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Effects of Attitudes Toward Remembering on Metamemory and Memory Performance in College Students

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Abstract: As modern technology enables instant access to virtually limitless information, students may perceive memorization of information as lacking in practical importance. The current study investigated the relationship between attitudes toward remembering and metamemory as well as objective memory performance. University students (N = 108, M_{Age} = 19.39, 77% women) completed the Importance of Remembering questionnaire (IORQ) as a measure of attitudes toward remembering. Subjective components of memory were measured by immediate and delayed judgments of learning (JOLs), global judgments of learning (global JOLs), retroactive confidence judgments (RCJs), and subjective mental workload. Objective memory performance was measured using a cued recall test using word pairs and picture pairs. The IORQ was only significantly correlated with absolute accuracy of delayed judgments of learning for words and pictures such that higher IORQ ratings were associated with less accurate judgments about how well they learned the items. No other correlations were significant. This suggests that a student's lack of belief in the importance of remembering, at least as conceptualized on the IORQ, may not affect most aspects of memory performance, including those related to academic outcomes.

Keywords: importance of memory; judgments of learning; mental workload; cued recall; college students

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1. Introduction

According to Yates (1966), Socrates was distressed by the invention of written language, which he worried would cause people to neglect the practice of the art of memory or the ancient mnemonic techniques that had been invented to expand one's memory capacity beyond the capacity of average persons. Even before the ancient Greek era, memory was highly valued by orators whose job was to deliver a lengthy speech without making any errors to tell the truth and to "prove the divinity of the soul" (Yates, 1966, p. 59). In the 20th century, the literature that investigated the development of expertise established that memory of domain-specific knowledge is the main difference between novices and experts (see Ericsson & Kintsch, 1995, for an extensive review). In the information technology age, people have become increasingly reliant on internet-connected devices for instant access to information as an aid to thinking and remembering (Finley et al., 2018), and the use of these devices is changing our cognitions (Marsh & Rajaram, 2019). Further, research conducted in the smartphone age has found that individuals are often unaware of whether they had used a smartphone to access a particular piece of information just one week prior (Siler et al., 2022). These same technological advances may also reduce the perceived importance of remembering information and subsequently negatively impact academic performance.

How would overreliance on technology negatively impact academic performance? A recent study by Fisher et al. (2021) showed that relying on the internet to access information has two negative consequences: reduced learning and inflated confidence in learning. They conducted four experiments in which participants were asked to learn about topics (photosynthesis, inflation, and autism) by either searching on the websites or reading the same information, which was provided by the experimenter. The results showed that participants in the internet search condition showed lower learning, as indicated by lower scores on the multiple-choice test, than participants in the no-search condition. Further, participants in the internet search condition showed overconfidence in learning, such that their confidence was either higher than or similar to participants in the no-search condition. These results were not accounted for by factors such as reduced time for learning, increased distractions, and false assumptions about the future accessibility of the answers. The authors concluded that their results were consistent with the notion that searching on the internet for the answers would lead to diminished effort in learning. These results are directly applicable to our concern about students having attitudes that remembering information is a waste of time. Having such attitudes would be likely to lead to an overreliance on the internet for the answers, which would then reduce learning due to overconfidence in learning, both of which would spell disaster for academic performance. Accordingly, the purpose of the present study was to determine whether attitudes toward remembering would be associated with both metamemory (subjective component) and memory performance (objective component).

1.1. Attitudes and Remembering

Several previously published studies suggest that an individual's attitudes toward remembering would be associated with actual memory performance. In one experiment, Sparrow et al. (2011) asked participants to type a series of trivial information (e.g., "An ostrich's eye is bigger than its brain") into a computer. Then, half of the participants were told to save the statements (essentially priming participants with the idea that they would be able to search the computer for the information if they needed it) and the other half of the participants were told to erase the statements. Subsequently, participants were asked to recall the statements. Participants were able to recall more statements in the erased condition than in the saved condition, presumably because participants who saved the statements thought that they would be able to search the computer later, and, therefore, they put less effort into remembering the statements.

In another experiment reported in the same article, participants were asked to type trivial statements into a computer, and, after typing each statement, they were told either that (1) the statement was saved, (2) the statement was saved in the folder X, or (3) the statement was erased. Subsequently, participants were asked to take a recognition test in which they were asked to judge whether (1) the statement was the same as before, (2) the statement was saved or erased, or (3) the statement was saved in a particular folder X. The results showed that recognition performance was the best for the statements that they were told would be erased. Further, when they were asked whether the statement was saved or erased, they were more accurate in making this judgment for the statements that they were told were saved. Additionally, when they were asked to judge whether the statement was saved in a particular folder, they were more accurate in judging when the statement was erased.

In a third experiment in the same article, participants were asked to type trivial statements into a computer and save each statement in a particular folder X. Subsequently, they were asked to recall the statements, followed by a task in which they were given a part of each statement and asked to identify which folder they saved the statement. The results

showed that participants were more accurate in identifying the folder than recalling the statements. These experiments showed that remembering is impaired when one believes that information is accessible later via a computer, a phenomenon that the authors called "the Google effect".

Subsequent research on the Google effect has shown that it is especially reliable when individuals are confident in the reliability with which information can be saved and retrieved (Schooler & Storm, 2021). A meta-analysis on the Google effect showed that, among other things, the effect is stronger among participants in the United States and among participants with high internet usage (Gong & Yang, 2024), both of which are factors that make American college students an ideal sample.

