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Mastery-approach goals eliminate retrieval-induced forgetting: The role of achievement goals in memory inhibition

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Abstract

The present study examined how achievement goals affect retrieval-induced forgetting. Researchers have suggested that mastery-approach goals (i.e., developing one's own competence) promote a relational encoding, whereas performance-approach goals (i.e., demonstrating one's ability in comparison to others) promote item-specific encoding. These different encoding processes may affect the degree to which participants integrate the exemplars within a category and, as a result, we expected that retrieval-induced forgetting may be reduced or eliminated under mastery-approach goals. Three experiments were conducted using a retrieval-practice paradigm with different stimuli, where participants' achievement goals were manipulated through brief written instructions. A meta-analysis that synthesized the results of the three experiments showed that retrieval-induced forgetting was not statistically significant in the mastery-approach goal condition, whereas it was statistically significant in the performance-approach goal condition. These results suggest that mastery-approach goals eliminate retrieval-induced forgetting, but performance-approach goals do not, demonstrating that motivation factors can influence inhibition and forgetting.

Keywords: motivation, achievement goals, retrieval-induced forgetting, integration effect

Mastery-approach goals eliminate retrieval-induced forgetting:

The role of achievement goals in memory inhibition

Learning is the fundamental element in human functioning. Importantly, although learning process has been mainly studied in cognitive psychology, placing relatively little emphasis on social context, in everyday life, people's learning is influenced by many socio-motivational factors. One crucial factor is people's achievement goals, one of the most widely studied motivational constructs in the literature of achievement motivation in social, personality, and educational psychology (for reviews, Hulleman, Schrager, Bodmann, & Harackiewicz, 2010; Kaplan & Maehr, 2007; Murayama, Elliot, & Friedman, 2012). Recently, some empirical attempt has been made to examine the effects of achievement goals on learning process, and found that achievement goals indeed affect memory encoding process (e.g., Murayama & Elliot, 2011). However, little attention has been paid to the possibility that achievement goals can also alter *retrieval* dynamics. Given that both encoding and retrieval processes are crucial for learning, this unbalanced empirical status is surprising. The current study examines the effects of achievement goals on memory retrieval process, aiming to provide a complementary picture on how socio-motivational factors influence learning. We especially focus on one essential aspect of memory retrieval that has attracted increasing attention in memory literature --- namely *retrieval-induced forgetting* (for other investigations of this phenomenon in social psychology, see McCulloch, Aarts, Fujita, & Bargh, 2008; Macrae & MacLeod, 1999).

Achievement goals and encoding processes

Achievement goals are conceptualized as competence-relevant aims that guide behavior in a setting that involves task achievement (e.g., Elliot, 1999; Elliot, Shell, Henry, & Maier, 2005; Elliot & McGregor, 2001).The dichotomy model of achievement motivation suggests two primary types of standards-based achievement goals: *mastery-approach goals* and *performance-approach goals* (see Dweck, 1986; Nicholls, 1984). Individuals with mastery-approach goals have absolute standards (i.e., complete understanding and mastery of a task) and/or intrapersonal standards (i.e., development of one's knowledge or skill). Thus, this type of goal focuses on the development of one's own competence (e.g., "my goal is to do well on the task to develop competency"). In contrast, individuals with performance-approach goals have normative standards (i.e., to perform better than other people). Thus, this type of goal focuses on the demonstration of one's own competence relative to that of other people (e.g., "my goal is to do better than others to demonstrate my competence"; see Elliot, 2005, for other possible conceptualizations of achievement goals).

