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# The value in rushing: Memory and selectivity when short on time

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ABSTRACT

While being short on time can certainly limit what one remembers, are there always such costs? The current study investigates the impact of time constraints on selective memory and the self-regulated study of valuable information. Participants studied lists of words ranging in value from 1–10 points, with the goal being to maximize their score during recall. Half of the participants studied these words at a constant presentation rate of either 1 s or 5 s. The other half of participants studied under both rates, either fast (1 s) during the first several lists and then slow (5 s) during later lists, or vice versa. Study was then self-paced during a final segment of lists for all participants to determine how people regulate their study time after experiencing different presentation rates during study. While participants recalled more words overall when studying at a 5-second rate, there were no significant differences in terms of value-based recall, with all participants demonstrating better recall for higher-valued words and similar patterns of selectivity, regardless of study time or prior timing experience. Self-paced study was also value-based, with participants spending more time studying high-value words than low-value. Thus, while being short on time may have impaired memory overall, participants' attention to item value during study was not differentially impacted by the fast and slow timing rates. Overall, these findings offer further insight regarding the influence that timing schedules and task experience have on how people selectively focus on valuable information.



## 1. Introduction

Whether a student, a parent with toddlers, or a busy employee, it often feels as if there is never enough time in the day. Time limitations can negatively impact what is later remembered—what might have been remembered given more time is otherwise forgotten—the consequences of which can be wide-ranging. While limited study time is known to notably diminish the likelihood of remembering overall (Mackworth, 1962; Murdock, 1962; Posner, 1964; Roberts, 1972), it is unclear how people attempt to remember valuable information when they have limited time in which to do so. For example, how might a student approach a textbook in light of an upcoming exam? Does the student attempt to read as much of the textbook as possible, foregoing entire chapters once out of time, or does the student selectively focus on what seems important?

The impact of time constraints on the construction and execution of study agendas has been predominantly investigated with respect to the self-regulated study of information varying in difficulty. People tend to spend more time studying difficult items than easier or well-learned items (Dunlosky & Hertzog, 1998; Mazzoni, Cornoldi, & Marchitelli, 1990; Nelson, Dunlosky, Graf, & Narens, 1994; Thiede, Anderson, & Therriault, 2003). When the amount of time available to study all of the information is insufficient, though, there is a shift in study, with a prioritization instead of easier materials (Dunlosky & Thiede, 2004; Son & Metcalfe, 2000; Thiede & Dunlosky, 1999). The effect of time constraints on the study of valuable information is less clear.

Research suggests that memory lapses suffered as a consequence of having too much information to remember may be tempered by selectively focusing on the most important information at the expense of that which is deemed less critical (e.g., Castel, Benjamin, Craik, & Watkins, 2002). This prioritization based on item value or importance has been referred to as value-directed remembering (Castel, 2008; Castel, McGillivray, & Friedman, 2012). As in the case of having too much to remember, having insufficient time in which to remember all of the information might similarly encourage strategizing during study, with an eye towards allocating one's resources and efforts during encoding in

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a manner that will maximize study productivity and later recall in spite of time limitations.

Even in the absence of time constraints, though, learners often require multiple trials or continued task experience before exhibiting value-directed remembering (Castel, 2008; Castel et al., 2012). When there is less time available to study presented information, there may also be less time to properly evaluate prior experiences and devise a corresponding course of action. Moreover, learning difficult information is intrinsically time demanding, while learning valuable information is not necessarily so. In fact, it is often the case that some to-be-remembered information is more valuable than other information despite being of similar ease/difficulty to remember (e.g., recalling the new telephone number of a close friend as opposed to that of a mere acquaintance). If the to-be-remembered information is of similar ease/difficulty to remember, as in the current study, then the successful encoding of low-value information should not inherently require more or less time than that of high-value information. Contrarily, difficult information necessarily requires more time to successfully encode than easy information. Thus, the limitations that time constraints during study present to learning may be more salient when the to-be-learned information is easy or difficult than when it varies in importance.

It may also be the case that learners continue to recognize the importance of adopting a value-based agenda when time is limited, but that they are less able to *efficiently* execute such an agenda in light of time constraints. The degree to which learners are selective represents the efficiency of their study: of the *n* items that one can successfully recall, are they the *n*-most important? It is possible that learners will continue to study selectively when time is limited, accommodating the decrease in allotted study time and consequential decrease in total recall by implementing more stringent criteria when determining to which subset of valuable items to attend. On the other hand, it may be that learners continue to generally prioritize high-value items over less valuable items when short on time, demonstrating value-directed remembering, but that the efficiency with which this strategy is executed diminishes. The odds of recalling a 10-point item over a 1-point item, for instance, might be lower when participants have limited study time than when time is far less constrained, indicating reduced selectivity. Learners may be less able to efficiently attend to and remember the most important information when they find themselves short on time, indicating not only quantitative costs to memory owing to time limitations, but also qualitative.

