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Strategic metacognition: Self-paced study time and responsible remembering

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Abstract
Metacognition involves the understanding and awareness of one's cognitive processes, and responsible remembering is the notion that people strategically focus on and remember important information to prevent negative consequences for forgetting. The present study examined the metacognitive control processes involved in responsible remembering by evaluating how information importance affects one's allocation of study time and subsequent recall. Specifically, participants were presented with pictures of children along with each child's food preferences (2 foods they like, 2 foods they dislike, and 2 foods they are allergic to and must avoid) to remember for a later test. When making no metacognitive assessments or judging the likelihood of later remembering each food preference (JOL), participants did not strategically study or demonstrate enhanced recall for the most important information (allergies). However, when making judgments of importance (at either the item or global level), participants spent more time studying and best recalled the information that they rated as most important to remember (allergies). Collectively, these results suggest that when people judge the importance of remembering information, whether at the global or item level, study decisions are better informed, resulting in strategic studying and greater recall for information with the most severe consequences for forgetting.

Keywords Metacognition · Monitoring · Control · Attention · Responsible remembering

In everyday life, we need to remember important things to keep ourselves and our loved ones safe. In studying memory for important information, researchers have demonstrated that people generally allocate more study time and better remember high-value information, often at the expense of low-value information (Ariel et al., 2009; Castel, 2008; Castel, Murayama, et al., 2013; Castel, Rhodes, et al., 2013; Soderstrom & McCabe, 2011). However, there are instances in which people forget important things that they expected to remember. For example, many children die every year from heatstroke after being left in parked cars, the potentially catastrophic consequence of "forgotten baby syndrome" (see Anselmi et al., 2020, for a review). To prevent such dire repercussions, people must prioritize memory for crucial information.

Metacognition, or the awareness and understanding of one's cognitive processes and abilities (Nelson & Narens, 1990; see also Dunlosky et al., 2016; Nelson, 1996), may be indispensable for remembering important information and preventing forgetting. In Nelson and Narens's (1990) framework of metacognition, they differentiate two major processes: metacognitive monitoring and control. Metacognitive monitoring typically involves making predictions about one's learning while metacognitive control processes involve the self-regulation of learning. First reported by Arbuckle and Cuddy (1969), one of the most utilized metacognitive monitoring assessments is the judgment of learning (JOL) whereby participants predict how likely they are to remember information on a later test (see Rhodes, 2016, for a review). Whether these judgments correspond with memory performance or not, metacognitive monitoring assessments inform metacognitive control processes (e.g., Metcalfe, 2009; Metcalfe & Finn, 2008; Nelson & Leonesio, 1988; Nelson et al., 1994; Son & Metcalfe, 2000; Thiede et al., 2003).

Metacognitive control processes are typically measured via self-regulated learning and study decisions which are often based on information gained from monitoring (Dunlosky & Ariel, 2011a; Dunlosky et al., 2016; Nelson, 1996;

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Nelson & Narens, 1990; Son & Metcalfe, 2000; Thiede & Dunlosky, 1999). One useful theoretical framework of control processes, agenda-based regulation (ABR: Ariel, 2013; Ariel & Dunlosky, 2013; Ariel et al., 2009; Dunlosky & Ariel, 2011a, 2011b), posits that when presented with to-be-remembered information, learners develop and use goal-oriented agendas based on monitoring assessments to inform control processes and focus on what they need to know. However, since metacognitive monitoring assessments are sometimes inaccurate (e.g., Castel, Murayama, et al., 2013; Castel, Rhodes, et al., 2013; Dunning et al., 2003; Hargis & Castel, 2019; Kelley & Sahakyan, 2003; Koriat, 1995), insufficient learning and failure to recall information could be the product of an ineffective allocation of cognitive resources because of inaccurate metacognitive monitoring.

When metacognitive monitoring assessments impact metacognitive control and subsequent retrieval, this metacognitive influence on recall is known as reactivity (cf. Arbuckle & Cuddy, 1969; Double & Birney, 2019; Double et al., 2018; Soderstrom et al., 2015; Spellman & Bjork, 1992). Specifically, reactivity refers to changes in memory as a result of making metacognitive judgments (relative to not making judgments), which can impact control and retrieval processes. For example, Robey et al. (2017) examined how self-regulated learning was influenced by having learners either make JOLs or retrospective confidence judgments. Results revealed that retrospective confidence judgments led to better restudy decisions (e.g., what information to study and not to study). Thus, metacognitive assessments can alter how information is studied and potentially alter what is remembered (see also Mitchum et al., 2016).

Reactivity has been hypothesized as potentially stemming from "metacognition modifying attention" (Castel et al., 2012), changed goals (i.e., shifting focus to items that are perceived as easy and moderate difficulty at the expense of more challenging items; Mitchum et al., 2016), and/or the strengthening of cues that were used as the basis of the judgments (Soderstrom et al., 2015). Additionally, rather than a single process, reactivity may stem from multiple mechanisms (see Janes et al., 2018). Ultimately, although there is not a current consensus on the veritable mechanisms that enable reactivity, metacognitive monitoring assessments likely update agendas such that participants focus on items that are consistent with their agenda (Ariel et al., 2009) resulting in changes in the allocation of study time or study decisions, contributing to reactivity.

Metacognition may have the greatest influence on memory when there are rewards for remembering and consequences for forgetting. For example, McGillivray and Castel (2011) presented participants with words paired with point values and asked participants to "bet" on whether they would later remember each word. If participants bet on a word and later remembered it, they would earn the points associated with the word; however, if participants bet on a word and later forgot it, they would lose the associated points (participants' goal was to maximize their score). With increased task experience, participants' metacognition and learning outcomes improved, and participants' enhanced selectivity for high-value words may have resulted from updated agendas (see Ariel et al., 2009) that were informed by instances of forgetting (see Halamish et al., 2011). Thus, when people are aware of their forgetting and the subsequent consequences, they may be able to update their agendas to focus on the most important information or the information with the greatest consequences if forgotten. Namely, such observations of forgetting may prompt people to engage in *responsible remembering* (Murphy & Castel, 2020, 2021a, 2021b, 2022).

Responsible remembering involves the strategic allocation of attention toward important information to prevent negative consequences for forgetting via enhanced metacognition and learning outcomes. For example, some metacognitive judgments may increase a learner's awareness that they will likely be unable to remember everything (see Robey et al., 2017), and this awareness may prompt learners to spend their limited cognitive resources primarily on the information that is most critical to remember rather than allocating resources to less consequential information. According to the responsible remembering framework, if to-be-remembered information is judged as important to remember, people may update agendas (Ariel et al., 2009) and differentially allocate attention resulting in better memory for that information.

To demonstrate responsible remembering, Murphy and Castel (2021a) presented participants with children and their food preferences (likes, dislikes, and allergies) and instructed them to remember those preferences for a later test. Contrary to previous work demonstrating the prioritization of high-value information relative to less valuable information (Ariel et al., 2009; Castel, 2008; Castel et al., 2002; Castel, Murayama, et al., 2013; Castel, Rhodes, et al., 2013; Soderstrom & McCabe, 2011; see Madan, 2017, for review), participants often recalled information in a habitual order (i.e., based on where it was presented on the screen, see Ariel et al., 2011) rather than focusing on the information with the greatest consequences if forgotten (the children's allergies). Even after being asked to predict their memory (JOLs) for each of the food preferences, participants still frequently forgot important information.

To aid participants in updating their agendas and engaging in responsible remembering, Murphy and Castel (2021a) introduced judgments of importance (JOIs): ratings of how important participants think it is to remember information. In contrast to participants not making any judgments or providing JOLs, participants that evaluated the importance of remembering the information best recalled the children's allergies at the expense of the other preferences. Thus, JOIs can engage responsible remembering but the underlying mechanism contributing to this desirable memory outcome remains unclear. If soliciting JOIs results in increased attentional resources allocated toward information judged to be important, this could reveal how participants achieved this memory for information with consequences for forgetting. Using a similar design and methodology as seen in Murphy and Castel (2021a), the current study will examine learners' metacognitive control decisions to elucidate why soliciting metacognitive judgments enhanced memory for important information. Specifically, we will investigate study time allocation across the children's food preferences and whether study decisions change with task experience or as a consequence of making JOIs compared with JOLs.

The current study

Previous work indicates that participants engage in responsible remembering when asked to judge the importance of to-be-remembered information (Murphy & Castel, 2021a), but it was formerly unclear how learners achieve such advantageous memory outcomes. In the current study, we investigated the metacognitive control processes that underlie the efficacy of JOIs in enhancing recall for the most important information. Specifically, we examined whether people remember information with consequences if forgotten (i.e., a child's allergies) as a result of selectively studying that information after judging its importance. We hoped to demonstrate that task experience can update learning based on observations of forgetting (see Halamish et al., 2011) and that people engage in *responsible remembering* by systematically shifting their attention and showing a study bias towards items judged as important, resulting in better recall of these items. To test this metacognitive mechanism and instill consequences for misguided metacognition, we presented participants with hypothetical children, their food preferences (foods they like and dislike), as well as foods they are allergic to (and thus must avoid) to determine if people learn to selectively focus on and study the children's allergies (adapted from Murphy & Castel, 2021a).

