HOW DO STUDENTS REGULATE THEIR LEARNING OF EMOTIONAL AND NEUTRAL INFORMATION?

by

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How Do Students Regulate their Learning of Emotional and Neutral Information?

Throughout their education, students are required to learn a vast amount of information. Sometimes the information is emotional (e.g., learning about the holocaust), whereas other times the information is neutral (e.g., learning about geography). Even so, it is unclear how the valence of the to-be-learned information impacts students' study decisions. There are many decisions that are under students' control when studying for class. For example, they can decide when to start studying, what strategy to use while studying, and how much time to spend studying. In the present research, I focused specifically on study time allocation (i.e., how much time students spend studying). There are a number of factors that can influence how students allocate their study time (e.g., item difficulty, goals, motivation). Critically, the valence of the to-be-learned material may influence the amount of time students spend studying. Even so, it is currently an open question as to how students allocate study time when learning emotional and neutral information. The goal of the present research was to address this issue. I begin by providing an overview of metacognition and metacognitive processes (i.e., control of learning and monitoring of learning). In the next sections, I discuss how students control and monitor their learning of non-emotional information. Finally, I review the literature on the influence of emotion on monitoring of learning and control of learning.

What is Metacognition?

Metacognition was initially defined by Flavell (1979) as one's "knowledge and cognition about cognitive phenomena" (p. 906). In the present research, my focus is on a branch of metacognition called metamemory. Metamemory refers to people's thoughts about their own memory (Nelson & Narens, 1990), and it is made up of people's knowledge about

their learning (i.e., metacognitive knowledge) and two interrelated processes: monitoring of learning and control of learning (for a review, see Dunlosky & Metcalfe, 2009). Control refers to any decision that students make about how to regulate their learning, whereas monitoring refers to students' assessments of their learning.

Although my primary interest is in how students control their learning, given the bi-directional relationship between control and monitoring, both are considered. To illustrate these processes, consider the following example. A student is attempting to learn facts about World War II for her history class by reading the textbook. While reading, the student must continuously make assessments about how well she is learning the information. This is an example of metacognitive monitoring. The student may then decide that she is not gaining much knowledge, and she continues studying by selecting a new strategy that she thinks will be more effective. For instance, the student may decide to answer the questions at the end of the chapter. This is an example of metacognitive control. Once the student decides that she has achieved her learning goal (via monitoring), she will end the study session (via control).

As this example illustrates, monitoring and control are interrelated, and together can influence actual memory performance (see Figure 1). A student can use information about the study strategy (e.g., how easy or challenging she finds the task) to inform her assessments about learning (i.e., monitoring). Additionally, she can use assessments made through monitoring to regulate (or control) her learning. The student's control decisions can influence her later memory (e.g., Ariel, Dunlosky, & Bailey, 2009; Thiede & Dunlosky, 1999; Tullis & Benjamin, 2012). Moreover, monitoring of learning can influence learning both directly (e.g., Soderstrom, Clark, Halamish, & Bjork, 2015; Tauber & Witherby, in press; Witherby &

Tauber, 2017) and indirectly by influencing study decisions (e.g., Dunlosky & Hertzog, 1997; Tauber & Rhodes, 2012; Thiede, 1999).

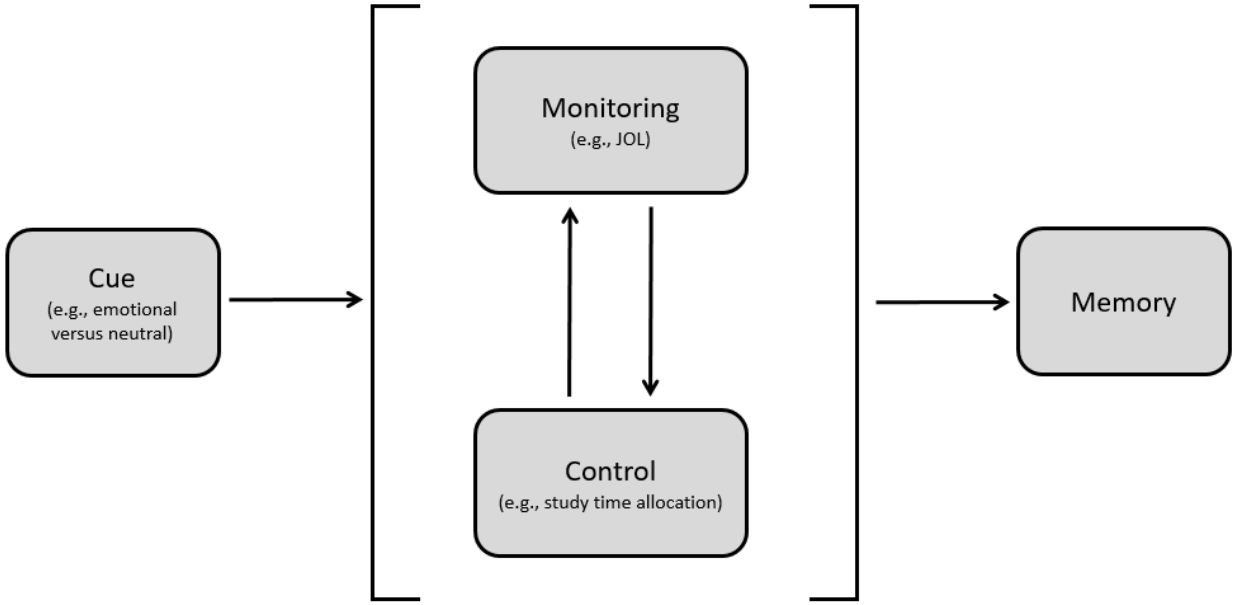

Figure 1. A theoretical model of self-regulated learning. Distinguishable features about the learning materials (i.e., cues), can influence monitoring of learning (e.g., JOLs) and control of learning (e.g., study time allocation). There is a bidirectional relationship between monitoring and control, such that one process can influence the other. Moreover, these processes influence memory.

This relationship between monitoring and control was described in a theoretical framework put forward by Nelson and Narens (1990). In their framework, they differentiated between object-level processes and meta-level processes. An example of an object-level process is the strategy that a student implements to learn material for class. An example of a meta-level process is the student's assessments of how well that strategy is working. Through monitoring, information from the object-level can inform the meta-level (i.e., assessing how learning is going). Through control, information from the meta-level can modify what is happening at the object-level (e.g., changing study strategies, ending study). My interest is in understanding the factors that influence object-level processes. That is, which factors

influence students' study decisions? Students can make a variety of decisions when studying (e.g., what to study, when to study, strategy selection), and as discussed in the next section, these decisions can be influenced by many different factors (e.g., goals, time pressure, item difficulty, monitoring of learning).

How Do Students Control their Learning?

Understanding how students regulate their learning is important because it can directly impact their actual learning (e.g., Ariel et al., 2009; Metcalfe, 2002; Thiede, 1999; Tullis & Benjamin, 2012). Thus, it is imperative to explore factors that lead to good (and to poor) study decisions. Researchers have developed a number of methods for assessing how students regulate their study (for a review, see Dunlosky & Metcalfe, 2009, Nelson & Narens, 1994). One common method, is to allow students to self-pace their study (e.g., Dunlosky & Connor, 1997; Mazzoni & Cornoldi, 1993; for reviews, see Son & Kornell, 2008; Son & Metcalfe, 2000). In a typical study, students are given a list of items to learn and are told to study them for as long as they would like, with their goal being to remember them for a later test. After studying the items, they take a test. In many cases, study time allocation is evaluated as a function of subjective item difficulty (e.g., participants' judgments about how easy or difficult an item will be to learn) or objective item difficulty (e.g., related versus unrelated word pairs). Using this methodology, researchers have found that students can be strategic in how they allocate their study time. For instance, students often allocate more study time to items that are subjectively, or objectively, more difficult (e.g., Le Ny, Denhiere, & Taillanter, 1972; Mazzoni, Cornoldi, & Marchitelli, 1990; Nelson & Leonesio, 1988).

As evident in Figure 1, one process that can influence how students control their learning is their monitoring of learning. According to the monitoring-affects-control hypothesis, students use the output of their monitoring process (e.g., judgments of how well an item has been learned, judgments about how easy an item will be to learn) to allocate study time strategically (Nelson & Leonesio, 1988). To illustrate, Nelson and Leonesio (1988) had students learn trigrams that varied in difficulty (e.g., BUG versus FXH). Students were presented with all trigrams and ranked their ease of learning for each. Next, in the self-paced study phase, students studied each trigram for as long as they wanted. Finally, students took a free-recall test. Consistent with the monitoring-affects-control hypothesis, students spent more time studying the trigrams that were judged to be more difficult to learn relative to the trigrams that were judged as being easier to learn.

Agenda-Based Regulation.

Recently, Ariel et al. (2009) proposed an agenda-based model of study time allocation. From this perspective, students are goal-oriented when learning material. To achieve their goals, they create agendas, which they use to make decisions about how to allocate study time. To demonstrate, Ariel et al. (2009) had students learn a list of word pairs that were easy (concrete – concrete; e.g., book – justice) or difficult (abstract – abstract; e.g., liberty – velocity). Additionally, they manipulated the incentive for learning each word pair. In the high-reward difficult group, students were given 5 points for learning each difficult word pair and 1 point for learning each easy word pair. In the high-reward easy group, students were given 5 points for learning each easy word pair and 1 point for learning each difficult word pair. Students began with an experimenter-paced study session, during which each word pair was presented individually along with the value for remembering it. Next,

students took an initial cued-recall test, after which they selected half of the pairs for restudy. Immediately after selecting each pair for restudy, students were allowed to self-pace their study for that pair. Last, students took a final cued-recall test.

Of most interest, Ariel et al. (2009) found that students' self-paced study times were based on the incentive for learning each word pair rather than on item difficulty. Specifically, there was a crossover interaction, such that students spent more time studying easy relative to difficult pairs in the high-reward easy group and more time studying difficult relative to easy pairs in the high-reward difficult group. Thus, students created an agenda with their goal being to remember the most valuable information. Students then used this agenda to allocate study time to the more valuable information at the expense of less valuable information, regardless of the difficulty of the pair.

Discrepancy-reduction agenda. Students' goals can change depending on the learning task, and this in turn can influence their agendas during study. For example, when students have unlimited time to learn the information and there is no incentive to prioritize certain information, they may adopt a mastery goal (i.e., learn all items) and regulate study time based on a discrepancy-reduction agenda (e.g., Dunlosky & Hertzog, 1998). With this agenda, students allocate the most study time to items that have the largest discrepancy between their current state of learning and their goal state of learning (dubbed the norm of study). Thus, students are most likely to focus their study time on the hardest items, because those items likely require the most studying to reach the norm of study.

To illustrate, Thiede and Dunlosky (1999) had students study a list of easy word pairs (concrete – concrete) and difficult word pairs (abstract – abstract). In the first study phase, presentation time was experimenter-paced and followed by a judgment of learning (JOL). A

JOL is a prospective memory monitoring judgment, with which students predict the likelihood that they will remember a given item in the future (for a review, see Rhodes, 2016). Next, students selected up to half of the pairs for restudy, and then were allowed to self-pace their study of the selected pairs. Finally, students took a cued-recall test. Of most interest, Thiede and Dunlosky (1999) observed an inverse relationship between JOLs and self-paced study times. That is, students spent the most time studying pairs for which they gave the lowest JOLs (cf. Dunlosky & Connor, 1997; Mazzoni & Cornoldi, 1993; Mazzoni et al., 1990; Nelson, Dunlosky, Graf, & Narens, 1994). This outcome fits within a discrepancy-reduction agenda because items with the lowest JOLs presumably are the furthest from the students' norm of study.

Region of proximal learning agenda. In other situations, such as when there is a time pressure to learn information and a mastery goal is not feasible (e.g., when students wait until the night before an exam to begin studying), students may adopt an agenda such that they prioritize studying information that is just beyond their current state of learning (i.e., the region of proximal learning perspective; Metcalfe, 2002). For example, Metcalfe (2002) had students learn English-Spanish vocabulary word pairs that were easy (e.g., family – familia), moderately difficult (e.g., turn – volver), and difficult (e.g., skylight – buhardilla). On each trial, students were presented with three word pairs to learn (one from each difficulty level). For each pair, only the English word was presented, and the Spanish translation could be obtained by selecting the English word for study. On some trials, students were given 5 s (high time pressure) to study the pairs, on some trials they were given 15 s (moderate time pressure) to study the pairs, and on the remaining trials they were given unlimited time (no time pressure) to study the pairs. After study, students took a cued-recall test. Of most

interest, when there was no time pressure, students allocated more time to studying difficult relative to easy word pairs (as per the discrepancy-reduction agenda). In contrast, when there was a high time pressure, students allocated more time to studying easy relative to difficult word pairs. Thus, when time was limited, students allocated study time to the pairs that were in their region of proximal learning (i.e., most likely to be learned in that timeframe).

Interest-based agenda. Students' agendas can also be influenced by their interest in learning the material. That is, students may adjust their goals such that they prioritize studying information that they find interesting relative to information that they do not. To illustrate, Son and Metcalfe (2000) had students self-pace their study of biography text passages (e.g., Sigmund Freud, Isaac Newton, Aristotle) that varied in pre-rated levels of interest. Prior to studying the passages, students read the first paragraph of each passage and rated it on how easy it would be to learn and how interesting they found it to be. After the study phase, students took a test. Most important, study time was positively related to judgments of interest. That is, students allocated more study time to passages that were judged as interesting relative to passages that were judged as uninteresting. This effect was replicated in two subsequent experiments in which students studied haikus and sonnets.

In sum, students' agendas can be influenced by many factors including the incentive to learn information, the difficulty of the information, time constraints that are imposed to learn the information, and how interesting the student finds the to-be-learned information to be. In the present research, I evaluated how the valence of the to-be-learned information influences students' agendas while studying. Moreover, I investigated whether type of material (words and pictures) impacts how students regulate their learning of emotional and neutral information. The outcomes of this research will be informative to theory on

metacognitive control. Additionally, as highlighted by Nelson and Narens' (1990) framework, control of learning and monitoring of learning are interrelated processes. To understand one process, it is important to understand the other. Thus, I also investigated students' monitoring of learning.

How Do Students Monitor their Learning?

Monitoring of learning refers to students' assessments of their learning. One way to evaluate monitoring of learning is by having students make judgments about their memory (e.g., confidence judgments, feeling of knowing judgments, ease of learning judgments, for a review, see Dunlosky & Metcalfe, 2009). A JOL is a common judgment used to evaluate metacognitive monitoring. To illustrate, Tauber and Dunlosky (2012) had students study words that were positive (e.g., cake), negative (e.g., knife), or neutral (e.g., table) and make a JOL (on a scale from 0% to 100%) predicting the likelihood that they would remember each on a future test. Following study, students took a free-recall test. Of most interest, JOLs were higher for emotional words (both positive and negative) than for neutral words.

According to contemporary theories of monitoring, JOLs are inferential and based on cues present at the time of study (e.g., cue-utilization theory; Koriat, 1997). For example, students in Tauber and Dunlosky's (2012) experiment likely noticed that the words differed in valence (i.e., positive, negative, or neutral) and used that information to create (or update) a belief about how valence influences memory. Students can use this belief to inform their JOLs (cf. analytic-processing theory; Dunlosky, Mueller, & Tauber, 2015; Mueller, Dunlosky, & Tauber, 2016). The present research will not directly contribute to these theoretical perspectives on monitoring during learning. Rather, my interest is in how students' JOLs are related to their study decisions with the goal to contribute to theory on

metacognitive control. As evident in Figure 1, cues available during study (e.g., the presence of emotion) can influence people's monitoring judgments (e.g., JOLs) and their control decisions (e.g., self-paced study times). Numerous researchers have investigated how valence influences monitoring. This research (discussed next) is informative for making predictions about how students will regulate their learning of information that varies in valence.

The Influence of Emotion on Monitoring of Learning

Investigating the impact of emotion on metacognitive monitoring is a growing area of research. Numerous researchers have demonstrated that students give higher JOLs to emotional material than to neutral material. This emotional salience effect on JOLs has been observed with single words (e.g., Hourihan, Fraundorf, & Benjamin, 2017; Tauber & Dunlosky, 2012; Tauber, Witherby, & Dunlosky, in press), word pairs (e.g., Zimmerman & Kelley, 2010), pictures (e.g., Hourihan & Bursey, 2017; Tauber, Dunlosky, Urry, & Opitz, 2016), and faces (e.g., Nomi et al., 2013; Witherby & Tauber, 2018). Moreover, students' JOLs are consistent with the typical effects of emotion on memory, in which emotional information is often remembered better than is neutral information (for a review, see Murphy & Isaacowitz, 2008).

The Present Experiments

Although researchers have a good understanding of the impact of emotion on JOLs, it is unclear how emotion will influence study decisions. The primary goal of the present research was to address this gap in the literature by evaluating how students self-pace their learning of emotional and neutral information. Investigating this issue is important for self-regulated learning theory, because it will help to elucidate the situations in which students will adopt certain agendas for study time allocation. Moreover, this research may be of applied interest because students have to learn an array of information that can vary in valence.

Given that many factors can influence students' agendas (Ariel et al., 2009), there are competing predictions about how they will regulate their learning of emotional and neutral information. In the present experiments, students did not have a time pressure to learn the materials. Thus, it is unlikely that they will adopt a region of proximal learning agenda (cf. Metcalfe, 2002). Instead, one hypothesis is that students may use a discrepancy-reduction agenda (e.g., Dunlosky & Hertzog, 1998), with which they allocate the most study time to items that are difficult to learn (i.e., items given low JOLs) relative to items that are easier to learn (i.e., items given high JOLs). In this case, students may spend more time studying neutral relative to emotional items. Alternatively, students may adopt an interest-based agenda (e.g., Son & Metcalfe, 2000), with which they allocate the most study time to items that are interesting relative to items that are not. To evaluate this possibility, a preliminary normative study was conducted to obtain ratings of interest for positive, negative, and neutral words and pictures (see Appendix A). Most important, for the stimuli used in the present experiments, participants rated positive items (both words and pictures) to be more interesting than neutral items (for descriptive and inferential statistics, see Tables 1 and 4 for words and pictures, respectively). Ratings of interest were higher for neutral items than for negative items. Thus, from an interest-based agenda, students may allocate the most study time to positive items relative to neutral and negative items. Students should also allocate more study time to neutral items than to negative items.

