Examining what prestudy and immediate judgments of learning reveal about the bases of metamemory judgments

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A B S T R A C T

Across three experiments we examined the basis for participants’ judgments of learning (JOLs) – memory beliefs or fluency – by manipulating item relatedness and font size and collecting prestudy JOLs, immediate JOLs, or both types (combination) of JOLs. Experiment 3 also measured self-paced study time as an indirect measure of participants’ perceived fluency of items. All three experiments revealed higher prestudy, immediate, and combination JOLs for related, and large font items than for unrelated, or small font items. However, combination conditions suggested that prestudy and immediate JOLs are not identical. Prestudy and immediate JOLs differed both in terms of magnitude and accuracy, with higher magnitude and relative accuracy for immediate JOLs than prestudy JOLs in all three experiments, suggesting memory beliefs alone are not sufficient to accurately track memory performance. These results combine with the study time data in Experiment 3, which did not differ significantly as a function of font size, to suggest that memory beliefs influence both types of JOLs. However, as participants gained exposure to stimuli characteristics, immediate JOLs shifted more than prestudy JOLs, suggesting that the timing of immediate JOLs facilitates participants’ analysis of fluency and other item qualities that affect recall, which are then factored into participants’ immediate JOLs more so than pre-study JOLs.

Introduction

Learners engaged in self-regulated learning must assess the likelihood of being able to learn and recall the material they are studying (Metcalfe & Kornell, 2005). It is critical that these judgments are accurate given that these assessments likely affect future study decisions (Metcalfe & Finn, 2008; Nelson & Narens, 1990). Researchers frequently collect metamemory judgments to evaluate how accurately people are able to gauge their learning. Judgments of learning (JOLs) are one type of item-level judgment that measure participants’ confidence they will be able to recall a studied item (0 = no confidence and 100 = complete confidence).

JOLs are typically collected after participants study an item. If the JOLs are collected immediately after studying the item they are called immediate JOLs, whereas JOLs collected after all items have been studied are referred to as delayed JOLs (Dunlosky & Nelson, 1994; Nelson & Dunlosky, 1991). Recently, Castel (2008) introduced another type of JOL, a prestudy JOL, in which participants predict the likelihood of being able to learn and recall an item before studying it. That is, participants are provided information about the to-be-learned material, such as whether the material is semantically related or unrelated...
(e.g., the word pair you are about to study is related), and provide their JOL based on that information. Thus, unlike immediate JOLs which are thought to reflect a combination of how easily the item was processed (i.e., fluency; Alter & Oppenheimer, 2009; Begg et al., 1989; Koriat, Bjork, Sheffer, & Bar, 2004; Undorf & Erdfelder, 2015) and beliefs about memory (Koriat, 1997), prestudy JOLs are thought to be based solely on participants’ memory beliefs regarding how stimuli characteristics (e.g., relatedness) will affect their ability to learn the item (Mueller, Dunlosky, Tauber, & Rhodes, 2014; Mueller, Tauber, & Dunlosky, 2013). Given that there are various judgments that can be collected at different points in time, extensive research has been conducted to examine how various experimental manipulations influence these judgments.

**Experimental manipulations that influence JOLs**

A variety of manipulations have been found to influence JOLs. However, we focus on what the literature has revealed about the impact semantic relatedness and font size have on participants’ expectations and actual ability to recall material given that these manipulations are most relevant for the current study.

**Relatedness**

Ample empirical evidence supports the notion that participants perceive semantically related words as easier to learn than unrelated words (Arbuckle & Cuddy, 1969; Castel, McCabe, & Roediger, 2007; Dunlosky & Matvey, 2001; Koriat & Bjork, 2005, 2006; Mueller, Dunlosky, & Tauber, 2015; Rhodes & Castel, 2008; Undorf & Erdfelder, 2015). Mueller et al. (2013) reviewed a number of studies in which immediate JOLs were collected after participants studied related and unrelated items. Across all the experiments they reviewed, younger and older adults consistently gave higher JOLs for related items than unrelated items. Unlike other cues that influence JOLs without affecting memory, relatedness is diagnostic of the likelihood of being able to recall an item; related items are in fact more memorable than unrelated items (Dunlosky & Matvey, 2001; Dunlosky & Schwartz, 2006). Thus, JOLs often align with actual recall for related and unrelated words (cf., Koriat & Bjork, 2005, 2006).

**Font size**

A less frequently examined manipulation is that of font size. Across a number of experiments Rhodes and Castel (2008) found that participants gave higher JOLs to words presented in large (48 point) font than to words presented in small (18 point) font. These differences in JOLs for the two font sizes held even when participants were explicitly told that font size would not impact the likelihood of recalling items. Exposure to two study-test blocks also did not eliminate the differences in participants’ JOLs. Rhodes and Castel did find that using both semantically related and unrelated pairs presented in small and large fonts yielded a slight reduction in JOLs as a function of font size (Experiment 3). However, even then, font size continued to impact participants’ JOLs. Kornell, Rhodes, Castel, and Tauber (2011), McDonough and Gallo (2012), Mueller et al. (2014), and Hu et al. (2015) also found differences in participants’ judgments for items presented in small and large fonts. These differences in JOLs are of interest because font size did not impact recall performance in these studies. This disconnect between participants’ expected (i.e., JOLs) and actual recall performance for items in small and large fonts is referred to as the **font size effect** (e.g., Rhodes & Castel, 2008).

In sum, the cited studies indicate that participants predict that they will be more likely to remember related items and those presented in large fonts than unrelated items and those in small fonts. However, unlike item relatedness, which does facilitate recall, font size has no demonstrated impact on recall, despite having significant influence on JOLs. This indicates that the cues participants attend to when providing JOLs may not always be accurate indicators of later recall performance.

**Proposed mechanisms**

Researchers have proposed two mechanisms to account for why participants give higher JOLs to related items and those in large fonts than to unrelated items or those in small fonts – fluency (Kornell et al., 2011; Rhodes & Castel, 2008; Undorf & Erdfelder, 2015) and memory beliefs (Dunlosky, Mueller, & Tauber, 2014; Hu et al., 2015; Mueller et al., 2013, 2014, 2015). Fluency and memory beliefs have also been referred to as nonanalytic and analytic processes, respectively (Kelley & Jacoby, 1996; Matvey, Dunlosky, & Guttentag, 2001), given that each draws on different types of information.

**Fluency**

Perceptual fluency is the degree of ease or difficulty one has processing information during encoding (Alter & Oppenheimer, 2009; Begg et al., 1989; Oppenheimer, 2008). Whittlesea and Williams (1998; see also Whittlesea & Leboe, 2003) suggest that perceptions of fluency may be driven either by processing speed (i.e., absolute fluency) or by the extent to which expected ease and perceived ease of processing differ (i.e., relative fluency). Thus, material that is processed quickly or more easily than expected will be perceived as more fluent; material that takes longer to process or that proves more challenging to process than expected will be perceived as less fluent (i.e., disfluent).

Undorf and Erdfelder’s (2015) view of fluency is more consistent with the latter, that is Whittlesea and Leboe’s discrepancy account for fluency, given that Undorf and Erdfelder have shown that study time can mediate effects of manipulations on participants’ JOLs. This suggests that learners consider whether items were processed faster or slower during encoding and incorporate this information when providing JOLs. In contrast, Mueller et al.’s (2015) view of fluency is more consistent with the processing speed component of Whittlesea and Leboe’s views of fluency, given that they discuss fluency in terms of absolute time differences. Koriat et al. (2004), bring together both views by proposing that “JOLs are based predominantly—perhaps exclusively—on the subjective experience associ-
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