)
	Absolute	0.78	(0.15)	0.64	(0.08)	0.55	(0.11)	0.52	(0.08)	0.46	(0.09)	0.41	(0.09)
	Relative	0.77	(0.17)	0.60	(0.17)	0.51	(0.11)	0.48	(0.11)	0.40	(0.08)	0.37	(0.08)
Perceptual ProM target													
Semantic	Standard	0.94	(0.08)	0.76	(0.11)	0.68	(0.13)	0.59	(0.11)	0.53	(0.12)	0.49	(0.11)
	Absolute	0.90	(0.10)	0.77	(0.11)	0.68	(0.12)	0.60	(0.14)	0.53	(0.11)	0.48	(0.12)
	Relative	0.73	(0.12)	0.64	(0.09)	0.54	(0.09)	0.52	(0.07)	0.41	(0.06)	0.39	(0.06)
Perceptual	Standard	0.86	(0.11)	0.69	(0.11)	0.62	(0.12)	0.56	(0.10)	0.48	(0.09)	0.43	(0.08)
	Absolute	0.88	(0.13)	0.74	(0.12)	0.65	(0.10)	0.57	(0.10)	0.50	(0.10)	0.44	(0.08)
	Relative	0.72	(0.17)	0.60	(0.11)	0.51	(0.12)	0.49	(0.10)	0.41	(0.08)	0.38	(0.07)

Note. Standard deviations in parentheses.
ProM, prospective memory.

decision task. No other effect reached significance, $F\text{s} < 1.64$, $p\text{s} > .20$.

Decision task

Decision task performance for each experimental condition is presented in Table 2. For accuracy, the 2 × 2 × 3 ANOVA showed a significant effect of ProM task, $F(1, 221) = 7.89$, $p < .01$, $\eta^2 = .03$. That is, participants in the semantic ProM task were more accurate than participants in the perceptual ProM task. Moreover, there was a significant interaction between importance and ongoing task, $F(2, 221) = 6.53$, $p < .01$, $\eta^2 = .05$. Additional analyses for each ongoing task separately indicated a significant main effect of importance for the perceptual ongoing task, $F(2, 112) = 4.79$, $p < .05$, $\eta^2 = .08$, but not for the semantic ongoing task, $F(2, 115) = 1.93$, $p = .15$, $\eta^2 = .03$. Post-hoc LSD comparisons for the perceptual ongoing task showed higher decision task accuracy in the standard instruction and absolute importance condition compared with the relative importance group ($p\text{s} < .01$). No other main effect or interaction was significant, all $F\text{s} < 2.27$, $p\text{s} > .10$.

For RTs, the 2 × 2 × 3 ANOVA showed a main effect of ongoing task, $F(1, 221) = 119.94$, $p < .001$, $\eta^2 = .34$. That is, performance was slower for the perceptual than for the semantic decision task. No other effect reached significance, all $F\text{s} < 3.01$, $p\text{s} > .05$.[3]

Manipulation check

In order to confirm that importance instructions actually changed the perception of the importance of the ProM task, we asked participants at the end of the experiment to rate the importance of the ProM task and the ongoing task on a 5-point Likert scale (1 = *very important* to 5 = *not important at all*) after the experiment. In the high processing overlap conditions, the importance ratings of the ongoing and ProM task were $M = 2.62$ ($SD = 1.07$) and $M = 2.18$ ($SD = 1.17$) for the standard instruction group, $M = 2.28$ ($SD = 0.92$) and $M = 2.03$ ($SD = 0.99$) for the absolute importance group, and $M = 2.31$ ($SD = 1.17$) and $M = 1.60$ ($SD = 1.04$) for the relative importance group, respectively. In the low processing overlap conditions, the importance ratings of the ongoing and ProM task were $M = 2.43$ ($SD = 0.81$) and $M = 2.73$ ($SD = 1.22$) for the standard instruction group, $M = 2.55$ ($SD = 0.89$) and $M = 1.90$ ($SD = 0.95$) for the absolute importance group, and $M = 2.37$ ($SD = 1.08$) and $M = 1.90$ ($SD = 1.03$) for the relative importance group, respectively. A 2 × 2 × 3 ANOVA with task (ProM task or ongoing task) as a within-subject variable and overlap condition (high or low) and importance condition (standard, absolute, or relative importance) as a between-subject variable showed main effects of importance, $F(1, 227) = 7.89$, $p < .001$, $\eta^2 = .06$, and task, $F(2, 227) = 14.49$, $p < .001$, $\eta^2 = .06$. This indicates that overall, participants rated the ProM task as more important than the ongoing task. Post-hoc LSD comparisons additionally showed that the absolute and relative importance groups rated the tasks significantly more important than the participants in the standard instruction condition ($p < .05$ and $p < .001$, respectively). No other effect reached significance, $F\text{s} < 2.82$ and $p\text{s} > 06$.