These hypotheses raise an important question. Namely, which of these agendas (i.e., discrepancy-reduction or interest-based) should students use? Given that memory tends to be poorer for neutral information relative to emotional information, a discrepancy-reduction agenda would be the most optimal for enhancing learning. There will likely be more room for

improvement when learning neutral items relative to emotional items. Thus, if students allocate more study time to neutral items than to emotional items, they will be correctly identifying the material that is least likely to be remembered and allocating their resources to it. Students may see a larger gain in the overall number of items recalled relative to if they allocate more study time to emotional items. Even so, I do not expect recall for neutral items to be superior to recall for emotional items in any of the experiments. Simply increasing study time does not necessarily mean that memory performance will increase (cf. the total time hypothesis). Instead, a discrepancy-reduction agenda may need to be coupled with explicit instruction of effective study strategies when learning challenging materials (e.g., Pelegrina, Bajo, & Justicia, 2000).

In Experiments 1 and 2, I evaluated how students regulate their learning of positive, negative, and neutral *words*. Students self-paced their study of neutral and emotional (positive and negative) words. Students made a JOL after studying each word (Experiment 1) or during an initial experimenter-paced study phase (Experiment 2). Finally, students took a free-recall test. For Experiments 1 and 2, I expected students to adopt a discrepancy-reduction agenda. That is, I expected students to spend more time studying neutral relative to emotional words. This prediction is consistent with prior research that has included similar task constraints (i.e., unlimited study time, simple word pairs; Dunlosky & Connor, 1997; Dunlosky & Hertzog, 1998; Nelson et al., 1994; Thiede & Dunlosky, 1999).

In Experiments 3 and 4, I evaluated how students regulate their learning of positive, negative, and neutral *pictures*. Otherwise, these experiments were identical to Experiments 1 and 2. The kind of materials (words versus pictures) may differentially influence study time allocation. For instance, Son and Metcalfe (2000) found that students tend to allocate more

study time to easy relative to difficult information when the to-be-learned material is complex (e.g., text passages). By contrast, with relatively simple materials, students often prioritize studying difficult relative to easy items (e.g., Mazzoni & Cornoldi, 1993; Thiede & Dunlosky, 1999). Pictures are more complex than are single words (e.g., Schlochtermeier et al., 2013; Tempel et al., 2013), and are also likely to be more provocative and interesting relative to single words. For example, studying a picture of a busy highway may be more likely to hold students' interest relative to studying just the word "highway". Thus, when studying pictures, students may be more likely to adopt an interest-based agenda and allocate more study time to interesting pictures (i.e., positive pictures) than to less interesting pictures (i.e., neutral or negative pictures).

Experiment 1

In Experiment 1, I investigated how students regulate their learning of emotional (positive and negative) and neutral words using self-paced study. Students self-paced their study of positive (e.g., circus), negative (e.g., pest), and neutral (e.g., clock) words. After studying each word, students made a JOL. Finally, students took a free-recall test.

Method

Design and participants. Valence (positive, negative, and neutral) was manipulated within-participant. The primary dependent variables were median self-paced study times, JOLs, and memory performance. In addition to evaluating the impact of emotion of these outcomes independently, I also explored the relationships between them (see Appendix B).

To estimate the number of students needed in each group, a power analysis was conducted using G*Power (Faul, Erdfelder, Lang, & Buchner, 2007). Using a medium effect size, d = .50 (e.g., Tauber & Dunlosky, 2012), power at .90, and an alpha level of .05, it was

estimated that I would need 44 students to observe an emotional salience effect on JOLs. To increase the likelihood of detecting an effect on self-paced study times, the target sample size was increased by 10%. Thus, 49 undergraduate students from Texas Christian University participated for partial course credit in psychology courses.

Materials and procedure. Prior to conducting Experiment 1, normative ratings were collected for the single words used in Experiments 1 and 2 (see Appendix A for details). Specifically, 300 words were taken from the Bradley and Lang (1999) Affective Norms for English Words (ANEW), and participants rated them on valence, arousal, complexity, interest, and importance. Of these, 45 words were selected (15 positive, 15 negative, and 15 neutral) to be used in Experiment 1. Normative ratings of valence, arousal, complexity, interest, importance, length, and word frequency are presented in Table 1 (ratings of length and word frequency were obtained from the English Lexicon Project; Balota et al., 2007). Ratings of valence were significantly higher (i.e., more positive) for positive words relative to negative and neutral words (see Table 1 for inferential statistics). Ratings of valence were also significantly higher for neutral words relative to negative words. Ratings of arousal were higher for positive and negative words relative to neutral words, and they did not differ between positive and negative words.[1] Ratings of interest were higher for positive words than for negative words, or for neutral words. In addition, ratings of interest were higher for neutral words than for negative words. Ratings of importance were higher for positive words relative

[1] Ratings of valence and arousal for positive, negative, and neutral words are consistent with those reported in the ANEW. Specifically, using the normative ratings from the ANEW, valence was significantly higher for positive words relative to negative words, $t(14) = 28.20$, $p < .001$, and neutral words, $t(14) = 13.92$, $p < .001$, and for neutral words relative to negative words, $t(14) = 13.39$, $p < .001$. Arousal was significantly higher for positive and negative words relative to neutral words, $t(14) = 5.14$, $p < .001$, and $t(14) = 4.72$, $p < .001$, respectively, and did not differ for positive and negative words, $t(14) = 1.03$, $p = .32$.

to negative and neutral words, and for neutral words relative to negative words. Positive, negative, and neutral words did not differ in ratings of complexity, length, or word frequency.

Table 1
Descriptive and Inferential Statistics for Stimuli Used in Experiments 1 and 2

Dimension	Positive	Negative	Neutral	Pos vs. Neg	Pos vs. Neu	Neg vs. Neu
Valence	5.28 (.04)	3.64 (.07)	4.49 (.03)	t = 36.21*, d = 1.91	t = 17.06*, d = 1.88	t = 11.26*, d = 1.80
Arousal	4.22 (.06)	4.20 (.07)	3.79 (.04)	t = 0.27, d = 0.10	t = 4.95*, d = 1.48	t = 5.10*, d = 1.43
Interest	4.73 (.06)	3.71 (.05)	4.00 (.04)	t = 12.44*, d = 1.84	t = 12.82*, d = 1.73	t = 6.15*, d = 1.41
Importance	4.34 (.08)	3.65 (.07)	4.09 (.09)	t = 7.74*, d = 1.56	t = 2.04, d = 0.73	t = 3.80*, d = 1.18
Complexity	4.38 (.09)	4.22 (.06)	4.22 (.08)	t = 1.35, d = 0.54	t = 1.29, d = 0.51	t = 0.08, d = 0.03
Length	5.27 (.40)	4.80 (.29)	5.40 (.36)	t = 1.00, d = 0.36	t = 0.25, d = 0.10	t = 1.26, d = 0.48
Frequency	9.40 (.23)	9.27 (.22)	9.83 (.32)	t = 0.40, d = 0.16	t = 1.21, d = 0.41	t = 1.41, d = 0.54

Note. For valence, high values indicate positive emotion. Standard errors of the mean are in parentheses. Pos = positive. Neg = negative. Neu = neutral. For all analyses, df = 14. *$p \leq .002$.

During study, positive, negative, and neutral words were intermixed, and presentation order was randomized anew for each student with the constraint that no more than three words in a row were of the same valence. Each word was presented one-at-a-time and students were given unlimited time to self-pace their study. Students pressed the spacebar when they were finished studying a word. After studying each word, students made a self-paced JOL. JOLs were made on a scale from 0% (absolutely will not recall the word) to 100% (absolutely will recall the word). After studying and making JOLs for all words, students took a free-recall test on which they were instructed to recall as many words as they

could remember. The test was self-paced, and students were told that they could recall the words in any order.

Results

Given that my primary interest is in how students regulate their learning of emotional information, analyses of self-paced study times are presented first. Next, I present analyses of JOL magnitude and memory performance.

Self-paced study times. Median response times were calculated for each student and then were averaged across students separately for each level of valence. As evident in Table 2, self-paced study times did not differ for positive, negative, and neutral words. These outcomes were confirmed by a one-way repeated-measures analysis of variance (ANOVA), $F(2, 96) = 1.42$, $p = .25$, $\eta_p^2 = .03$.

Table 2
Average Median Self-Paced Study Times (in Sec) for Each Valence Category in Experiments 1 – 4

Experiment	Positive	Negative	Neutral
Experiment 1	3.10 (.10)	2.87 (.08)	2.96 (.06)
Experiment 2	1.81 (.09)	1.85 (.09)	1.89 (.04)
Experiment 3	8.39 (.20)*	7.06 (.24)	7.89 (.18)*
Experiment 4	6.51 (.17)* †	5.38 (.17)	5.82 (.12)

Note. Within-participant standard errors of the mean (Loftus & Masson, 1994) are in parentheses. * significantly different from negative, $p < .05$ (see text for p values). † significantly different from neutral, $p < .05$ (see text for p values).

Judgment of learning magnitude. For each student, mean JOLs were computed separately for each level of valence. As evident in Figure 2, JOLs were higher for emotional words relative to neutral words (cf. Hourihan et al., 2017; Tauber & Dunlosky, 2012). This observation was confirmed by a one-way repeated-measures ANOVA, $F(2, 96) = 17.90$, $p <$

.001, η_p^2 = .27. Follow-up tests using Tukey's LSD revealed that JOLs were higher for positive words relative to neutral words, $p < .001$, and for negative words relative to neutral words, $p < .001$. JOLs for positive and negative words did not differ, $p = .07$.

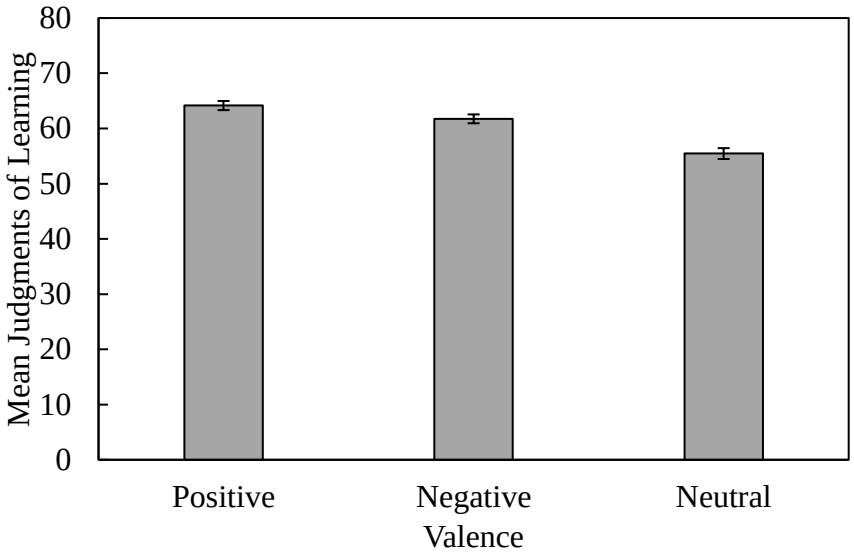

Figure 2. Mean judgments of learning in Experiment 1. Error bars represent the within-participant standard error (Loftus & Masson, 1994).

Memory performance. Memory performance was calculated as the mean proportion of words students correctly recalled. Minor spelling errors that did not change the meaning of the word (e.g., pluralizing) were counted as correct. Memory performance did not differ for positive, negative, and neutral words, $F(2, 96) = 2.14$, $p = .12$, $\eta_p^2 = .04$ (see Table 3).

Table 3
Mean Proportion Correctly Recalled for Each Valence Category in Experiments 1 - 4

Experiment	Positive	Negative	Neutral
Experiment 1	.38 (.02)	.40 (.01)	.35 (.01)
Experiment 2	.39 (.02)	.43 (.01) †	.36 (.01)*
Experiment 3	.41 (.01)* †	.49 (.01) †	.31 (.02)*
Experiment 4	.47 (.01)* †	.55 (.01) †	.37 (.01)*

Note. Within-participant standard errors of the mean (Loftus & Masson, 1994) are in parentheses. * significantly different from negative, $p < .05$ (see text for p values). † significantly different from neutral, $p < .05$ (see text for p values).

Experiment 2

Replicating prior research, students in Experiment 1 gave higher JOLs to emotional words than to neutral words. Memory performance was in the expected direction numerically (i.e., higher for emotional than for neutral words); however, the difference did not reach conventional level of significance. Most important, self-paced study times did not differ between positive, negative, and neutral words. Thus, in contrast to the predictions outlined in the introduction, participants did not strategically regulate their learning based on valence.

Given that the null effect of valence on self-paced study times has only been observed in one experiment, the primary goal of Experiment 2 was to re-evaluate this issue using a two-phase study design that is commonly used in research on metacognitive control (e.g., Ariel et al., 2009; Dunlosky & Hertzog, 1997; Nelson & Leonesio, 1988; Son & Metcalfe, 2000; Thiede & Dunlosky, 1999). One explanation for the null effect in Experiment 1 could be that students had a challenging time maintaining their agenda during the study phase because they were required to complete three tasks simultaneously: self-pace their time during study, learn the word, and make a JOL for the word. Thus, having students divide their processing resources amongst these tasks could have resulted in a breakdown of their agenda (cf. Thiede & Dunlosky, 2011). A two-phase design may reduce processing demands by isolating tasks in different phases, which may enable students to more effectively use their agenda to regulate their learning.

In Experiment 2, students made JOLs during an initial experimenter-paced study phase and then studied each word during a second self-paced study phase Finally, students took a free-recall test.

Method

Design and participants. A one-way within-participant design was used with valence (positive, negative, and neutral) manipulated within-participant. Using the same power analysis from Experiment 1, 49 undergraduate students from Texas Christian University participated in exchange for partial course credit.

Materials and procedure. The materials were identical to those of Experiment 1. Students studied 45 words (15 positive, 15 negative, and 15 neutral) in two phases, with presentation order randomized anew for each student, for each phase, with the same constraint as in Experiment 1. In the first phase, each word was presented for 1 s, after which students made a self-paced JOL. In the second phase, students self-paced their study by pressing the spacebar when they were done studying each word. Finally, students took a free-recall test as in Experiment 1.

Results

Analyses of self-paced study times are presented first, followed by analyses of JOL magnitude and memory performance.

Self-paced study times. As evident in Table 2, median self-paced study times did not differ based on valence, $F < 1$.

Judgment of learning magnitude. Replicating Experiment 1, JOLs were higher for emotional words relative to neutral words (see Figure 3). This outcome was confirmed with a one-way within-participant ANOVA, $F(2, 96) = 12.89$, $p < .001$, $\eta_p^2 = .21$. Follow-up tests using Tukey's LSD revealed that JOLs were higher for negative and positive words relative to neutral words, *p*s < .001. JOLs were also higher for positive words relative to negative words, $p = .04$.

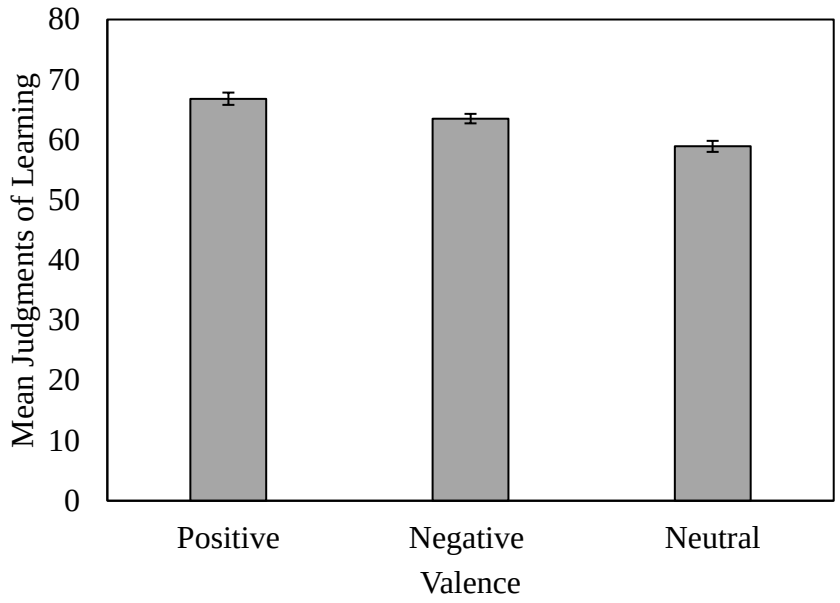

Figure 3. Mean judgments of learning in Experiment 2. Error bars represent the within-participant standard error (Loftus & Masson, 1994).

Memory performance. As evident in Table 3, memory performance was influenced by valence, $F(2, 96) = 3.58$, $p = .032$, $\eta_p^2 = .07$. Students recalled more negative words than neutral words, $p = .005$. Recall did not differ for positive and negative words, $p = .16$, or for positive and neutral words, $p = .26$.

Experiment 3

Consistent with prior research, students in Experiments 1 and 2 provided higher JOLs for emotional relative to neutral words and recalled more emotional words relative to neutral words (e.g., Hourihan et al., 2017; Tauber & Dunlosky, 2012; Tauber et al., in press). By contrast, self-paced study times did not differ based on valence. Thus, students did not strategically regulate their learning of emotional and neutral words. One possibility is that the kind of material students have to learn may influence their study decisions. For instance, researchers have found that students spent more time studying easy items relative to difficult items when they had to learn more complex materials such as text passages or sonnets (Son

& Metcalfe, 2000), whereas they spent more time studying difficult relative to easy items when they had to learn simple materials such as single sentences or word pairs (e.g., Mazzoni & Cornoldi, 1993; Thiede & Dunlosky, 1999). To obtain a thorough understanding of how students regulate their learning of emotional material, it is critical to assess how they regulate their learning for different kinds of emotional material. In Experiment 3, I evaluated whether students would strategically regulate their study when learning emotional and neutral pictures.