Based on these considerations, it is possible that the low perceived importance of remembering fostered by the use of the internet would be detrimental to one's ability to remember information as measured by a cued recall test.

1.2. Metamemory

Metamemory, a type of metacognition, includes the control and monitoring of activities specific to memory (Nelson & Narens, 1990, 1994). In the present study, metamemory was examined in four ways: judgments of learning (JOLs), global judgments of learning (global JOLs), retrospective confidence judgments (RCJs), and subjective mental workload.

The first measure was JOLs, which are the judgments one makes at the encoding stage in order to influence decisions on how much to study (Nelson & Narens, 1990, 1994; Nelson & Dunlosky, 1991). Dunlosky and Nelson (1992) showed that JOLs are predictive of subsequent recall, even though the accuracy is far from perfect. Further, introducing a delay between studying a word pair and making a JOL would increase the accuracy, referred to as the delayed JOL effect (Begg et al., 1989; Kelemen & Weaver, 1997). Over the years, several theories have been proposed to explain the delayed JOL effect (Dunlosky & Nelson, 1997; Metcalfe & Finn, 2008), including a proposal that the effect is an artifact of reactivity created by asking participants to make the judgments (e.g., Senkova & Otani, 2021). Whatever the reason for the effect, the delayed JOL effect has been replicated by many studies (see Rhodes & Tauber, 2011 for meta-analysis and review); therefore, the present study investigated whether the low perceived importance of remembering would influence this well-established effect.

The second measure was global JOLs. For this measure, participants are asked to make a prediction about their performance on a memory test that they are about to take. Unlike an item-by-item measure of JOLs, this measure is focused on the entire test and is another way of assessing participants' confidence in their memory. Note that the accuracy of global JOLs is calculated by subtracting actual performance from predicted performance. This means that higher scores indicate lower accuracy.

The third measure was RCJs, which are judgments one makes at the retrieval stage in order to decide whether the answer one has retrieved is correct or incorrect (Eakin & Moss, 2019). This type of judgment has not been studied extensively in the literature of metacognition, and, instead, it has been mainly investigated in the literature of recognition memory because one's confidence in response would reflect one's response bias (i.e., willingness to say "yes") in the context of signal detection theory. Nevertheless, one's attitudes toward remembering might be associated with one's confidence in one's memory.

The fourth measure was mental workload or psychological costs, defined as the perceived difficulty of a task and one's perceived ability to complete the task (Hart & Staveland, 1988). Believing that a task, such as remembering, is more difficult than it actually is may impair one's willingness to do that task. This may in turn reduce one's tendency to practice that

task, leading to an actual difficulty with the task (Knoll, 2015). This is another way that an attitude toward remembering may affect actual memory performance.

Subjective mental workload has been extensively studied in the human factors field using a subjective rating scale such as the NASA Task Load Index (NASA-TLX, Hart & Staveland, 1988; see Johnson & Proctor, 2004). This measure is based on five dimensions of mental workload: mental demand, physical demand, effort, performance, and frustration. For a cognitive task, physical demand is irrelevant. This dimension was included in the scale in order to measure the mental workload of physical tasks that astronauts are often asked to perform. The NASA-TLX has been shown to have a strong test–retest reliability (r = 0.83; Kirby et al., 1988), and it correlates well with other measures of mental workload, such as the Workload Profile (WP) and the Subjective Workload Assessment Technique (SWAT; Rubio et al., 2004), with correlations ranging from 0.97 to 0.98. In the present study, the NASA-TLX was used to measure subjective mental workload in order to determine whether the low perceived importance of remembering would make a memory task more mentally taxing to perform.

There are at least two reasons to believe that attitudes regarding the importance of memory would influence metacognitive judgments in addition to actual performance. First, in the literature of metacognition, much debate has been devoted to the mechanisms by which one would make a metamemory judgment such as a JOL. Two theories have dominated the debate: direct access theory and inferential theory. The former theory assumes that to make a judgment, one would directly access memory traces (consciously or unconsciously) and assess the state of these traces to make a judgment such as the likelihood of later retrieval (e.g., Burke et al., 1991). The latter theory assumes that such judgments are made based on inferences, and, to make these inferences, one would use any available cues (e.g., Koriat, 1997). For instance, it has been shown that the font size of a word (small versus large font) would influence a JOL via processing fluency or how quickly one would be able to process the word. That is, because a word with a large font size is easy to process (i.e., an available cue), one would make an inference that this word is easy to learn, which would then lead to overconfidence in learning (e.g., McDonough & Gallo, 2012).

Ample evidence exists showing that metamemory judgments are based on inferential processes (see Rhodes, 2016). Accordingly, we contend that attitudes toward remembering are another cue that one may use to make these metacognitive inferences. If one thinks that it is a waste of time to remember information, one may make an inference (correctly or incorrectly) that the likelihood of later retrieval would be low. Second, lack of practice is another reason to believe that attitudes toward remembering may influence metamemory judgments. We contend that remembering is a skill that needs to be practiced. Just like any other skill, such as throwing a ball, lack of practice has two negative consequences: poor performance and poor metacognitive judgment of current and future performance. We assume that these principles would apply similarly to cognitive skills such as remembering.

In terms of mental workload, we contend that lack of practice would make remembering more mentally taxing for those who do not place importance on remembering. It has been shown that cognitive skills are similar to perceptual-motor skills in terms of learning rate, training effects, and learning stages (Rosenbaum et al., 2001). As such, a skill such as remembering would be more difficult and mentally taxing when one believes that remembering is a waste of time and does not routinely practice.