## 2. Study goals

The primary goal of the current experiment was to directly examine the potential impact of time constraints on the study of valuable information: is it beneficial to study at a faster rate, in that it encourages a more selective and efficient study effort, or does memory for high-value information comparably decline with overall recall relative to a slower rate of study?

An additional goal was to investigate whether learners adjust to shifts in study time and the impact such change can have on value-based study. Perhaps those participants who have only studied under a constant rate are able to optimize their study by selectively allocating their attention to high-value items, while participants who experience a change in study time are less able to recover or adapt a prior strategy in the short-term.

A further goal was to examine whether prior study time experiences might transfer to situations in which study is entirely self-paced. Although shifts in study may result in an immediate decrement in selectivity, it may also be the case that learners with more varied study experiences, such as with fast *and* slow study, are better equipped to optimally self-regulate their study than learners who were only familiarized with a constant study rate.

## 3. Method

### 3.1. Participants

Participants consisted of 192 undergraduate students[1] at the University of California, Los Angeles (142 female, 1 unreported), ranging in age from 18 to 26 years ($M = 20.34$, $SD = 1.41$). Participants received partial credit for a course requirement.

### 3.2. Materials

The study was designed and presented to participants via the Collector program (Gikeymarcia/Collector, n. d.). Stimuli consisted of 12 lists containing 20 novel words apiece. Each of the words was randomly assigned a value ranging from 1 to 10, with two words assigned to each value. The words in each list were randomly selected without replacement from a larger word bank of 280 random nouns and verbs (e.g., twig, button, point, taste). Word length ranged from 4–7 letters and averaged to 8.81 ($SD = 1.57$) on the log-transformed Hyperspace Analogue to Language (HAL) frequency scale[2] with a range from 5.48 to 12.65 (Lund & Burgess, 1996). The 240 studied words were randomly selected from this bank for each participant in order to avoid any potential item effects (Murayama, Sakaki, Yan, & Smith, 2014). Thus, the words studied in List 1 for one participant might have been entirely different from another participant's List 1. Furthermore, one participant might study the word “drizzle” while another might not, or might have studied “drizzle” as a 3-point word while another studied it as a 9-point word.

### 3.3. Procedure

Participants were told that they would be shown a series of word lists, each containing 20 different words. They were further told that each word would be paired with a value ranging from 1 point to 10 points and that there would be two words per point value within each list. Participants were instructed to remember as many of the words in each list as possible while also striving to achieve a maximal score, a sum of the points associated with each word correctly recalled. They would be asked to recall the words from each list at the end of its presentation, at which point they would then be told their score (out of 110 possible points). Participants were also told that the words would be presented on the screen one at a time at a rate of which they would be informed just prior to each list's commencement.

Participants were randomly assigned to one of four study time conditions which determined the rate of presentation during the first eight lists: Constant-Fast [1–1], Constant-Slow [5–5], Speed Up [5–1], or Slow Down [1–5]. Participants in the Constant conditions studied the words in Lists 1–8 at a rate of either 1 s (Constant-Fast) or 5 s per word (Constant-Slow). Participants in the Speed Up condition studied at a rate of 5 s per word during Lists 1–4 and then 1 s per word during Lists 5–8; thus, their rate of study increased. Contrastingly, participants in the Slow Down condition studied at a rate of 1 s per word during Lists 1–4 and then 5 s per word during Lists 5–8; thus, their rate of study decreased. Study was self-paced for all participants during Lists 9–12, with a cap on neither the per-item nor per-list study time. This design created three different timing segments: Segment 1 consisted of Lists 1–4; Segment 2 of Lists 5–8; and Segment 3 of the self-paced Lists 9–12.

[1] The current study is based on a pooled set of original data ($N = 96$) and replication data ($N = 96$). The results from the original data are largely consistent with those reported from the pooled data and can be obtained from the corresponding author upon request.

[2] The Log HAL frequency measure of the words included in the English Lexical Project ranges from 0 to 17, with an average frequency of 6.16 and a standard deviation of 2.40 (Balota et al., 2007).