Relative to word stimuli, pictures often elicit larger emotion effects (e.g., De Houwer & Hermans, 1994; Kensinger & Schacter, 2006; Hinojosa, Carretie, Valcarcel, Mendez-Bertolo, & Pozo, 2009). This finding may be partially driven by the fact that pictures are more visually complex than are single words because they provide more information for students to process (e.g., Schlochtermeier et al., 2013; Tempel et al., 2013). Given that students tend to allocate more study time to easy items relative to difficult items when all of the items are complex, they may spend more time studying emotional pictures relative to neutral pictures because they are typically easier to learn (i.e., memory performance tends to be enhanced for emotional relative to neutral items). Moreover, students' agendas for study time allocation can be influenced by their level of interest in the material (e.g., Son & Metcalfe, 2000). In a preliminary normative study, participants rated positive pictures as being more interesting than neutral and negative pictures, and rated neutral pictures as being more interesting than negative pictures (for descriptive and inferential statistics, see Table 4). Thus, if students adopt an interest-based agenda, they should allocate the most study time to positive pictures, followed by neutral and negative pictures. Alternatively, even with more complex stimuli, students may adopt a discrepancy-reduction agenda and allocate more study time to neutral pictures than to emotional pictures.

In Experiment 3, students learned a series of emotional (positive and negative) and neutral pictures. Students self-paced their study of each picture and made a JOL. Finally, students took a free-recall test.

Method

Design and participants. A one-way within-participant design was used with valence (positive, negative, and neutral) as the independent variable. Based off the power analysis from the previous experiments, 48 undergraduate students participated in exchange for course credit.

Materials and procedure. Prior to conducting Experiment 3, normative ratings were collected for the picture stimuli (see Appendix A for details). Specifically, 150 pictures were taken from the International Affective Picture System (IAPS; Lang, Bradley, & Cuthbert, 2008) and participants rated them on valence, arousal, complexity, interest, and importance. Of these, 45 pictures were selected (15 positive, 15 negative, and 15 neutral). Normative ratings for these pictures are presented in Table 4. Ratings of valence were significantly higher (i.e., more positive) for positive pictures relative to negative or neutral pictures (see Table 4 for inferential statistics). Moreover, ratings of valence were significantly higher for neutral pictures relative to negative pictures. Ratings of arousal did not differ for positive and negative pictures, but pictures from both categories were rated as significantly more arousing compared to neutral pictures.[2] Positive pictures were rated as more interesting and important compared to negative and neutral pictures. Neutral pictures were rated as more interesting

[2] Ratings of valence and arousal for positive, negative, and neutral pictures are consistent with those reported in the IAPS. Specifically, using the normative ratings from the IAPS, valence was significantly higher for positive pictures relative to negative pictures, $t(14) = 18.09$, $p < .001$, and neutral pictures, $t(14) = 15.52$, $p < .001$, and for neutral pictures relative to negative pictures, $t(14) = 13.53$, $p < .001$. Arousal was significantly higher for positive and negative pictures relative to neutral pictures, $t(14) = 2.43$, $p = .029$, and $t(14) = 3.23$, $p = .006$, respectively, and did not differ for positive and negative pictures, $t < 1$.

than negative pictures, but ratings of importance did not differ for neutral and negative pictures. Finally, ratings of complexity did not differ for positive, negative, and neutral pictures.

Table 4
Descriptive and Inferential Statistics for Stimuli Used in Experiments 3 and 4

Dimension	Positive	Negative	Neutral	Pos vs. Neg	Pos vs. Neu	Neg vs. Neu
Valence	5.33 (.06)	3.30 (.06)	4.33 (.08)	t = 26.51*, d = 1.92	t = 11.31*, d = 1.73	t = 9.77*, d = 1.76
Arousal	4.69 (.12)	4.37 (.09)	4.09 (.09)	t = 1.95, d = 0.75	t = 4.33*, d = 1.21	t = 2.25*, d = 0.74
Interest	4.97 (.07)	3.68 (.08)	4.22 (.07)	t = 11.97*, d = 1.82	t = 8.16*, d = 1.63	t = 7.69*, d = 1.37
Importance	4.83 (.10)	4.18 (.10)	4.33 (.10)	t = 4.56*, d = 1.31	t = 3.77*, d = 1.12	t = 1.16, d = 0.39
Complexity	4.41 (.08)	4.47 (.06)	4.38 (.07)	t = 0.67, d = 0.26	t = 0.32, d = 0.11	t = 1.24, d = 0.41

Note. For valence, high values indicate positive emotion. Standard errors of the mean are in parentheses. Pos = positive. Neg = negative. Neu = neutral. For all analyses, df = 14. *$p \leq .04$

Students self-paced their study of the 45 pictures. Pictures were presented individually in a new randomized order for each student, with the constraint that no more than three pictures in a row were of the same valence. Students pressed the spacebar when they were finished studying each picture. Immediately after studying each picture, students made a self-paced JOL. Finally, students took a free-recall test, on which they described as many pictures as they could remember (cf. Tauber et al., 2016). As in the previous experiments, the test was self-paced and students were instructed that they could recall the pictures in any order.

Results

Analyses of self-paced study times are presented first, followed by analyses of JOL magnitude and memory performance.

Self-paced study times. As evident from Table 2, average median self-paced study times were longer for positive and neutral pictures than for negative pictures, and they did not differ for positive and neutral pictures. These outcomes were confirmed with a one-way within-participant ANOVA, $F(2, 94) = 7.20$, $p < .001$, $\eta_p^2 = .13$. Follow-up analyses using Tukey's LSD indicated that self-paced study times were longer for positive pictures than for negative pictures, $p = .001$ and for neutral pictures than for negative pictures, $p = .03$. Self-paced study times did not differ for positive and neutral pictures, $p = .10$.

Judgment of learning magnitude. Consistent with prior research, students' JOLs were higher for emotional pictures relative to neutral pictures (see Figure 4). This observation was confirmed with a one-way within-participant ANOVA, $F(2, 94) = 27.24$, $p < .001$, $\eta_p^2 = .37$. Follow-up tests using Tukey's LSD confirmed that JOLs were higher for positive and negative pictures relative to neutral pictures, *p*s < .001. JOLs for positive and negative pictures did not differ, $p = .41$.

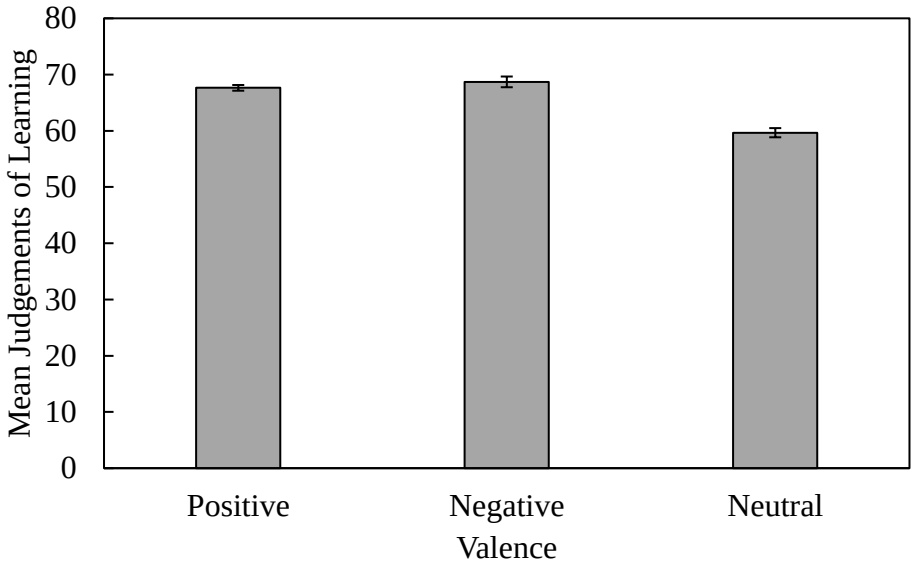

Figure 4. Mean judgments of learning in Experiment 3. Error bars represent the within-participant standard error (Loftus & Masson, 1994).

Memory performance. Free-recall responses were scored by two independent raters (cf. Tauber et al., 2016). Students provided a total of 887 responses. Of those, 12 responses (1.4%) were removed. Three responses were removed because students recalled a picture that they had already recalled in an earlier response. Nine responses were removed because students described a picture that was not studied (i.e., they made a commission error). The remaining 875 responses were analyzed. Raters' scores were in agreement on 99.0% of the remaining responses (866 responses). For 1.0% (i.e., 9) of the responses, the raters' scores were in conflict and were resolved by a third rater.

As evident from Table 3, students recalled significantly more negative pictures than positive pictures and more positive pictures relative to neutral pictures (cf. Tauber et al., 2016). These conclusions were confirmed with a one-way within-participant ANOVA, $F(2, 94) = 28.43$, $p < .001$, $\eta_p^2 = .38$. Follow-up tests using Tukey's LSD confirmed that students recalled more negative pictures than positive and neutral pictures, *p*s < .001, and more positive pictures relative to neutral pictures, $p < .001$.

Experiment 4

In Experiment 3, students spent more time studying positive and neutral pictures relative to negative pictures. Replicating prior research (e.g., Hourihan & Bursey, 2017; Tauber et al., 2016), students gave higher JOLs to emotional pictures than to neutral pictures and recalled more emotional pictures than neutral pictures. These outcomes are partially consistent with prior work demonstrating that students are more likely to allocate study time to easier items (i.e., positive pictures) than to difficult items (i.e., neutral pictures) when the to-be-learned items are complex (cf. Son & Metcalfe, 2007). In addition, these outcomes are partially consistent with the discrepancy-reduction hypothesis, because students spent more

time studying neutral pictures (that were given low JOLs) compared to negative pictures (that were given high JOLs). Even so, these outcomes most closely align with the predictions from an interest-based agenda. Specifically, students allocated the most study time to pictures that were rated as the most interesting (i.e., positive pictures) and the least study time to pictures that were rated as the least interesting (i.e., negative pictures). Positive pictures were also rated as more interesting than were neutral pictures, and students allocated marginally more study time to positive relative to neutral pictures (p = .10). Finally, neutral pictures were rated as more interesting than were negative pictures, and students allocated significantly more time to neutral relative to negative pictures.

Given that this is the first time these effects have been observed, the goal of Experiment 4 was to replicate and extend these outcomes using a different self-regulated learning paradigm. As in Experiment 2, students completed two study phases. In the first phase, study time was experimenter-paced and students made a JOL after studying each word. In the second phase, students self-paced their study of each image. Finally, students took a free-recall test.

Method

Design and participants. A one-way design was used with valence (positive, negative, and neutral) manipulated within-participant. Using the power analysis from the prior experiments, 50 undergraduate students participated in exchange for course credit.

Materials and procedure. Materials were identical to those of Experiment 3. The procedure was identical to that of Experiment 2, except that students studied pictures rather than words. Specifically, in an initial study phase, students were presented with a series of positive, negative, and neutral pictures presented in a random order for 1 s each, with the

same constraint as in the previous experiments. Immediately after studying each picture, students made a self-paced JOL. Next, students completed a self-paced learning phase. During this phase, presentation order was randomized anew per student with the constraint that no more than three pictures in a row were of the same valence. Students were instructed to press the spacebar when they were finished studying each picture. Finally, students took a free-recall test as in Experiment 3.

Results

Analyses of self-paced study times are presented first. Next, I present analyses of JOL magnitude and memory performance.

Self-paced study times. As in Experiment 3, students spent more time studying positive pictures relative to negative and neutral pictures (see Table 2). This outcome was confirmed with a one-way within-participant ANOVA, $F(2, 98) = 9.45$, $p < .001$, $\eta_p^2 = .16$. Follow-up tests using Tukey's LSD confirmed that students' self-paced study times were longer for positive pictures relative to neutral pictures, $p = .005$, and negative pictures, $p = .001$. Study times did not differ for negative and neutral pictures, $p = .07$.

Judgment of learning magnitude. As in the previous experiments, students gave higher JOLs to emotional pictures than to neutral pictures (see Figure 5). This outcome was confirmed with a one-way within-participant ANOVA, $F(2, 98) = 24.60$, $p < .001$, $\eta_p^2 = .33$. Follow-up analyses using Tukey's LSD confirmed that JOLs were higher for positive pictures relative to neutral pictures, $p < .001$, and for negative pictures relative to neutral pictures, $p < .001$. JOLs for positive and negative pictures did not differ, $p = .71$.

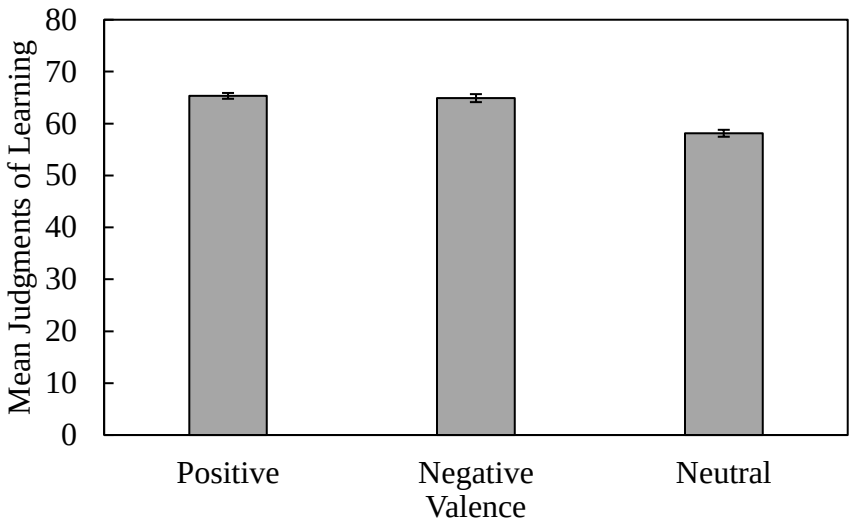

Figure 5. Mean judgments of learning in Experiment 4. Error bars represent the within-participant standard error (Loftus & Masson, 1994).

Memory performance. Free-recall responses were scored as per the procedure adopted in Experiment 3. Students provided a total of 1,046 responses. Of those, five responses (<1%) were removed. Four responses were removed because students recalled a picture that they had already recalled in an earlier response. One response was removed because the student did not provide enough detail to identify which picture they recalled. Thus, the remaining 1,041 responses were analyzed. Raters' scores were in agreement on 99% of the remaining responses (1, 032 responses). For 1.0% (i.e., 9) of the responses, the raters' scores were in conflict and were resolved by a third rater.

As evident from Table 3, memory performance was influenced by valence, $F(2, 98) = 29.47$, $p < .001$, $\eta_p^2 = .38$. Follow-up analyses confirmed that students recalled more negative pictures relative to positive or neutral pictures, *p*s < .001, and more positive pictures relative to neutral pictures, $p < .001$.

General Discussion

The present research was the first to evaluate how students regulate their learning of emotional relative to neutral information. In Experiments 1 and 2, students' self-paced study

times did not differ for positive, negative, and neutral words. This was true when students self-paced their study and made JOLs during one phase (Experiment 1) and when these processes were separated into two phases (Experiment 2). These outcomes are surprising, and they are not consistent with either of the theoretical predictions outlined in the introduction. I anticipated that students would (a) adopt a discrepancy-reduction agenda, with which they prioritize learning words that were more difficult to remember (i.e., neutral words) relative to words that were easier to remember (i.e., emotional words) or (b) adopt an interest-based agenda, with which they prioritize learning more interesting words (i.e., positive words) relative to less interesting words (i.e., negative words). The null effect of valence on self-paced study times in these experiments demonstrate that students did not strategically allocate their study time when learning words that differed in valence.

By contrast, when learning emotional and neutral pictures in Experiments 3 and 4, students' self-paced study times were influenced by valence. Specifically, students allocated the most study time to positive pictures and the least study time to negative pictures. Self-paced study times for neutral pictures fell between positive and negative pictures. These effects maintained regardless of whether students self-paced their study and made JOLs in one phase (Experiment 3) or in separate phases (Experiment 4). These outcomes are consistent with the agenda-based regulation theory (cf. Ariel et al., 2009). From this perspective, self-regulated learning is goal-oriented, and students create agendas, or plans, for how they will regulate their learning to achieve their goals. Students' agendas can be influenced by the kind of information they are studying and by their monitoring judgments (see Figure 1; e.g., Dunlosky & Connor, 1997; Mazzoni et al., 1990; Thiede & Dunlosky, 1999). As well, other factors, such as the constraints of the task (e.g., time pressures) and

incentives for learning the material, can influence students' agendas (e.g., Ariel et al., 2009; Metcalfe, 2002). The outcomes of Experiments 3 and 4 contribute to this theoretical perspective by demonstrating that students' agendas can be influenced by their interest in learning the material (cf. Son & Metcalfe, 2000).

What can account for the inconsistency in students' study decisions when learning words (Experiments 1 and 2) relative to pictures (Experiments 3 and 4)? One possibility is that students' self-paced study times were not sensitive to valence when learning single words because they spent little time studying them in general. Students' average median self-paced study times ranged from 1.81 s to 3.10 s in Experiments 1 and 2. By contrast, with pictures, students spent roughly twice as long studying them (ranged from 5.38 to 8.39 s), which allowed for more room to detect an effect of valence on study time. This speculation is consistent with prior research that has demonstrated that the effects of valence tend to be larger when using picture stimuli relative to word stimuli (e.g., De Houwer & Hermans, 1994; Kensinger & Schacter, 2006; Hinojosa, et al., 2009). An important direction for future research will be to further investigate this issue, perhaps by adopting procedures that will encourage longer study times in general (e.g., encouraging a mastery goal or providing incentives for high performance).