Experiment 1a

In Experiment 1a, participants studied children and their associated food preferences for a later test (similar to Murphy & Castel, 2021a), but we required participants to make study decisions for the different food items to determine if engaging metacognitive control mechanisms prompt learners to engage in responsible remembering (as opposed to more serial remembering as seen in Murphy & Castel, 2021a, with all items presented simultaneously). On the initial trials of the task, we expected participants to engage in serial remembering by recalling information according to the order it was placed on the screen (Ariel et al., 2011; Murphy & Castel, 2021a). However, with increased task experience, we expected that responsible remembering would take precedence over serial remembering and participants would become strategic rememberers by selectively studying and systematically best remembering the most important information (allergies) to avoid negative outcomes for forgetting.

Method

Participants

Participants were 27 undergraduate students ($M_{age} = 20.85$, $SD_{age} = 1.77$) recruited from the University of California Los Angeles (UCLA) Human Subjects Pool and received course credit for their participation. A sensitivity analysis indicated that for a 3 (preference: likes, dislikes, allergies) × 6 (list) within-subjects analysis of variance (ANOVA), and a medium correlation ($r = 0.49$, based on the actual correlations between measures) between repeated measures, assuming alpha = 0.05, power = 0.80, the smallest effect size the design could reliably detect is $\eta_p^2 = 0.04$. Participants were tested individually or in groups of up to eight individuals in a laboratory session lasting approximately 1 h.

Procedure and materials

Participants were told to imagine they would be meeting several children that they would be taking care of in the future and babysitting and that they should remember each child's information for a later test. Participants were then shown pictures of children; each child had a name, two foods they like, two foods they dislike, and two foods that they are allergic to and must avoid (e.g., likes: yogurt and spaghetti; dislikes: pickles and guacamole; allergic to: plums and kale). An example of the study and test phase is shown in Fig. 1. Half of the children were male, and half were female; the children were of similar apparent age (around 5 years old). Food items were used only once throughout the task and were randomly paired with children and randomly presented as either likes, dislikes, or allergies. Participants were given 20 s to study each child's information but could only view one set of preferences at a time and self-regulated their study time between the likes, dislikes, and allergies. Participants clicked on an opaque box beneath each category label to reveal the food items in the selected category, and when they clicked on a new category, the food items in that category were revealed, while the items from the previously selected category became hidden again. At the top of their screen, participants were given a clock indicating the total study time remaining (in seconds) for each child.

Fig. 1 Example of the study phase (**a**) and test phase (**b**) in Experiment 1

After the study phase, participants were cued with the name and picture of each child, one at a time, in random order, and asked to recall the child's information (they could recall items in any order they wished). Participants were given 20 s to recall the foods associated with each child and also indicated whether each recalled item was a like, dislike, or allergy. This was repeated for a total of six study–test cycles with four kids per study–test cycle (for a total of 24 kids) and new food preferences paired with different sets of children on each list. The task was scored such that items were only considered correct if they were correctly paired with each child while also being correctly identified with the associated preference.

Results

The results from Experiment 1a are shown in Fig. 2. We first evaluated participants' distribution of study time between each category, providing a measure of the potential strategic allocation of attention toward important information. A 3 (preference: likes, dislikes, allergies) × 6 (list) repeated-measures ANOVA revealed a main effect of preference, $F(2, 52) = 5.15$, $p = 0.009$, $\eta_p^2 = 0.17$, such that the likes ($M = 7.01$, $SD = 1.84$) were studied for more time (seconds) than the dislikes ($M = 5.46$, $SD = 1.60$; $p_{holm} = 0.020$, $d = 0.54$) and the allergies ($M = 5.52$, $SD = 1.50$; [$p_{holm} = 0.020$, $d = 0.53$); however, study time for the allergies and dislikes was similar ($p_{holm} = 0.921$, $d = 0.02$). Mauchly's test of sphericity indicated violations for list (Mauchly's $W = 0.12$, $p < 0.001$), however, Huynh–Feldt corrected results did not reveal an interaction between list and preference (Mauchly's $W < 0.01$, $p < 0.001$; Huynh–Feldt corrected results), $F(3.76, 97.82) = 1.79$, $p = 0.141$, $\eta_p^2 = 0.06$. Thus, the likes were studied more than the other preferences, and this did not change as the task endured.

To investigate possible differences in recall for the different food preferences, we conducted a 3 (preference: likes, dislikes, allergies) × 6 (list) repeated-measures ANOVA. This analysis revealed a main effect of preference, $F(2, 52) = 24.22$, $p < 0.001$, $\eta_p^2 = 0.48$, such that the likes ($M = 0.34$, $SD = 0.18$) were recalled better than the dislikes ($M = 0.17$, $SD = 0.11$; $p_{holm} < 0.001$, $d = 1.16$) and the allergies ($M = 0.17$, $SD = 0.09$; $p_{holm} < 0.001$, $d = 1.16$); however, recall for the allergies and dislikes was similar ($p_{holm} = 0.977$, $d = 0.01$). There was not a main effect of list, $F(5, 130) = 1.77$, $p = 0.124$, $\eta_p^2 = 0.06$, and list did not interact with preference (Mauchly's $W = 0.02$, $p = 0.002$;

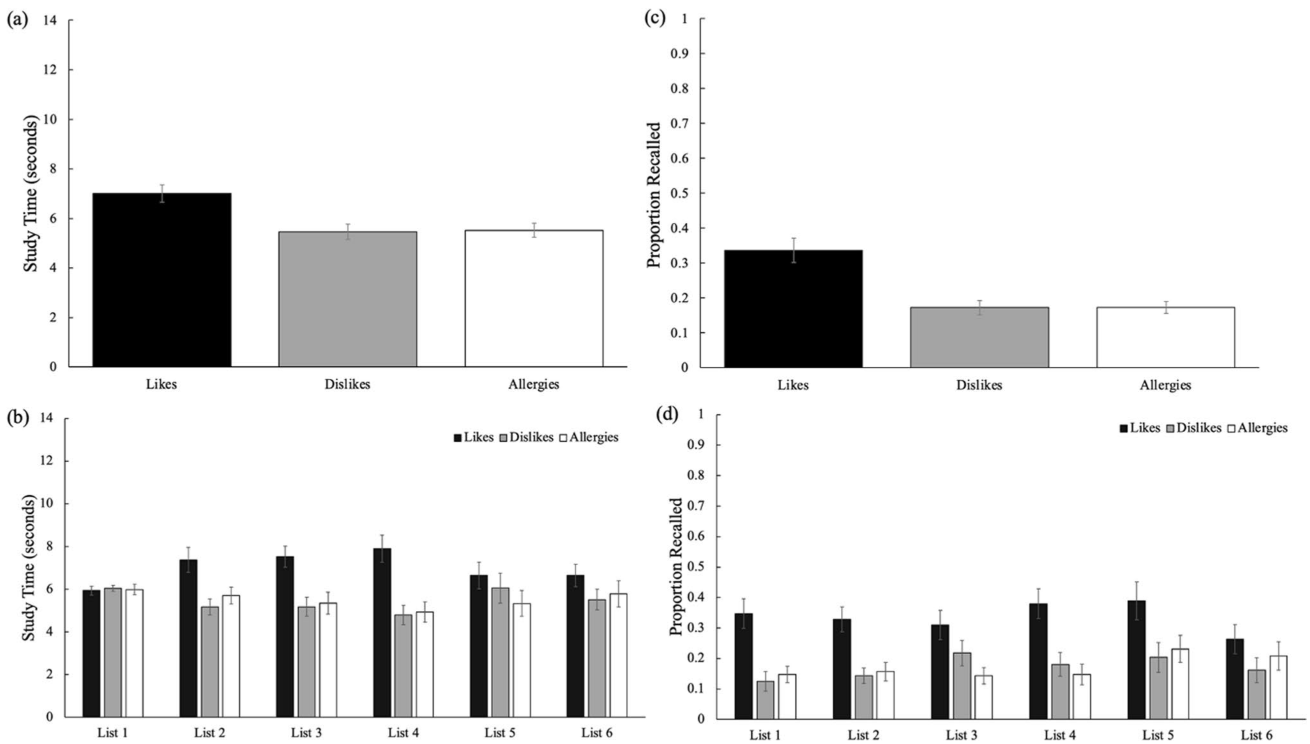


Fig. 2 Average study time across lists for each preference (**a**), average study time for each preference on each list (**b**), recall performance across lists for each category (**c**), and recall performance for each preference on each list (**d**) in Experiment 1a. Error bars reflect the standard error of the mean

Huynh–Feldt corrected results), $F(6.93, 180.27) = 1.01$, $p = 0.427$, $\eta_p^2 = 0.04$. Thus, the likes were recalled better than the other preferences and this pattern did not vary as a function of task experience.