Different achievement goals encourage different learning processes. Specifically, research has suggested that mastery-approach goals facilitate deep-level processing, whereas performance-approach goals facilitate surface-level processing (e.g., Crouzevialle & Butera, 2013; Elliot, McGregor, & Gable, 1999; Howell, & Watson, 2007; Murayama & Elliot, 2011; Nolen, 1988): mastery-approach goals facilitate broadly focused attention that includes items related to the target as well as relational encoding, whereas performance-approach goals facilitate narrowly focused attention and item-specific encoding. Along these lines, Murayama and Elliot (2011) examined the effect of achievement goals on memory performance using a remember-know procedure and found that mastery-approach goals enhanced correct remember responses in a delayed memory test, whereas performance-approach goals increased correct remember responses in an immediate memory test. They interpreted these time-dependent effects in terms of the differential encoding processes promoted by different types of achievement goals. Thus, mastery-approach goals facilitated long-term retention because this approach involves creating more associations between the items that would support sustained memory performance, whereas performance-approach goals facilitated only short-term retention because of the item-specific encoding that would produce rapid decay in memory strength.

Retrieval-induced forgetting and the integration effect

The retrieval of information from memory is a dynamic process. That is, whereas retrieving information from memory produces superior long-term memory to restudying information (*testing effect*; e.g., Roediger & Karpicke, 2006a, b), retrieval also makes other, related information that is not retrieved less recallable, a phenomenon known as *retrieval-induced forgetting* (Anderson, Bjork, & Bjork, 1994). Retrieval-induced forgetting has been observed with various stimuli, such as autobiographical memories (e.g., Barnier, Hung, & Conway, 2004), visuospatial memories (Ciranni & Shimamura, 1999), eyewitness memory (e.g., MacLeod, 2002), and text passages (e.g., Little, Storm, & Bjork, 2011), suggesting that this phenomenon is robust and general (Storm & Levy, 2012; for a meta-analysis, Murayama, Miyatsu, Buchli, & Storm, 2014). However, little has been known about how socio-motivational factors influence this aspect of memory retrieval.

A standard approach to examining retrieval-induced forgetting is the retrieval-practice paradigm (Anderson et al., 1994). The retrieval-practice paradigm consists of three phases: study, retrieval practice, and final test. During the study phase, category–exemplar pairs (e.g., *fruit–apple*, *fruit–orange*, and *drink–scotch*) are presented. In the subsequent retrieval practice phase, participants retrieve a subset of exemplars from half the categories (e.g., *fruit–ap?*). Finally, in the final test phase, participants are asked to recall all the exemplars when presented with category–plus-one-letter stem cues (e.g., *fruit–a?*, *fruit–o?*, and *drink–s?*). Non-retrieval-practiced (Nrp) items represent participants' baseline level because these items are not practiced and they are drawn from unpracticed categories. Not surprisingly, research has found that the recall of retrieval-practiced (Rp+) items is higher than that of Nrp items, indicating a testing effect. Importantly, the majority of research has also found that the recall of non-retrieval practiced items in a practiced category (Rp-) is lower than that of Nrp items. In other words, despite the fact that neither the Nrp nor the Rp- items are practiced, people forget more Rp- items than Nrp items (for reviews, Anderson, 2003; Storm & Levy, 2012).

Although still a topic of much debate, one of the best-supported explanations of retrieval-induced forgetting is the inhibitory account (for a review, see Anderson, 2003; Anderson & Levy, 2011; for an alternative explanation, see, Raaijmakers & Jakaab, 2013). According to the inhibition perspective, both targets (i.e. Rp+ items) and related non-target items from the same categories (i.e. Rp- items) are activated when individuals encounter a cue. Therefore, successful retrieval of target items from memory requires inhibiting the activation of competitors. As a result, competitors are deactivated and forgotten.

This inhibition, however, can be masked when there is integration between target items and their competitors (*integration effect*; e.g., Anderson, 2003; Anderson & McCulloch, 1999). That is, when individuals find interconnections between items sharing a common retrieval cue (e.g., semantic similarity, elaborate encoding of relations), the competition between the targets and competing items of a given category decreases. Accordingly, individuals need not inhibit non-target items to facilitate successful retrieval of targets during retrieval practice, and thus retrieval-induced forgetting is decreased or eliminated (Anderson, 2003; Anderson & McCulloch, 1999). For example, Anderson and McCulloch (1999; see also Anderson & Bell, 2001) demonstrated that integrative rehearsal, which involves encouraging participants to identify the relationships between exemplars of a category, reduces retrieval-induced forgetting. Additionally, post-experimental questionnaires indicated that even when participants were not explicitly told to integrate the exemplars within a category, they often chose to do so spontaneously, and this strategy also reliably reduced the retrieval-induced forgetting effect.