Another possibility is that self-paced study is not a particularly sensitive measure in general for understanding how students regulate their learning. Given that the valence manipulation is often weaker with words than with pictures, it may be especially challenging to detect differences for words when using a somewhat insensitive measure. Consistent with this speculation, the measure of metacognitive control used in an experiment can have important implications for the conclusions drawn about students' study choices. For example,

Thiede and Dunlosky (1999) had students regulate their learning of word pairs that were easy (e.g., concrete-concrete) or difficult (e.g., abstract-abstract) using two measures of control: self-paced study and item selection. When students were given an easy learning goal (i.e., remember 6 out of 30 pairs), self-paced study times did not discriminate between concrete and abstract word pairs. By contrast, item selection did. Students selected more concrete word pairs for restudy relative to abstract word pairs. Thiede and Dunlosky (1999) observed a similar dissociation between self-paced study and item selection when evaluating how students' study decisions were related to their JOLs. Specifically, whereas self-paced study times did not differ for pairs given high and low JOLs, students chose to restudy more word pairs that were given high JOLs relative to word pairs that were given low JOLs.

To explain these dissociations, Thiede and Dunosky (1999) suggested that students may have had a more challenging time maintaining their learning goal and using it as a basis for their study decisions when they regulated their learning with self-paced study relative to item selection. Regulating learning by self-pacing study places a high demand on working memory. Students must simultaneously maintain their goal, attend to item information (e.g., is this an easy item or a difficult item), execute their agenda (e.g., spend more time studying the easy item), and encode the to-be-learned item. By contrast, with item selection, students can make their decisions about which items to study without the added burden of simultaneously encoding the items. Thus, an important direction for future research will be to evaluate whether students regulate their learning of emotional and neutral information strategically with other measures of metacognitive control.

As a preliminary evaluation of this possibility, I conducted follow-up work using the materials from Experiments 1 and 2 and item selection as the measure of control. Students

studied positive, negative, and neutral words for a fixed amount of time. After studying each word, they decided whether they wanted to restudy that word before the test. Students were only allowed to select half of the words for restudy, which forced them to be strategic with their decisions. The proportion of neutral words (M = .43, SE = .02) selected for restudy was significantly greater relative to positive words (M = .27, SE = .02), $t(40) = 4.32$, $p < .001$, d = 1.05, or negative words (M = .30, SE = .02), $t(40) = 3.76$, $p < .001$, d = .93, with no differences between the latter categories, $t < 1$. Thus, when allowed to regulate their learning of emotional and neutral words with item selection, students adopted a discrepancy-reduction agenda.

Why might students adopt a discrepancy-reduction agenda when learning words, but an interest-based agenda when learning pictures? As mentioned earlier, it is possible that pictures are more captivating relative to single words, and as such, are more likely to hold students' interest. That is, although an emotional word (e.g., circus) may be rated as more interesting than a neutral word (e.g., basket), given that they are just single words, students may not be particularly motivated to spend more time studying the emotional word relative to the neutral word. Pictures, on the other hand, are more complex and provide more information for students to process compared to single words. As such, students may be motivated to prioritize studying more interesting pictures relative to less interesting pictures. An important next step will be to evaluate how students regulate their learning with item selection when learning emotional and neutral pictures. Students may adopt an interest-based agenda as was observed in Experiments 3 and 4 with study time allocation. Alternatively, they may adopt a discrepancy-reduction agenda as was observed when using item selection with single words.

As a secondary interest, I also replicated the emotional-salience effect on JOLs. Students gave higher JOLs to emotional items than to neutral items. This outcome has been

observed when students studied words (e.g., Hourihan et al., 2017; Tauber & Dunlosky, 2012) and pictures (e.g., Hourihan & Bursey, 2017; Tauber et al., 2016). In addition, in all but one experiment, I replicated the finding that emotional information is often remembered better than is neutral information (e.g., Murphy & Isaacowitz, 2008). Thus, the most effective agenda for students to adopt while studying should be to prioritize learning neutral information over emotional information. Even so, it is unlikely that students will see large gains in performance simply by increasing the amount of time spent studying neutral information (cf. Pelegrina et al., 2000). Instead, learning will most likely be enhanced by identifying the information that needs to be learned and using effective learning strategies such as self-testing to encode the information.

In sum, the present research was the first to evaluate how students regulate their learning of emotional information. The outcomes contribute to metacognitive theory by demonstrating that students can use their interest in the to-be-learned information to strategically regulate their learning. Moreover, these outcomes are important for two empirical points. First, the kind of to-be-learned material can impact how students regulate their learning. For instance, valence did not influence self-paced study times when students learned emotional and neutral words. By contrast, valence influenced self-paced study times when students learned emotional and neutral pictures. Second, the measure of metacognitive control used can have important implications on the conclusions drawn about how people regulate their learning. Specifically, study time allocation does not appear to be sensitive to valence when students regulate their learning of single words. By contrast, follow-up research demonstrated that students adopt a discrepancy-reduction agenda when regulating their learning of emotional and neutral words with item selection. Additional work is needed

to provide a cohesive account of how students will regulate their learning of different kinds of emotional information using various measures of metacognitive control.

APPENDIX A

Method and Results for Normative Studies

Study 1

The primary goal of Study 1 was to obtain normative ratings of complexity, interest, and importance for positive, negative, and neutral words. In addition, I also aimed to obtain normative ratings of valence and arousal for comparison with established normative ratings.

Method

Participants. Participants were recruited from Amazon's Mechanical Turk and there were two inclusion criteria: participants had to speak English and have a 90% or above approval rating. A total of 93 participants completed the study and were paid $1.00. Of them, 18 participants were removed from analyses because they provided responses that indicated that they did not take the study seriously (e.g., entering the same response for every item). Thus, the final sample consisted of 75 participants (M_{age} = 32.87, SD = 9.14; 32 female).

Materials and procedure. Three hundred words were taken from the Bradley and Lang (1999) Affective Norms for English Words (see Table A1). Participants completed the rating task in five blocks. For each block, participants rated all 300 words on one characteristics: complexity, interest, importance, valence, or arousal. The order of blocks and the words within each block were randomized anew for each participant. For all characteristics, participants were presented with the entire list of words, and for each word they were provided with a Likert-style scale to rate it on a scale of 1 to 7. Next, I provide the instructions participants were given for each task.

Participants were first given the following general instructions about the rating task:

> "In the following task, you will rate a list of words on different characteristics. Specifically, you will be given a characteristic and be asked to rate all of the words in

the list on that characteristic. You will repeat this process for each characteristic. Please make sure to carefully read the description of the characteristic, so that you will be able to accurately rate each word.

Please **take the task seriously**, but do not spend too much time on any given item. In addition, **please use the entire range of the scale**."

Before rating the words on complexity, participants were given the following instructions:

"Please rate the following words based on their **complexity**.

When thinking about complexity, we **do not** want you to make ratings based on how complex the literal word is. For example, we **do not** want you to judge the word "paperclip" to be more complex than the word "art" simply because it has more letters or syllables. Rather, we want you to rate each word based on the complexity of the item that *word represents*. For the preceding example, we would want you to consider the complexity of a paperclip as a concept and of art as a concept.

Your ratings will be made on a scale of 1 (Low Complexity) to 7 (High Complexity)."

Before rating the words on interest, participants were given the following instructions:

"Please rate the following words based on how **interesting** you find them to be.

Your ratings will be made on a scale of 1 (Uninteresting) to 7 (Very Interesting)."

Before rating the words on importance, participants were given the following instructions:

"Please rate the following words based on their **importance**.

When thinking about importance, please rate each word based on how important you think the item that the word represents is in everyday life.

Your ratings will be made on a scale of 1 (Low Importance) to 7 (High Importance)."

Before rating the words on valence, participants were given the following instructions

(adapted from Bradley & Lang, 1999):

"Please rate the following words based on how **unhappy or happy** you find them to be.

On one extreme of the scale (i.e., **unhappy**), the word makes you feel unhappy, annoyed, unsatisfied, melancholic, despaired, or bored. The other end of the scale is the exact opposite. On this end of the scale (i.e., **happy**), the word makes you feel

happy, pleased, satisfied, contented, or hopeful.

Your ratings will be made on a scale of 1 (Unhappy) to 7 (Happy)."

Before rating the words on arousal, participants were given the following instructions (adapted from Bradley & Lang, 1999):

"Please rate the following words based on how **calm or exciting** you find them to be.

On one extreme of the scale (i.e., **calm**), the word makes you feel completely relaxed, calm, sluggish, dull, sleepy, or unaroused. The other end of the scale is the exact opposite. On this end of the scale (i.e., **excited**), the word makes you feel stimulated, excited, frenzied, jittery, wide-awake, or aroused.

Your ratings will be made on a scale of 1 (Calm) to 7 (Excited)."

After finishing all five blocks, participants completed the following individual difference measures: need for cognition (Cacioppo, Petty, & Kao, 1984; Cronbach's $\alpha = .77$), need for emotion (Raman, Chattopadhyay, & Hoyer, 1995; Cronbach's $\alpha = .90$), and need for structure (Thompson, Naccarato, Parker, & Moskowitz, 2001; Cronbach's $\alpha = .68$). The order of these measures was randomized anew for each participant. Finally, participants answered demographic questions. All tasks were self-paced.

Results

Normative ratings. Descriptive statistics for each characteristic for each word are presented in Table A1. The 45 words that were selected for Experiments 1 and 2 are denoted with an asterisk (see main text for more information on the selected words).

Individual difference measures. For exploratory purposes, I investigated whether individual differences in need for cognition, need for emotion, and need for structure were related to participants' ratings (see Table A2). To evaluate this issue, I computed composite scores for each measure per participant by taking the average of all of their ratings for that measure. Specifically, I computed 8 composite scores per participant, one for each type of

rating and one for each individual difference measure. For example, for complexity, for each participant I computed an average of their complexity ratings for all 300 words. The composite scores for each measure were then entered into a correlation matrix.

Table A2

Correlations between Participants' Normative Ratings and Individual Differences Measures in Study 1

	M	*SE*	1	2	3	4	5	6	7
1. Complexity	4.27	.13	1.00						
2. Interest	4.19	.14	.68**	1.00					
3. Importance	4.06	.15	.71**	.78**	1.00				
4. Valence	4.45	.11	.59**	.81**	.74**	1.00			
5. Arousal	4.01	.16	.62**	.73**	.77**	.68**	1.00		
6. NFE	2.63	.09	-.42**	-.50**	-.49**	-.52**	-.35*	1.00	
7. NFS	3.92	.07	-.05	-.01	-.11	.06	-.12	-.19	1.00
8. NFC	4.11	.09	-.06	.04	-.03	.01	-.05	.30*	-.02

Note. NFE = Need for Emotion. NFS = Need for Structure. NFC = Need for Cognition. ** $p < .001$, * $p < .01$

Participants' scores on the need for emotion scale were negatively related to their ratings for all normative characteristics (complexity, $r = -.42$, $N = 75$, $p < .001$, $R^2 = .18$; interest, $r = -.50$, $N = 75$, $p < .001$, $R^2 = .25$; importance, $r = -.49$, $N = 75$, $p < .001$, $R^2 = .24$; valence, $r = -.52$, $N = 75$, $p < .001$, $R^2 = .27$; arousal, $r = -.35$, $N = 75$, $p = .002$, $R^2 = .12$). Thus, a greater need for emotion was associated with lower ratings of complexity, interest, importance, arousal, and valence (i.e., participants rated the words as being more negative). Participants' scores on the need for emotion scale were positively related to their scores on the need for cognition scale, $r = .30$, $N = 75$, $p = .009$, $R^2 = .09$. Thus, participants with a greater need for emotion were also likely to have a greater need for cognition. Participants' scores on the need for cognition scale were not significantly related to their ratings on any of the normative characteristics, *p*s > .64. Similarly, participants' scores on the need for

structure scale were not significantly related to their ratings on any of the characteristics, *p*s > .29, or either of the other individual difference measures, *p*s > .11. Participants' ratings on the normative characteristics were all positively correlated with each other, *r*s > .59, *p*s < .001.

Study 2

In Study 2, I obtained normative ratings of complexity, interest, and importance for positive, negative, and neutral pictures. In addition, I also obtained ratings of valence and arousal for comparison with published norms.

Method

Participants. Participants were recruited from Amazon's Mechanical Turk with the same constraints as in Study 1. Ninety-eight participants completed the study and were compensated with $1.00. None of the participants in Study 2 had completed Study 1. Five participants were removed from analyses because they provided responses that indicated that they did not take the study seriously. Thus, the remaining sample consisted of 93 participants (M_{age} = 29.85, *SD* = 8.52; 24 female).

Materials and procedure. Study 2 was similar to Study 1, except participants rated pictures instead of words. Specifically, 150 pictures were taken from the International Affective Picture System (IAPS; Lang et al., 2008). The instructions for the rating task were modified slightly to account for the fact that participants were rating pictures instead of words. For complexity, the instructions did not include an example as in Study 1. Instead, participants were instructed to rate the pictures based on their complexity on a scale from 1 (low complexity) to 7 (high complexity). Otherwise, the rating tasks were identical to those of Study 1. After finishing all 5 blocks, participants completed the individual difference

measures (i.e., need for cognition, Cronbach's α = .67; need for emotion, Cronbach's α = .87; and need for structure, Cronbach's α = .57) and the demographic questions as in Study 1.

Results

Normative ratings. Descriptive statistics for each characteristic and for each picture are presented in Table A3. The 45 pictures that were used in Experiments 3 and 4 are denoted with an asterisk (see main text for more information on these pictures).

Individual difference measures. As in Study 1, I explored the relationships between participants' ratings and individual differences in need for cognition, need for emotion, and need for structure (see Table A4). Composite scores were computed as in Study 1.

Table A4
Correlations between Participants' Normative Ratings and Individual Differences Measures in Study 2

	M	*SE*	1	2	3	4	5	6	7
1. Complexity	4.44	.11	1.00						
2. Interest	4.32	.12	.83**	1.00					
3. Importance	4.41	.12	.79**	.85**	1.00				
4. Valence	4.31	.11	.74**	.80**	.72**	1.00			
5. Arousal	4.42	.11	.79**	.82**	.78**	.87**	1.00		
6. NFE	2.31	.07	-.42**	-.38**	-.42**	-.37**	-.39**	1.00	
7. NFS	3.91	.05	.19	.03	.21*	.04	.11	-.47**	1.00
8. NFC	4.12	.07	-.20	-.18	-.21*	.01	-.06	.41**	-.40**

Note. NFE = Need for Emotion. NFS = Need for Structure. NFC = Need for Cognition. ** $p < .001$, * $p < .05$

As in Study 1, there were significant negative relationships between participants' scores on the need for emotion scale and their ratings for all normative characteristics (complexity, $r = -.42$, $N = 93$, $p < .001$, $R^2 = .18$; interest, $r = -.38$, $N = 93$, $p < .001$, $R^2 = .14$; importance, $r = -.42$, $N = 93$, $p < .001$, $R^2 = .18$; valence, $r = -.37$, $N = 93$, $p < .001$, $R^2 = .14$; arousal, $r = -.39$, $N = 93$, $p < .001$, $R^2 = .15$). Thus, participants' who scored higher on the need for emotion scale provided lower ratings of complexity, interest, importance, valence

(i.e., rated the items as more negative), and arousal. Participants' scores on the need for emotion scale were negatively associated with their scores on the need for structure scale, r = -.47, N = 93, p < .001, R^2 = .22, and positively associated with their scores on the need for cognition scale, r = .41, N = 93, p < .001, R^2 = .17. Thus, participants with a high need for emotion were likely to have a low need for structure and a high need for cognition. Participants' scores on the need for structure scale and the need for cognition scale were not significantly related to their ratings of complexity, interest, valence, or arousal, ps > .05. Participants' ratings of importance were positively related to their scores on the need for structure scale, r = .21, N = 93, p = .04, R^2 = .04, and negatively related to their scores on the need for cognition scale, r = -.21, N = 93, p = .04, R^2 = .04. Thus, participants who were high in need for structure rated the pictures as more important, and participants were high in need for cognition rated the pictures as less important. Participants' scores on the need for structure and need for cognition scales were negatively related, r = -.40, N = 93, p < .001, R^2 = .16. Thus, participants who scored high in need for structure scored low in need for cognition. Participants' ratings on the normative characteristics were all positively correlated with each other, rs > .72, ps < .001.