Discussion

In Experiment 1a, participants self-regulated their study time for each preference allowing for the examination of control processes that may contribute to selective memory for important information. Prior work has shown that participants can selectively remember important information when presented in a simultaneous fashion such that self-regulated study time is related to better memory for high-value information (Middlebrooks & Castel, 2018). Additionally, people tend to select items for study that benefit them the most in terms of learning goals (Kornell & Metcalfe, 2006). Thus, in the present context, we expected participants to engage in responsible remembering by spending more time studying and subsequently better recalling the children's allergies.

Contrary to our hypothesis, self-regulating study time did not result in responsible remembering; rather, participants spent more time studying and demonstrated a recall advantage for the foods children like, and this did not change with task experience, replicating prior work (Murphy & Castel, 2021a). Participants may have believed the likes were important to remember (potentially keeping the children safe and happy with minimal memory demands), potentially explaining their study behavior and recall advantage for the likes. However, using a similar paradigm, Murphy and Castel (2021a) demonstrated that counterbalancing the order of the food categories eliminated the enhanced recall of the likes and instead increased recall for whatever preference was listed first (top of the screen). Additionally, Murphy and Castel (2021a) illustrated that when judging the importance of remembering the foods in each category, the allergies were rated as most important. Thus, rather than responsible remembering, participants' responses in Experiment 1a were likely driven by serial remembering or a habitual reading bias (Ariel et al., 2011) which may have been so salient that even observations of forgetting (see Halamish et al., 2011) the allergies were insufficient to draw participants' attention to the allergies. Rather than allowing participants to allocate their study time however they like, restricting self-regulated study flexibility may result in learners more strategically allocating study time and prioritizing the information with consequences if forgotten.

Experiment 1b

In Experiment 1a, having participants self-regulate study time for each preference resulted in the likes being most studied and best recalled. In Experiment 1b, we investigated how participants prioritize the study of the different preferences when self-regulated study time is less flexible. When participants are more restricted in their study choices, they may become aware of the need to allocate their attention toward what is most important, as this limited number of choices may encourage the metacognition modifying attention processes that would guide attention toward what is important (Castel et al., 2012). Participants may initially focus on the likes (as in Experiment 1a) but with increased task experience (especially when aware that not all information will be later remembered), we expected participants to engage in responsible remembering by spending more time studying and subsequently best recalling the allergies.

Method

Participants

Participants were 28 undergraduate students ($M_{age} = 20.30$, $SD_{age} = 2.74$) recruited from the UCLA Human Subjects Pool and received course credit for their participation. A sensitivity analysis indicated that for a 3 (preference: likes, dislikes, allergies) × 6 (list) within-subjects ANOVA, and a small correlation ($r = 0.16$) between repeated measures, assuming alpha = 0.05, power = 0.80, the smallest effect size the design could reliably detect is $\eta_p^2 = 0.06$. Participants were tested individually or in groups of up to eight individuals in a laboratory session lasting approximately 1 h.

Procedure and materials

The task in Experiment 1b was similar to the task in Experiment 1a except that on each trial, while still self-regulating their study time between the likes, dislikes, and allergies, participants could only view one food item at a time. Again, they clicked on an opaque box to reveal concealed foods, however, once participants clicked on an item, it was displayed for just 5 s, and they were unable to click on another item until the 5 s expired. Once the 5 s expired, the selected food became hidden again. Participants were allowed only six clicks for each child; thus, participants could study each of the six foods for 5 s each or could study an item and return to previously studied items, leaving some foods unstudied. Regardless of their study selections, the six clicks of 5 s each resulted in 30 s of total study time for each child. If participants did not click on items or were too slow to click on items, the task automatically advanced to the next child after 35 s.

Results

The results from Experiment 1b are shown in Fig. 3. To investigate possible differences in study time for the different food preferences, a 3 (preference: likes, dislikes, allergies) × 6 (list) repeated-measures ANOVA did not reveal a main effect of preference (Mauchly's $W = 0.63$, $p = 0.002$; Huynh–Feldt corrected results), $F(1.52, 40.98) = 1.35$, $p = 0.267$, $\eta_p^2 = 0.05$, such that the likes ($M = 10.07$, $SD = 2.37$), dislikes ($M = 8.90$, $SD = 2.23$), and allergies ($M = 9.99$, $SD = 3.02$) were studied for a similar amount of time (seconds). Additionally, list interacted with preference (Mauchly's $W < 0.01$, $p < 0.001$; Huynh–Feldt corrected results), $F(3.36, 90.81) = 2.74$, $p = 0.042$, $\eta_p^2 = 0.09$, but there were no significant simple effect comparisons of interest.

To investigate possible differences in recall for the different food preferences, we conducted a 3 (preference: likes, dislikes, allergies) × 6 (list) repeated-measures ANOVA, which revealed a main effect of preference (Mauchly's $W = 0.60$, $p = 0.001$; Huynh–Feldt corrected results), $F(1.48, 39.97) = 10.44$, $p < 0.001$, $\eta_p^2 = 0.28$, such that the likes ($M = 0.35$, $SD = 0.16$) were recalled better than the dislikes ($M = 0.17$, $SD = 0.10$; $p_{holm} < 0.001$, $d = 0.86$) and the allergies ($M = 0.26$, $SD = 0.19$; $p_{holm} = 0.034$, $d = 0.47$); additionally, recall for the allergies was greater than the dislikes ($p_{holm} = 0.040$, $d = 0.38$). Furthermore, results revealed a main effect of list, $F(5, 135) = 3.89$, $p = 0.003$, $\eta_p^2 = 0.13$, such that recall improved with task experience, but list did not interact with preference (Mauchly's $W = 0.02$, $p < 0.001$; Huynh–Feldt corrected results), $F(6.70, 180.95) = 1.57$, $p = 0.150$, $\eta_p^2 = 0.06$. This indicates that there were practice effects, but that this pattern did not vary as a function of preference.

Discussion

In Experiment 1b, we investigated whether more restricted self-regulated learning would lead participants to strategically focus on the most important information (allergies). We hypothesized that participants would initially engage in serial remembering and best recall the likes but after observations of forgetting would engage in responsible remembering by studying the allergies more than the other preferences and subsequently best remember them. Contrary to our hypothesis, self-regulating blocks of study time, even after gaining task experience, did not eliminate

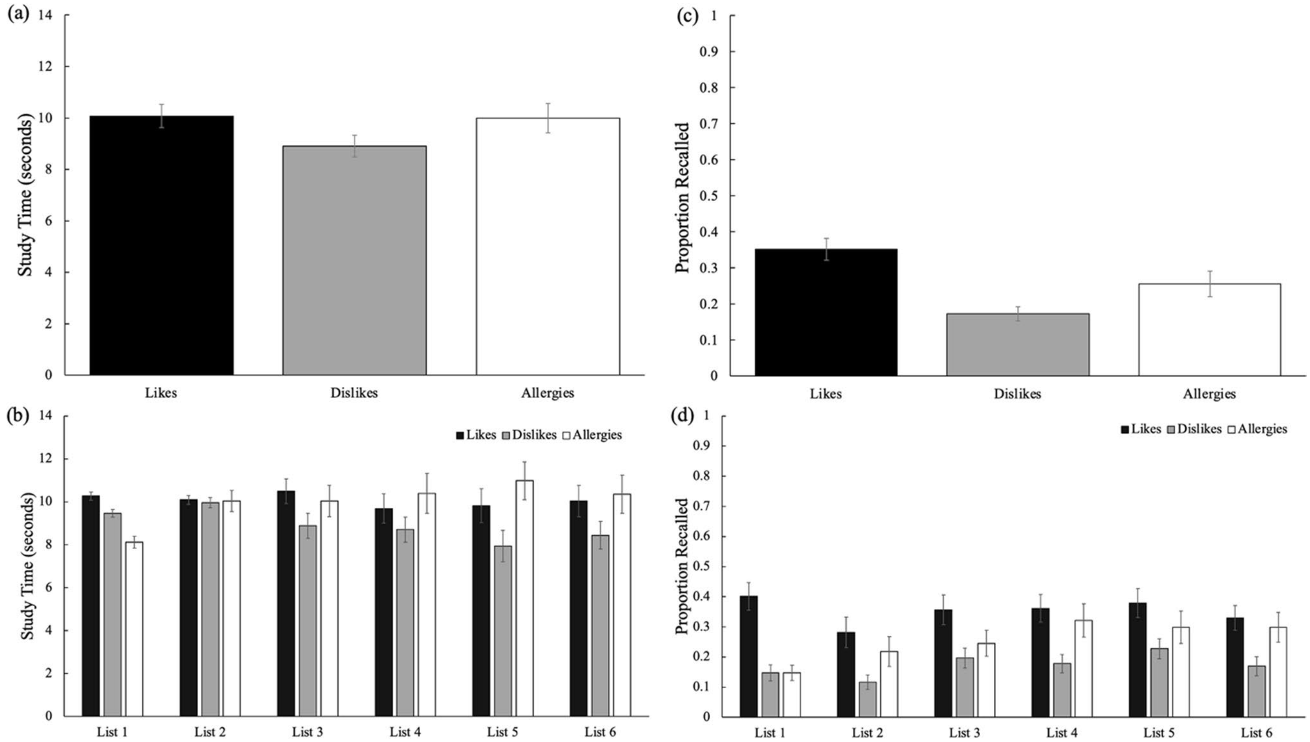


Fig. 3 Average study time across lists for each preference (**a**), average study time for each preference on each list (**b**), recall performance across lists for each category (**c**), and recall performance for each preference on each list (**d**) in Experiment 1b. Error bars reflect the standard error of the mean

the recall advantage for the likes and result in responsible remembering for the children's allergies.