1.3. Overview

The purpose of the present study was to determine whether attitudes toward remembering would be associated with metamemory and memory performance. Participants'

attitudes toward remembering were assessed using a questionnaire (Importance of Remembering questionnaire or IORQ), which asked participants to rate the importance of remembering 15 types of specific information related to personal, school, and work. In this measure, higher ratings indicated that remembering a particular item is important. Further, the IORQ included an item (#16) that asked participants to rate their general attitudes toward remembering ("Remembering isn't important). This item was reverse-scored to make it consistent with other items.

Memory performance was assessed by asking participants to study a list of word pairs and picture pairs (e.g., apple–orange or line drawings of apple and orange) and subsequently testing their memory using a cued recall test (e.g., apple–?? or a line drawing of apple). Two aspects of memory were investigated: subjective and objective. To examine the subjective aspect of memory, in the present study, participants were asked to make JOLs while studying the word/picture pairs, and the ratings and accuracy of JOLs were examined. Both immediate and delayed JOL effects were examined by asking participants to make JOLs immediately after studying a pair for some items and after a delay for other items. The second measure was global JOLs, in which, prior to a cued recall test, participants were asked to predict the number of items (out of 30 items) they would be able to recall. The third measure of the subjective aspect of memory was RCJ. This measure was administered during the cued recall test, such that after recalling a target word, participants were asked to rate their confidence in the accuracy of their response. The fourth measure was a subjective rating of mental workload, which was assessed at the end of the study by administering the NASA TLX. To examine the objective aspect of memory, participants were asked to take a cued recall test. In this test, participants were presented with the cue side of the pair (the left side) and asked to recall the target side of the pair (the right side).

The following hypotheses were proposed:

Hypothesis 1. *There would be a positive correlation between the scores of the IORQ and the ratings and accuracy of JOLs (for both immediate and delayed judgments), indicating that participants with a high perceived importance of memory show higher ratings and accuracy of JOLs or, conversely, participants with a low perceived importance of remembering show lower ratings and accuracy of JOLs.*

Hypothesis 2. *There would be a negative correlation between the scores of IORQ and the accuracy of global JOLs, indicating that participants with high perceived importance of memory show higher accuracy of global JOLs. (Note: Higher scores of global JOLs indicate lower accuracy).*

Hypothesis 3. *There would be a positive correlation between the scores of IORQ and RCJs, indicating that participants with a high perceived importance of memory show higher RCJ ratings, indicating higher confidence in their recall.*

Hypothesis 4. *There would be a negative correlation between the scores of IORQ and the ratings of the NASA TLX, indicating that participants with a high perceived importance of memory rate subjective mental workload lower compared to participants with a low perceived importance of remembering.*

Hypothesis 5. *There would be a positive correlation between the scores of the IORQ and the scores on the cued recall test, indicating that participants with a high perceived importance of memory show higher memory performance or, conversely, participants with low perceived importance of remembering show lower memory performance.*

2. Materials and Methods

2.1. Participants

Participants included 108 students, 25 men and 83 women (M_{Age} = 19.39, *SD* = 2.06), in undergraduate psychology courses at Central Michigan University. A post hoc power analysis using G*Power 3.1 confirmed that sufficient power was achieved for finding medium-sized effects in our primary analyses ($1 - \beta = 0.90$). These students were recruited from the Psychology Subject Pool. Participants were given extra credit for their participation, as decided by their professors. This experiment was conducted with approval from the Central Michigan University Institutional Review Board (IRB 2023-841, 10 November 2023).

2.2. Materials

Measure of attitudes toward remembering. The Importance of Remembering questionnaire (IORQ) was developed to measure participants' attitudes toward remembering (see Appendix A). This questionnaire was a modified version of a previous one, which was criticized for being too general, including statements such as "Remembering in a waste of time" (Otani et al., 2018). For this new version, we decided to ask participants to rate the importance of remembering specific information, such as multiplication tables and safety instructions, in three domains: personal, school, and work. The new questionnaire asked participants to rate each of 15 items using a 5-point scale (1—not very important; 5—very important). In addition, one item, the 16th item, was used to measure their overall attitudes toward remembering ("Remembering isn't important"), and participants were asked to rate their response using a 5-point scale (1—strongly disagree, 5—strongly agree). This item was reversed-scored for the analysis to make it such that the higher scores would indicate higher importance of remembering (Cronbach's α = 0.69).

Learning materials. The materials were the same as those used by Knoll et al. (2017). Each participant learned two lists, one consisting of 30 cue–target word pairs and the other consisting of 30 cue–target picture pairs. These lists were presented on a computer screen with words in lowercase letters and pictures as line drawings. These words and pictures were selected from the Snodgrass and Vanderwart (1980) picture norms by first selecting 120 names of common objects and animals (e.g., cats). These items had moderately high mean percentage name agreement (*M* = 89.08, *SD* = 12.79) and image agreement (*M* = 3.73, *SD* = 0.56). Next, these names were divided into two sets of 60 items each (Set A and Set B), and, for each set, 30 pairs were created by randomly pairing the items. Using these sets, the word list and the picture list were counterbalanced across participants.