Achievement goals and retrieval-induced forgetting

Importantly, prior research on the integration effect suggests that one's achievement goal at the time of encoding may moderate retrieval-induced forgetting. As mastery-approach goals facilitate relational processing, this type of goal may promote the integration of items (targets and competitors) belonging to the same category. In this situation, competition may not occur during retrieval practice, making it unnecessary for individuals to inhibit non-targets in order to successfully retrieve targets. Accordingly, we can expect that retrieval-induced forgetting would be reduced or even eliminated when people adopt mastery-approach goals. On the other hand, because performance-approach goals facilitate item-specific processing, competition between the items is unavoidable, making it necessary for individuals to inhibit non-targets in order to successfully retrieve targets. As such, we can expect that retrieval-induced forgetting would occur when people adopt performance-approach goals.

In sum, the current study tests the hypothesis that mastery-approach goals would resolve the competition during retrieval. Specifically, we predict that mastery-approach goals would diminish or eliminate retrieval-induced forgetting, whereas performance-approach goals would not. These findings would provide the very first evidence that the achievement motivation (i.e., achievement goals) is a critical factor that modulates memory inhibition (i.e., retrieval-induced forgetting). [1]

Experiments 1 – 3

The present study included three experiments. All of these experiments manipulated achievement goals using task instructions (Barron & Harackiewicz, 2000; Curya, Elliot, Sarrazin, Da Fonseca, & Rufo, 2002; Murayama & Elliot, 2011), followed by a typical retrieval-practice paradigm to assess retrieval-induced forgetting. Following on prior work (Murayama & Elliot, 2011), achievement goals were manipulated as follows: In the mastery condition, participants were instructed to complete the memory task in an effort to develop their own competence and mastery of the information presented; in the performance condition, participants were instructed to complete the memory task in an effort to demonstrate the superior strength of their own memories relative to that of others. Each experiment used different lists of category–exemplar pairs to ensure the generalizability of the findings. These category–exemplar pairs were selected from Butler, Williams, Zacks, and Maki (2001) and Anderson et al. (1994). Given that each experiment only differed in terms of the materials that were used, and did not include any other manipulations, we report the integrated results using a meta-analysis of the three experiments (Cumming, 2014).

Method

Participants and design. In all the experiments, participants were recruited through Amazon Mechanical Turk (for the validity of this methodology, see Buhrmester, Kwang, & Gosling, 2011). For each experiment, we aimed to collect at least 66 participants, based on a priori power analysis with medium effect size (f = 0.25) and power at .80. We did not conduct any interim statistical analyses before we finished collecting the data. Experiment 1 recruited a total of 73 participants [42 females and 31 males; age range = 20–61 years; mean age (*SD*) = 36.60 years (10.39)]. Experiment 2 recruited a total of 74 participants [40 females and 34 males; age range = 19 – 76 years; mean age (*SD*) = 35.58 years (12.00)], but two participants had participated in Experiment 1 and were eliminated prior to the data analysis. Experiment 3 recruited a total of 75 participants [39 females and 36 males; age range = 19–66 years; mean age (*SD*) = 33.18 years (10.39)], but nine participants were eliminated prior to the data analysis because they had participated in Experiment 1 or 2. Additionally, two participants were excluded prior to the data analysis because they failed to complete the experiment. In all experiments, participants were given USD $2.00 for completing the experiment, and participants were randomly assigned to the mastery-approach goals or performance-approach goals condition.