DISCUSSION

The aim of the present study was to investigate the influence of *absolute* importance on ProM task and on ongoing task performance. We also manipulated the processing overlap between the ongoing task and the ProM task in order to test the consequences of importance in ongoing task performance for high and low task processing overlaps conditions.

[3] There was a marginal significant interaction between ProM task and importance ($F(2, 221) = 3.01$, $p = .05$). However, in this analysis, the RTs of both decision tasks (semantic and perceptual) are mixed. Two separate 2 × 3 ANOVA for each ongoing task showed neither a main effect of importance nor an interaction, $F\text{s} < 2.40$, $p\text{s} > .10$. Thus, the interaction between ProM task and importance is not further discussed.

Table 2. Ongoing decision task type accuracy and reaction times (in milliseconds) for ProM task type and importance manipulation conditions

	ProM task type	Decision task type	Importance condition: Standard M	Standard SD	Absolute M	Absolute SD	Relative M	Relative SD
Accuracy	Semantic	Semantic	0.94	(0.04)	0.93	(0.05)	0.94	(0.03)
		Perceptual	0.94	(0.03)	0.95	(0.03)	0.90	(0.04)
	Perceptual	Semantic	0.90	(0.07)	0.90	(0.05)	0.94	(0.04)
		Perceptual	0.92	(0.07)	0.92	(0.06)	0.90	(0.06)
RT	Semantic	Semantic	1524	(653)	1278	(373)	1237	(364)
		Perceptual	2573	(926)	2349	(819)	1991	(725)
	Perceptual	Semantic	1456	(569)	1276	(355)	1401	(333)
		Perceptual	2144	(619)	2208	(763)	2305	(668)

Note. Standard deviations in parentheses.
ProM, prospective memory.

Participants performed a complex ongoing STM task that included making a semantic or perceptual decision for each to-be-recalled word. For the ProM task, they were instructed to press a designated key either whenever a semantic target word occurred (i.e., an animal) or when a perceptual target word occurred (i.e., a word including three *e*'s). The results showed increased ProM performance when the task was important and under high processing overlap conditions. This replicated the results of the study by Meier and Graf (2000) concerning the effects of processing overlaps on ProM performance. Critically, the effect of importance was independent of the overlap conditions. Moreover, neither STM task nor decision task performance was affected by absolute importance instructions, but they were affected by relative importance instructions.

These results challenge the assumption that increasing importance always changes resource allocation policies and, as a consequence, causes a monitoring cost in ongoing task performance (e.g., McDaniel & Einstein, 2000). Rather, they suggest that the type of importance manipulation determines whether or not resource allocation policy is adjusted. Relative importance induces a change in resource allocation towards the ProM task rather than towards the ongoing task. This results in ongoing task costs. In contrast, for absolute importance, resource allocation for the ProM task and the ongoing task is balanced and does not lead to an increase in ongoing task costs. This is in line with many everyday life situations, which do not allow allocating attention because of resource limitations (cf. Nowinski & Dismukes, 2005). Specifically, in safety-work contexts such as aviation and medicine, it is necessary to keep track of the ongoing activity at no cost and keep the intention in mind at the same time (cf. Dismukes, 2012; Dismukes & Nowinski, 2007). Therefore, the effect of absolute importance in the present study is consistent with real-life observations.

The effect of absolute importance may be similar to *metacognitive strategies*. For example, implementation intentions are assumed to call on automatic processes whenever a plan has to be linked to goal-directed responses (cf. Gollwitzer, 1999). However, in order to obtain evidence that ProM task-context associations are increased for absolute importance, future studies are necessary. We acknowledge that a limitation of the present study may be that the relative importance condition was assessed after the initial data acquisition. This may have influenced the results. Specifically, it seems that relative importance improved ProM performance more in the perceptual ProM task, while absolute importance improved ProM performance more in the semantic ProM task (Figure 2), but the study lacked power to detect these differences statistically. It is possible that with a more homogeneous sample, the effect would have materialized. This may be addressed in a future study in which all conditions are administered at the same time.

To summarize, the present study shows that absolute importance improves ProM performance at no costs (cf. Meier & Rey-Mermet, 2012; Scullin, McDaniel, & Einstein, 2010; Walter & Meier, 2014). We suggest that absolute importance may induce similar mechanisms as some metacognitive strategies (cf. Brewer *et al*., 2011; Chelazzi, Perlato, Santandrea, & Della Libera, 2013; Gollwitzer, 1999; Marsh, Hicks, & Cook, 2006). The assumption of the two-routes approach of successful ProM performance additionally supports this suggestion (cf. McDaniel, LaMontagne, Beck, Scullin, & Braver, 2013). In conclusion, the results challenge the assumption that strategic monitoring is always necessary when an intention is important. Thus, different types of importance manipulations result in different routes to ProM retrieval. The implications are highly relevant for real-world contexts.

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