Free recall dynamics in value-directed remembering

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ABSTRACT

An emerging literature on value-directed remembering has shown that people are able to encode and remember information that is more important. Researchers operationalize importance by differentially assigning value to the memoranda that participants are asked to encode and remember. In the present investigation, a slightly altered value-directed-remembering paradigm was used to investigate how value modifies the dynamics of memory organization and search in free recall. In Experiment 1, free recall dynamics were compared between a control and a value condition. In Experiment 2, we manipulated the order of presentation of the values by adding an ascending and a descending condition where values were presented congruently or incongruently with the evolution of temporal context. Experiments 3 and 4 paralleled Experiments 1 and 2 respectively, with the addition of overt rehearsal and an unexpected memory test for the numbers/values. Overall, the results indicated that value-directed encoding has an influence on measures of delayed free recall encoding, organization, and search processes.

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Introduction

Humans encounter a vast amount of information on a daily basis that has no importance or bearing on their lives. Thus, the ability to select and successfully remember information that is more important, while simultaneously ignoring information that is less important is an essential cognitive ability. For example, students want to remember information that is important for an upcoming test, professionals want to remember information that is important for an upcoming meeting, and family members want to remember information that is important for them and the people they love. Why does our memory system prioritize and organize information and how does the importance of that information interact with this process? Recently, researchers have begun exploring the role of value on memory. The current project aims to extend our understanding of the relation between value and memory by exploring the dynamics of free recall.

Many studies have demonstrated that memory is sensitive to the value of information, either at encoding or retrieval. These findings include enhanced memory for information relating to one's self (Rogers, Kuiper, & Kirker, 1977; Symons & Johnson, 1997) as well as other people close to them (Rogers et al., 1977), enhanced memory for information relating to survival needs (Nairne, Thompson, & Pandeirada, 2007), and enhanced memory for mean-

ingful aspects of an event (e.g. Wanner, 1968). It therefore appears that individuals can flexibly assess the importance of information during encoding, and that this assessment influences what information is likely to be stored and ultimately retrieved. What remains unclear is how assessing the importance of information at encoding modifies the way individuals organize and search their memory during recall.

Free recall studies typically give participants the freedom to subjectively organize the encoding and retrieval of word lists into episodic memory (Tulving, 1962). Previous free recall research has failed to take into account the possibility that information value may guide the organizational principles at encoding and possibly influence search processes at retrieval. Employing mnemonic materials that are either inherently important (e.g. self-relevant) or are imbued with value is a necessary step for evaluating whether many principles of episodic memory hold up under more ecological conditions. Making memory research more ecologically representative will facilitate the development of theories that are based on a broader variety of mnemonic experiences and allow researchers to apply theoretical explanation at a higher-level of generality rather than at the level of individual tasks (Hintzman, 2011).

Value and memory

Human memory research suggests that motivation to remember, especially when it arises before rather than after the information is encoded (Loftus & Wickens, 1970; Naveh-Benjamin, Craik,

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Gavrilescu, & Anderson, 2000), allows people to attend and organize information in ways that facilitate storage in long-term memory (Kassam, Gilbert, Swencionis, & Wilson, 2009). One way of increasing motivation to remember is assigning importance values to the to-be-remembered items (Watkins & Bloom, 1999). While assigning importance values to options has been a central component in the decision making literature, especially in regards to choice behavior (Tversky, 1969, 1972), relatively little research has investigated the effects of importance on memory.

The majority of studies that have investigated the relation between memory and importance have implemented a value-directed remembering paradigm (VDR), a procedure developed by Watkins and Bloom (1999). In a typical VDR paradigm, participants are given a list of words to study for a later memory test. These words vary in importance values. The way to achieve this is to assign an importance "value" to each word (illustrated by a number next to the word; i.e., "Chicken 4"). Participants are instructed that, during a subsequent recall test, they will be awarded the associated point value of the words they are able to recall. The participants' goal is to maximize the points they accumulate through recall. A general finding from the studies that have used the VDR paradigm is that participants tend to remember the more important (higher-value) words significantly more than the less important (lower-value) words (Ariel, Dunlosky, & Bailey, 2009; Castel, 2008; Castel, Farb, & Craik, 2007; Castel, Rhodes, McCabe, Soderstrom, & Loaiza, 2012; Soderstrom & McCabe, 2011). Several other studies have provided additional insight regarding the relation between memory and importance (for instance see Bui, Friedman, McDonough, & Castel, 2013; Castel, 2008; Castel, Benjamin, Craik, & Watkins, 2002; Castel et al., 2012; Madan & Spetch, 2012)