Instead, similar to Experiment 1a and previous work (Murphy & Castel, 2021a), participants' responses were likely driven by serial processing. Specifically, the likes were better recalled despite similar study time as the dislikes and allergies, indicating that the likes may have benefitted from increased rehearsal relative to the other preferences. For example, the primacy effect (enhanced memory for information at the beginning of a list; see Murdock, 1962) is largely driven by the increased rehearsal of primacy items (see Rundus, 1971; Rundus & Atkinson, 1970). Here, while participants studied the dislikes and allergies, participants may also have rehearsed the likes, resulting in the likes receiving the most rehearsal, leading to better memory for the likes despite similar study time. Although the metacognitive control measures in Experiments 1a and 1b did not result in responsible remembering, soliciting metacognitive judgments may reduce the recall advantage of the likes and result in participants prioritizing items with consequences if forgotten (allergies).

Experiment 2a

In Experiment 1, allowing participants to self-regulate their study time did not result in superior memory for the information with negative consequences if forgotten (the child's allergies). Rather than engaging in responsible remembering, participants engaged in serial remembering by best recalling the foods the children liked. Thus, for participants to engage in responsible remembering and overcome this pattern of serial remembering, a metacognitive component may be necessary. In Experiment 2, we examined how making judgments at the global and item level (as each may capture different processes) influenced memory.

We first examined global judgments where we asked participants to predict category memorability and importance before each list (Experiment 2a). Global judgments may inform metacognition as they should consider performance on prior lists and reflect the relative importance of remembering each category rather than focusing on specific items. In contrast, item-specific judgments (Experiment 2b) likely capture item encoding fluency and possibly other factors like the importance of the information in question, perhaps guiding later task performance (see Händel et al., 2020, for individual differences in global and item-level judgments).

Previous work has indicated that when soliciting judgments of the importance of remembering information (JOIs), participants are more likely to engage in responsible remembering by best recalling the information judged as important to remember (Murphy & Castel, 2021a). In Experiment 2a, participants self-regulated their study time (similar to Experiment 1a) but also either provided global JOIs or global JOLs before studying each list of children (between subjects). After experiencing instances of forgetting a child's allergies, despite being judged as likely or important to remember, we expected participants to allocate more study time towards and better recall this information.

Method

Participants

After exclusions, participants were 90 undergraduate students ($M_{age} = 19.99$, $SD_{age} = 1.45$) recruited from the UCLA Human Subjects Pool. Participants were tested online and received course credit for their participation. Participants were excluded from the analysis if they admitted to cheating (e.g., writing down answers) in a posttask questionnaire (participants were told they would still receive credit if they cheated). This exclusion process resulted in two exclusions. In Experiment 2, we were more interested in the power to detect effects of the different judgment types than list and as such, a sensitivity analysis indicated that for a 2 (judgment type: JOL, JOI) × 3 (preference: likes, dislikes, allergies) mixed ANOVA, and a medium correlation ($r = 0.43$) between repeated measures, assuming alpha = 0.05, power = 0.80, the smallest effect size the design could reliably detect is $\eta_p^2 = 0.02$.

Procedure and materials

The task in Experiment 2a was similar to the task in Experiment 1a except that participants were randomly assigned to either make a global judgment of the likelihood of remembering each category of items (JOL; $n = 45$) or a global judgment as to how important it was to remember (JOI; $n = 45$) each child's likes, dislikes, and allergies before each list was studied. For participants making JOLs, participants answered with numbers between 0 and 100, with 0 meaning they *definitely would not remember the foods* and 100 meaning they *definitely would remember the foods*. For participants making JOIs, participants answered with numbers between 0 and 100, with 0 meaning *not important to remember* and 100 meaning *very important to remember*. Participants were given as much time as they needed to make their judgments for all three categories. Additionally, the test phase in Experiment 2a was user-paced to allow participants to maximize their recall performance.

Results

The results from Experiment 2a are shown in Figs. 4 and 5. To examine differences in study time for the food categories, we conducted a 2 (judgment type: JOL, JOI) × 3 (preference: likes, dislikes, allergies) × 6 (list) mixed ANOVA. Results revealed a main effect of preference (Mauchly's $W = 0.58$, $p < 0.001$; Huynh–Feldt corrected results), $F(1.43, 125.55) = 48.43$, $p < 0.001$, $\eta_p^2 = 0.36$, and preference interacted with judgment type, $F(1.43, 125.55) = 9.73$, $p < 0.001$, $\eta_p^2 = 0.11$, such that participants making JOLs spent more time studying the allergies than the dislikes ($p_{holm} = 0.001$) but not the likes ($p_{holm} = 0.208$), participants making JOIs allocated more of their study time to the allergies than both the likes and dislikes (both $p_{holm} < 0.001$), and participants making JOIs allocated more of their study time to the allergies than participants making JOLs ($p_{holm} < 0.001$). Preference interacted with list (Mauchly's $W = 0.05$, $p < 0.001$; Huynh–Feldt corrected results), $F(6.95, 611.26) = 3.14$, $p = 0.003$, $\eta_p^2 = 0.03$, such that study time for allergies increased with each subsequent list (and study time for the other preferences decreased) but there was not a three-way interaction between preference, list, and judgment type, $F(6.95, 611.26) = 1.09$, $p = 0.369$, $\eta_p^2 = 0.01$.

To investigate differences in judgments, we conducted a 2 (judgment type: JOL, JOI) × 3 (preference: likes, dislikes, allergies) × 6 (list) mixed ANOVA. Results revealed a main effect of judgment type, $F(1, 87) = 102.30$, $p < 0.001$, $\eta_p^2 = 0.54$, such that JOIs ($M = 68.78$, $SD = 20.24$) were greater than JOLs ($M = 27.17$, $SD = 18.30$). Additionally, results revealed a main effect of preference (Mauchly's $W = 0.80$, $p < 0.001$; Huynh–Feldt corrected results), $F(1.70, 147.43) = 51.78$, $p < 0.001$, $\eta_p^2 = 0.37$, and judgment type interacted with preference, $F(1.70, 147.43) = 24.61$, $p < 0.001$, $\eta_p^2 = 0.22$, such that JOIs for the allergies were greater than JOIs for the likes and dislikes (both $p_{holm} < 0.001$). Moreover, there was a main effect of list (Mauchly's $W = 0.12$, $p < 0.001$; Huynh–Feldt corrected results), $F(2.48, 215.59) = 59.58$, $p < 0.001$, $\eta_p^2 = 0.41$, and list interacted with judgment type, $F(2.48, 215.59) = 11.34$, $p < 0.001$, $\eta_p^2 = 0.12$, such that JOLs declined as the task endured. Preference interacted with list (Mauchly's $W = 0.02$, $p < 0.001$; Huynh–Feldt corrected results), $F(6.50, 565.88) = 2.09$, $p = 0.048$, $\eta_p^2 = 0.02$, such that there was a greater decrease in judgments across lists for the likes and dislikes compared with the allergies. Lastly, there was a