Materials. The study list consisted of 36 category–exemplar pairs (e.g., *BIRD–Sparrow*, *BIRD–Falcon*, *FRUIT–Apple*, and *FRUIT–Banana*). This list included six members of each of six categories. In Experiment 1, the category-exemplar pairs were selected from Butler et al. (2001). In Experiment 2, the pairs were selected from Anderson et al. (1994). In Experiment 3, half of the category-exemplar pairs were selected from Butler et al. (2001) and the other half of the category-exemplar pairs were selected from Anderson et al. (1994).

To counterbalance the stimuli, the six categories were divided into three subgroups (A, B, and C) of two categories each, and each category was divided into two subsets (a and b) of three exemplars each. During the study phase, all category–exemplar pairs were presented. During the retrieval-practice phase, one subset of subgroup A, B, or C was assigned to the Nrp category, and the subsets of the remaining subgroups were assigned to the Rp+ or Rp- category (e.g., subgroup A was assigned to Nrp, subset a of subgroups B and C was assigned to Rp+, and subset b of these groups was assigned to Rp-). In this way, six lists were created, and participants were presented with one of the lists in the experiment. Additionally, during the retrieval-practice and final test phases, category-plus-one-letter–stem pairs were presented (e.g., *BIRD–S???* and

FRUIT–A???). Six category–exemplar pairs consisting of two members of three categories were used as filler items during the study and retrieval-practice phases.

Procedure. First, participants were given achievement goals using instructions based on Murayama and Elliot (2011; see also Elliot & Harackiewicz, 1996). Participants in the mastery-approach condition were asked to complete the following memory task with the aim of developing their own mental abilities by getting a high score on the task. They were also informed that they would be given feedback about their scores after completing the task. Participants in the performance-approach condition were asked to complete the memory task with the aim of demonstrating the strength of their memory by scoring higher than other people on the task. They were also told that they would be given feedback about the rank of their scores after completing the task.

After receiving these instructions, participants began the retrieval practice task, which consisted of three phases: study, retrieval practice, and final test. During the study phase, 42 category–exemplar pairs were presented one at a time. The first three and the last three pairs were filler items. Each pair was presented for 5 seconds. Except for the filler pairs, the presentation order was randomized. Immediately after the study phase, the retrieval-practice phase began with the category-plus-one-letter-stem cues appearing on the screen for 8 seconds; participants were asked to input the particular exemplar that completed the one-letter stem. Each category-exemplar pair was presented only once. As in the study phase, the first three and last three pairs were filler items, and the order of the category–exemplar pairs was random. After a 3-minute distractor task (solving mathematical problems), the final test began. In the final test phase, category-plus-one-letter-stem cues appeared on the screen for 8 seconds, and participants were asked to input the particular exemplar that completed the one-letter stem. The presentation order of all category-plus-one-letter-stem cues was randomized.

After the memory task, participants completed a questionnaire consisting of two manipulation-check questions and nine distractor questions based on Murayama and Elliot (2011). One question asked the extent to which participants developed their own mental abilities throughout the memory task (mastery-approach goals). The other question asked the extent to which participants attempted to score higher than other people (performance-approach goals). These questions were answered on a seven-point scale ranging from 1 (*strongly disagree*) to 7 (*strongly agree*).

Results and Discussion

Following the recommendation of Cumming (2014), we report the integrated results using a meta-analysis of the three experiments and we report all the studies conducted to avoid publication bias. The meta-analysis was conducted using raw mean values (total $N = 209$). Table 1 reports the results of each experiment.