Recent metamemory research provides a great illustration of how the study of value-directed remembering can allow us to generalize our understanding of memory processes across tasks. Until recently, most self-regulated study theories focused on the role of item difficulty in driving metacognitive control processes, with the majority of studies showing that participants allocate more study time on the most difficult items (Son & Metcalfe, 2000). Additional research has focused on the role of perceived item difficulty in study regulation, demonstrating that task constraints, like the amount of study-time available, will also influence study time allocation (Metcalfe & Kornell, 2003; Koriat, Ma'ayan, & Nussinson, 2006).

Most well-known theories regarding self-regulating study, base their predictions primarily on item difficulty. Ariel et al. (2009) utilized a variant of the VDR paradigm (using words of high and low value within a self-regulated study paradigm) to explore how value interacts with difficulty in the context of self-regulated study. Ariel et al. (2009) observed that participants spent more time studying higher-value word-pairs, and they chose to restudy higher-value word-pairs more often than lower-value words, regardless of item difficulty. Ariel et al. (2009) proposed that participants develop agendas that guide their study-time allocation decisions as well as their restudy decisions, thus supporting an agenda-based regulation of study-time allocation theory. In a more recent experiment, Soderstrom and McCabe (2011) replicated Ariel et al. and additionally demonstrated that participants provide higher judgments of learning (JOLs) for those higher-value word-pairs.

Two important points can be derived from this work. First, it appears that learners are able to exhibit some meta-awareness regarding encoding value. Second, utilizing such materials within the metacognitive framework allowed researchers to understand the processes of self-regulated study from a more fundamental perspective. Most importantly, it appears that the utilization of materials that differ in their value allowed metamemory researchers to develop a theory that compliments and extends all previous theories regarding self-regulated study by incorporating a motivational dimension that can interact with other well-established dimensions. The aim of the present investigation is to utilize such materials in the study of delayed free recall in order to investigate delayed free recall dynamics.

Recall dynamics in delayed free recall

Memory researchers have investigated the dynamics of delayed free recall for well over half a century to explore the organization and search of episodic memory (Kahana, 2012; Murdock, 1974; Tulving, 1968). In a delayed free recall paradigm participants are presented with several lists of words each in a random order. After participants study each list, they perform a brief distractor task and are then asked to retrieve as many words from the list as possible. Several systematic effects, that we now consider regularities of episodic memory search, have been established via examination of delayed free recall data (Kahana, 2012).

In Murdock (1962) reported his classic findings on the relation between serial position and recall probability. Participants exhibited superior memory for the items that appeared at the beginning (primacy effect) and the end (recency effect) of the study list, even though the recency effect is diminished in delayed free recall. The primacy effect spans the first three or four items of each list, while the recency effect spans over the last eight items. Moreover, Hogan (1975) and Laming (1999) showed that subjects initiate recall with one of the last items of the study list, even though this effect is also diminished in delayed free recall (Howard & Kahana, 1999). More specifically, Howard and Kahana (1999) showed that probability of first recall – which item in the list that a participant outputs at the beginning of recall - is higher for either the last word presented in the list (immediate free recall) or the first word presented in the list (delayed free recall).

Temporal contiguity during study also affects output dynamics at retrieval. Kahana (1996) demonstrated that participants tend to successfully recall items from nearby list positions, as seen by plotting the lag conditional-response probability functions based on recall output, which is a sharply decreasing function of lag. A lag conditional-response probability function shows the conditional probability of recalling an item from serial position i +/- lag immediately after recalling the item from serial position i. Positive values of lag correspond to forward recall transitions and these are generally stronger than negative values of lag that correspond to backward recall transitions (Kahana, 1996).

The present investigation

The present investigation aims to provide an enriched understanding of the episodic memory search processes operating under conditions in which some of the study information is considerably more important to remember than other information. Previous research, using a similar version of the delayed free recall paradigm, demonstrated that more important information is generally better remembered than less important information (Ariel et al., 2009; Castel, 2007, 2008; Soderstrom & McCabe, 2011; Castel et al., 2012). However, it is still an open question whether value-directed remembering manipulation eliminates, modulates, or leaves the dynamics of free recall unabated. Our primary goal was to gain further knowledge regarding the underlying memory search processes that drive this relation via the analysis of retrieval dynamics of free recall, order of recall and contiguity effects. In an additional two replication experiments, overt rehearsal and a