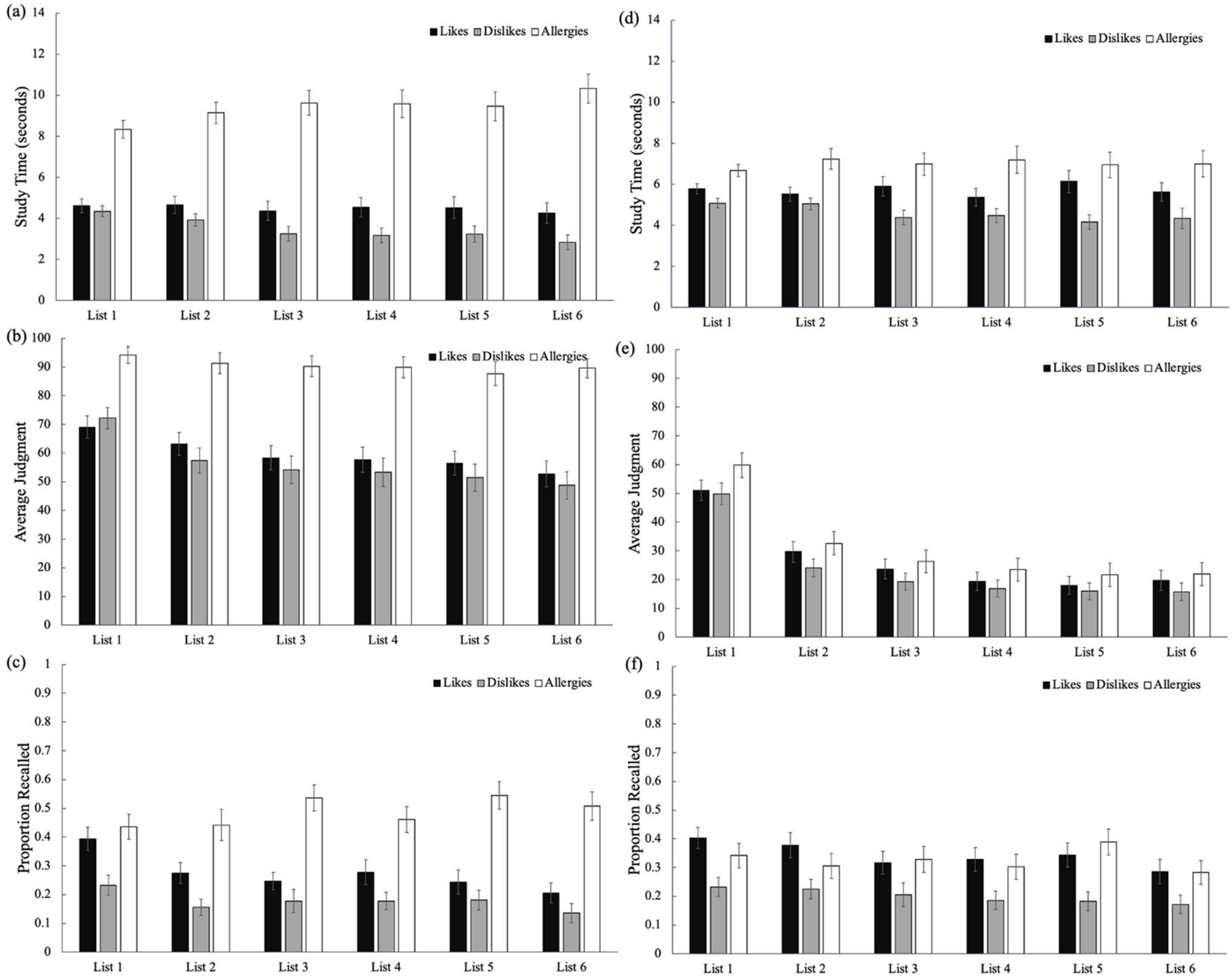
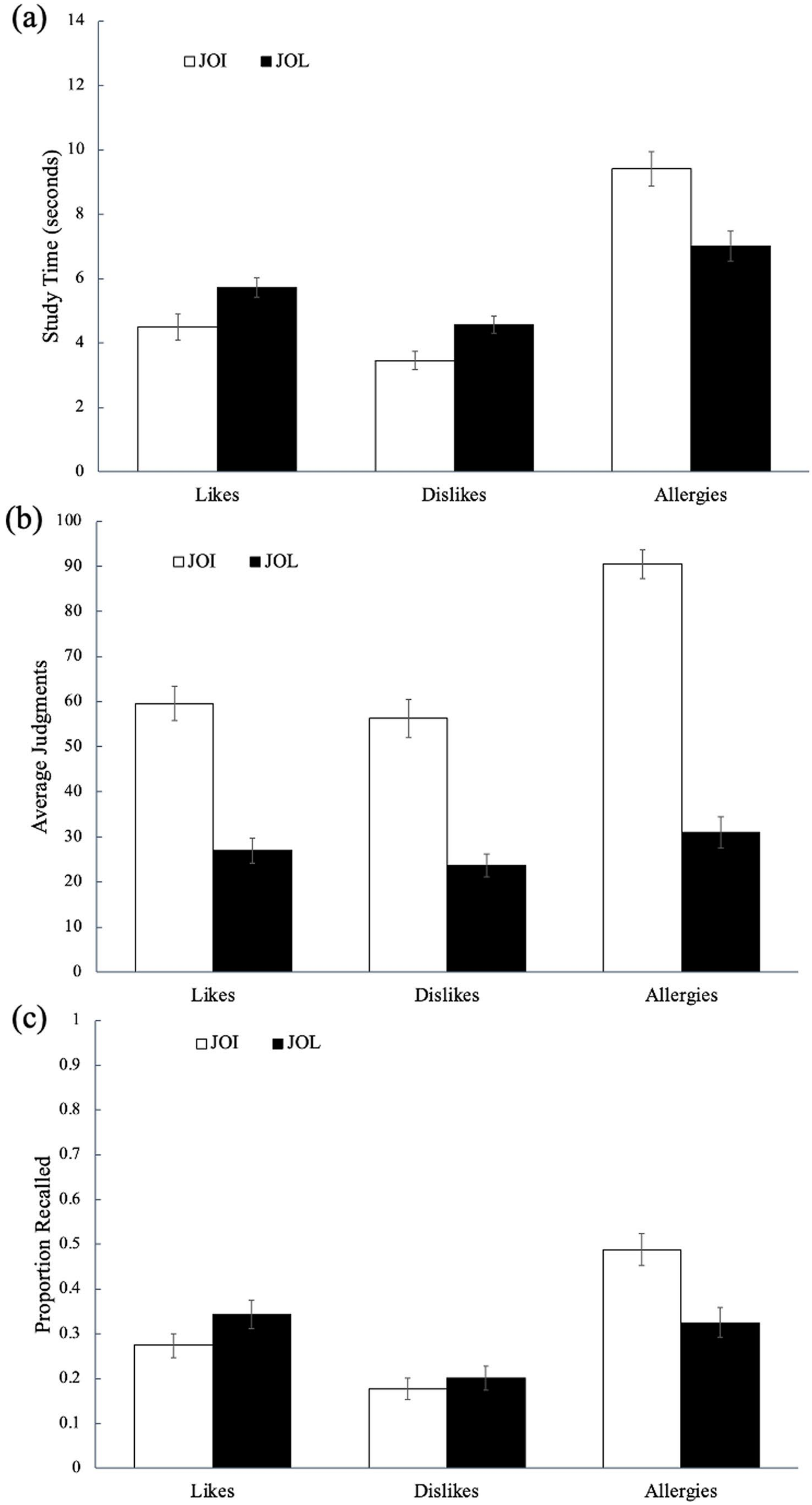


Fig. 4 Average study time (**a**), judgments (**b**), and recall (**c**) for participants making JOIs and average study time (**d**), judgments (**e**), and recall (**f**) for participants making JOLs as a function of list and preference in Experiment 2a. Error bars reflect the standard error of the mean

three-way interaction between preference, list, and judgment type, $F(6.70, 575.83) = 3.99$, $p < 0.001$, $\eta_p^2 = 0.04$, such that JOLs for each of the preferences declined as the task endured but for participants making JOIs, participants judged the likes and dislikes as less important to remember on later lists but JOIs for the allergies were similar across lists.

To examine differences in recall for the food categories, a 2 (judgment type: JOL, JOI) × 3 (preference: likes, dislikes, allergies) × 6 (list) mixed ANOVA was conducted. Results did not reveal a main effect of judgment type, $F(1, 88) = 0.48$, $p = 0.488$, $\eta_p^2 = 0.01$, such that participants making JOLs ($M = 0.29$, $SD = 0.17$) recalled a similar proportion of foods as participants making JOIs ($M = 0.31$, $SD = 0.15$). However, results revealed a main effect of preference (Mauchly's $W = 0.78$, $p < 0.001$; Huynh–Feldt corrected results), $F(1.67, 146.88) = 48.05$, $p < 0.001$, $\eta_p^2 = 0.35$, and judgment type interacted with preference, $F(1.67, 146.88) = 15.27$, $p < 0.001$, $\eta_p^2 = 0.15$, such that recall of the allergies was greater than recall of the dislikes ($p_{holm} = 0.001$) but not the likes ($p_{holm} > 0.999$) for participants making JOLs; participants making JOIs recalled the allergies better than the likes and dislikes (both $p_{holm} < 0.001$), and participants making JOIs demonstrated enhanced recall of allergies compared to participants making JOLs ($p_{holm} = 0.001$). Moreover, there was a main effect of list (Mauchly's $W = 0.62$, $p < 0.001$; Huynh–Feldt corrected results), $F(4.44, 390.56) = 3.38$, $p = 0.007$, $\eta^2 = 0.04$, such that recall decreased with task experience, but list did not interact with judgment type, $F(4.44, 390.56) = 0.47$, $p = 0.776$, $\eta^2 = 0.01$. Preference interacted with list (Mauchly's $W = 0.29$, $p < 0.001$; Huynh–Feldt corrected results), $F(8.70, 765.75) = 3.80$, $p < 0.001$, $\eta_p^2 = 0.04$, such that recall for the allergies increased as a function of list while recall for likes and dislikes decreased but there was not a three-way


(a)
JOI
JOL
Study Time (seconds)
0
2
4
6
8
10
12
14
Likes
Dislikes
Allergies
(b)
JOI
JOL
Average Judgments
0
10
20
30
40
50
60
70
80
90
100
Likes
Dislikes
Allergies
(c)
JOI
JOL
Proportion Recalled
0
0.1
0.2
0.3
0.4
0.5
0.6
0.7
0.8
0.9
1
Likes
Dislikes
Allergies

◂**Fig. 5** Average study time (**a**), judgments (**b**), and recall (**c**) for each preference collapsed across lists as a function of judgment type in Experiment 2a. Error bars reflect the standard error of the mean

interaction between preference, list, and judgment type, $F(8.70, 765.75) = 1.12$, $p = 0.346$, $\eta_p^2 = 0.01$.