Retrieval practice and Rp+ items performance. A meta-analysis integrating the results from all the experiments did not show a significant difference in retrieval practice performance between the mastery-approach goal ($M = .65$, $SD = 0.19$, 95% CI [.62, .69]) condition and the performance-approach goal condition ($M = .66$, $SD = 0.18$, 95% CI [.61, .72]; *averaged raw mean difference* = .005, 95% CI [-.05, .06], $p = .86$). Also, the meta-analysis did not show a significant difference in Rp+ items performance between the mastery-approach goal condition ($M = .67$, $SD = 0.20$, 95% CI [.63, .71]) and the performance-approach goal condition ($M = .68$, $SD = 0.19$, 95% CI [.64, .72]; *averaged raw mean difference* = .01, 95% CI [-.04, .08], $p = .60$). Retrieval practice performance was lower compared with that of previous studies (near 80-90%;

e.g., Anderson et al., 1994; Anderson & McCulloch, 1999; Bäuml, & Kuhbandner, 2007). In our experiments, category-plus-one-letter-stem cues were presented, whereas category-plus-two-letter-stem cues were used in many previous studies (e.g., Anderson et al., 1994; Anderson & McCulloch, 1999). Thus retrieval practice was likely more difficult in comparison. However, much research has indicated that retrieval practice performance does not affect retrieval-induced forgetting (*strength independence*: Macrae & MacLeod, 1999).

Retrieval-induced forgetting. The calculated effect size and confidence interval of the retrieval-induced forgetting effect (i.e., Rp- recall performance minus Nrp recall performance; a positive value represents forgetting of Rp- items) is reported in Figure 1 (positive value indicates that retrieval-induced forgetting occurred). Consistent with our expectation, retrieval-induced forgetting was present in the performance-approach goal condition whereas the effect was reduced or eliminated in the mastery-approach goal condition. The magnitude of retrieval-induced forgetting fluctuated across the experiments, but the variation across the studies was well within the confidence intervals, suggesting that the fluctuation was simply produced by sampling errors (Cumming, 2014). In fact, the heterogeneity of the effect sizes was not statistically significant (mastery goal condition was Q (2) = 1.61, p = .45, I^2 = 0.00%; performance goal condition was Q (2) = 0.61, p = .74, I^2 = 0.00%).

A meta-analysis across the experiments showed that the amount of retrieval-induced forgetting in the mastery-approach goal condition was not significantly different from 0 (*averaged raw mean difference* = -.005, 95% CI [-.04, .03], p = .80), whereas retrieval-induced forgetting was significantly higher than 0 in the performance-approach goal condition (*averaged raw mean difference* = .05, 95% CI [.01, .09], p = .01, see Figure 1). The observed raw mean difference in performance-approach condition is comparable to the value reported in a recent meta-analysis on retrieval-induced forgetting (Murayama et al., 2014), demonstrating the validity of our experiments. The difference between these two conditions was also statistically significant (*averaged raw mean difference* = .06, 95% CI [.00, .11], p = .05).

Additionally, we used meta-analysis to determine the positive effects of retrieval practice across the experiments. To do so we compared recall performance for the Rp+ and Nrp items (i.e., a positive value represents the facilitation of recall performance through retrieval practice.). The result showed that the amount of facilitation in the mastery-approach goal and performance-approach goal conditions were significantly greater than zero (*averaged raw mean difference* = .11, 95% CI [.07, .16], p < .001; *averaged raw mean difference* = .07, 95% CI [.04, .11], p < .001). There was no statistically significant difference in the amount of facilitation for retrieval practice between the two goal conditions (*averaged raw mean difference* = .04, 95% CI [-.01, .10], p = .15).

Manipulation check. Table 2 reports the rating values of the manipulation check in each experiment. A meta-analysis showed that participants in the mastery-approach goal condition adopted mastery-approach goals more often than those in the performance-approach goal condition (*averaged raw mean difference* = -0.76, 95% CI [-1.19, -0.33], p = .001), whereas performance-approach goals were more prevalent in the performance-approach goal condition than in the mastery-approach goal condition (*averaged raw mean difference* = 0.56, 95% CI [0.18, 0.95], p = .004), indicating that our manipulation of achievement goals was successful.