Measure of mental workload. To measure subjective mental workload of the memory task, the NASA Task Load Index (NASA TLX) was administered (Hart & Staveland, 1988). This instrument consists of six subscales, each with a line that shows 21 vertical tick marks. The left-most side of the line is anchored "very low," and the right-most side of the line is anchored "very high." The five subscales are mental demand, physical demand, temporal demand, performance, effort, and frustration. For the purpose of this study, the subscale of physical demand was omitted because the task did not include physical activities. Also, the performance question was reverse-scored to make higher ratings to indicate higher performance. According to Kirby et al. (1988), this instrument has strong test–retest reliability (*r* = 0.83). Further, this instrument was found to have high convergent validity, showing correlation between 0.97 and 0.98 with other workload measures, including the Workload Profile (WP) and the Subjective Workload Assessment Technique (SWAT; Rubio et al., 2004).

2.3. Procedure

Participants, tested individually, were asked to learn two lists (a word list and a picture list counterbalanced across participants). For each list, participants went through three phases: study, filler task, and test. During the study phase, they were presented with a list via a PowerPoint presentation. Each pair was presented at the center of a computer screen for six seconds. Participants were asked to memorize as many pairs as possible. Also, like Knoll et al. (2017), for each pair, participants were asked to make a JOL using a procedure similar to Dunlosky and Nelson (1992). After a pair is presented, participants were asked to judge how likely they would be able to remember the target (the right side of the pair) in the test phase when the left side of the pair is presented for cued recall. To make these JOLs, participants were shown the cue item (e.g., cat—???) and were asked to rate on a scale of 0 to 100 (0 being a 0% chance of recall and 100 being a 100% chance of recall) how likely they would be able to recall the target item in the testing phase. Participants made the judgment at their own pace and wrote the rating on a response sheet. In addition, for half of the pairs (15 items randomly selected), participants made a JOL immediately after a pair was presented (immediate JOL), and, for the other half of the pairs (15 items randomly selected), they made a JOL after several pairs had been presented (delayed JOL). These immediate and delayed JOL pairs were randomly ordered with a restriction that no more than three consecutive items were assigned for the same JOL type. Further, all the delayed JOLs were made after the last immediate JOL pair was presented and judged, such that at least 10 items separated the exposure of a pair and the delayed JOL.

After all items in a list were presented, participants were asked to give a global JOL, which was a prediction of how many items they would be able to recall in the test phase. After the study phase, participants completed a two-minute distractor task, crossing out the numbers that are divisible by three. Then, during the test phase, participants completed a cued recall test in which they were shown a cue word or picture one at a time on the computer screen and asked to recall the target word or picture. They then wrote their responses on a sheet of paper and made an RCJ (retroactive confidence judgment) on a 5-point scale (1—not very confident; 5—very confident). Once the first list was studied and tested, participants completed the first NASA TLX and additional distractor items as a filler task. Then, they learned the second list, going through the three phases (study, filler task, and test) once more.

Once the memory test of the second list was over, participants completed the second NASA TLX. In both instances, they were asked to reflect on the learning phase of the experiment and rate each subscale of the TLX, except for the physical demand subscale. Rating was performed by placing an "X" along the line from very low to very high. After completing the TLX, participants completed the IOR measure and they were asked to respond to demographic questions.

3. Results

3.1. ANOVAs to Compare Memory and Metamemory Outcomes Across Conditions (These Analyses Are Not Related to Study Hypotheses but Demonstrate the Validity of Our Data)

Recall. Table 1 shows the mean number of correct responses from the memory test. As shown, performance was low for both the word list (M = 8.47, SD = 6.60, 28.23%) and the picture list (M = 9.97, SD = 7.20, 33.23%). Nevertheless, recall was higher for the pictures than for the words, showing a well-established phenomenon referred to as the picture superiority effect (e.g., Paivio & Csapo, 1973). A reason for the low recall level was that there were participants with zero recall. Because excluding these participants did not make a difference in the subsequent correlational analyses, these participants were kept. These participants with zero recall were evenly distributed across conditions: 11 for

immediate word recall, 17 for delayed word recall, 11 for immediate picture recall, and 12 for delayed picture recall. A 2 (list type: words and pictures) × 2 (judgment type: immediate and delayed) repeated-measures ANOVA showed that the main effect of list type was significant, $F(1, 106) = 4.38$, $p = 0.04$, $\eta_p^2 = 0.04$, indicating that recall was higher for the pictures ($M = 4.94$, $SD = 3.58$) than for the words ($M = 4.23$, $SD = 3.30$). Further, the main effect of judgment type was significant, $F(1, 106) = 17.72$, $p < 0.001$, $\eta_p^2 = 0.14$, indicating that recall was higher for the immediate ($M = 4.94$, $SD = 3.15$) than for the delayed judgment type ($M = 4.24$, $SD = 3.03$). The interaction was not significant, $F(1, 106) = 0.01$, $p = 0.93$, $\eta_p^2 = 0.00$.

JOLs. Next, JOLs were analyzed in terms of actual ratings, relative accuracy, and absolute accuracy for immediate and delayed judgments. As Table 1 shows, the mean JOL ratings were higher for the immediate than for the delayed judgments for both the words ($M_{immediate} = 54.28$ $SD = 22.53$ versus $M_{delayed} = 33.57$, $SD = 19.08$) and pictures ($M_{immediate} = 56.85$, $SD = 20.38$ versus $M_{delayed} = 39.58$, $SD = 20.13$). A 2 (list type: words and pictures) × 2 (judgment type: immediate and delayed) repeated-measures ANOVA showed that the main effect of list type was significant, $F(1, 107) = 11.14$, $p = 0.001$, $\eta_p^2 = 0.09$, indicating that the ratings were higher for the pictures ($M = 48.22$, $SD = 15.91$) than for the word list ($M = 43.93$, $SD = 17.13$). Further, the main effect of judgment type was significant, $F(1, 107) = 99.50$, $p < 0.001$, $\eta_p^2 = 0.48$, indicating that the ratings were higher for the immediate ($M = 55.57$, $SD = 18.85$) than for the delayed judgment ($M = 36.58$, $SD = 17.26$). The interaction was not significant, $F(1, 107) = 1.54$, $p = 0.22$, $\eta_p^2 = 0.01$.