Discussion

To evaluate whether metacognitive judgments can catalyze the engagement of responsible remembering via control mechanisms, in Experiment 2a, participants made global JOLs or JOIs for each category before each list. Based on previous work (Murphy & Castel, 2021a), we hypothesized that participants making JOIs would engage in responsible remembering by focusing on the information with the most severe consequences for forgetting (allergies). Consistent with our hypothesis, participants making JOIs allocated more study time to the allergies and subsequently better recalled them than participants making JOLs. Thus, Experiment 2a illustrated a useful form of reactivity such that making JOIs updated agendas and informed control processes so that participants could strategically prioritize and best recall the information they judged as most important to remember. Comparatively, participants making JOLs did not show this pattern, indicating that making JOLs does not lead to the same adaptive reactivity as JOIs. Ultimately, Experiment 2a suggests that, in some instances, a metacognitive judgment that specifically draws participants' attention to the consequences of forgetting may be required to engage in responsible remembering.

Experiment 2b

In Experiment 1, participants did not prioritize important information in their study decisions. However, in Experiment 2a, participants making JOIs allocated more study time towards and best recalled the most important information (allergies), exemplifying responsible remembering. Thus, responsible remembering involves the proper interplay between metacognitive monitoring and control, leading to the strategic allocation of attention toward information with consequences if forgotten. Specifically, only when control processes are informed by metacognitive judgments that draw on the awareness of the need to remember important information is this information studied more and better remembered. In Experiment 2b, we examined this tendency when either making JOLs or JOIs at the item level rather than the global level. Similar to Experiment 2a, we expected that participants making JOIs would spend more time studying and subsequently better remember the allergies compared with the other preferences.

Method

Participants

After exclusions, participants were 88 undergraduate students ($M_{age} = 19.97$, $SD_{age} = 1.63$) recruited from the UCLA Human Subjects Pool. Participants were tested online and received course credit for their participation. Participants were excluded from the analysis if they admitted to cheating (e.g., writing down answers) in a posttask questionnaire (participants were told they would still receive credit if they cheated). This exclusion process resulted in three exclusions. A sensitivity analysis indicated that for a 2 (judgment type: JOL, JOI) × 3 (preference: likes, dislikes, allergies) mixed ANOVA, and a medium correlation ($r = 0.57$) between repeated measures, assuming alpha = 0.05, power = 0.80, the smallest effect size the design could reliably detect is $\eta_p^2 = 0.02$.

Procedure and materials

The task in Experiment 2b was similar to the task in Experiment 2a except that participants either made judgments of learning (JOLs; $n = 44$) or judgments of importance (JOIs; $n = 44$) at the item level rather than global judgments. Specifically, participants provided judgments for each category of items after each child was presented on each list. Participants were given 20 s to study each child's information but were given as much time as they needed to make their judgments for all three categories.

Results

The results from Experiment 2b are shown in Figs. 6 and 7. To examine differences in study time for the food categories, a 2 (judgment type: JOL, JOI) × 3 (preference: likes, dislikes, allergies) × 6 (list) mixed ANOVA was conducted. Results revealed a main effect of preference (Mauchly's $W = 0.41$, $p < 0.001$; Huynh–Feldt corrected results), $F(1.26, 108.72) = 37.49$, $p < 0.001$, $\eta_p^2 = 0.30$, and judgment type interacted with preference, $F(1.26, 108.72) = 9.73$, $p = 0.001$, $\eta_p^2 = 0.10$, such that participants making JOLs studied the allergies more than the dislikes ($p_{holm} = 0.023$) but not the likes ($p_{holm} = 0.140$), participants making JOIs studied the allergies more than the other preferences (both $p_{holm} < 0.001$), and participants making JOIs spent more time studying the allergies than participants making JOLs ($p_{holm} < 0.001$). Preference interacted with list (Mauchly's $W = 0.02$, $p < 0.001$; Huynh–Feldt corrected results), $F(5.88, 505.35) = 4.88$, $p < 0.001$, $\eta_p^2 = 0.05$, such that study time for the likes and dislikes decreased as the task endured but study time for the allergies increased on later lists. Lastly, there was a three-way interaction between preference, list, and

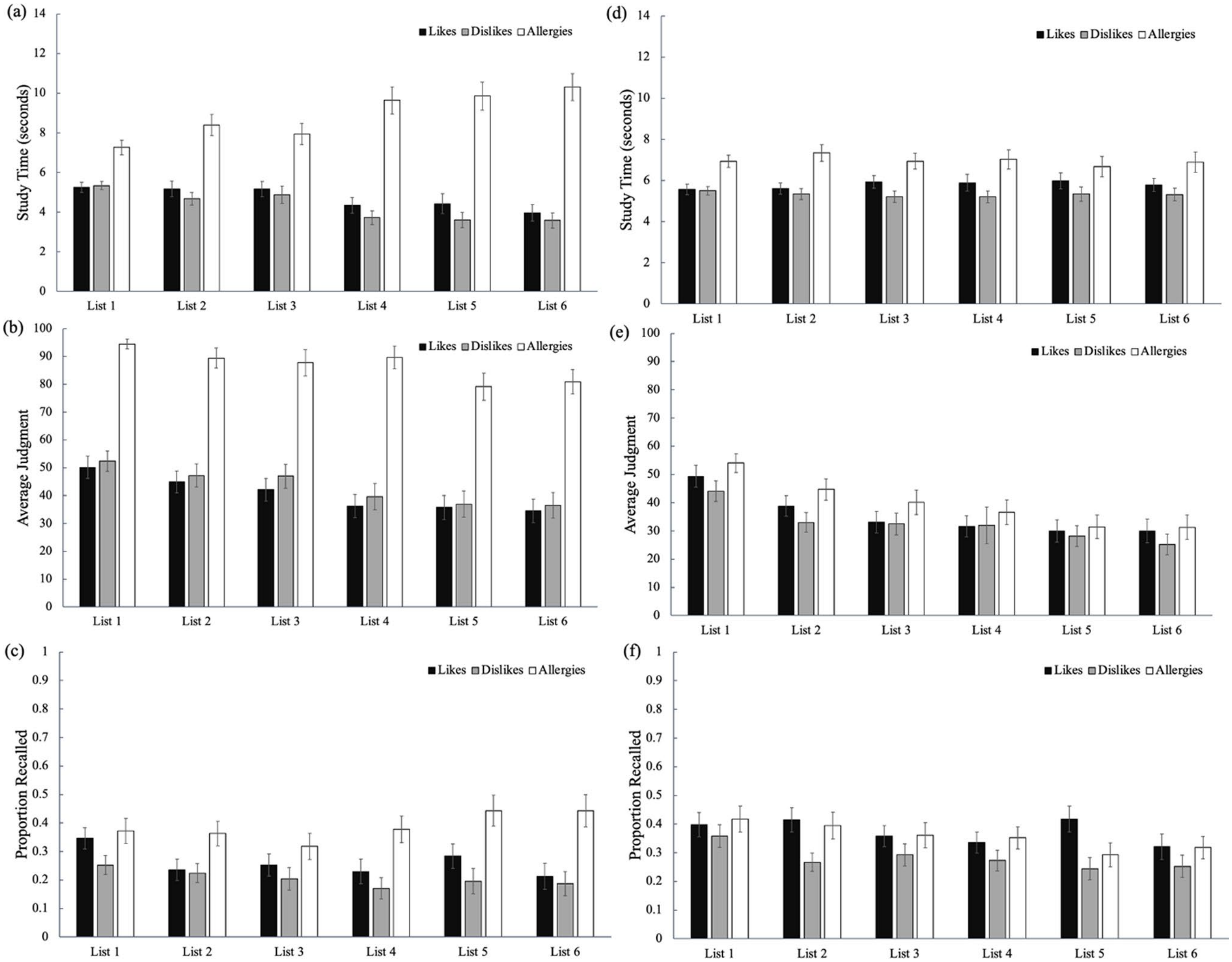


Fig. 6 Average study time (**a**), judgments (**b**), and recall (**c**) for participants making JOIs and average study time (**d**), judgments (**e**), and recall (**f**) for participants making JOLs as a function of list and preference in Experiment 2b. Error bars reflect the standard error of the mean

judgment type, $F(5.88, 505.35) = 5.82$, $p < 0.001$, $\eta_p^2 = 0.06$, such that participants making JOIs increased their study time of allergies with each subsequent list.

