Mitigating the adverse effects of response deadline on recognition memory: Differential effects of semantic memory support on item and associative memory☆

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A B S T R A C T

Prior research indicates that the effects of response deadline on episodic memory retrieval may be selective. Accordingly, this paper examines whether response deadline causes differential impairments in item and associative memory. Further, it investigates and contrasts the role of two types of semantic memory support– item memory support (in the form of *meaningfulness* of items, Experiment 1) and associative memory support (in the form of *relatedness* between items, Experiment 2), in potentially alleviating these episodic memory impairments. Across two experiments, participants studied pairs composed of pictures (presented as brand logo graphics) and words (presented as brand names), and later were tested on the components (item recognition) or the association between the components (associative recognition) under either long or short response deadlines. The results demonstrate the differential effects of response deadline on recognition memory, with larger detriments caused in associative memory versus item memory. Furthermore, while meaningfulness of items attenuates the negative effects of response deadline on *item* (versus *associative*) recognition (Experiment 1), relatedness between items alleviates the adverse effects of response deadline on *associative* (versus *item*) recognition (Experiment 2), though this was not the case in a boundary condition in which related pairs were used as foils, posing greater demand on recollection processes. The results are interpreted to indicate that the attenuation of the negative effects of response deadline on recognition memory occurs in the type of episodic memory that receives greater semantic memory support.

Introduction

A vast number of memory decisions and judgments are made under speeded response scenarios, be it promptly responding to someone in a social setting or identifying objects under time pressure. Interestingly, prior research indicates that response deadline affects certain cognitive processes, systems, and tasks, while relatively sparing the others. For example, Campbell and Austin (2002) demonstrated that while solving simple arithmetic problems, when subjected to fast (vs. slow) response deadlines, participants reported increasing the use of direct retrieval strategies (which are more automatic) as opposed to procedural strategies (which are slower, more effortful), with this deadline effect amplified in the case of numerically larger problems. Also, Zakrzewski, Coutinho, Boomer, Church, and David (2014), used a task in which

participants had to categorize stimuli into perceptual categories, and found that uncertainty responses, i.e., responses in which a participant declined to respond to difficult or uncertain trials, were drastically reduced under speeded response compared to primary perceptual responses (i.e., sparse, middle, and dense categorization responses). This indicates that uncertainty responses may be metacognitive responses, dependent on slower controlled processes that may be vulnerable to response time constraints. Evidently, response deadline affects some processes and systems more than others.

In the context of episodic memory, the effects of response deadline can vary across recollection- and familiarity-based processes. Dual process models typically postulate that there are two processes—recollection and familiarity—that underlie recognition memory (Gardiner, 1988; Tulving, 1985; Yonelinas, 1994; Yonelinas, 2002).

Recollection is a conscious, attention demanding, and effortful process of remembering the target event and its details in a spatial–temporal context. Familiarity, on the other hand, is a relatively automatic process of knowing that one has encountered the stimulus item before, but without the memory of the encounter context (Jacoby, 1991; Yonelinas, 2002).

Studies have indicated that recollection and familiarity may be governed by distinctive functional and neuroanatomical mechanisms (though see Wixted & Mickes, 2010; and Wixted & Squire, 2010, in the context of Remember/Know judgments). One such distinction has been made with respect to the processing speed underlying the two processes, with some agreement that familiarity is a faster process than recollection (Atkinson & Juola, 1974; Jacoby, 1991; Mandler, 1980; Mandler & Boeck, 1974; but see Rotello & Zeng, 2008, for a recent analysis showing different results; Yonelinas & Jacoby, 1994). These and other researchers found that participants were more likely to rely on familiarity when subjected to a shorter response deadline, while, recollection, became increasingly influential with longer response deadlines.

Item and associative memory

One of the distinctions made in memory is between two types of episodic memory – item memory and associative memory (Humphreys, 1976; Humphreys & Bain, 1983; Murdock, 1974). *Item memory* refers to memory for single units of information, such as, the memory for a brand name (e.g., the word Jaguar) or the graphical element of a brand logo (e.g., the picture of a jumping Jaguar, the animal). *Associative memory*, on the other hand, is memory for the co-occurrence of two or more units of information in a prior event, e.g., memory for a brand name along with its corresponding brand logo graphic (Naveh-Benjamin, 2000). Several global memory models, which use computational approaches, suggest a distinction between items and associations between items (e.g., SAM, Gillund & Shiffrin, 1984; TODAM, Murdock, 1982). In addition, studies have shown that item and associative memory are different with respect to forgetting rates (Hockley, 1991; but see Weeks, Humphreys, & Hockley, 2007), the time course of retrieval (Gronlund & Ratcliff, 1989), the effects of different stimulus variables (Clark, 1992; Clark & Burchett, 1994), and of learning instructions (Hockley & Cristi, 1996), as well with respect to age-related trajectories (Naveh-Benjamin, 2000). They also seem to be underlined to a degree by different retrieval processes – familiarity and recollection, for item and associative information, respectively (Hockley & Consoli, 1999). Finally, and related to the topic of the current research, they seem to be affected differently by response deadline, as outlined below.

