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Exploring the intrinsic-extrinsic distinction in prospective metamemory

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ABSTRACT

The overwhelming majority of research on metamemory examines retrospective memory – memory for past events. The metamemory of prospective memory – remembering to carry out intentions in the future – is little studied. The cue utilization account is a prominent framework for analyzing retrospective metamemory, here applied to prospective metamemory. This framework predicts that intrinsic cues (e.g., characteristics of the to-be-remembered information) readily impact metamemory whereas extrinsic cues (e.g., features of the general learning environment) have much less impact. The current study examined prospective memory using target-response word pairs. Participants were to remember to interrupt an ongoing task when a target was noticed, and then recall the associated response. Prior to the ongoing task, participants predicted (using judgments-of-learning, JOLs) whether they would notice a given target and whether they would recall the response for that target. This paradigm allows an assessment of metamemory and actual memory for the prospective component (the noticing of the target) and the retrospective component (the retrieval of the response). Four experiments found that prospective-JOLs were affected by an intrinsic cue (target-word association) but not by an extrinsic cue (target focality), as predicted by the cue-utilization account. The same results were found for the retrospective-JOLs. The results provide initial evidence that the cue-utilization framework generalizes to prospective metamemory. These results also revealed two complementary metamemorial illusions: target-response association impacts prospective-JOLs but not actual prospective memory performance, and target focality fails to impact prospective-JOLs but does affect actual prospective memory. This indicates that prospective metamemory may be subject to illusions in ways similar to retrospective metamemory.

Introduction

The study of metamemory examines people's awareness and understanding of their own memory and learning. One goal of this research is to learn how people predict their memory performance, usually when they first encounter to-be-learned material. Therefore, a typical experiment in metamemory has participants learn items one at a time in preparation for a later test. For example, upon studying an item, participants provide a 0–100 confidence rating, known as a judgment of learning (JOL), regarding how likely they are to remember that item later. Eventually, participants complete the memory test, and actual performance can be compared with predicted performance in a variety of ways.

Over the past couple of decades, researchers have learned what types of information, or cues, influence people's predictions (for reviews, see Bjork, Dunlosky, & Kornell, 2013; Schwartz & Efklides, 2012). To do this, researchers often include manipulations that affect actual memory performance to see whether people's JOLs are sensitive to that manipulation. Alternatively, researchers may explore cues that affect metamemory but not actual memory. In his cue-utilization framework, Koriat (1997) outlined different categories of cues that people may use when making JOLs. The framework differentiates between intrinsic cues, extrinsic cues, and mnemonic cues. Intrinsic cues are cues that are contained within the study items, such as the relation between items in a word pair. Extrinsic cues are conditions of the broader learning context, such as the interval between the study and test phases of an experiment. Mnemonic cues are the subjective feelings that people experience during studying, such as feelings of ease of processing.

One proposal of Koriat's (1997) framework is that intrinsic cues, which tend to be the focus of current processing when participants make their JOLs, will influence JOLs more readily than will extrinsic cues. A prominent example of insensitivity to extrinsic cues came from a study by Koriat, Bjork, Sheffer, and Bar (2004). These researchers had participants study word pairs that would be tested at varying retention intervals. In one experiment, participants were told they would be tested either immediately, one day later, or one week later. Participants studied the items, made a JOL for each one, and eventually took the

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memory test. As expected, recall performance decreased dramatically with increasing retention interval but interestingly, participants' JOLs were remarkably stable. Subsequent experiments revealed that participants displayed some sensitivity to retention interval when it was manipulated within subjects but the effect of retention interval on actual recall remained much greater.

Although the framework has received some criticism (e.g., Dunlosky & Matvey, 2001), research has generally supported it and the pattern regarding intrinsic and extrinsic cues. Participants' metamemory has shown to be either insensitive or under-sensitive to various manipulations of the learning conditions (e.g., Carroll, Nelson, & Kirwan, 1997; Castel, 2008; Kornell & Bjork, 2009; Susser, Mulligan, & Besken, 2013) while metamemorial predictions are typically very reliant on information inherent to the items being studied (e.g., Li, Jia, Li, & Li, 2016; Mueller, Tauber, & Dunlosky, 2013). For example, Susser et al. (2013) found that participants' JOLs were not influenced by the mixed vs. pure structure of the study list (an extrinsic cue) but they generally were influenced by perceptual characteristics of the items (intrinsic cues).

The vast majority of metamemory research, and all of the examples discussed above, focused on retrospective memory, or memory for events experienced in the past. That is, in these experiments, participants study a list of items knowing that they will eventually have to retrieve or recognize those items on a later test. In such experiments, the experimenter puts the participants in a "retrieval mode" during which they are directed to think back to recover information about a prior event.

An alternative application of memory, however, is prospective memory, which entails remembering to carry out an action in the future (see McDaniel & Einstein, 2007a). In these situations we need to remember to remember. Examples of prospective memory are prevalent in our day-to-day lives. We may have to remember to pass a message to a friend, to attend a departmental meeting, or to return a book to the library (e.g., Crovitz & Daniel, 1984). In these situations, we first must become aware *that something* has to be done (that we need to interact with our friend), and then we can retrieve what that something is (pass the message). Therefore, fulfilling prospective memory intentions requires remembering two pieces of information: (1) that an intention needs to be completed (at the appropriate place and time), and (2) the contents of the intention. The former is considered to be the actual prospective component of the intentions while the latter is the retrospective component akin to a cued-recall situation.