To investigate differences in judgments, we conducted a 2 (judgment type: JOL, JOI) × 3 (preference: likes, dislikes, allergies) × 6 (list) mixed ANOVA. Results revealed a main effect of judgment type, $F(1, 86) = 23.96$, $p < 0.001$, $\eta_p^2 = 0.22$, such that JOIs ($M = 56.94$, $SD = 19.08$) were greater than JOLs ($M = 35.82$, $SD = 21.11$). Additionally, results revealed a main effect of preference (Mauchly's $W = 0.64$, $p < 0.001$; Huynh–Feldt corrected results), $F(1.49, 127.69) = 86.43$, $p < 0.001$, $\eta_p^2 = 0.50$, and judgment type interacted with preference, $F(1.49, 127.69) = 52.62$, $p < 0.001$, $\eta_p^2 = 0.38$, such that participants making JOIs rated the allergies as more important than the likes and dislikes (both $p_{holm} < 0.001$). Moreover, there was a main effect of list (Mauchly's $W = 0.23$, $p < 0.001$; Huynh–Feldt corrected results) $F(3.16, 272.01) = 36.23$, $p < 0.001$, $\eta_p^2 = 0.30$, such that judgments declined as the task endured but list did not interact with judgment type, $F(3.16, 272.01) = 1.19$, $p = 0.316$, $\eta_p^2 = 0.01$. Preference did not interact with list (Mauchly's $W = 0.04$, $p < 0.001$; Huynh–Feldt corrected results), $F(6.70, 575.83) = 0.84$, $p = 0.547$, $\eta_p^2 = 0.01$, and there was not a three-way interaction between preference, list, and judgment type, $F(6.70, 575.83) = 0.93$, $p = 0.480$, $\eta_p^2 = 0.01$.

To examine differences in recall for the food categories, we conducted a 2 (judgment type: JOL, JOI) × 3 (preference: likes, dislikes, allergies) × 6 (list) mixed ANOVA. Results did not reveal a main effect of judgment type, $F(1, 86) = 2.00$, $p = 0.161$, $\eta_p^2 = 0.02$, such that participants making JOLs ($M = 0.34$, $SD = 0.17$) recalled a similar proportion of foods as participants making JOIs ($M = 0.28$, $SD = 0.18$). However, results revealed a main effect of preference (Mauchly's $W = 0.70$, $p < 0.001$; Huynh–Feldt corrected results), $F(1.56, 134.55) = 19.01$, $p < 0.001$, $\eta_p^2 = 0.18$, and judgment type interacted with preference, $F(1.56, 134.55) = 6.44$, $p = 0.005$, $\eta_p^2 = 0.07$, such that recall of the allergies was similar to recall of the dislikes ($p_{holm} = 0.115$) but not the likes ($p_{holm} > 0.999$) in participants making JOLs; participants making JOIs demonstrated enhanced recall of the allergies compared with the likes and dislikes (both $p_{holm} < 0.001$), but participants making JOIs demonstrated similar recall of allergies compared to participants making JOLs ($p_{holm} > 0.999$). Moreover, there was a main effect of list (Mauchly's $W = 0.49$, $p < 0.001$; Huynh–Feldt corrected results) $F(4.13, 354.91) = 3.37$, $p = 0.009$, $\eta_p^2 = 0.04$, such that recall decreased with task experience, but list did not interact with judgment type, $F(4.13, 354.91) = 1.30$, $p = 0.270$, $\eta_p^2 = 0.02$. Preference did not interact with list (Mauchly's $W = 0.30$, $p < 0.001$; Huynh–Feldt corrected results), $F(8.75, 752.79) = 1.38$, $p = 0.197$, $\eta_p^2 = 0.02$, but there was a three-way interaction between preference, list, and judgment type, $F(8.75, 752.79) = 2.27$, $p = 0.018$, $\eta_p^2 = 0.03$, such that recall for the allergies increased as a function of list in participants making JOIs.

Discussion

In Experiment 2b, we examined whether judging the importance of remembering at the item level, rather than at the global level as in Experiment 2a, would lead to participants engaging in responsible remembering. Consistent with our hypothesis and the findings of Experiment 2a, participants judging the importance of remembering allocated the most study time to the children's allergies and subsequently recalled more allergies than likes and dislikes. Furthermore, participants making JOIs increased their study time of and subsequently better recalled the allergies as the task progressed, indicating that after observations of forgetting, making JOIs may have led to updated agendas.

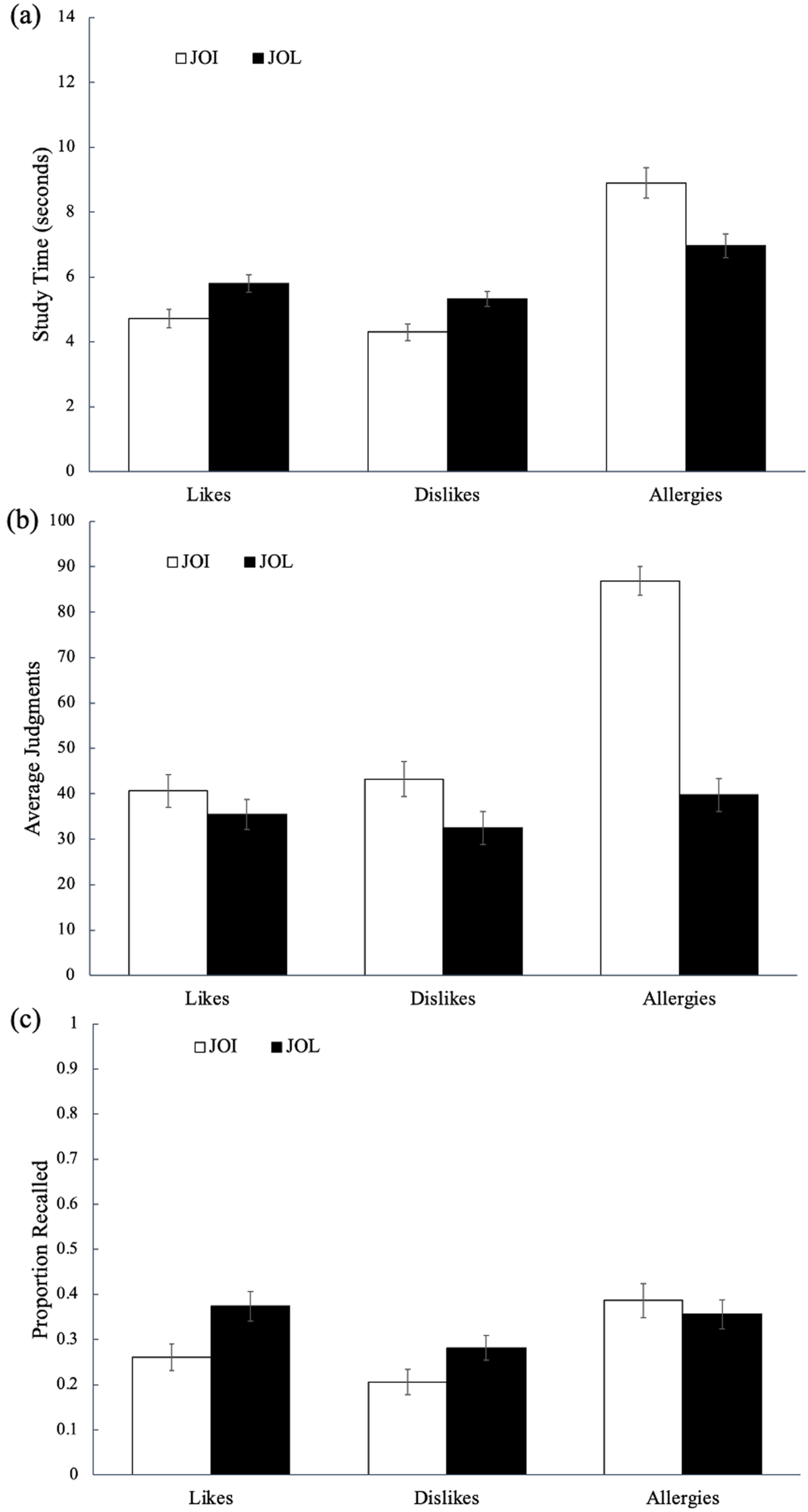
We note that the recall patterns are somewhat different in Experiment 2b than in Experiment 2a such that the participants making JOIs did not demonstrate better recall of the allergies compared with participants making JOLs. However, participants' study time and judgments are largely consistent in each experiment, and participants making JOIs demonstrated better recall of the allergies relative to the other preferences while participants making JOLs recalled the likes and allergies at similar rates. Thus, both groups recalled a similar proportion of items but making JOIs resulted in differential prioritization and recall of the preferences; future work may benefit from including a no-judgment control group to examine potential positive reactivity for the allergies as a result of making JOIs. Collectively, these results suggest that when participants judge the importance of remembering information, whether at the global or item level, study decisions are better informed, resulting in better prioritization of memory for information with the most severe consequences for forgetting.

General discussion

People are often overwhelmed with information to remember and to protect ourselves and our loved ones, we need to focus on remembering what is most important. For example, 40% of children who have food allergies in the United States have been to the emergency room (Gupta et al., 2018), many because of a lapse of memory for the child's allergies (Fleischer et al., 2012). To prevent grave consequences for forgetting important information, people must engage in *responsible remembering*, the notion that people strategically remember important information to avoid potentially severe repercussions of forgetting (Murphy & Castel, 2020).