Table A1

Normative Ratings in Study 1

Word	Complexity	Interest	Importance	Valence	Arousal
accident	4.71 (0.19)	3.53 (0.21)	3.67 (0.24)	3.43 (0.23)	4.31 (0.23)
addict	4.55 (0.20)	3.56 (0.21)	3.35 (0.24)	3.33 (0.23)	4.07 (0.23)
alcoholic	4.64 (0.20)	3.41 (0.23)	3.60 (0.24)	3.71 (0.24)	4.11 (0.23)
ambulance	4.43 (0.19)	4.11 (0.23)	4.36 (0.23)	3.68 (0.21)	4.43 (0.24)
angel*	4.56 (0.20)	4.45 (0.23)	4.40 (0.22)	5.17 (0.17)	4.03 (0.24)
ankle	4.13 (0.22)	3.91 (0.23)	4.47 (0.22)	4.69 (0.18)	3.55 (0.23)
arm	4.21 (0.21)	3.91 (0.22)	4.92 (0.21)	4.72 (0.15)	3.79 (0.24)
army	4.80 (0.20)	4.32 (0.22)	4.20 (0.22)	4.00 (0.18)	4.40 (0.22)
avalanche	4.68 (0.20)	4.32 (0.22)	3.85 (0.23)	3.55 (0.22)	4.45 (0.23)
avenue	4.03 (0.19)	3.96 (0.22)	3.79 (0.23)	4.56 (0.18)	3.65 (0.22)
baby*	4.85 (0.20)	4.85 (0.22)	4.61 (0.22)	5.27 (0.18)	4.24 (0.24)
banner	4.05 (0.23)	3.91 (0.22)	3.57 (0.24)	4.28 (0.19)	3.71 (0.25)
bar	4.04 (0.23)	3.61 (0.22)	3.68 (0.25)	4.28 (0.21)	4.17 (0.21)
barrel	3.76 (0.22)	3.83 (0.23)	3.51 (0.25)	4.23 (0.18)	3.87 (0.25)
basket*	4.16 (0.22)	4.20 (0.22)	3.75 (0.24)	4.59 (0.18)	3.61 (0.23)
bath	3.67 (0.21)	4.09 (0.23)	4.47 (0.21)	4.97 (0.19)	3.45 (0.23)
bathroom	4.00 (0.19)	4.04 (0.22)	4.68 (0.21)	4.57 (0.16)	3.69 (0.24)
beach*	4.57 (0.21)	4.85 (0.20)	4.23 (0.23)	5.32 (0.17)	4.21 (0.24)
beast*	4.36 (0.21)	3.80 (0.24)	3.63 (0.25)	3.85 (0.22)	4.24 (0.22)
bed	4.04 (0.24)	4.39 (0.22)	4.76 (0.21)	5.32 (0.18)	3.56 (0.26)
bees	4.32 (0.21)	4.11 (0.22)	4.24 (0.23)	4.31 (0.20)	4.25 (0.21)
bird	4.36 (0.21)	4.36 (0.21)	4.28 (0.23)	5.03 (0.18)	3.85 (0.22)
blister	3.93 (0.20)	3.33 (0.21)	3.40 (0.23)	3.33 (0.22)	3.93 (0.22)
board	3.73 (0.22)	4.04 (0.21)	3.85 (0.23)	4.21 (0.18)	3.77 (0.25)
body	4.69 (0.20)	4.35 (0.21)	4.81 (0.21)	4.69 (0.18)	3.89 (0.23)
bomb*	4.72 (0.21)	3.48 (0.23)	3.49 (0.25)	3.47 (0.24)	4.53 (0.24)
book	4.51 (0.21)	4.69 (0.22)	4.64 (0.21)	4.85 (0.18)	3.95 (0.23)
bottle	3.69 (0.23)	4.11 (0.23)	3.76 (0.25)	4.59 (0.17)	3.67 (0.23)
bowl	3.71 (0.23)	3.77 (0.22)	3.80 (0.23)	4.36 (0.18)	3.60 (0.24)
boxer	4.05 (0.21)	3.99 (0.23)	3.72 (0.23)	4.28 (0.20)	4.16 (0.22)
bride	4.37 (0.22)	4.28 (0.20)	4.24 (0.23)	5.03 (0.17)	4.47 (0.23)
building*	4.77 (0.19)	3.93 (0.21)	4.45 (0.22)	4.43 (0.17)	3.61 (0.23)
bullet*	3.95 (0.23)	3.73 (0.23)	3.51 (0.23)	3.73 (0.23)	4.13 (0.24)
bunny	4.15 (0.21)	4.65 (0.19)	4.03 (0.23)	5.03 (0.18)	3.96 (0.24)
burn	3.80 (0.20)	3.73 (0.22)	3.53 (0.23)	3.45 (0.23)	3.91 (0.24)
butter	3.71 (0.22)	4.27 (0.23)	3.96 (0.22)	4.95 (0.17)	3.61 (0.24)
butterfly	4.51 (0.19)	4.72 (0.20)	3.92 (0.22)	5.23 (0.18)	4.07 (0.23)
cabinet	4.00 (0.20)	4.01 (0.22)	3.95 (0.24)	4.56 (0.18)	3.68 (0.24)
cake*	3.89 (0.20)	4.72 (0.21)	4.01 (0.25)	5.17 (0.19)	4.24 (0.24)
cancer	4.89 (0.19)	4.09 (0.24)	4.05 (0.26)	3.13 (0.25)	4.65 (0.24)

candy*	3.84 (0.21)	4.57 (0.20)	3.97 (0.21)	5.16 (0.18)	4.31 (0.25)
cane	3.67 (0.24)	4.03 (0.23)	3.72 (0.24)	4.52 (0.18)	3.51 (0.22)
cash	3.96 (0.22)	4.72 (0.21)	4.96 (0.20)	5.08 (0.19)	4.47 (0.23)
casino	4.32 (0.21)	4.20 (0.21)	3.55 (0.24)	4.31 (0.22)	4.24 (0.23)
cat	4.33 (0.23)	4.67 (0.20)	4.20 (0.22)	5.19 (0.17)	4.36 (0.22)
cell	4.37 (0.23)	3.99 (0.23)	4.24 (0.23)	4.31 (0.18)	3.72 (0.23)
cellar	4.12 (0.19)	4.07 (0.23)	3.32 (0.23)	4.13 (0.20)	3.91 (0.23)
cemetery	4.41 (0.20)	4.27 (0.22)	3.85 (0.23)	3.51 (0.23)	3.75 (0.24)
chair	3.71 (0.20)	3.87 (0.22)	4.25 (0.21)	4.71 (0.15)	3.47 (0.22)
champion	4.77 (0.21)	4.71 (0.22)	4.11 (0.24)	5.03 (0.18)	4.37 (0.22)
child	4.77 (0.20)	4.49 (0.21)	4.77 (0.24)	5.12 (0.18)	4.13 (0.24)
chin	3.69 (0.22)	3.80 (0.23)	4.05 (0.22)	4.56 (0.17)	3.64 (0.23)
chocolate	4.16 (0.21)	4.85 (0.20)	4.29 (0.22)	5.49 (0.15)	4.69 (0.23)
Christmas	4.68 (0.21)	4.76 (0.20)	4.48 (0.22)	5.39 (0.18)	4.84 (0.22)
church	4.52 (0.19)	4.32 (0.21)	4.08 (0.23)	4.77 (0.20)	3.84 (0.23)
circle	4.00 (0.22)	3.92 (0.21)	3.49 (0.23)	4.64 (0.17)	3.55 (0.24)
circus	4.37 (0.19)	4.73 (0.21)	3.79 (0.23)	4.96 (0.17)	4.60 (0.22)
city	4.73 (0.20)	4.56 (0.21)	4.55 (0.23)	4.84 (0.17)	4.45 (0.21)
clock	4.15 (0.21)	4.35 (0.22)	4.35 (0.23)	4.80 (0.17)	3.83 (0.23)
coast	4.39 (0.20)	4.27 (0.21)	4.05 (0.23)	4.95 (0.18)	3.95 (0.24)
coffin	4.07 (0.20)	3.75 (0.22)	3.37 (0.22)	3.55 (0.23)	3.97 (0.23)
cord	3.80 (0.22)	3.73 (0.24)	3.81 (0.22)	4.27 (0.19)	3.81 (0.24)
corner	3.72 (0.21)	3.85 (0.25)	3.77 (0.23)	4.12 (0.17)	3.47 (0.22)
corpse	4.07 (0.21)	3.75 (0.23)	3.61 (0.24)	3.39 (0.25)	4.05 (0.22)
cottage	4.25 (0.20)	4.59 (0.22)	3.83 (0.23)	4.75 (0.17)	3.57 (0.23)
cow	4.28 (0.23)	4.08 (0.22)	4.08 (0.23)	4.73 (0.17)	3.87 (0.23)
crash	4.35 (0.19)	3.88 (0.22)	3.56 (0.24)	3.45 (0.23)	4.56 (0.22)
crime	4.60 (0.19)	3.69 (0.22)	3.59 (0.24)	3.40 (0.24)	4.36 (0.23)
cuddle	4.08 (0.22)	4.81 (0.21)	4.64 (0.22)	5.44 (0.19)	3.81 (0.23)
dagger	3.87 (0.19)	3.89 (0.22)	3.37 (0.22)	3.68 (0.22)	4.24 (0.23)
death	4.83 (0.22)	3.99 (0.24)	3.81 (0.26)	3.04 (0.24)	3.96 (0.24)
debt	4.24 (0.21)	3.67 (0.23)	4.32 (0.23)	3.52 (0.25)	4.25 (0.23)
demon	4.23 (0.20)	4.25 (0.25)	3.27 (0.23)	3.64 (0.24)	4.32 (0.23)
dentist	4.28 (0.20)	3.71 (0.23)	4.11 (0.22)	4.43 (0.22)	4.17 (0.22)
devil	4.64 (0.21)	4.15 (0.25)	3.31 (0.26)	3.48 (0.24)	4.05 (0.23)
diamond*	4.40 (0.19)	4.69 (0.21)	3.95 (0.22)	5.24 (0.19)	4.19 (0.24)
dinner	4.37 (0.21)	4.71 (0.21)	4.97 (0.20)	5.04 (0.16)	4.01 (0.21)
diploma	4.37 (0.23)	4.28 (0.22)	4.49 (0.22)	5.32 (0.16)	3.89 (0.22)
dirt	3.56 (0.21)	3.41 (0.24)	3.39 (0.23)	3.83 (0.21)	3.40 (0.21)
doctor*	4.67 (0.20)	4.07 (0.21)	4.65 (0.21)	4.41 (0.19)	3.97 (0.22)
doll	3.89 (0.23)	3.99 (0.21)	3.45 (0.22)	4.76 (0.19)	3.81 (0.23)
dollar*	4.11 (0.23)	4.80 (0.20)	4.89 (0.21)	5.23 (0.17)	4.03 (0.23)
door*	3.81 (0.23)	3.93 (0.23)	4.44 (0.21)	4.37 (0.18)	3.65 (0.23)

dove	4.19 (0.20)	4.33 (0.21)	3.97 (0.24)	4.83 (0.15)	3.77 (0.24)
dream	5.17 (0.18)	4.93 (0.21)	4.43 (0.22)	5.19 (0.17)	4.12 (0.23)
dress	3.65 (0.22)	4.43 (0.23)	4.11 (0.25)	5.07 (0.17)	3.79 (0.23)
dummy	3.69 (0.21)	3.52 (0.22)	3.49 (0.24)	3.77 (0.20)	3.59 (0.21)
dump	3.67 (0.20)	3.55 (0.23)	3.32 (0.24)	3.49 (0.21)	3.67 (0.23)
earth	4.91 (0.22)	4.93 (0.19)	5.13 (0.20)	5.19 (0.16)	4.07 (0.23)
egg	3.81 (0.22)	4.17 (0.22)	4.29 (0.24)	4.56 (0.18)	3.93 (0.23)
elbow*	4.20 (0.22)	3.93 (0.24)	4.40 (0.23)	4.43 (0.16)	3.73 (0.24)
engine*	4.68 (0.19)	4.04 (0.22)	4.37 (0.22)	4.68 (0.18)	4.07 (0.22)
fabric	4.16 (0.23)	4.21 (0.22)	4.29 (0.22)	4.61 (0.17)	3.61 (0.24)
family	5.16 (0.19)	5.00 (0.20)	5.49 (0.18)	5.71 (0.15)	4.25 (0.23)
farm	4.11 (0.21)	4.23 (0.22)	4.16 (0.21)	4.93 (0.18)	3.76 (0.24)
fever	3.84 (0.21)	3.80 (0.23)	3.53 (0.24)	3.37 (0.23)	3.81 (0.22)
fight	4.13 (0.20)	3.69 (0.22)	3.73 (0.23)	3.63 (0.23)	4.60 (0.22)
filth	4.04 (0.21)	3.44 (0.22)	3.39 (0.24)	3.51 (0.23)	3.95 (0.22)
finger	4.20 (0.20)	3.97 (0.21)	4.55 (0.22)	4.55 (0.17)	3.67 (0.21)
fire*	4.23 (0.20)	4.17 (0.23)	4.05 (0.23)	3.83 (0.22)	4.55 (0.24)
fireworks	4.48 (0.17)	4.63 (0.20)	3.63 (0.23)	4.80 (0.20)	5.05 (0.21)
fish	4.41 (0.22)	4.11 (0.21)	4.04 (0.22)	4.68 (0.19)	4.01 (0.23)
flag	3.87 (0.22)	4.27 (0.22)	4.09 (0.24)	4.65 (0.17)	3.93 (0.23)
flood	4.17 (0.21)	3.93 (0.22)	3.65 (0.23)	3.36 (0.24)	3.97 (0.24)
flower*	4.63 (0.19)	4.65 (0.21)	4.20 (0.23)	5.28 (0.16)	3.77 (0.24)
foam	3.80 (0.21)	3.76 (0.22)	3.64 (0.24)	4.40 (0.16)	3.76 (0.26)
food	4.35 (0.22)	4.73 (0.20)	5.09 (0.22)	5.29 (0.17)	4.03 (0.23)
foot	4.28 (0.23)	4.00 (0.24)	4.52 (0.22)	4.43 (0.17)	3.71 (0.25)
fork	3.65 (0.24)	3.84 (0.23)	4.03 (0.22)	4.59 (0.19)	3.71 (0.24)
friend	4.84 (0.21)	5.20 (0.18)	5.15 (0.19)	5.60 (0.16)	4.13 (0.23)
frog	3.89 (0.21)	3.57 (0.22)	3.55 (0.24)	4.08 (0.19)	3.65 (0.22)
funeral	4.13 (0.20)	3.77 (0.23)	3.68 (0.24)	3.39 (0.24)	3.72 (0.23)
fungus	4.27 (0.20)	3.83 (0.24)	3.39 (0.23)	3.49 (0.22)	3.89 (0.23)
fur	3.81 (0.21)	4.09 (0.23)	3.67 (0.22)	4.53 (0.20)	3.79 (0.23)
garden	4.32 (0.21)	4.51 (0.22)	4.48 (0.21)	5.07 (0.18)	3.89 (0.25)
germs	4.28 (0.21)	3.91 (0.23)	4.03 (0.24)	3.52 (0.22)	4.15 (0.23)
gift*	4.24 (0.20)	4.61 (0.22)	4.16 (0.24)	5.27 (0.17)	4.25 (0.23)
gold	4.12 (0.23)	4.83 (0.21)	4.40 (0.24)	5.24 (0.18)	4.48 (0.24)
graduate	4.59 (0.20)	4.52 (0.20)	4.32 (0.22)	5.29 (0.18)	3.99 (0.22)
grass	4.05 (0.22)	4.11 (0.21)	4.17 (0.22)	4.77 (0.15)	3.65 (0.23)
grenade	4.36 (0.23)	3.77 (0.22)	3.72 (0.25)	3.64 (0.24)	4.49 (0.23)
grin	3.84 (0.21)	4.17 (0.23)	4.20 (0.23)	4.81 (0.19)	3.89 (0.24)
gun*	4.40 (0.20)	3.67 (0.22)	3.65 (0.23)	3.64 (0.23)	4.61 (0.23)
hammer	4.01 (0.24)	3.75 (0.21)	3.73 (0.22)	4.40 (0.18)	3.88 (0.24)
hand	4.27 (0.22)	4.25 (0.23)	4.91 (0.20)	4.61 (0.19)	3.76 (0.23)
hat	3.79 (0.23)	3.83 (0.23)	3.73 (0.21)	4.45 (0.18)	3.61 (0.24)

heart	4.96 (0.21)	5.01 (0.19)	5.36 (0.20)	5.16 (0.18)	4.16 (0.24)
heaven	5.15 (0.20)	4.68 (0.22)	4.41 (0.22)	5.20 (0.19)	3.92 (0.23)
heroin	4.29 (0.22)	4.13 (0.23)	3.44 (0.25)	3.63 (0.25)	4.40 (0.23)
highway	4.32 (0.20)	4.27 (0.22)	4.36 (0.23)	4.45 (0.16)	4.09 (0.22)
home	4.61 (0.19)	4.95 (0.21)	5.05 (0.21)	5.59 (0.16)	3.65 (0.25)
honey*	4.29 (0.21)	4.35 (0.21)	4.19 (0.21)	5.31 (0.18)	3.87 (0.24)
horse	4.19 (0.21)	4.45 (0.22)	4.04 (0.22)	4.89 (0.17)	3.96 (0.22)
hospital	4.60 (0.20)	3.89 (0.22)	4.63 (0.23)	3.75 (0.20)	4.37 (0.22)
hostage	4.67 (0.19)	4.35 (0.22)	3.77 (0.24)	3.36 (0.23)	4.51 (0.23)
hotel	4.28 (0.21)	4.44 (0.23)	4.15 (0.23)	4.63 (0.18)	3.99 (0.23)
house	4.43 (0.20)	4.68 (0.21)	4.91 (0.21)	5.13 (0.18)	3.79 (0.24)
hug*	3.95 (0.23)	4.60 (0.21)	4.76 (0.21)	5.20 (0.19)	4.24 (0.24)
hurricane	4.91 (0.21)	4.51 (0.22)	3.87 (0.23)	3.40 (0.24)	4.57 (0.22)
industry	5.00 (0.18)	4.37 (0.23)	4.20 (0.22)	4.53 (0.16)	4.03 (0.21)
infant	4.81 (0.20)	4.51 (0.23)	4.56 (0.24)	4.97 (0.20)	3.89 (0.23)
infection	4.60 (0.20)	3.87 (0.22)	3.64 (0.24)	3.24 (0.24)	3.93 (0.24)
injury*	4.35 (0.22)	3.65 (0.22)	4.01 (0.24)	3.37 (0.23)	4.11 (0.22)
ink	3.61 (0.23)	4.04 (0.22)	3.97 (0.22)	4.43 (0.17)	3.72 (0.23)
insect	4.29 (0.20)	3.67 (0.21)	3.60 (0.22)	3.75 (0.23)	4.03 (0.21)
iron	3.83 (0.21)	3.96 (0.23)	3.92 (0.25)	4.61 (0.18)	3.97 (0.23)
jail*	4.24 (0.21)	3.63 (0.23)	3.60 (0.24)	3.20 (0.25)	4.07 (0.24)
jelly	3.75 (0.22)	4.33 (0.23)	3.84 (0.24)	4.65 (0.18)	3.56 (0.24)
jewel	4.55 (0.19)	4.79 (0.21)	4.27 (0.21)	5.17 (0.16)	4.11 (0.23)
journal*	4.21 (0.20)	4.25 (0.21)	3.68 (0.23)	4.65 (0.16)	3.72 (0.23)
jug	3.67 (0.23)	3.95 (0.23)	3.63 (0.23)	4.25 (0.18)	3.77 (0.25)
ketchup	4.07 (0.23)	3.99 (0.23)	3.73 (0.24)	4.57 (0.19)	3.79 (0.23)
kettle	3.76 (0.22)	3.83 (0.23)	3.75 (0.24)	4.51 (0.18)	3.60 (0.23)
key*	4.07 (0.22)	4.45 (0.23)	4.28 (0.21)	4.48 (0.18)	3.73 (0.23)
kids	4.57 (0.21)	4.71 (0.21)	4.99 (0.21)	5.20 (0.18)	4.16 (0.23)
king	4.40 (0.20)	4.47 (0.22)	3.95 (0.25)	4.43 (0.19)	4.05 (0.23)
kiss	4.55 (0.20)	5.03 (0.20)	4.71 (0.22)	5.37 (0.18)	4.52 (0.23)
kitten	4.52 (0.21)	4.91 (0.21)	4.29 (0.21)	5.28 (0.18)	4.07 (0.24)
knife*	4.00 (0.21)	3.76 (0.22)	4.04 (0.22)	3.95 (0.21)	4.12 (0.23)
lake	4.39 (0.21)	4.48 (0.21)	4.28 (0.23)	5.03 (0.17)	4.00 (0.24)
lamp*	3.79 (0.21)	3.87 (0.23)	3.95 (0.23)	4.72 (0.17)	3.79 (0.24)
lawn	4.19 (0.20)	4.08 (0.21)	4.12 (0.23)	4.41 (0.17)	3.67 (0.23)
leader	4.61 (0.18)	4.29 (0.23)	4.27 (0.24)	4.93 (0.18)	4.04 (0.23)
letter	4.19 (0.22)	4.13 (0.22)	4.12 (0.23)	4.53 (0.18)	3.79 (0.24)
lightbulb	4.44 (0.21)	4.15 (0.22)	4.45 (0.23)	4.63 (0.17)	3.91 (0.22)
lion	4.36 (0.22)	4.53 (0.22)	3.71 (0.24)	4.68 (0.17)	4.35 (0.23)
locker	3.79 (0.23)	3.75 (0.23)	3.75 (0.23)	4.31 (0.20)	3.80 (0.24)
machine	4.60 (0.19)	4.31 (0.20)	4.53 (0.20)	4.63 (0.17)	4.00 (0.22)
maggot	4.04 (0.21)	3.69 (0.23)	3.27 (0.25)	3.63 (0.24)	4.31 (0.23)