Table 1. Mean recall, JOL ratings, JOL relative accuracy, and JOL absolute accuracy.

	Words		**Pictures**	
	Immediate (*SD*)	**Delayed (*SD*)**	**Immediate (*SD*)**	**Delayed (*SD*)**
Recall	4.56 (3.64)	3.87 (3.46)	5.31 (3.85)	4.66 (3.65)
JOL Ratings	54.28 (22.53)	33.57 (19.08)	56.85 (20.36)	39.58 (20.13)
JOL Relative Accuracy (Gamma)	0.37 (0.47)	0.83 (0.38)	0.38 (0.39)	0.84 (0.26)
JOL Absolute Accuracy (Absolute Value)	23.88 (36.48)	8.71 (17.34)	22.63 (35.01)	8.37 (16.22)

Note. JOL refers to judgments of learning.

The relative accuracy was computed by Goodman–Kruskal gamma correlation between JOL ratings and recall for each participant, which measured whether higher JOL ratings were associated with higher recall regardless of the actual ratings (for more information about this measure, see Eakin & Moss, 2019). For example, gamma can be similar regardless of whether an item is rated 30% or 60% as long as recall of this item is higher than other items that are rated lower; that is, what is important is that higher ratings are associated with higher recall whereas lower ratings are associated with lower recall. Similar to other correlational measures, gamma scores range from −1 to +1, with +1 indicating the perfect calibration. Additionally, one weakness of gamma correlation is that gamma sometimes becomes undefined because the denominator of the formula becomes zero, and, therefore, participants with undefined gamma have to be excluded from the analysis.

As shown in Table 1, gamma was higher for the delayed JOLs than for the immediate JOLs for both the words ($M_{immediate} = 0.33$, $SD = 0.49$ versus $M_{delayed} = 0.82$, $SD = 0.41$) and the pictures ($M_{immediate} = 0.39$, $SD = 0.36$ versus $M_{delayed} = 0.86$, $SD = 0.24$), showing a well-established phenomenon referred to as the delayed JOL effect (e.g., Dunlosky & Nelson, 1992). A 2 (list type: words and pictures) × 2 (judgment type: immediate and delayed) repeated-measures ANOVA showed that the main effect of list type was not significant, $F(1, 70) = 1.19$, $p = 0.28$, $\eta_p^2 = 0.02$, indicating that gamma was similar between

the words (M = 0.57, SD = 0.28) and the pictures (M = 0.62, SD = 0.22). The main effect of judgment type was significant, $F(1, 70) = 95.83$, $p < 0.001$, $\eta_p^2 = 0.58$, indicating that gamma was higher for the delayed (M = 0.84, SD = 0.24) than for the immediate judgment (M = 0.36, SD = 0.29). The interaction was not significant, $F(1, 70) = 0.04$, $p = 0.84$, $\eta_p^2 = 0.001$.

The absolute accuracy was measured by averaging JOL ratings (0 to 100%) for each participant and subtracting the mean percent recall from the mean JOLs (which was based on 0% to 100%). If the value is zero, this means that calibration was perfect (that is, the JOL rating matched recall). Note that this way of measuring absolute accuracy is problematic. That is, if one participant overestimates recall but another participant underestimates recall, it may give an appearance of good accuracy as a group when averaged across participants. To avoid this shortcoming, absolute values were used to compare different conditions to avoid positive and negative values canceling out each other. Table 2 shows the mean absolute JOL accuracy, and, as shown, the absolute accuracy was higher (i.e., a lower mean closer to zero) for the delayed judgments than for the immediate judgments for both the words ($M_{immediate}$ = 36.45, SD = 23.83 versus $M_{delayed}$ = 14.31, SD = 13.06) and the pictures ($M_{immediate}$ = 33.72, SD = 24.26 versus $M_{delayed}$ = 14.34, SD = 11.37), again showing the delayed JOL effect. A 2 (list type: words and pictures) × 2 (judgment type: immediate and delayed) repeated-measures ANOVA showed that the main effect of list type was not significant, $F(1, 106) = 0.80$, $p = 0.37$, $\eta_p^2 = 0.01$, indicating that absolute JOL accuracy was similar between the words (M = 25.48, SD = 15.45) and the pictures (M = 24.03, SD = 15.02). The main effect of judgment type was significant, $F(1, 106) = 160.26$, $p < 0.001$, $\eta_p^2 = 0.60$, indicating that accuracy was higher for the delayed (M = 14.33, SD = 9.96) than for the immediate judgment (M = 35.19, SD = 19.24). The interaction was not significant, $F(1, 106) = 0.99$, $p = 0.32$, $\eta_p^2 = 0.01$.

Global JOLs. For global JOL ratings, participants were asked to predict how many items they would recall out of 30 items. Note that for the global judgments, the items used for immediate and delayed JOLs were not separated. Table 2 shows that global JOL ratings were similar between words (M = 8.81, SD = 5.04) and pictures (M = 9.28, SD = 5.74), $t(107) = 0.91$, $p = 0.37$, $d = 0.09$. The accuracy of global JOLs was measured by subtracting the number of correct recalls from the global JOLs for each participant and converting the values to absolute values to eliminate the sign. The results showed that accuracy was similar between the words (M = 4.74, SD = 4.05) and pictures (M = 5.06, SD = 3.94), $t(106) = 0.63$, $p = 0.53$, $d = 0.06$.