Differential effects of response deadline on item and associative recognition

Extant research suggests that response deadline may selectively cause larger detriments in associative recognition compared to item recognition. For accurate associative recognition, one needs to utilize effortful recollection of episodic information (Hockley & Consoli, 1999; Kelley & Wixted, 2001), which gets restrained by shorter response times. However, item recognition, which typically involves simpler discriminations between old and new items, can be based largely on familiarity processing (Hockley & Consoli, 1999), which remains relatively unaffected by response deadline.

Gronlund and Ratcliff (1989) used the response signal procedure (Dosher, 1976; Reed, 1973; Reed, 1976), in which recognition decision needed to be made within a experimenter specified time (response signal lags ranged from 100 to 2500 ms), to investigate the time course of recognition of associative memory and item memory. Their results indicated that item and associative information made separate contributions to recognition decisions, and that associative information was available much later than item information. Thus, when response deadline is shorter, associative memory is likely to be affected more

(see also, Light, Patterson, Chung, & Healy, 2004).

Based on the above, we expect that response deadline will cause larger detriments in associative recognition compared to item recognition. This expectation is based on the results, mentioned above, indicating that response deadline affects recollection-based processes more than familiarity-based processes (Atkinson & Juola, 1974; Jacoby, 1991; Mandler, 1980; Mandler & Boeck, 1974; Yonelinas, 2002), and that item recognition could potentially be served well by familiarity alone, whereas associative recognition is more reliant on recollection (Hockley & Consoli, 1999; Kelley & Wixted, 2001).

Semantic memory support

Pertinently, what is of interest to our current research is whether certain types of pre-learned information, based on semantic memory, may differentially alleviate the deleterious effects of response deadline on item and associative recognition. Analogous to the environmental support hypothesis (Craik, 1986), prior research has shown that relying on prior semantic knowledge or schemas (semantic memory support) within a domain can aid episodic encoding and retrieval of information, which in turn can improve memory performance (Castel, McGillivray, & Worden, 2013; Craik & Bosman, 1992; McGillivray & Castel, 2010; Umanath & Marsh, 2014). Chalmers and Humphreys found that familiarization frequency, i.e., frequency of presentation of the definitions of low and high-frequency words, improved item recognition (Chalmers & Humphreys, 1998) and associative recognition (Chalmers & Humphreys, 2003) of low-frequency words, but did not affect the recognition of high-frequency words. This increase in recognition discriminability could partly be attributable to better episodic memory of the low-frequency words because of the semantic support provided (i.e., definitions of words). Notwithstanding, semantic knowledge can sometimes hurt memory performance, especially in the context of false memory. For example, Underwood (1969) used a list learning paradigm and found that words that were related to presented words were falsely recognized. Similarly, Deese (1959) and Roediger and McDermott (1995) demonstrated that critical non-presented words (e.g. needle) were erroneously remembered as being studied when participants were presented a list of the associates of the critical word (e.g., thread, pin, eye, sewing, etc.). Seemingly, the effects of pre-learned information on memory performance seem to vary. In the current research, we investigated whether semantic memory support can attenuate episodic memory detriments caused by response deadline and whether these effects are differentially obtained for item and associative recognition. Further, we tried to reconcile discrepancies in prior research by investigating a boundary condition in which these attenuation effects were less likely (Experiment 2).

Prior research suggests that there are two types of semantic memory support, meaningfulness of items and relatedness between items (Mohanty, Naveh-Benjamin, & Ratneshwar, 2016). *Meaningfulness of an item* refers to the extent to which that item is known and represented in the semantic network of an individual (Anderson, 1983; Collins & Loftus, 1975; Collins & Quillian, 1969). *Relatedness between items*, however, represents an aggregate of the interconnections between specific items in a person's semantic network (Collins & Loftus, 1975).

This paper contrasts the effects of two types of semantic memory support– item memory support (in the form of *meaningfulness* of items), and associative memory support (in the form of *relatedness* between items), in potentially decreasing item and associative recognition impairments caused by response deadline. We propose that the two types of semantic memory support may help differentially the retrieval of item and associative information under response deadline. Informed by the transfer-appropriate processing framework (Morris, Bransford, & Franks, 1977), which predicts enhanced memory performance when the processing requirements at retrieval match those that were needed at encoding, one can postulate that people under response time constraints during retrieval will perform especially well if the type of