market	4.45 (0.20)	4.39 (0.21)	4.44 (0.21)	4.84 (0.17)	4.11 (0.22)
massacre	4.83 (0.19)	3.99 (0.24)	3.89 (0.24)	3.36 (0.24)	4.53 (0.24)
material	4.45 (0.20)	4.43 (0.23)	4.47 (0.21)	4.57 (0.17)	3.76 (0.23)
medicine	4.95 (0.19)	4.35 (0.19)	4.84 (0.21)	4.45 (0.19)	3.64 (0.22)
milk	3.95 (0.21)	4.05 (0.25)	4.29 (0.22)	4.55 (0.19)	3.83 (0.22)
mold*	4.13 (0.20)	3.64 (0.24)	3.43 (0.24)	3.67 (0.23)	3.95 (0.22)
money	4.71 (0.19)	4.80 (0.21)	5.24 (0.19)	5.28 (0.17)	4.37 (0.21)
morgue	4.44 (0.22)	3.89 (0.23)	3.84 (0.25)	3.59 (0.25)	3.97 (0.23)
mosquito	4.04 (0.21)	3.49 (0.23)	3.39 (0.23)	3.55 (0.25)	4.20 (0.21)
mother	5.25 (0.18)	5.13 (0.19)	5.21 (0.22)	5.47 (0.16)	4.32 (0.23)
mountain	4.49 (0.20)	4.67 (0.21)	4.20 (0.24)	4.95 (0.17)	4.17 (0.24)
movie	4.36 (0.19)	4.81 (0.19)	4.04 (0.20)	5.33 (0.15)	4.55 (0.22)
muscular	4.39 (0.21)	4.04 (0.20)	4.01 (0.21)	4.67 (0.18)	4.11 (0.23)
museum	4.72 (0.19)	4.92 (0.18)	4.24 (0.23)	5.09 (0.17)	3.95 (0.24)
mushroom	3.95 (0.22)	4.03 (0.22)	3.71 (0.24)	4.15 (0.18)	4.08 (0.25)
music	5.09 (0.19)	4.88 (0.20)	4.65 (0.21)	5.63 (0.16)	4.56 (0.24)
nature	5.25 (0.18)	4.89 (0.21)	5.03 (0.22)	5.45 (0.16)	3.99 (0.23)
needle*	3.83 (0.22)	3.80 (0.19)	3.73 (0.23)	3.99 (0.20)	3.95 (0.23)
nurse	4.23 (0.20)	3.92 (0.20)	4.57 (0.21)	4.85 (0.17)	4.00 (0.23)
nursery	4.69 (0.20)	4.24 (0.21)	4.17 (0.23)	4.68 (0.18)	3.80 (0.23)
ocean	4.93 (0.21)	4.99 (0.20)	4.63 (0.24)	5.13 (0.17)	4.09 (0.24)
office*	4.32 (0.17)	4.03 (0.22)	4.27 (0.21)	4.45 (0.15)	3.93 (0.23)
owl	4.35 (0.20)	4.64 (0.18)	3.73 (0.23)	4.73 (0.17)	3.85 (0.22)
paint	3.93 (0.20)	4.19 (0.20)	3.87 (0.23)	4.75 (0.17)	3.81 (0.23)
palace	4.57 (0.18)	4.79 (0.22)	3.95 (0.23)	5.01 (0.18)	4.08 (0.23)
paper	3.83 (0.22)	3.96 (0.22)	4.39 (0.21)	4.76 (0.18)	3.43 (0.23)
paradise	4.99 (0.21)	5.07 (0.19)	4.32 (0.22)	5.45 (0.18)	4.24 (0.23)
party	4.01 (0.21)	4.44 (0.22)	3.71 (0.23)	4.87 (0.20)	4.84 (0.21)
passage	4.17 (0.20)	4.17 (0.21)	3.87 (0.23)	4.65 (0.18)	3.71 (0.23)
pencil	3.76 (0.23)	4.01 (0.21)	4.08 (0.21)	4.36 (0.19)	3.72 (0.25)
pest	3.91 (0.21)	3.43 (0.22)	3.51 (0.24)	3.49 (0.23)	3.93 (0.22)
pig	4.04 (0.21)	3.72 (0.24)	3.72 (0.21)	4.27 (0.20)	3.60 (0.23)
pillow	3.84 (0.23)	4.01 (0.23)	4.29 (0.21)	4.99 (0.18)	3.61 (0.25)
pistol	4.24 (0.19)	3.81 (0.22)	3.59 (0.23)	3.75 (0.22)	4.28 (0.24)
plant	4.51 (0.22)	4.43 (0.21)	4.29 (0.23)	5.00 (0.18)	3.75 (0.22)
poison*	4.33 (0.20)	3.71 (0.23)	3.60 (0.26)	3.16 (0.22)	4.37 (0.22)
poster	3.77 (0.22)	3.89 (0.23)	3.61 (0.23)	4.48 (0.17)	3.56 (0.24)
present	4.19 (0.19)	4.36 (0.22)	4.17 (0.22)	5.15 (0.17)	4.35 (0.21)
priest	4.55 (0.20)	3.99 (0.20)	3.89 (0.24)	4.37 (0.20)	3.69 (0.23)
puppy*	4.43 (0.19)	4.95 (0.20)	4.47 (0.20)	5.69 (0.16)	4.57 (0.22)
queen	4.44 (0.21)	4.47 (0.22)	3.87 (0.25)	4.77 (0.18)	3.97 (0.23)
rain	4.32 (0.22)	4.67 (0.22)	4.48 (0.23)	4.75 (0.19)	3.91 (0.23)
rainbow	4.52 (0.21)	5.07 (0.18)	4.40 (0.23)	5.44 (0.17)	3.93 (0.23)

rat*	4.05 (0.23)	3.40 (0.24)	3.15 (0.23)	3.69 (0.23)	4.04 (0.23)
rattle	3.67 (0.21)	3.71 (0.23)	3.40 (0.24)	4.03 (0.19)	4.00 (0.24)
razor	4.03 (0.21)	3.75 (0.22)	3.84 (0.23)	4.12 (0.21)	3.84 (0.22)
reptile	4.13 (0.19)	3.91 (0.22)	3.47 (0.24)	4.15 (0.21)	3.89 (0.22)
restaurant	4.41 (0.20)	4.6 (0.22)	4.28 (0.22)	5.04 (0.17)	3.84 (0.21)
riches	4.87 (0.20)	4.6 (0.20)	4.52 (0.21)	5.20 (0.18)	4.61 (0.21)
rifle	4.29 (0.21)	3.67 (0.22)	3.59 (0.23)	3.60 (0.21)	4.39 (0.24)
river	4.49 (0.19)	4.71 (0.21)	4.37 (0.23)	4.96 (0.18)	3.88 (0.23)
roach	3.93 (0.21)	3.55 (0.22)	3.25 (0.24)	3.32 (0.22)	4.19 (0.24)
robber	4.16 (0.20)	3.72 (0.22)	3.59 (0.24)	3.20 (0.23)	4.09 (0.24)
rock	3.71 (0.23)	3.81 (0.23)	3.76 (0.25)	4.44 (0.20)	3.64 (0.23)
salad	4.07 (0.21)	3.68 (0.22)	3.97 (0.23)	4.67 (0.18)	3.61 (0.24)
scar	4.24 (0.19)	3.73 (0.24)	3.72 (0.23)	3.75 (0.23)	3.67 (0.21)
scorpion	4.33 (0.21)	3.93 (0.23)	3.44 (0.23)	3.63 (0.22)	4.51 (0.23)
scum	3.71 (0.20)	3.60 (0.24)	3.25 (0.24)	3.55 (0.24)	3.99 (0.22)
shadow	4.01 (0.21)	4.12 (0.21)	3.87 (0.24)	4.11 (0.18)	3.73 (0.23)
shark	4.19 (0.20)	4.04 (0.23)	3.52 (0.23)	3.87 (0.22)	4.25 (0.23)
ship	4.56 (0.19)	4.52 (0.21)	3.92 (0.23)	4.68 (0.19)	4.20 (0.23)
shotgun	4.37 (0.20)	3.69 (0.23)	3.41 (0.21)	3.69 (0.24)	4.37 (0.23)
silk	3.87 (0.20)	4.35 (0.21)	3.67 (0.24)	4.81 (0.16)	3.67 (0.24)
skull	4.15 (0.20)	3.97 (0.20)	3.65 (0.22)	3.84 (0.21)	3.77 (0.23)
sky	4.44 (0.22)	4.79 (0.20)	4.88 (0.20)	5.08 (0.18)	3.91 (0.25)
slave	4.49 (0.20)	3.87 (0.23)	3.55 (0.24)	3.36 (0.23)	3.92 (0.23)
slime	4.05 (0.22)	4.01 (0.24)	3.52 (0.26)	3.92 (0.21)	4.03 (0.21)
snake*	4.20 (0.19)	3.68 (0.22)	3.32 (0.22)	3.63 (0.22)	4.31 (0.23)
snow	4.27 (0.21)	4.27 (0.21)	4.00 (0.22)	5.07 (0.18)	3.93 (0.23)
spider	4.21 (0.22)	4.00 (0.24)	3.61 (0.23)	3.67 (0.24)	4.03 (0.23)
spouse	4.37 (0.21)	5.01 (0.20)	5.04 (0.21)	5.21 (0.18)	4.24 (0.24)
spray	3.97 (0.22)	3.63 (0.20)	3.72 (0.24)	4.40 (0.17)	3.91 (0.24)
spring	4.41 (0.20)	4.63 (0.20)	4.36 (0.22)	5.21 (0.17)	3.96 (0.22)
square	3.83 (0.22)	3.88 (0.23)	3.77 (0.23)	4.41 (0.19)	3.68 (0.23)
star*	4.85 (0.18)	5.16 (0.19)	4.65 (0.20)	5.16 (0.17)	4.27 (0.23)
statue	4.57 (0.21)	4.40 (0.21)	4.04 (0.24)	4.61 (0.16)	3.77 (0.24)
storm	4.65 (0.19)	4.15 (0.20)	3.80 (0.24)	3.93 (0.20)	4.37 (0.22)
street	4.27 (0.21)	4.05 (0.23)	4.41 (0.21)	4.75 (0.17)	4.01 (0.24)
sugar	3.88 (0.20)	4.24 (0.21)	4.19 (0.20)	4.92 (0.17)	3.97 (0.22)
sun	4.55 (0.24)	4.83 (0.22)	5.00 (0.23)	5.27 (0.16)	3.97 (0.24)
sunlight	4.36 (0.20)	4.99 (0.20)	4.93 (0.21)	5.37 (0.16)	4.01 (0.24)
sunrise	4.60 (0.20)	5.00 (0.20)	4.84 (0.20)	5.27 (0.18)	4.24 (0.23)
sunset	4.47 (0.20)	4.81 (0.21)	4.85 (0.20)	5.44 (0.17)	3.71 (0.24)
surgery	4.84 (0.21)	3.97 (0.21)	4.09 (0.22)	3.60 (0.24)	4.28 (0.23)
swamp	4.47 (0.21)	3.84 (0.21)	3.61 (0.24)	3.81 (0.21)	3.83 (0.24)
table	3.88 (0.21)	3.73 (0.21)	4.12 (0.23)	4.51 (0.17)	3.52 (0.25)

tank	4.09 (0.22)	3.83 (0.21)	3.77 (0.23)	4.20 (0.20)	4.27 (0.22)
taxi	4.04 (0.21)	3.99 (0.23)	3.57 (0.24)	3.97 (0.19)	3.73 (0.22)
teacher	4.44 (0.17)	4.61 (0.20)	4.79 (0.21)	5.11 (0.17)	3.91 (0.23)
terrorist	4.68 (0.22)	3.95 (0.24)	3.59 (0.25)	3.09 (0.24)	4.59 (0.23)
thief	3.99 (0.22)	3.48 (0.21)	3.59 (0.24)	3.31 (0.22)	4.31 (0.23)
thorn	3.97 (0.22)	3.75 (0.22)	3.52 (0.25)	3.83 (0.22)	3.87 (0.24)
tobacco	4.23 (0.20)	4.03 (0.24)	3.63 (0.24)	3.75 (0.25)	3.77 (0.22)
tomb	4.12 (0.22)	4.12 (0.23)	3.67 (0.24)	3.55 (0.23)	3.99 (0.23)
tool*	4.12 (0.21)	4.08 (0.23)	4.03 (0.22)	4.48 (0.17)	3.80 (0.22)
tornado	4.49 (0.20)	4.45 (0.21)	3.80 (0.25)	3.51 (0.23)	4.44 (0.23)
tower*	4.35 (0.20)	4.24 (0.22)	3.88 (0.24)	4.45 (0.18)	3.84 (0.24)
toy	4.12 (0.20)	4.24 (0.22)	4.16 (0.22)	5.00 (0.18)	3.89 (0.24)
trash*	4.05 (0.22)	3.49 (0.23)	3.71 (0.22)	3.57 (0.22)	3.73 (0.22)
treasure*	4.40 (0.21)	4.77 (0.21)	4.31 (0.22)	5.47 (0.16)	4.65 (0.23)
treat	4.09 (0.21)	4.40 (0.20)	4.08 (0.22)	4.95 (0.18)	4.11 (0.22)
tree	4.29 (0.21)	4.45 (0.20)	4.72 (0.19)	5.19 (0.16)	3.67 (0.25)
trophy	4.19 (0.20)	4.35 (0.22)	3.84 (0.25)	4.96 (0.19)	3.99 (0.24)
truck*	4.21 (0.20)	3.89 (0.22)	4.12 (0.24)	4.37 (0.18)	3.80 (0.22)
trumpet*	4.00 (0.22)	3.96 (0.23)	3.59 (0.23)	4.45 (0.19)	3.95 (0.23)
trunk	3.96 (0.21)	3.84 (0.23)	3.81 (0.24)	4.20 (0.19)	3.53 (0.22)
tumor	4.64 (0.21)	3.87 (0.23)	3.91 (0.25)	3.37 (0.26)	4.43 (0.24)
umbrella	3.93 (0.21)	4.13 (0.23)	3.93 (0.23)	4.72 (0.17)	3.67 (0.24)
vacation*	4.68 (0.18)	4.95 (0.20)	4.29 (0.20)	5.24 (0.19)	4.48 (0.23)
vehicle	4.48 (0.19)	4.17 (0.22)	5.01 (0.19)	4.51 (0.18)	4.12 (0.22)
venom	4.35 (0.19)	4.00 (0.22)	3.48 (0.26)	3.52 (0.24)	4.16 (0.23)
vest	3.61 (0.21)	3.92 (0.23)	3.48 (0.25)	4.40 (0.17)	3.48 (0.22)
victim	4.77 (0.19)	3.97 (0.22)	4.09 (0.23)	3.51 (0.24)	4.13 (0.23)
village	4.43 (0.20)	4.47 (0.22)	4.28 (0.22)	4.67 (0.19)	3.88 (0.23)
volcano	4.56 (0.21)	4.48 (0.22)	3.60 (0.24)	4.03 (0.22)	4.69 (0.22)
vomit	3.71 (0.22)	3.56 (0.24)	3.29 (0.24)	3.20 (0.24)	4.25 (0.21)
wagon*	3.87 (0.20)	4.07 (0.23)	3.53 (0.24)	4.44 (0.18)	3.57 (0.23)
war	4.95 (0.22)	4.07 (0.23)	3.65 (0.26)	3.51 (0.25)	4.67 (0.24)
waste	4.11 (0.22)	3.31 (0.22)	3.49 (0.22)	3.47 (0.24)	3.64 (0.21)
watch	4.27 (0.21)	4.17 (0.22)	4.48 (0.23)	4.72 (0.17)	3.72 (0.23)
water	4.25 (0.23)	4.39 (0.21)	5.20 (0.20)	5.13 (0.14)	3.96 (0.25)
waterfall	4.72 (0.19)	4.97 (0.20)	4.23 (0.22)	5.39 (0.18)	4.29 (0.23)
weapon*	4.51 (0.21)	4.00 (0.24)	3.76 (0.25)	3.83 (0.22)	4.28 (0.24)
wedding	4.56 (0.20)	4.59 (0.21)	4.41 (0.23)	5.09 (0.18)	4.56 (0.23)
wife	4.28 (0.20)	4.55 (0.21)	4.69 (0.22)	5.09 (0.19)	4.25 (0.23)
window	4.09 (0.21)	4.36 (0.23)	4.44 (0.21)	4.77 (0.17)	3.73 (0.24)
wine	3.87 (0.22)	4.21 (0.22)	3.76 (0.24)	4.89 (0.20)	3.91 (0.25)
wink	3.93 (0.21)	4.15 (0.20)	3.88 (0.24)	4.88 (0.17)	3.91 (0.24)
world	5.12 (0.20)	4.88 (0.20)	5.28 (0.20)	4.97 (0.18)	4.28 (0.22)

wounds	4.49 (0.19)	3.77 (0.22)	3.84 (0.23)	3.35 (0.24)	4.23 (0.24)
yellow	3.95 (0.24)	4.24 (0.24)	4.00 (0.24)	4.37 (0.19)	3.81 (0.24)

Note. Standard errors of the mean are in parentheses. The words are listed in alphabetical order, though they were presented in a newly randomized order for each block for each participant in Study 1 (see text for details). For all characteristics, words were rated on a scale from 1 – 7 (complexity, 1 = low complexity, 7 = high complexity; interest, 1 = uninteresting, 7 = very interesting; importance, 1 = low importance, 7 = high importance; valence, 1 = unhappy, 7 = happy; arousal, 1 = calm, 7 = excited). *denotes words used in Experiments 1 and 2.