RCJ. RCJ ratings were higher for the pictures (M = 2.40, SD = 0.87) than for the words (M = 2.18, SD = 0.78), $t(107) = 2.86$, $p < 0.01$, $d = 0.28$, reflecting the picture superiority effect (see Table 2).

Table 2. Mean global JOL ratings, global JOL accuracy, and RCJ ratings.

	Words (*SD*)	**Pictures (*SD*)**
Global JOL Ratings	8.81 (5.04)	9.28 (5.74)
Global JOL Accuracy	4.74 (4.03)	5.10 (3.95)
RCJ	2.18 (0.78)	2.40 (0.86)

Note: JOL refers to judgment of learning.

3.2. Correlations Between IORQ and Memory and Metamemory Outcomes

Correlations. The following variables were correlated with the IORQ overall scores (based on 15 items) to examine whether there is a relationship between attitudes toward remembering and other memory/metamemory variables: (1) word recall on immediate test, (2) word recall on delayed test, (3) picture recall on immediate test, (4) picture recall on delayed test, (5) immediate JOL ratings on words, (6) delayed JOL ratings on words,

(7) immediate JOL ratings on pictures, (8) delayed JOL ratings on pictures, (9) gamma scores for immediate JOL for words, (10) gamma scores for delayed JOL for words, (11) gamma scores for immediate JOL for pictures, (12) gamma scores for delayed JOL for pictures, (13) absolute accuracy for immediate JOL for words, (14) absolute accuracy for delayed JOL for words, (15) absolute accuracy for immediate JOL for pictures, (16) absolute accuracy for delayed JOL for pictures, (17) global JOL for words, (18) global JOL for pictures, (19) global JOL accuracy for words, (20) global JOL accuracy for pictures, (21) RCJ ratings for words, and (22) RCJ ratings for pictures.

The correlation matrix for these variables is illustrated in Table S1, which is included in the Supplemental Materials due to its size at https://osf.io/x3zrp/ (accessed on 4 January 2025). Only two variables, absolute accuracy for JOL for delayed words and absolute accuracy for JOL for delayed pictures, showed significant relationships with the IORQ scores. For both variables, the correlations were positive and significant: for the words, $r(105) = 0.226$, 95% CI_r [0.038, 0.339], $p = 0.019$, and the pictures $r(106) = 0.231$, 95% CI_r [0.043, 0.403], $p = 0.017$. Scatter plots are shown in Figure 1 (for the words) and Figure 2 (for the pictures). Both figures show that the absolute accuracy of JOL becomes lower (i.e., the score deviates more from zero) as the IORQ scores increase. In other words, the absolute accuracy of JOL ratings became lower as participants rated the importance of remembering higher. Nevertheless, overall, the results of these correlational analyses fail to support Hypotheses 1 through 3 and 5. That is, higher IORQ scores would be positively correlated with higher accuracy and performance.

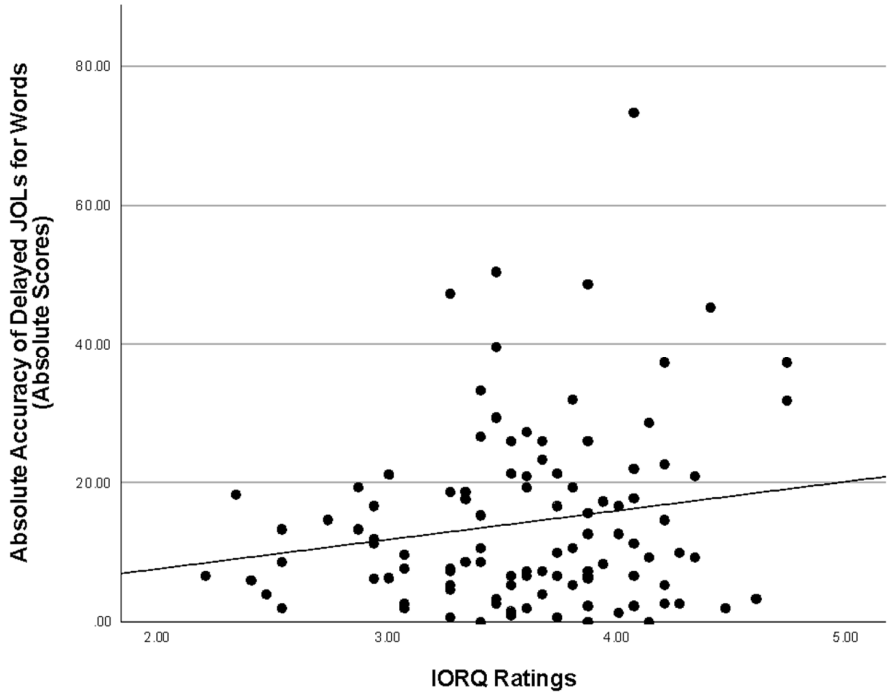


Figure 1. Correlation between absolute accuracy of delayed JOLs for words and IORQ ratings. *Notes:* The plot shows that as the IORQ ratings increased, absolute accuracy of JOL for words deviated more from zero (i.e., became less accurate). IORQ refers to Importance of Remembering questionnaire; JOL refers to judgments of learning.

