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Handedness differences observed in episodic memory retrieval do not extend to the domain of prospective memory

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ABSTRACT

A robust inconsistent handed advantage exists for episodic retrospective memory processes. The current study was undertaken to test whether this handedness difference extends to the domain of prospective memory (PM). Two studies, one based on a self-report measure (the Prospective and Retrospective Memory Questionnaire) and the second involving a performance-based test (Memory for Intentions Screening Test), were carried out. Handedness effects were absent for both measures of PM. The absence of a handedness effect strongly suggests that PM processes are primarily characterized by executing intentions that depend on semantic networks for retrieval and do not necessarily rely on recalling spatio-temporal context, as is the case with episodic retrospective memory.

1. Introduction

A large body of evidence shows a robust advantage in episodic memory retrieval for mixed/inconsistent-handers, relative to strong/consistent handers. For example, inconsistent-handedness is associated with superior recall of lab-based and real world-based memories (Chu, Abeare, & Bondy, 2012; Lyle, Hanaver-Torrez, Hackländer, & Edlin, 2012; Parker & Dagnall, 2010; Propper, Christman, & Phaneuf, 2005), superior source memory (Christman, Propper, & Dion, 2004; Lyle & Jacobs, 2010; Lyle, Logan, & Roediger, 2008; Lyle, McCabe, & Roediger, 2008), an increased tendency for recognition to be accompanied by recollection (as indexed by "Remember" judgments) vs. familiarity (as indexed by "Know" judgments) (Propper & Christman, 2004), an earlier offset of childhood amnesia (Christman, Propper, & Brown, 2006), superior incidental learning under conditions of deep, but not shallow, levels of processing (Alipour, Aerab-Sheybani, & Akhondy, 2012; Christman & Butler, 2011), superior memory for faces (Lyle & Orsborn, 2011), and superior memory for hand usage (Edlin, Carris, & Lyle, 2013).

These results have been interpreted in terms of the conjunction of two other findings. First, according to the hemispheric encoding and retrieval asymmetry model (HERA model; Babiloni et al., 2006; Tulving, Kapur, Craik, Moscovitch, & Houle, 1994), left vs. right frontal areas are primarily involved in the encoding vs. retrieval of episodic memories, thus implicating the role of the corpus callosum in the transfer of episodic memory information between hemispheres. Second, the corpus callosum is larger in inconsistent-handers, relative to consistent-handers (Luders et al., 2010; Witelson & Goldsmith, 1991). Thus, the superior performance of inconsistent-handers in episodic retrieval presumably reflects the greater interaction and transfer of information between the two hemispheres in inconsistent-handers.

Handedness differences in memory are obtained in retrospective memory paradigms, in which participants attempt to recall past events. A related form of episodic memory, called prospective memory, refers to the ability to remember "to perform previously planned actions at the right time, or within the right time interval or after a certain event takes place while being involved in other activities" (Groot, Wilson, Evans, & Watson, 2002, p. 645). Moreover, there is considerable overlap between the neural areas involved in both retrospective episodic and prospective memory (Martin et al., 2007; West & Krompinger, 2005), and prospective memory can be thought of as a type of episodic memory (Roediger, 1996). This raises the possibility that handedness differences observed for retrospective memory may extend to prospective memory.

Accordingly, Experiment 1 explores potential handedness differences in self-reported prospective memory, while Experiment 2 looks at potential handedness differences in a performance-based measure of prospective memory in young adults in the age group of 17–25 years. This strict age criterion was adopted following results that show changes in PM and the choice to use aids for better PM performance as a function of age (Cuttler & Graf, 2007;

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Long, Cameron, Karju, Lutz, & Means, 1999). Additionally, the current study is theorized on the rationale that handedness has its links to inter-hemispheric interaction, hence the involvement of the corpus callosum studies show a progressive decline in its myelination with increasing age (e.g., Hasan et al., 2009).

2. Experiment 1

2.1. Method

2.1.1. Participants

105 participants from an Introduction to Psychology course participated as part of another memory study in exchange of research credit towards their class. However, due to – incomplete questionnaire data ($n = 18$) and over aged participants whose age was over 3 *SD* from the mean ($n = 5$; 25–50 years), data from 82 participants (55 females, $M_{age} = 19.24$ years, $SD = 1.24$, range – 17–24 years) were included for the final analysis.

2.1.2. Materials

The Prospective and Retrospective Memory Questionnaire (PRMQ; Crawford, Smith, Maylor, Della Salla, & Logie, 2003) is a 16-item scale that was administered to obtain self-report data on minor memory mistakes experienced in daily life. The scale is composed of PM questions (e.g., do you forget appointments if not prompted by someone else or by a reminder such as calendar or diary?) and retrospective memory (RM) questions (e.g., Do you fail to recall things happened to you in the last few days?). Participants were asked to report the frequency of such cognitive failures on a Likert scale of 5 points (1 = never to 5 = very often) with higher scores reflecting increased difficulties in the memory domain.