Table A3

Normative Ratings in Study 2

Slide Number	Description	Complexity	Interest	Importance	Valence	Arousal
1050	Snake	4.66 (0.21)	3.73 (0.22)	4.28 (0.25)	3.81 (0.26)	4.76 (0.19)
1052	Snake	4.51 (0.20)	3.94 (0.22)	4.08 (0.23)	3.51 (0.22)	4.96 (0.22)
1205	Spider	4.42 (0.21)	3.97 (0.23)	3.72 (0.23)	3.35 (0.22)	4.48 (0.21)
1274	Roaches	3.90 (0.22)	3.34 (0.23)	3.45 (0.23)	2.94 (0.22)	4.29 (0.21)
1280*	Rat	4.38 (0.22)	3.41 (0.24)	3.89 (0.23)	3.30 (0.22)	4.39 (0.20)
1321	Bear	4.47 (0.18)	4.42 (0.21)	4.27 (0.21)	3.92 (0.20)	4.97 (0.19)
1350*	Pig	4.20 (0.20)	4.12 (0.23)	3.74 (0.21)	4.17 (0.20)	4.18 (0.20)
1440	Seal	4.48 (0.20)	4.78 (0.19)	4.63 (0.20)	5.03 (0.17)	4.40 (0.21)
1463	Kittens	4.54 (0.19)	5.18 (0.19)	4.77 (0.19)	5.48 (0.16)	4.57 (0.21)
1510	Dog	4.16 (0.20)	4.55 (0.19)	4.44 (0.20)	4.90 (0.18)	4.20 (0.21)
1600	Horse	4.14 (0.20)	4.73 (0.19)	4.53 (0.22)	5.09 (0.16)	3.63 (0.21)
1603	Butterfly	4.57 (0.21)	5.19 (0.18)	4.72 (0.20)	5.44 (0.16)	4.27 (0.22)
1710	Puppies	4.51 (0.21)	5.19 (0.18)	4.69 (0.20)	5.75 (0.15)	4.74 (0.20)
1721	Lion	4.51 (0.20)	4.86 (0.19)	4.58 (0.20)	5.15 (0.17)	4.71 (0.21)
1811	Monkeys	4.28 (0.19)	4.86 (0.19)	4.34 (0.21)	4.86 (0.19)	5.16 (0.17)
1812	Elephants	4.42 (0.21)	5.13 (0.18)	4.90 (0.20)	5.26 (0.17)	4.68 (0.22)
1920	Porpoise	4.45 (0.19)	5.25 (0.18)	4.83 (0.19)	5.59 (0.16)	4.82 (0.20)
1930	Shark	4.61 (0.19)	4.08 (0.21)	4.41 (0.21)	3.74 (0.22)	4.98 (0.21)
2026*	Woman	4.27 (0.19)	4.20 (0.22)	4.14 (0.23)	4.47 (0.18)	4.10 (0.19)
2030	Woman	4.08 (0.21)	4.74 (0.20)	4.57 (0.22)	5.32 (0.19)	4.68 (0.22)
2050*	Baby	4.28 (0.22)	4.89 (0.21)	4.77 (0.20)	5.56 (0.17)	4.52 (0.22)
2071	Baby	4.27 (0.23)	5.23 (0.19)	5.05 (0.20)	5.61 (0.19)	4.78 (0.23)
2095	Toddler	4.63 (0.20)	3.72 (0.22)	4.89 (0.21)	2.88 (0.22)	4.19 (0.21)
2120	Angry Face	4.06 (0.21)	3.68 (0.22)	3.83 (0.23)	3.19 (0.22)	4.29 (0.19)
2158	Children	4.57 (0.20)	5.14 (0.20)	4.96 (0.19)	5.58 (0.16)	4.62 (0.21)
2209	Bride	4.58 (0.19)	5.04 (0.20)	4.77 (0.19)	5.32 (0.17)	4.81 (0.19)
2215	Neutral Man	4.10 (0.21)	3.90 (0.21)	3.85 (0.22)	4.28 (0.17)	3.92 (0.21)
2222*	Boys Reading	4.54 (0.19)	4.92 (0.18)	5.22 (0.18)	4.99 (0.17)	4.05 (0.20)
2274	Kids	4.60 (0.21)	4.92 (0.20)	4.75 (0.20)	5.40 (0.17)	4.54 (0.21)
2276	Girl	4.55 (0.19)	3.86 (0.22)	4.69 (0.21)	3.06 (0.22)	4.25 (0.21)
2279*	Braces	4.49 (0.18)	3.90 (0.22)	4.31 (0.20)	4.01 (0.2)	4.17 (0.19)
2340*	Family	4.48 (0.20)	4.87 (0.20)	5.15 (0.18)	5.40 (0.17)	4.75 (0.21)
2373	Band	4.03 (0.20)	4.89 (0.18)	4.35 (0.21)	5.10 (0.17)	4.63 (0.19)
2377	Reading	4.11 (0.21)	4.70 (0.21)	4.87 (0.21)	4.71 (0.17)	4.17 (0.22)
2383*	Secretary	4.13 (0.19)	4.02 (0.21)	4.23 (0.21)	4.48 (0.18)	4.10 (0.21)
2391	Boy	4.51 (0.18)	4.81 (0.20)	4.48 (0.20)	5.31 (0.16)	4.86 (0.19)
2393*	Factory Worker	4.80 (0.17)	4.37 (0.20)	4.39 (0.22)	4.40 (0.19)	4.28 (0.20)
2396	Couple	3.92 (0.19)	4.25 (0.22)	4.09 (0.20)	4.38 (0.16)	3.95 (0.20)
2399	Woman	4.40 (0.19)	3.65 (0.22)	4.24 (0.21)	3.55 (0.21)	4.14 (0.19)

2411	Girl	4.31 (0.20)	4.47 (0.21)	4.68 (0.20)	4.87 (0.17)	4.28 (0.21)
2445*	Feet	4.38 (0.20)	4.92 (0.23)	5.33 (0.24)	4.90 (0.21)	4.71 (0.25)
2446	Boots	4.23 (0.21)	3.60 (0.23)	3.49 (0.21)	3.66 (0.22)	4.01 (0.21)
2458	Crying Baby	4.31 (0.21)	4.16 (0.21)	4.40 (0.21)	3.72 (0.22)	4.49 (0.20)
2480	Elderly Man	4.12 (0.20)	4.39 (0.21)	4.55 (0.21)	4.49 (0.19)	3.81 (0.22)
2487	Musician	4.25 (0.18)	4.63 (0.20)	4.16 (0.21)	4.69 (0.19)	4.19 (0.20)
2511	Woman	4.24 (0.20)	4.45 (0.21)	4.18 (0.21)	5.28 (0.16)	4.24 (0.21)
2516	Elderly Woman	3.96 (0.21)	4.15 (0.22)	4.23 (0.20)	4.72 (0.19)	3.88 (0.22)
2550	Couple	4.55 (0.21)	5.05 (0.18)	4.74 (0.21)	5.44 (0.16)	4.44 (0.21)
2635*	Cowboy	4.69 (0.19)	4.53 (0.22)	4.51 (0.20)	4.69 (0.19)	4.51 (0.18)
2682	Police	4.55 (0.19)	3.92 (0.22)	4.45 (0.21)	3.61 (0.23)	4.48 (0.18)
2683	War	4.99 (0.20)	4.01 (0.23)	4.72 (0.22)	2.96 (0.23)	5.22 (0.20)
2691	Riot	4.92 (0.20)	4.01 (0.22)	4.58 (0.21)	3.27 (0.23)	5.02 (0.19)
2692	Bomb	4.89 (0.18)	4.09 (0.21)	4.63 (0.22)	3.49 (0.22)	4.87 (0.20)
2703	Sad Children	5.01 (0.19)	3.95 (0.22)	5.03 (0.21)	3.14 (0.24)	4.63 (0.21)
2715	Smoking	4.57 (0.21)	3.70 (0.24)	3.94 (0.23)	3.31 (0.20)	3.85 (0.21)
2722*	Jail	4.47 (0.19)	3.67 (0.23)	4.10 (0.22)	3.34 (0.24)	3.82 (0.21)
2751	Drunk Driving	4.73 (0.20)	3.94 (0.22)	4.41 (0.23)	3.48 (0.22)	4.49 (0.19)
2830*	Woman	4.49 (0.18)	4.33 (0.20)	4.26 (0.21)	3.66 (0.19)	4.11 (0.21)
2840*	Chess	4.44 (0.18)	4.45 (0.20)	4.68 (0.20)	4.47 (0.18)	3.75 (0.23)
3103*	Injury	4.68 (0.21)	3.53 (0.23)	4.04 (0.23)	2.99 (0.24)	4.38 (0.21)
3180*	Battered Female	4.32 (0.20)	3.89 (0.22)	4.34 (0.21)	3.35 (0.22)	4.43 (0.20)
3185	Stitches	4.74 (0.20)	3.46 (0.22)	4.35 (0.22)	2.95 (0.22)	4.33 (0.21)
4532	Attractive Man	4.23 (0.20)	4.80 (0.21)	4.54 (0.19)	5.16 (0.17)	4.34 (0.20)
4598*	Couple	4.77 (0.18)	5.23 (0.18)	5.27 (0.18)	5.05 (0.20)	5.22 (0.18)
4625	Couple	4.58 (0.19)	4.91 (0.19)	4.87 (0.20)	5.61 (0.16)	4.58 (0.20)
4626	Wedding	4.67 (0.20)	5.45 (0.18)	5.32 (0.18)	5.78 (0.16)	5.25 (0.19)
5001*	Sunflower	4.25 (0.21)	4.59 (0.21)	4.46 (0.22)	5.11 (0.17)	4.15 (0.23)
5210*	Seaside	4.52 (0.19)	5.05 (0.19)	4.55 (0.20)	5.27 (0.16)	4.22 (0.22)
5450	Liftoff	5.52 (0.17)	5.30 (0.19)	5.29 (0.19)	5.10 (0.19)	5.39 (0.18)
5470	Astronaut	5.14 (0.18)	5.22 (0.19)	5.41 (0.19)	5.29 (0.16)	5.11 (0.19)
5551	Clouds	4.16 (0.21)	4.88 (0.19)	4.44 (0.21)	5.02 (0.19)	3.94 (0.23)
5829*	Sunset	4.38 (0.20)	5.35 (0.19)	4.89 (0.19)	5.32 (0.18)	4.46 (0.23)
5910	Fireworks	4.89 (0.18)	5.27 (0.17)	4.78 (0.21)	5.28 (0.19)	5.37 (0.17)
5973	Tornado	4.70 (0.19)	4.78 (0.20)	4.68 (0.21)	3.58 (0.23)	5.03 (0.20)
6010	Jail	4.66 (0.20)	3.63 (0.22)	4.32 (0.22)	3.08 (0.23)	4.38 (0.22)
6020	Electric Chair	4.45 (0.19)	3.68 (0.24)	4.10 (0.22)	3.58 (0.22)	4.45 (0.20)
6150	Outlet	3.83 (0.22)	3.74 (0.23)	3.92 (0.22)	3.99 (0.18)	3.68 (0.23)
6190	Aimed Gun	4.71 (0.20)	3.81 (0.22)	4.24 (0.22)	3.35 (0.23)	4.72 (0.21)
6220	Boys with Guns	5.06 (0.20)	3.89 (0.21)	4.68 (0.22)	3.38 (0.23)	4.78 (0.20)
6231	Aimed Gun	4.66 (0.20)	3.58 (0.23)	4.15 (0.24)	3.16 (0.22)	4.69 (0.22)
6300*	Knife	4.19 (0.23)	3.57 (0.24)	4.06 (0.23)	3.22 (0.22)	4.75 (0.20)
6312*	Abduction	4.97 (0.19)	4.04 (0.24)	4.69 (0.22)	3.26 (0.23)	5.13 (0.18)

6370*	Attack	4.10 (0.21)	3.39 (0.24)	4.00 (0.23)	2.99 (0.22)	4.59 (0.21)
6821	Gang	4.91 (0.20)	3.92 (0.22)	4.47 (0.23)	2.90 (0.23)	4.96 (0.21)
6830	Guns	4.90 (0.20)	4.18 (0.22)	4.29 (0.22)	3.39 (0.24)	4.84 (0.20)
6940	Tank	4.96 (0.18)	4.32 (0.20)	4.56 (0.21)	3.31 (0.21)	5.08 (0.20)
7000	Rolling Pin	3.89 (0.22)	3.89 (0.23)	4.17 (0.23)	4.27 (0.19)	3.70 (0.23)
7001	Buttons	4.02 (0.22)	3.62 (0.23)	3.99 (0.23)	4.14 (0.19)	3.47 (0.21)
7002	Towel	3.58 (0.22)	3.84 (0.23)	3.91 (0.22)	4.08 (0.18)	3.62 (0.23)
7009	Mug	3.72 (0.23)	3.86 (0.23)	3.91 (0.23)	4.25 (0.18)	3.67 (0.23)
7010*	Basket	3.98 (0.23)	3.86 (0.22)	4.12 (0.23)	4.52 (0.18)	3.57 (0.22)
7011	Gas Can	3.97 (0.21)	3.58 (0.23)	4.16 (0.22)	3.58 (0.20)	3.65 (0.20)
7012	Rubber Bands	3.80 (0.22)	3.57 (0.22)	3.57 (0.22)	3.80 (0.18)	3.52 (0.21)
7019*	Tools	4.28 (0.21)	3.99 (0.21)	4.42 (0.21)	4.11 (0.17)	3.97 (0.22)
7020	Fan	3.90 (0.22)	3.80 (0.23)	4.01 (0.23)	4.26 (0.20)	3.60 (0.22)
7025	Stool	3.95 (0.23)	3.86 (0.23)	4.02 (0.23)	4.38 (0.19)	3.48 (0.22)
7039	Train	4.48 (0.19)	5.08 (0.20)	4.70 (0.20)	5.16 (0.16)	4.46 (0.21)
7050	Hair Dryer	3.97 (0.22)	3.77 (0.22)	3.77 (0.23)	3.94 (0.19)	3.65 (0.22)
7057	Coffee Cup	4.02 (0.20)	4.25 (0.22)	4.26 (0.22)	4.80 (0.19)	3.96 (0.22)
7058	Dice	3.97 (0.21)	4.22 (0.22)	3.75 (0.22)	4.30 (0.18)	3.95 (0.20)
7061	Puzzle	4.25 (0.20)	4.49 (0.22)	4.05 (0.24)	4.39 (0.17)	3.91 (0.21)
7080	Fork	3.76 (0.23)	3.58 (0.22)	3.86 (0.23)	4.14 (0.18)	3.70 (0.22)
7081	Luggage	4.39 (0.21)	4.03 (0.21)	3.99 (0.22)	4.26 (0.18)	3.65 (0.21)
7090	Book	3.92 (0.22)	4.35 (0.22)	4.45 (0.21)	4.52 (0.19)	3.83 (0.23)
7175*	Lamp	3.94 (0.22)	4.03 (0.23)	4.05 (0.21)	4.44 (0.19)	3.60 (0.22)
7211	Clock	3.99 (0.22)	4.14 (0.23)	4.29 (0.22)	4.42 (0.19)	3.86 (0.21)
7235	Chair	3.82 (0.22)	3.99 (0.24)	4.00 (0.22)	4.24 (0.19)	3.68 (0.23)
7242*	Building	4.45 (0.19)	4.20 (0.22)	3.95 (0.22)	4.04 (0.20)	3.81 (0.22)
7250*	Cake	3.72 (0.21)	4.73 (0.22)	4.52 (0.20)	5.13 (0.19)	4.51 (0.20)
7300	Peanuts	4.13 (0.21)	4.20 (0.21)	4.49 (0.21)	4.85 (0.18)	4.08 (0.22)
7325*	Watermelon	4.23 (0.18)	4.81 (0.20)	4.34 (0.20)	5.48 (0.16)	4.35 (0.22)
7330	Ice Cream	4.28 (0.22)	5.03 (0.21)	4.18 (0.22)	5.26 (0.19)	4.86 (0.20)
7359*	Pie with Bug	4.30 (0.21)	3.45 (0.24)	3.72 (0.22)	3.27 (0.23)	4.54 (0.20)
7380	Roach on Pizza	4.42 (0.21)	3.43 (0.24)	3.55 (0.24)	3.05 (0.24)	4.49 (0.22)
7400*	Candy	4.02 (0.21)	4.61 (0.21)	4.14 (0.20)	4.96 (0.19)	4.62 (0.22)
7451	Hamburger	4.44 (0.19)	4.91 (0.20)	4.56 (0.21)	5.39 (0.19)	4.87 (0.20)
7492*	Ferry	4.71 (0.19)	5.41 (0.17)	4.78 (0.19)	5.54 (0.16)	4.58 (0.22)
7496	Street	4.56 (0.18)	4.23 (0.21)	3.96 (0.21)	4.28 (0.18)	4.19 (0.19)
7508	Ferris Wheel	4.84 (0.18)	4.97 (0.19)	4.31 (0.20)	5.29 (0.17)	4.86 (0.20)
7560*	Freeway	4.54 (0.18)	4.31 (0.20)	4.55 (0.21)	4.46 (0.19)	4.70 (0.18)
7595	Traffic	4.12 (0.21)	3.76 (0.22)	4.12 (0.22)	4.24 (0.17)	3.86 (0.21)
7632	Airplane	4.45 (0.19)	4.18 (0.22)	4.30 (0.21)	4.25 (0.18)	4.20 (0.21)
7700*	Office	4.61 (0.20)	4.03 (0.22)	4.26 (0.23)	4.12 (0.18)	3.86 (0.20)
8040	Diver	4.96 (0.18)	4.96 (0.19)	4.55 (0.21)	5.20 (0.15)	5.00 (0.19)
8162	Hot Air Balloon	4.84 (0.18)	5.08 (0.18)	4.48 (0.21)	5.05 (0.17)	4.84 (0.21)