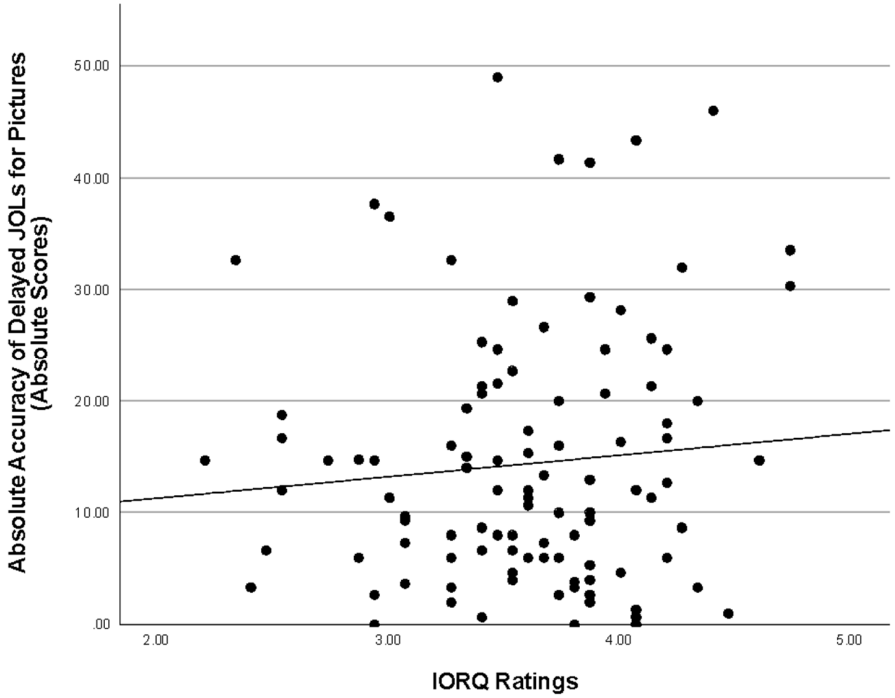


Figure 2. Correlation between absolute accuracy of delayed JOLs for pictures and IORQ ratings. *Notes.* The plot shows that as the IORQ ratings increased, absolute accuracy of JOLs for pictures deviated more from zero (i.e., became less accurate). IORQ refers to Importance of Remembering questionnaire; JOLs refers to judgments of learning.

3.3. Mental Workload Results

The NASA TLX was used to measure the subjective mental workload. This scale is based on a 21-point scale measuring six dimensions: mental demand, physical demand, temporal demand, performance, effort, and frustration. Because the tasks in this study did not involve physical activities, physical demand was omitted. The ratings for mental demand showed a higher mean for the words (M = 14.86, SD = 4.23) than for the pictures (M = 13.47, SD = 4.70), $t(107) = 3.65$, $p < 0.001$, $d = 0.35$. The ratings for temporal demand also showed a higher mean for the words (M = 10.46, SD = 4.83) than for the pictures (M = 9.67, SD = 4.81), $t(107) = 2.28$, $p = 0.03$, $d = 0.22$. The dimension of performance was reverse-scored to make a higher score to be associated with higher performance, and the means were similar between the words (M = 13.13, SD = 5.43) and pictures (M = 12.82, SD = 5.51), $t(107) = 0.47$, $p = 0.64$, $d = 0.05$. The ratings for effort showed a higher mean for the words (M = 13.49, SD = 4.52) than for the pictures (M = 12.80, SD = 4.73), $t(107) = 2.14$, $p = 0.04$, $d = 0.21$. Lastly, the ratings for frustration were higher for the words (M = 11.10, SD = 5.63) than for the pictures (M = 10.82, SD = 5.56). The differences were consistent with the notion that the pictures were easier to remember than the words. The reliability of NASA TLX was modest for both the words ($\alpha = 0.64$) and the pictures ($\alpha = 0.73$). Table S1 shows the correlation between the IORQ ratings and the ratings on each dimension. As shown, none of the correlations were significant, failing to support Hypothesis 4.

4. Discussion

The purpose of this study was to investigate the relationship between attitudes toward remembering and both objective and subjective aspects of memory. Hypothesis 1 stated that there would be a positive correlation between the IORQ scores and JOL ratings and accuracy for both immediate and delayed judgments. Hypothesis 2 predicted that there would be a negative correlation between the IORQ scores and global JOL accuracy. Hypothesis 3 predicted that there would be a positive correlation between the IORQ scores and RCJ

ratings. Hypothesis 4 stated that there would be a negative correlation between IORQ scores and mental workload ratings on the NASA TLX. Hypothesis 5 predicted that there would be a positive correlation between IORQ scores and cued recall performance.

The results failed to support these hypotheses. The only two significant correlations involving the IORQ indicated that contrary to the expectation, higher scores on the IORQ (i.e., believing that remembering is important) were associated with lower absolute accuracy of JOLs for delayed judgments for both words and pictures, and even this finding must be interpreted with caution due to it being contrary to predictions and because no technique was applied for controlling alpha inflation. The results showed that contrary to the hypotheses of this study, attitudes toward remembering were mostly unrelated to the actual behavior of remembering.