General Discussion

The present study examined the effect of achievement goals on retrieval-induced forgetting, illustrating how achievement motivation influences retrieval dynamics in learning process. The core hypothesis was that different types of achievement goals foster different kinds of encoding processes, and thus may moderate retrieval-induced forgetting, (i.e., mastery-approach goals reduce retrieval-induced forgetting, whereas performance-approach goals do not). Three experiments were conducted, and the synthesized results supported our hypothesis. These results suggest that mastery-approach goals may enhance the semantic integration of learning materials because of a relational encoding process, whereas performance-approach goals help people encode information in an item-specific manner (Nolen, 1988; Murayama & Elliot, 2011).

One potential alternative explanation for our finding is that achievement goals may simply encourage different degrees of task commitment (i.e., effort invested for the task), rather than the qualitative differences in the learning process. That is, participants in the performance-approach goal condition paid attention to the task, whereas those in mastery-approach goal condition did not. Indeed, individuals tend to believe that performance goals are harder than mastery goals (Senko & Harackiewicz, 2005). Two points, however, indicate that this was not the case. First, retrieval practice and Rp+ performance did not differ across goal conditions. If lack of attention or task-compliance caused retrieval-induced forgetting to be eliminated, performance should have been lower in the mastery-approach goal condition than the performance-approach goal condition, but this was not the case. Second, retrieval-induced forgetting seems to reflect a more automatic and unconsciousness inhibitory mechanism (for review, see Anderson, 2005). Accordingly, the amount of attention devoted to the task should not by itself contribute to the magnitude of retrieval-induced forgetting observed.

However, the present study has some limitations. First, the current experiments did not include a no-goal condition (i.e., no goal instructions). The present study compared different achievement goals, and found that, retrieval-induced forgetting occurred only in performance-approach goal condition. Thus, it is difficult to disentangle whether mastery-approach goals indeed eliminated retrieval-induced forgetting or performance-approach goals facilitated retrieval-induced forgetting. However, given that many previous studies using the standard retrieval practice paradigm without goal instructions detected retrieval-induced forgetting, we think it is reasonable to argue that our findings showed the elimination of retrieval-induced forgetting under the mastery-approach goal condition. Secondly, although our findings suggest that different achievement goals facilitate different encoding strategy, the current study does not provide the direct evidence that mastery-approach goals facilitate the integration between the targets and the competitors. Although it is generally difficult to directly measure encoding strategy in the standard experimental paradigm of retrieval-induced forgetting (other than using self-reported questions), future research is needed that directly examines the encoding process induced by achievement goal instructions.

The present study showed that achievement goals influence retrieval-induced forgetting, illustrating the importance of socio-motivational factors in memory retrieval process. A logical next step would be to examine the effect of other socio-motivational factors on memory retrieval. For example, given that recent studies have incorporated the approach-avoidance distinction to conceptualize achievement goals (e.g., Elliot, 2005; Elliot, McGregor, 2001), it would important to investigate how approach-avoidance dimension in achievement goals influence retrieval-induced forgetting. Performance-avoidance goals (i.e., goals not to do worse than others), for example, may have different impacts on retrieval-induced forgetting from performance-approach goals (i.e., goals to do better than others). In addition, regulatory focus has also been shown to influence memory performance (Higgins & Tykocinski, 1992; Higgins, Shah, & Friedman, 1997; Sassenberg, Landkammer, & Jacoby, 2014). Individuals, according to regulatory focus theory, are motivated to approach pleasure and positive outcomes (i.e., promotion focus) and to avoid pain and negative outcomes (i.e., prevention focus; Higgins, 1997, 1998). Conceptually, promotion focus is somewhat similar with mastery-approach goals (whereas prevention focus is similar with mastery-avoidance goals), and thus we could expect that retrieval-induced forgetting would be eliminated by having participants adopt promotion focus, although this was not directly examined in the present study. Importantly, different regulatory focus may map on to different strategy; promotion-focus facilitates global processing and relational elaboration that integrates different elements at hand, whereas prevention-focused states elicit local processing and item-specific elaboration (e.g., Förster & Higgins, 2005; Steinhart, Mazursky, & Kamins, 2013; Zhu & Meyers-Levy, 2007). Zhu and Meyer-Levy (2007, Experiment 1) examined this issue using a memory task. In their experiment, participants were asked to remember a multi-category list after manipulating regulatory-focused state, demonstrating that a promotion-focused state led to more consecutive reporting (i.e., increased clustering) of same category item than a prevention-focused state. Given that increased clustering reflects relational processing (see Hunt & Seta, 1984), promotion-focused states lead to more relational elaboration which integrates items of the same category. Thus, it is possible that regulatory focus perspective would provide a proxy for understanding how encoding strategy plays a role in the relationship between achievement goals and retrieval-induce forgetting, and this is a good avenue for future research.

