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Recognizing what matters: Value improves recognition by selectively enhancing recollection

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ABSTRACT

We examined the effects of value on recognition by assessing its contribution to recollection and familiarity. In three experiments, participants studied English words, each associated with a point-value they would earn for correct recognition, with the goal of maximizing their score. In Experiment 1, participants provided Remember/Know judgments. In Experiment 2 participants indicated whether items were recollected or if not, their degree of familiarity along a 6-point scale. In Experiment 3, recognition of words was accompanied by a test of memory for incidental details. Across all experiments, participants were more likely to recognize items with higher point-value. Furthermore, value appeared to primarily enhance recollection, as effects on familiarity were small and not consistent across experiments. Recollection of high-value items appears to be accompanied by fewer incidental details, suggesting that value increases focus on items at the expense of irrelevant information.

Introduction

In everyday life, we are bombarded with a wealth of information, and selectivity is necessary for efficient learning. For example, when studying for a test, a student typically has more course material available to them than they can possibly remember. To optimize test performance, they need to selectively learn the information that is the most important and most likely to be on the test, often at the expense of less important information. Time constraints, item difficulty, and the value of the material, often determine what is selected for learning (Ariel, Dunlosky, & Bailey, 2009). Much research has illustrated that value enhances the learning and recall of short free-recall and cued-recall word lists (Ariel et al., 2009; Castel, Benjamin, Craik, & Watkins, 2002; Castel, Murayama, Friedman, McGillivray, & Link, 2013). To examine value-selective learning, Castel et al. (2002) established the Value-Directed Remembering (VDR) design, wherein participants learn words associated with point-values, and earn those points for correct recall. These point-values were used to simulate some information being more important than other information. They found that although young adults can recall more words than older adults, both older and younger adults are equally able to selectively recall higher-value words (Castel et al., 2002; Castel et al., 2013). In these studies, participants experience the limitations of their ability to freely recall items through feedback on successive tests. Participants thus learn to differentially encode high-value items to maximize their performance.

When recognition memory is tested the need to differentially focus on high-value items would appear less critical due to the larger number of items one can typically recognize compared to recall after a single study of a presented list. For example, it has been shown that recognition memory for individual pictures after a single study

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is nearly limitless (Standing, 1973), while the ability to freely recall items after a single study opportunity is constrained by working memory capacity (Linderholm & van den Broek, 2002; Unsworth, 2007). In addition, recall also leads to substantial output interference (Roediger & Schmidt, 1980). As such, recalling unimportant information has a negative impact on the ability to recall high-value information, while recognizing unimportant information would likely have less impact on the ability to recognize a valuable item. Although there may be little pressure to differentially encode high- and low-value items for a recognition test, there is nevertheless evidence that high-value items are recognized better. For example, Adcock, Thangavel, Whitfield-Gabrieli, Knutson, and Gabrieli (2006) examined the role of value in a recognition task. In their study, participants were presented with 120 scenic pictures while in an fMRI scanner, each worth a high-value ($5), low-value ($0.10), or no value. Participants were told they would earn the corresponding amount of money for correct recognition at testing, and would lose some money for incorrect responses. The following day, higher-value scenes were recognized with both higher accuracy and higher confidence. The ventral tegmental area and nucleus accumbens pars compacta specifically exhibited memory-related activation during high-value reward cues, which is in line with a wide range of research supporting their involvement in reward processing and motivation (Carter, MacInnes, Huettel, & Adcock, 2009; Hyman, Malenka, & Nestler, 2006; Kalivas & Volkow, 2005; Weiland et al., 2014). The hippocampus also displayed memory-related activation both during the reward cue—perhaps in anticipation of important learning—and during scene encoding. This finding suggests that value may enhance later retrieval by supporting encoding that is associated with episodic binding, which has been associated with the hippocampus (Kragel & Polyn, 2015; Mitchell & Johnson, 2009; Simons & Spiers, 2003). The behavioral findings of Adcock et al. (2006) have been replicated in an older adult sample and an additional young adult sample (Spaniol, Schain, & Bowen, 2013). Overall, these studies suggest that value enhances recognition, and raise the question of how value affects the encoding process to support enhanced recognition.

Although much research has investigated the effect of value on later free recall, and some research has investigated its role in recognition, little research to date has investigated the role of value in shaping the quality of memory on a recognition task. A common distinction is made between *remembering* and *knowing* in the experience of recognition. Remembering entails being able to consciously recollect a previous experience or event, typically including the memory of various details related with this episode. Remembering includes awareness of one's existence in a previous experience or event, and is often like reliving the experience (Tulving, 1985). In contrast, knowing involves recognizing information without consciously recollecting the phenomenon or previous event. Knowing can most often be described as feelings of familiarity, without a conscious memory of the learning experience. Based on previous work suggesting greater hippocampal activation during encoding of high-value items (Adcock et al., 2006) it seems plausible that value would differentially enhance recollection, leading to more "Remember" responses, while feelings of familiarity may not be increased.

The subjective experiences of "Remembering" and "Knowing" are often described in the context of the dual-process theory, wherein memory is separated into recollection and familiarity processes. "Remembering" results when a recollection process is active, while a "Know" response results if only a familiarity process is active. By this view value could increase encoding leading to greater recollection and selectively greater "Remember" responses, or it could result in generally greater memory strength, leading to enhanced levels of both "Remember" and "Know" responses. By another view, "Remember" and "Know" responses reflect the application of different thresholds for recognition. According to Unequal Variance Signal Detection (UVSD) models (Dunn, 2004; Wixted & Mickes, 2010), recollection is not a separate process, but rather a higher level of memory strength. By this view, value might shift the strength of items in memory, leading to increases in old items that are recollected and judged familiar. Value could also change the shape of the distribution of old items, leading to a selective increase in those meeting threshold for a "Remember" response.

If valuable items are recognized better than low-value items, it suggests that encoding differs as a function of value. High-value cues may prompt further elaborative encoding of the target, which has been shown to result in later recollection (Fawcett, Lawrence, & Taylor, 2016; Gardiner, Gawlik, & Richardson-Klavehn, 1994). The involvement of the hippocampus during learning valuable items also suggests that encoding includes episodic binding (Adcock et al., 2006). However, because participants must study a large number of items for recognition tests, it was also plausible that they would instead primarily use less effortful maintenance rehearsal strategies, and that this rehearsal would increase for high-value items. Given this type of rehearsal supports increased familiarity (Fawcett et al., 2016; Gardiner et al., 1994), valuable items may show increases in familiarity as well as recollection.

In addition to differences in the subjective quality of the recognition of items, value could also affect the degree to which recognition is accompanied by memory for incidental details. It may be that if value enhances episodic binding of information during encoding, recognition of high-value items would be accompanied by incidental source memory. Another factor is the influence of value on attention during encoding. Items associated with high value have been shown to be subject to attentional capture (Anderson, Laurent, & Yantis, 2011), and this greater attentional focus could preclude the encoding of irrelevant details.

Experiment 1

In Experiment 1, the effect of value on recognition, recollection, and familiarity was measured using the Remember-Know task. This task relies on participants' introspection about the characteristics of their recognition