Possible explanations for the lack of support for the hypotheses could include that the IORQ does not tap into the components of attitudes toward remembering most relevant to the specific measures of memory performance included in this study. The questionnaire's items ask about the importance of remembering a wide range of everyday general information, but memory and metamemory were assessed using paired associations unrelated to everyday life. In addition, it is possible that these phenomena would have been better examined using a directed forgetting paradigm, such that participants would have to exercise cognitive control of which items to remember and which items to forget (e.g., Franks et al., 2023). Finally, in social psychology, there has been a debate dating back to the 1930s regarding the role of attitudes in determining behaviors. In particular, Wicker (1969) conducted an extensive review of the literature and concluded that there is "little evidence" (p. 75) to support the notion that there exist attitudes inside of a person that would influence behaviors in both verbal and actual actions. The debate about the attitude–behavior relation is still ongoing, and it has been shown that the relation is complex (see Ajzen et al., 2018). Accordingly, given the complexity of the relation, just because one perceives the importance of memory as low, it is not simple to show how these attitudes are actually connected to their actual behavior of remembering.

Nevertheless, there were two correlations that were significant, showing that attitudes have some influence (albeit small) on behavior. These correlations showed that participants who rated higher on the importance of remembering showed lower absolute JOL accuracy for delayed judgments for both words and pictures. These results were contrary to the hypotheses that valuing remembering would make one's judgments about learning more accurate. It is not clear the reason for the unexpected results. However, these results are consistent with the notion that JOLs are based on inferential processes rather than the process of directly accessing memory traces. As mentioned in the Section 1, there is ample evidence showing that metacognitive judgments such as JOLs are based on inferential processes (see Rhodes, 2016). The results of the present study were consistent with the inferential theory of metacognition because JOLs were influenced by one's belief about the importance of remembering information. That is, lower absolute accuracy shown by those who had higher scores on the IOR questionnaire indicated that JOLs can be distorted by one's belief about remembering. A similar distortion was found by Knoll et al. (2017) that one's beliefs about their own learning style influence JOLs such that those who scored high on a visualizer or verbalizer scale showed higher JOL ratings on words or pictures regardless of their actual memory performance.

Outside of the focal hypotheses, other aspects of the present results were highly consistent with well-established phenomena in the human memory literature. First, recall was higher for pictures than words, demonstrating the picture superiority effect (Paivio & Csapo, 1973). Second, delayed JOLs were more accurate than immediate JOLs, replicating the delayed JOL effect (e.g., Nelson & Dunlosky, 1991). The replication of these previous findings confirms the validity of the present data.

There are a number of weaknesses in the present study. First, while college students are a relevant sample for investigating these memory phenomena, both the IORQ and the materials used for the recall test could have been modified to better reflect measures of attitudes and performance in real educational situations. As such, it is possible that the selection of measures needs to be refined in future studies. Second, the instruction was an intentional learning instruction, which did not give participants a choice about remembering the presented materials. Future studies need to adopt a paradigm that is best suited for bringing out a bias such as the directed forgetting paradigm used by Franks et al. (2023). Third, attitudes and behaviors may not be aligned due to a lack of clear motivations and specific links between attitudes and behaviors in this study. Future research should attempt to increase the ecological validity of measures and tasks.

Further, the current study does not account for individual differences in cognitive styles, familiarity with technology, or baseline memory abilities, which may significantly affect the results. The previously cited literature on topics such as the Google effect (Sparrow et al., 2011) and metacognition (Nelson & Narens, 1990) suggest that reliance on external memory aids and personal confidence in memory could interact with attitudes to produce different outcomes. Accordingly, researchers attempting to extend this area of research should explore these and other individual differences as potential moderating variables. Additional future research may include memory tasks with more real-world relevance, such as recalling content for an actual course. Such research may use a range of tasks that better represent the types of memory one may use in academic and professional settings, which would strengthen the alignment between the IORQ and associated outcomes and lead to more interpretable findings.

In conclusion, the present results failed to provide support for the notion that the low perceived importance of remembering is detrimental to actual memory performance. It is also important to note that the offloading of memory processes might be adaptive whenever information overload threatens effective problem solving. For example, it is not necessary for medical doctors to memorize all ICD-10 codes, which include about 69,000 codes, to be able to effectively diagnose a disease https://www.cms.gov/medicare/coding-billing/icd-10-codes (accessed 4 January 2025). One may also argue that memorizing too many codes might interfere with the task of diagnosing common diseases and that the memorization of rare codes costs effort that could be directed elsewhere in more productive ways. It is therefore important to know when to offload. However, our concern is that the advances in information technology have increased tendencies to be cognitively lazy (e.g., Carr & Harnad, 2011). Accordingly, it continues to be important that researchers be vigilant about the harmful effects of modern technology on a variety of domains, from mental health to cognition.

Supplementary Materials: The following supporting information can be downloaded at: https://www.mdpi.com/article/10.3390/psycholint7010005/s1, Table S1: Correlations Between IOR and Recall and JOL Measures.

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Appendix A

Instruction: In your daily life, you need to use many different types of information. You can rely on your memory to remember these, or you can look up on your smartphone when you need it. For each item below, please rate on a 5-point scale how important it is for you to commit the item to your memory rather than relying on your smartphone to access it later.

1—Not very important 2—Not important 3—Unsure 4—Important 5—Very important

1. Telephone numbers of your friends and family
2. Driving directions to go places
3. Lyrics of your favorite songs
4. Birthdays of your friends and family
5. Shopping list
6. Names of your classmates
7. Assignment due dates and test dates
8. Student identification number
9. Basic math knowledge/rules (examples: multiplications, fractions, simple algebra)
10. Information in the textbook that was not mentioned in the lecture
11. Names of people you work with
12. Important future dates (e.g., appointments, meetings)
13. Street address of your work
14. Your work schedule
15. Safety rules at your workplace
16. Remembering isn't important (1 = Strongly Disagree, 5 = Strongly Agree)

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