To elucidate an underlying mechanism of responsible remembering (strategic control processes), we presented participants with children and their food preferences (likes, dislikes, and allergies) to remember for a later test and allowed participants to self-regulate their studying. We expected participants to initially engage in serial remembering by allocating the most study time towards and best remembering the first listed preference in the encoding phase (the likes; see Murphy & Castel, 2021a). However, we hypothesized that observations of unexpected forgetting, as well as judging the importance of remembering, would better inform agendas and subsequently influence metacognitive control processes. Specifically, we predicted that participants would increase their allocation of study time for important information (allergies) resulting in enhanced recall for that information.

In Experiment 1, we first investigated the metacognitive control processes involved in responsible remembering by measuring how participants allocate their study time when making no metacognitive judgments. Similar to previous work (Murphy & Castel, 2021a), participants spent the most time studying and best recalled the likes, consistent with serial remembering. In Experiment 2, we had participants make either judgments of learning (JOLs) or judgments of importance (JOIs) at the global or item level in hopes that these judgments would update their agendas and better inform control processes. Results revealed that participants making JOIs engaged in responsible remembering, as evinced by more time spent studying the allergies and enhanced memory for the allergies. Although participants making JOLs spent more time studying (and better recalled) the allergies compared with the dislikes, exemplifying some strategic processes, they spent a similar amount of time studying (and similarly recalled) the likes as they did the allergies, indicating that participants making JOIs showed a more strategic allocation of study time as indicated by


(a)
□ JOI ■ JOL
Study Time (seconds)
0
2
4
6
8
10
12
14
Likes
Dislikes
Allergies
(b)
□ JOI ■ JOL
Average Judgments
0
10
20
30
40
50
60
70
80
90
100
Likes
Dislikes
Allergies
(c)
□ JOI ■ JOL
Proportion Recalled
0
0.1
0.2
0.3
0.4
0.5
0.6
0.7
0.8
0.9
1
Likes
Dislikes
Allergies

◂**Fig. 7** Average study time (**a**), judgments (**b**), and recall (**c**) for each preference collapsed across lists as a function of judgment type in Experiment 2b. Error bars reflect the standard error of the mean

greater study (and recall) of the allergies compared to both likes and dislikes.

The present study suggests that, in some instances, people may not focus on the information that has the most severe consequences for forgetting. For example, in Experiment 1, participants did not prioritize their study time for the children's allergies and instead spent much of their time studying less important information such as the children's likes and dislikes. However, when making JOIs at either the global or item level in Experiment 2, participants updated their agendas (Ariel et al., 2009), which subsequently influenced control processes, leading participants to strategically allocate their attention toward what they rated as the most important information to remember. Furthermore, Experiment 2 revealed that not just any metacognitive judgment can lead to an engagement in responsible remembering. While JOLs focus on monitoring learning, JOIs bring attention to the ramifications of forgetting and benefit recall for children's allergies via additional study time. Ultimately, the present study suggests that in some instances, people may need to first assess the importance of information to engage responsible remembering mechanisms and prioritize memory for important information.

The enhanced recall for important information when making JOIs may exemplify a form of positive reactivity (see Mitchum et al., 2016), perhaps the result of metacognition modifying attention (Castel et al., 2012) whereby participants change their goals based on their metacognitive judgments. Thus, similar to prior work demonstrating that retrospective confidence judgments can benefit restudy decisions, perhaps due to differences in cue utilization (e.g., Robey et al., 2017), JOIs may increase learners' awareness of forgetting and alter how they use cues to guide their learning (see Koriat, 1997, for cue-utilization framework). In the present study, when making no metacognitive judgments or making JOLs, participants likely focused on extrinsic cues (like each item's location on the screen) rather than on intrinsic cues (such as importance). However, judging the importance of each category modified how participants allocated their study time; participants shifted their attention toward the information with the most severe consequences of forgetting, leading to enhanced recall of this important information. Specifically, as they gained task experience, learners shifted their allocation of study time when making JOIs by spending less time studying the likes and dislikes and more time on the allergies. Therefore, when people make study decisions based on cues that do not benefit their goals, they may ineffectively allocate attention towards less important information but JOIs can update learners' goals and lead to strategic studying of the most important information, resulting in an adaptive form of reactivity that can prevent the potentially grave consequences of forgetting.

The enhanced recall of the allergies when judging the importance of remembering the foods in each category may also have resulted from JOIs strengthening the impact of the importance of the to-be-remembered information. Specifically, the present study is also consistent with the strengthening of cues account of reactivity (Soderstrom et al., 2015) whereby judgments can strengthen the cues or information that the judgments are based on. If the strengthening of cues hypothesis is veritable, this would suggest that making JOIs can strengthen the intrinsic cue of importance, the focus of the judgment. In contrast, JOLs could influence memory for the foods based on other cues like their location in the study phase rather than the relative importance of the preferences.

The reactivity observed in the current study is also consistent with the richness of encoding account (Craik & Tulving, 1975; Hunt, 2003; Hunt & Smith, 1996; Hunt & Worthen, 2006; Moscovitch & Craik, 1976; Watkins, 1978; Watkins & Watkins, 1975; for the richness of encoding hypothesis of survival processing effect, see Kroneisen & Erdfelder, 2011; Röer et al., 2013), whereby enhancement of memory occurs because people generate ideas about the to-be-remembered information, which increases its number of retrieval cues, allowing it to be better remembered (e.g., participants may connect an allergen to their own experiences or imagine what could happen if forgotten). Such a hypothesis suggests that the efficacy of JOIs in modifying study behavior may be a result of participants being able to generate more pairings of allergies and importance than for the other preferences, leading to more elaborative encoding. This could suggest that when elaborative encoding does not occur naturally, JOIs lead to richer encoding of the most important information by drawing participants' attention to the potential repercussions of forgetting.

Although JOIs may have increased the richness of the encoding of the allergies, any metacognitive construct or rating that leads to the generation of more ideas about the most important information may be sufficient to enhance memory for such items. Thus, when elaborative encoding of important information does not occur naturally, interventions such as JOIs may catalyze the richer encoding for such items, allowing people to avoid the negative consequences of forgetting. Ultimately, the current study is consistent with many theories of reactivity, suggesting that reactivity may stem from multiple mechanisms, but further research should parse the relative impact of each account.

Although many participants in the current study failed to engage in responsible remembering, these participants may not have considered the consequences of forgetting a child's allergies to the same extent that they would in everyday life. Outside of the laboratory, people may be responsible rememberers such that they do not need to make metacognitive judgments like JOIs for important information to be prioritized in memory. Further, the importance of most information is subjective, so what is considered to be responsible remembering may be dependent on the individual. Additionally, the current study used a sample of younger adults that likely do not have children and may be less likely to take remembering a child's allergies as seriously as parents or older adults, who are more likely to have children and grandchildren. Future work should examine how parents, older adults, or other people who are involved in childcare may prioritize memory for important information. Future research could also benefit by developing different scenarios (i.e., remembering medicines, locations of important things, mild versus severe allergies, etc.) to further determine how and when responsible remembering occurs, as well as increase the generalizability of our findings to better reflect what happens outside of the laboratory.

Future research could also look at the myriad of factors that impact when and to what extent responsible remembering occurs. For example, using a similar paradigm as in the current study, researchers could manipulate the age of the children or the severity of the allergies to see how other factors affect memory for important information. Moreover, future work could use food items that the learner is allergic to or examine memory in people with more babysitting experience to determine whether the saliency of the to-be-remembered foods influences recall. Regardless, the present findings demonstrate that people may not always be responsible rememberers and when people's attention is not drawn to the consequences for forgetting, whether because of the nature of a laboratory task or simple negligence, the forgetting of important information may occur.

In the current study, allocating more study time towards the allergies benefitted memory for these items but future work could examine what encoding processes are occurring during this extra study time as well as the potential trade-offs accompanying devoting more time, effort, or resources to more important information. Specifically, there may be some benefits of not studying certain information such that if less study time is attributed to less important information, this could potentially reduce the interference of that information during the recall of important information. Finally, future work could examine more direct measures of forgetting (i.e., the failure to access information previously accessible to memory) rather than just recall failure.

In sum, people sometimes forget important information, even when there are consequences for forgetting. Rather than engaging in responsible remembering, people may inefficiently allocate attention toward less important information when they fail to consider the importance of remembering. At an applied level, in the United States, about 8% of children report having food allergies, and approximately 39% of these children have a history of severe allergic reactions (Gupta et al., 2011). Thus, failing to consider the importance of remembering a child's allergies can have potentially disastrous repercussions, such as fatal allergic reactions like anaphylaxis, a life-threatening medical emergency that can lead to sudden respiratory failure. However, identifying the importance of to-be-remembered information may help prevent such instances. Making JOIs can help draw attention toward the consequences of forgetting, subsequently updating agendas and informing control processes so that the important information is best remembered, exemplifying responsible remembering.

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Declarations

Conflicts of interest The authors certify that they have no affiliations with or involvement in any organization or entity with any financial or nonfinancial interest in the subject matter or materials discussed in this manuscript.

Open practices statement None of the experiments reported in this article was formally preregistered, but the stimuli, data, and analysis code have been made available on the Open Science Framework here.

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