In summary, research on retrieval-induced forgetting has attracted an increasing amount of attention in the field of learning and memory. Previous studies, however, have primarily focused on purely cognitive factors, and overlooked a possible critical role of motivation in memory inhibition. The situation has been the same in the field of achievement motivation, as this literature has mainly focused on the facilitative effect of achievement motivation on learning, but neglected the possibility that achievement motivation could help the *suppression* of learning.

The current study would serve as a bridging role between these two fields that have had little communication with each other, illustrating the important, and potentially interactive, effects of motivation goals on inhibition and forgetting.

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Footnote

1. Other explanation of retrieval-induced forgetting is the competition-based account (see, Raaijmakers & Jakaab, 2013). According to this account, the retrieval practice increases the activation of Rp+ items, and Rp+ items interfere with Rp- items in final test. As a result, individuals cannot retrieve Rp- items successfully. Thus, the competition-based account is not necessary to assume inhibitory mechanism. However, the integration between Rp+ items and Rp- items may resolves the interference in final test, and thus we can also predict that mastery-apporach goals reduce or even eliminate retrieval-induced forgetting, whereas performance-approach goals would not based on the competition-based account.

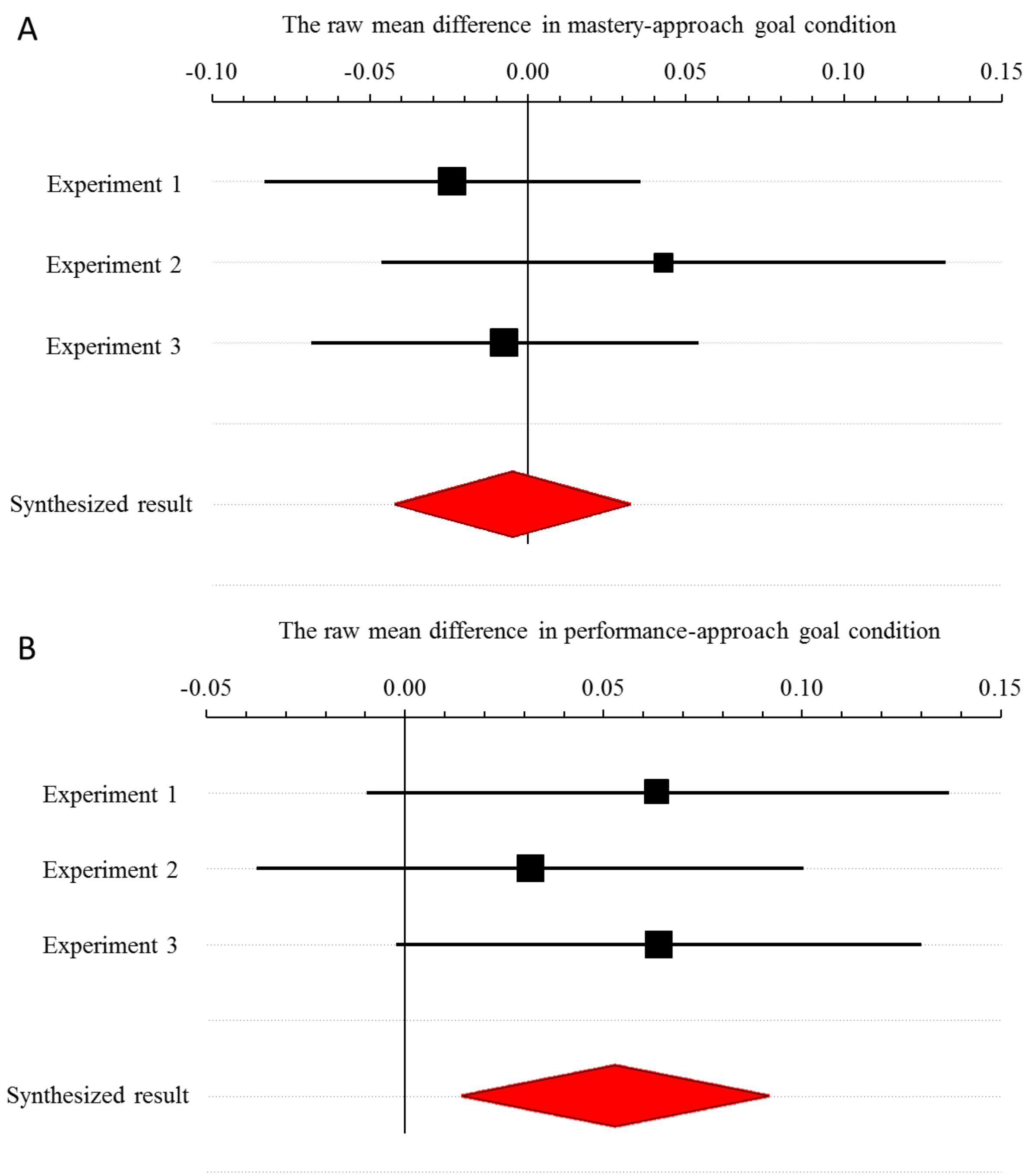

Figure 1. Meta-analysis of the three current experiments on retrieval-induced forgetting. Panel A (upper panel) displays the raw mean difference of correct recall proportions between Nrp and

Rp- item in the mastery-approach condition. Panel B (lower panel) shows the raw mean difference of correct recall proportions between Nrp and Rp- item in the performance-approach condition. Error bars represent 95% confidence intervals. Positive value indicates that retrieval-induced forgetting occur.

Table 1. The mean correct recall proportions of each item and 95% confidence intervals in each experiment.

	Retrieval practice		Final test					
			Rp+		Rp-		Nrp	
	M (*SD*)	95% CI	*M* (*SD*)	95% CI	*M* (*SD*)	95% CI	*M* (*SD*)	95% CI
Experiment1								
Mastery-approach goals	.65 (0.17)	[.59, .71]	.68 (0.19)	[.61, .74]	.57 (0.19)	[.50, .63]	.55 (0.19)	[.48, .61]
Performance-approach goals	.64 (0.19)	[.58, .70]	.68 (0.17)	[.62, .73]	.56 (0.20)	[.50, .63]	.63 (0.13)	[.58, .67]
Experiment2								
Mastery-approach goals	.68 (0.21)	[.61, .76]	.68 (0.19)	[.62, .75]	.59 (0.21)	[.52, .66]	.63 (0.21)	[.56, .71]
Performance-approach goals	.71 (0.15)	[.66, .76]	.70 (0.20)	[.63, .77]	.58 (0.19)	[.52, .65]	.61 (0.18)	[.56, .67]
Experiment3								
Mastery-approach goals	.62 (0.24)	[.54, .70]	.63 (0.24)	[.54, .71]	.50 (0.23)	[.42, .57]	.49 (0.23)	[.41, .57]
Performance-approach goals	.62 (0.23)	[.53, .71]	.66 (0.22)	[.57, .74]	.51 (0.20)	[.44, .59]	.58 (0.22)	[.49, .66]