The Edinburgh Handedness Inventory (EHI; Oldfield, 1971) is a 10-item scale that was administered to check for hand preference and to categorize participants on the basis of strength of handedness (consistent vs. inconsistent handers).

2.1.3. Procedure

PRMQ and EHI questionnaires were administered as filler tasks as part of another memory study. Degree of handedness was measured by administering the EHI and the median split method was performed on the absolute scores to obtain a cut off to divide the group into consistent- vs. inconsistent-handers (Propper et al., 2005). The EHI median score was 80, and all those who were above the median score were classified in the consistent-handed group ($n = 38$; $M_{EHI\,score} = 96.05$, $SD = 5.71$) and those with a score of 80 and below were classified in the inconsistent-handed group ($n = 44$; $M_{EHI\,score} = 57.84$, $SD = 18.69$).

2.2. Results and discussion

Separate 2 (handedness groups) by 2 (gender) between subjects' ANOVA was performed on the PM and RM scales and the total scores of the PRMQ; descriptive statistics are presented in Table 1. In terms of the PM scale, there were no significant main effects of handedness, gender and their interaction ($p > .1$). However, in the case of RM scale, there was a main effect of gender, $F(1,78) = 6.44$, $p = 0.01$, *partial* $\eta^2 = 0.08$. No significant main effect of handedness, or interaction effect between gender and handedness were present ($p > .1$) A 2×2 between subjects' ANOVA was attempted on the total scores of the PRMQ; The main effect of gender was present, $F(1,78) = 4.97$, $p = 0.03$, *partial* $\eta^2 = 0.06$.

Gender was a significant factor in self-report memory lapses, with females reporting significantly less RM memory lapses and nominally better PM recall in daily life as compared to males. Studies have not found gender differences in metamemory abilities (e.g., Hultsch, Hertzog, & Dixon, 1987; Ponds & Jolles, 1996), however there may be a female advantage in verbally recalling/being conscious of episodic memory performances from the past (Herlitz & Rehnman, 2008).

Results did not show main effects of handedness in PM or RM based on PRMQ, although a past study on the Everyday Memory Questionnaire showed consistent handers' reporting significantly more difficulties in monitoring tasks and conversations, factors that tap into absent mindedness and recall failures (Christman & Propper, 2008). In the current study, both consistent- and inconsistent-handed individuals in this study reported more or less similar frequency of PM lapses in daily life. It is worth noting that despite the robust evidence for handedness differences in actual episodic retrieval, there were no handedness differences in participants' self-reporting of their memory ability. This may reflect that fact that consistent-handers are more prone to the Dunning–Kruger effect, in which people overestimate their ability (and/or underestimate others' ability) on common tasks (Rose, Jasper, & Corser, 2012). Thus, consistent-handers may have overestimated their retrospective memory skills.

Owing to limitations of self-report data, a follow-up study was carried out to check for handedness differences in a performance-based PM task using the Memory for Intentions Screening Test (MIST; Raskin & Buckheit, 1998).

While there are several experimental and clinical tests available to measure PM, the MIST was used for the study for the following reasons. It is a standardized test that can be used for both healthy and patient samples to assess PM. The test incorporates not only the important PM based measures of time and event cues but also attributes such as responding in verbal or action modes, and the effect of delay from the time the intention is encoding until it is executed at the requested time point. Furthermore, it's an ecologically valid tool with instructions having strong relevance to daily life (Raskin, 2009). Finally, in addition to extending the handedness study in the PM domain, we also took this opportunity to extend handedness research into the clinical area.

3. Study 2

3.1. Method

3.1.1. Participants

159 participants from an Introduction to Psychology class participated in the study in exchange for research credit towards their class. However, 16 participants were excluded from the analyses

Table 1
Mean scores (*SD*) of the prospective memory scale of the PRMQ across handedness and gender groups.

PRMQ	Consistent handers		Inconsistent handers	
	Males $n = 11$	Females $n = 27$	Males $n = 16$	Females $n = 28$
Prospective memory	27.73 (3.32)	26.26 (5.21)	28.75 (4.75)	26.32 (5.28)
Retrospective memory	31.55 (4.63)	28.37 (3.51)	30.56 (4.05)	28.96 (4.03)
Total PRMQ scores	59.27 (7.00)	54.63 (8.04)	59.31 (8.38)	55.29 (8.60)