To study prospective memory in the laboratory, researchers typically use a paradigm developed by Einstein and McDaniel (1990). The main component of this paradigm has participants engaged in an ongoing task. This task represents the ongoing demands of everyday activity that may compete with our ability to remember to carry out prospective memory intentions. As examples of ongoing tasks, participants may rate the pleasantness of a series of words, or be asked to categorize letter strings as words or non-words. However, earlier in the experiment, participants are instructed to complete an action that will occur during that ongoing task. They may have to press a key when they encounter a particular word (i.e., the target word). During the ongoing task, the target word(s) is presented a certain number of times and performance is generally calculated as the number of times the action is completed out of the total number of target presentations. Researchers have uncovered a variety of factors – involving both features of intentions themselves and of ongoing tasks – that influence prospective memory success (e.g., Brandimonte & Passolunghi, 1994; Einstein et al., 2005; Hicks, Marsh, & Cook, 2005; Loft & Yeo, 2007).

Accompanying the many prospective memory demands we face are aids to help us remember. We may place an object by the front door, set a reminder on our calendar, or write a note on our hand. These tools give us more control over our prospective memory and allow us to ease the burden of what we have to remember. Yet, critically, one requirement for using these aids is knowledge that they are needed; if we are confident in our ability to remember to do something, we may not opt for any assistance. Indeed, as Meeks, Hicks, and Marsh (2007) note, "… at the time people form an intention they must decide concomitantly just how much environmental support they are going to need to actually accomplish the task" (p. 998; see also Gilbert, 2015). Therefore, it is important to understand how people think prospective memory operates.

Despite the ample research on monitoring and prediction with regard to retrospective memory, far less research has focused on the metamemory of prospective memory. This is surprising given the importance of prospective memory in our everyday lives and the interest in both theoretical and applied avenues of prospective memory research. Some studies have examined traditional metamemory manipulations from research on retrospective memory and adapted them to see if they produce similar results in prospective memory. For example, Schnitzspahn, Zeintl, Jäger, and Kliegel (2011) used a prospective memory design to explore two traditional JOL phenomena: the underconfidence-with-practice effect and the delayed-JOL effect. The underconfidence-with-practice effect is the finding that JOLs made on an initial study trial tend to be overconfident but then drift toward underconfidence across additional study-test trials (see Koriat, Sheffer, & Ma'ayan, 2002). The delayed-JOL effect is the finding that JOLs made at a delay are more accurate than JOLs made immediately after study (see Rhodes & Tauber, 2011). Schnitzspahn et al. found the delayed-JOL effect with prospective as well as retrospective memory, but only found the underconfidence-with-practice effect with retrospective memory. Other studies have examined characteristics that affect prospective memory performance itself to see if these factors influence predictions about prospective memory performance. For example, Meier, von Wartburg, Matter, Rothen, and Reber (2011) examined target specificity, which can influence actual prospective-memory performance, and found that it produced no effect on predictions about performance (see Meeks et al., 2007; Rummel, Kuhlmann, & Touron, 2013, for a similar strategy).

The small number of studies has produced important results (e.g., Knight, Harnett, & Titov, 2005; Meeks et al., 2007; Schnitzspahn et al., 2011), but have not been embedded in a systematic framework to understand how, exactly, people predict their prospective memory. Therefore, the current study applied a general metamemory framework to the study of prospective memory. We used Koriat's (1997) cue-utilization framework as a guide because it makes predictions about when cues should or should not influence metamemory. Specifically, intrinsic cues typically influence JOLs because they are the focus of processing when JOLs are made and are therefore accessible to the learner at that time (Castel, 2008). Extrinsic cues, in particular aspects of the learning environment, are generally less salient when predictions are made and thus less likely to influence JOLs. Consequently, an important goal of the study is to learn about prospective metamemory in terms of this general theoretical framework. Conversely, this inquiry will also allow us to learn about the applicability of the theoretical framework. The cue-utilization framework was developed (and has had substantial application) as a general theory of metamemorial monitoring and prediction. However, the framework rests almost entirely on research in retrospective metamemory. For the framework to be considered truly general, it should apply to other domains as well, including prospective memory.

To begin the application of the cue-utilization framework to prospective metamemory, we chose one intrinsic and one extrinsic cue. For the intrinsic cue, we chose the relation between the prospective memory target and the response that has to be made. Prospective memory performance is often superior when the target word and its response are semantically associated (referred to as related intentions; e.g., respond to "dog" by saying "food") compared to when the target and response are unrelated (e.g., respond to "dog" by saying "album"; Cohen, West, & Craik, 2001; Marsh, Hicks, Cook, Hansen, & Pallos, 2003; Pereira, Ellis, & Freeman, 2012; cf. Loft & Yeo, 2007). Target-response association has also been studied extensively in traditional