8163	Parachute	4.60 (0.19)	5.14 (0.20)	4.67 (0.21)	5.46 (0.15)	5.30 (0.18)
8200	Water Skier	4.62 (0.19)	4.96 (0.19)	4.4 (0.20)	5.20 (0.16)	5.31 (0.18)
8312	Golf	4.17 (0.20)	4.63 (0.22)	4.31 (0.21)	4.98 (0.18)	4.10 (0.23)
8370	Rafting	4.92 (0.18)	5.20 (0.19)	4.49 (0.19)	5.27 (0.17)	5.41 (0.16)
8380*	Athletes	4.73 (0.19)	5.22 (0.18)	5.35 (0.17)	5.42 (0.18)	5.22 (0.19)
8485	Fire	5.28 (0.20)	3.98 (0.23)	4.89 (0.21)	2.98 (0.22)	5.25 (0.20)
8496*	Water Slide	4.48 (0.20)	4.88 (0.20)	4.62 (0.21)	5.65 (0.17)	5.44 (0.19)
8499	Rollercoaster	4.66 (0.18)	5.13 (0.18)	4.47 (0.21)	5.39 (0.16)	5.34 (0.18)
8500*	Gold	4.37 (0.21)	4.95 (0.22)	5.17 (0.20)	5.39 (0.18)	5.12 (0.20)
8502*	Money	4.66 (0.20)	5.08 (0.21)	5.27 (0.18)	5.70 (0.15)	5.19 (0.21)
9000*	Cemetery	4.54 (0.19)	4.25 (0.21)	4.58 (0.20)	3.58 (0.21)	3.74 (0.22)
9043*	Teeth	4.38 (0.21)	3.25 (0.23)	3.90 (0.23)	3.42 (0.23)	4.23 (0.21)
9220	Cemetery	4.70 (0.18)	3.94 (0.19)	4.82 (0.18)	3.29 (0.21)	3.87 (0.20)
9260	Hands	3.97 (0.21)	4.09 (0.21)	4.16 (0.20)	4.18 (0.18)	3.81 (0.23)
9270	Toxic Waste	4.86 (0.16)	4.46 (0.20)	4.86 (0.18)	4.06 (0.20)	4.53 (0.19)
9295	Garbage	5.16 (0.19)	3.67 (0.23)	4.48 (0.23)	3.03 (0.22)	4.42 (0.20)
9341*	Pollution	4.46 (0.20)	4.09 (0.20)	4.68 (0.22)	3.28 (0.22)	4.47 (0.19)
9390*	Dishes	4.51 (0.19)	3.53 (0.23)	3.75 (0.21)	3.55 (0.21)	4.08 (0.21)
9417*	Ticket	4.45 (0.19)	3.91 (0.22)	4.65 (0.21)	3.68 (0.21)	4.57 (0.19)
9440	Skulls	4.88 (0.18)	3.85 (0.23)	3.91 (0.24)	3.27 (0.23)	4.40 (0.21)
9594*	Injection	4.73 (0.19)	3.72 (0.23)	4.59 (0.22)	3.33 (0.20)	4.41 (0.19)
9620	Shipwreck	5.06 (0.19)	4.46 (0.22)	4.72 (0.20)	3.18 (0.22)	4.92 (0.20)
9830*	Cigarettes	4.65 (0.22)	3.52 (0.24)	3.77 (0.24)	2.97 (0.22)	4.06 (0.21)
9909	Burning Car	4.85 (0.19)	3.78 (0.22)	4.47 (0.22)	2.99 (0.22)	4.95 (0.20)
9910	Car Accident	5.08 (0.19)	3.88 (0.23)	4.58 (0.20)	3.23 (0.22)	4.88 (0.20)

Note. Standard errors of the mean are in parentheses. Slide number = the reference number for the picture in the IAPS database. The pictures are listed in numerical order based on the slide number, though they were presented in a newly randomized order for each block for each participant in Study 2 (see text for details). For all characteristics, pictures were rated on a scale from 1 – 7 (complexity, 1 = low complexity, 7 = high complexity; interest, 1 = uninteresting, 7 = very interesting; importance, 1 = low importance, 7 = high importance; valence, 1 = unhappy, 7 = happy; arousal, 1 = calm, 7 = excited).*denotes words used in Experiments 3 and 4.

APPENDIX B

Results and Discussion of the Relationships between Self-paced Study Times, JOLs, and Memory Performance

Experiment 1

In Experiment 1, students self-paced their study of a list of emotional and neutral words. Students made a JOL for each word and took a cued-recall test.

Results

Relationships between self-paced study times, JOLs, and memory performance. To evaluate the relationships between self-paced study times and memory performance, self-paced study times and JOLs, and JOLs and memory performance, I conducted Goodman-Kruskal gamma correlations, as is the convention in the metamemory field (Nelson, 1984). To do so, I calculated a gamma correlation between the respective measures (e.g., self-paced study times and JOLs) for each student, separately for each level of valence (positive, negative, and neutral). The correlations for each measure were then averaged across students (see Table B1) and analyzed with a one-way within-participant analysis of variance (ANOVA). This procedure was used for all relationships in all experiments.

Table B1

Mean Gamma Correlations for all Dependent Measures used in Experiments 1 – 4

Relationship	Positive	Negative	Neutral	Overall
Experiment 1				
Self-paced study times and memory performance	.12 (.06)	.05 (.05)	.08 (.06)	.08 (.01)*
Self-paced study times and JOLs	-.09 (.04)*	.00 (.05)	.03 (.03)	-.01 (.03)
JOLs and memory performance	.26 (.06)*	.33 (.07)*	.33 (.06)*	.32 (.04)*
Experiment 2				
Self-paced study times and memory performance	.11 (.06)	-.02 (.06)	.01 (.05)	.03 (.00)
Self-paced study times and JOLs	.02 (.05)	-.01 (.04)	-.03 (.04)	.00 (.03)
JOLs and memory performance	.27 (.07)*	.02 (.07)	.11 (.07)	.16 (.04)*
Experiment 3				
Self-paced study times and memory performance	.05 (.05)	-.03 (.05)	.08 (.06)	.03 (.03)
Self-paced study times and JOLs	.05 (.04)	.08 (.04)	.10 (.05)*	.08 (.03)*
JOLs and memory performance	.11 (.06)	.10 (.06)	.14 (.06)*	.17 (.03)*
Experiment 4				
Self-paced study times and memory performance	.06 (.05)	-.04 (.05)	.12 (.05)*	.15 (.12)
Self-paced study times and JOLs	-.05 (.03)	-.11 (.04)*	-.13 (.05)*	-.09 (.04)*
JOLs and memory performance	-.07 (.06)	.23 (.05)*	.05 (.06)	.10 (.04)*

Note. Standard errors of the mean are in parentheses. *$p < .05$.

Self-paced study times and memory performance. Average gamma correlations between self-paced study times and memory performance did not differ based on valence, $F < 1$. To evaluate whether students' self-paced study times discriminated between words that were remembered and words that were forgotten, gamma correlations were compared to zero (i.e., chance performance) using a one-way *t*-test. Given that gamma correlations did not

differ based on valence, I collapsed across valence to obtain an overall gamma correlation between self-paced study times and JOLs (see Table B1). The mean gamma correlation was significantly greater than zero, $t(48) = 2.57$, $p = .013$, $d = .37$, indicating that students spent more time studying words that were recalled relative to words that were not recalled.

Self-paced study times and JOLs. Average gamma correlations between self-paced study times and JOLs significantly differed based on valence, $F(2, 94) = 4.67$, $p = .012$, $\eta_p^2 = .09$ (see Table B1). Follow-up tests using Tukey's LSD revealed that correlations were significantly more negative for positive words relative to neutral words, $p = .002$. Gamma correlations for negative words did not differ from those for positive words, $p = .08$, or for neutral words, $p = .32$. For negative and neutral words, gamma correlations did not differ from zero, ts < 1.02. Gamma correlations for positive words were significantly less than zero, $t(47) = 2.20$, $p = .032$, $d = .32$, indicating that students spent more time studying positive words that were given low JOLs relative to positive words that were given high JOLs. The overall gamma correlation collapsed across valence did not differ from zero, $t < 1$.

JOLs and memory performance. Average gamma correlations between JOLs and memory performance did not differ based on valence, $F < 1$ (see Table B1). As such, gamma correlations were collapsed across valence and compared to chance performance. The mean overall gamma correlation was significantly greater than zero, $t(47) = 8.68$, $p < .001$, $d = 1.25$, indicating that students gave higher JOLs to words that were recalled relative to words that were not recalled.

Experiment 2

In Experiment 2, students completed the learning task in two phases. In the first phase, students studied each word for a fixed amount of time and made a JOL. In the second phase, students self-paced their study of each word. Students took a free-recall test as in Experiment 1.

Results

Self-paced study times and memory performance. Gamma correlations between self-paced study times and memory performance did not differ based on valence, $F(2, 96) = 2.02$, $p = .14$ (see Table B1). Collapsing across valence, the average gamma correlation did not differ from zero, $t < 1$. Thus, students' self-paced study times did not discriminate between words that were recalled versus words that were not recalled.

Self-paced study times and JOLs. Gamma correlations between self-paced study times and JOLs did not differ based on valence, $F < 1$ (see Table B1). Collapsing across valence, the average gamma correlation did not differ from zero, $t < 1$. Thus, students self-paced study times did not discriminate between words that were given higher versus lower JOLs.

JOLs and memory performance. As evident in Table B1, gamma correlations between JOLs and memory performance were influenced by valence, $F(2, 90) = 3.71$, $p = .028$, $\eta_p^2 = .07$. Follow-up tests revealed that the average gamma correlation for positive words was significantly greater than was the gamma correlation for negative words, $p = .006$. The average gamma correlations for positive and neutral words did not differ, $p = .08$, nor did the gamma correlations for negative and neutral words, $p = .41$. In addition, the average gamma correlation for positive words was significantly greater than zero, $t(45) = 4.04$, $p < .001$, $d = .60$, indicating that for positive words, students gave higher JOLs to words they remembered than to words they forgot. Gamma correlations for negative, $t < 1$, and neutral

words, $t(46) = 1.47$, $p = .15$, did not differ from zero. The average gamma correlation collapsed across valence was significantly greater than zero, $t(46) = 3.82$, $p < .001$, $d = .56$.

Experiment 3

Experiment 3 was identical to Experiment 1, except students self-paced their study of emotional and neutral IAPS pictures.

Results

Self-paced study times and memory performance. Gamma correlations between self-paced study times and memory performance did not differ based on valence, $F(2, 92) = 1.04$, $p = .36$ (see Table B1). Moreover, the average gamma correlation collapsing across valence did not differ from zero, $t(46) = 1.07$, $p = .29$. Thus, students' self-paced study times did not discriminate between pictures that were recalled versus pictures that were not recalled.

Self-paced study times and JOLs. Gamma correlations between self-paced study times and JOLs did not differ based on valence, $F < 1$ (see Table B1). The average gamma correlation collapsed across valence was positive, and was significantly greater than zero, $t(47) = 2.61$, $p = .01$, $d = .38$. Thus, students spent more time studying pictures that were given high JOLs and less time studying pictures that were given low JOLs.

JOLs and memory performance. Gamma correlations between JOLs and memory performance did not differ based on valence, $F < 1$ (see Table B1). Collapsing across valence, the average gamma correlation was significantly greater than zero, $t(47) = 5.47$, $p < .001$, $d = .79$. Thus, students gave higher JOLs to pictures that were recalled and lower JOLs to pictures that were not recalled.

Experiment 4

Experiment 4 was identical to Experiment 2, except students learned emotional and neutral pictures.

Results

Self-paced study times and memory performance. Gamma correlations between self-paced study times and memory performance did not differ based on valence, $F(2, 94) = 2.29$, $p = .11$ (see Table B1). Collapsing across valence, the average gamma correlation did not differ from zero, $t(49) = 1.23$, $p = .23$. Thus, students' self-paced study times did not discriminate between pictures that were and were not recalled.

Self-paced study times and JOLs. Gamma correlations between self-paced study times and JOLs did not differ based on valence, $F(2, 94) = 1.82$, $p = .17$ (see Table B1). The average gamma correlation collapsing across valence was significantly less than zero, $t(49) = 2.39$, $p = .02$, $d = .34$. Thus, students spent more time studying pictures that were given lower JOLs relative to words that were given higher JOLs.

JOLs and memory performance. Gamma correlations between JOLs and memory performance significantly differed based on valence, $F(2, 92) = 5.43$, $p = .006$, $\eta_p^2 = .11$ (see Table B1). Follow-up tests using Tukey's LSD revealed that the average gamma correlation for negative pictures was significantly greater than was the average gamma correlation for positive pictures, $p = .001$. The average gamma correlation for neutral pictures did not differ from the average gamma correlation for negative or positive pictures, ps $> .11$. The average gamma correlation for negative pictures was significantly greater than zero, $t(48) = 4.28$, $p < .001$, $d = .61$, indicating that students gave higher JOLs to negative pictures that were recalled and lower JOLs to negative pictures that were not recalled. The average gamma

correlations for positive and neutral pictures did not differ from zero, *p*s > .22. Collapsing across valence, the average gamma correlation was significantly greater than zero, $t(49) = 2.40$, $p = .02$, $d = .34$, indicating that students gave higher JOLs to pictures they recalled and lower JOLs to words they did not recall.

Discussion

In general, gamma correlations between self-paced study times and JOLs were small and not significantly different from zero. This outcome suggest that self-paced study times may not be a sensitive measure for evaluating how students' study decisions are related to their JOLs. In Experiment 3, the average gamma correlation was significantly greater than zero, and in Experiment 4, the average gamma correlation was significantly less than zero. These outcomes provide conflicting information about the relationship between self-paced study and JOLs. Even so, the correlations were small (.08 and -.09, respectively) and in two experiments (Experiments 1 and 2) they did not differ from zero. Prior research has demonstrated that item selection (a different measure of metacognitive control) has a stronger relationship with JOLs than does study time allocation (e.g., Thiede & Dunlosky, 1999). Thus, an important direction for future research will be to evaluate the relationship between JOLs and item selection when students learn information that varies in valence.

In Experiment 1, the overall gamma correlation between self-paced study times and memory performance was small, but significantly greater than zero. By contrast, in Experiments 2 – 4, overall gamma correlations did not differ from zero. Thus, in general there was little-to-no relationship between self-paced study times and memory performance. This outcome is perhaps surprising, because intuitively one might expect study time and memory performance to be positively related. Even so, simply investing more study time

without engaging in effective learning strategies is unlikely to result in large memory improvements, which may explain the lack of a relationship between these measures.

Finally, the overall gamma correlations between JOLs and memory performance were significantly greater than zero in all experiments. The correlations were not substantial (ranged from .10 to .32), but they indicated that students had above chance performance at discriminating between the items that they would remember on the final test and the items they would forget on the final test. This outcome consistent with typical performance found in similar research (for a review, see Rhodes, 2016).

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ABSTRACT

HOW DO STUDENTS REGULATE THEIR LEARNING OF EMOTIONAL AND NEUTRAL INFORMATION?

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Students are tasked with learning a vast amount of information, and some of that information may be emotional whereas other information may be neutral. Critically, the kind of information that students learn can influence their study decisions and their study decisions can influence their memory. According to the agenda-based regulation theory, students set agendas, or goals that they want to accomplish while studying. There are a number of factors that can influence students' agendas (e.g., difficulty of the material, interest in material), which can influence how they regulate their learning. In the present research, I evaluated how people control their learning (via allocation of study time) of emotional and neutral information. Participants self-paced their study of positive, negative, and neutral words (Experiments 1 and 2) or pictures (Experiments 3 and 4). Participants made a judgment of learning for each item and took a free-recall test. For words, self-paced study times were not influenced by valence. By contrast, for pictures, students allocated the most study time to positive pictures, which were also rated as being the most interesting. Thus, when regulating learning of emotional and neutral pictures, students adopted an interest-based agenda, such that they strategically allocated the most study time to the most interesting information. These outcomes contribute to agenda-based regulation theory by demonstrating that students'

agendas can be influenced by their interest in the to-be-learned material. Moreover, conclusions about students' self-regulated learning can be influenced by the kinds of material they have to study as well as the measure used to evaluate their study decisions.