Bangladesh
Journal of
Psychology

(ISSN 1022-7466)
Volume 25, December 2025, pp. 68-79
DOI: https://doi.org/10.3329/bjop.v25i1. 84813
Received: 15.10.2025 Accepted: 26.12.2025

Feedback, Metacognitive Judgement and Task Difficulty: Determinants of Cognitive Task Performance

Nadia Afrin, Homayra Begum, Muhammad Akram Uzzaman, and Samsad Afrin Himi*

Abstract

This study investigated the interactive effects of feedback, task difficulty, and metacognitive judgment on cognitive task performance. Sixty university students (aged between 20–25 years) were randomly assigned to either a feedback or a no-feedback group. The shortened version of Raven's Progressive Matrices (consisting of three task sets) was used to assess the cognitive task performance. Task difficulty was increased with task sets. After each set, they rated their confidence on a 4-point Likert scale. The feedback group was informed of the number of correct responses. A 2 (feedback: yes vs no) × 3 (task difficulty: low vs medium vs high) × 2 (metacognitive judgement: low vs high) three-way mixed analysis of variances revealed a significant main effect of feedback on performance: participants who received feedback consistently outperformed those who did not. A significant interaction between feedback and task difficulty, $F(1, 11) = 30.994$, $p < .001$, $\eta^2 = .156$, indicated that feedback was particularly effective under high-difficulty conditions. However, none of the other main effects and interaction effects was found to be significant. The results emphasize the importance of feedback under high cognitive load. Future research should examine how individual differences and feedback types shape learning and strategy use.

Keywords: feedback, metacognitive judgment, task difficulty, cognitive task performance

Department of Psychology, Jagannath University, Dhaka, Bangladesh
* **Corresponding E-mail:** samsad@psy.jnu.ac.bd

Introduction

Cognitive task performance refers to an individual's capacity to efficiently and accurately engage in activities that require mental effort. It encompasses skills such as reasoning, problem solving, and working memory, all of which are closely related to basic activities of daily life. Key factors such as feedback (Hammer et al., 2015) and metacognitive judgment (Souchay et al., 2004) have been shown to influence task performance. For example, feedback associated with the expectation of larger rewards improves visuo-spatial working memory in children. Wang and Yang (2021) found that the effect of feedback on memory depend on initial correctness and confidence levels. Similarly, Unsworth et al. (2016) also reported that feedback reduced failures of cognitive performance. Feedback provides external information that helps learners monitor and correct their performance, but excessive feedback in difficult tasks may even influence metacognitive judgement (Luo & Liu, 2023). Metacognitive judgment, such as confidence and self-assessments, influence how individuals allocate effort and adjust strategies. Together, these factors interact to determine how effectively individuals learn, adapt, and perform across cognitive domains.

Cognitive Task Performance and Feedback

Feedback acts as a catalyst for improvement by informing learners of their progress and guiding strategy adjustment. It has a significant role in achievement (Hattie & Timperley, 2007), especially when it is specific, timely, and task-focused (Shute, 2008). As a metacognitive cue, feedback prompts reflection, helping learners assess progress and refine strategies (Butler & Winne, 1996). Research shows that interactive or elaborative feedback enhances cognitive abilities, such as reasoning, working memory, and transfer of judgment skills (Zhang & Hyland, 2022). However, feedback effectiveness depends on task characteristics. For example, Haddara and Rahnev (2022) found that trial-by-trial feedback improved confidence calibration but not metacognitive sensitivity, while Luo and Liu (2023) showed it enhanced performance in easy tasks but impaired it in difficult ones—highlighting task difficulty as a key moderator.

Cognitive Task Performance and Metacognitive Judgment

Metacognition—the awareness and regulation of one's thinking—is central to effective learning and performance (Flavell, 1979). It involves planning, monitoring, and evaluating one's cognitive processes and predicts academic and problem-solving success (Veenman et al., 2006; Zimmerman, 2000). Metacognitive judgments influences reasoning and decision accuracy (Ackerman & Thompson, 2017) and typically decreases as task difficulty increases (Arnold et al., 2024). Because metacognitive monitoring allows error detection, performance adjustment, and knowledge transfer (Dunlosky & Bjork, 2008). Although feedback generally enhances performance (Thorndike, 1927), it can sometimes distort metacognitive judgments, especially under extreme task difficulty (Chitac, 2022; Fleming & Lau, 2014). Nelson and Narens (1990) found that monitoring produces judgments (e.g., confidence) that guide control decisions and monitoring and control interact in a feedback loop. Metacognitive judgments (e.g., judgments of learning) are direct expressions of monitoring. Learners rely on cues to make metacognitive judgments. These cues arise during monitoring of cognitive processing and it explains how monitoring gives rise to judgments (Koriat, 1997).

Feedback, Task Difficulty, and Metacognitive Judgment in Cognitive Task Performance

Feedback effectiveness varies with task difficulty. It is most beneficial for moderately difficult tasks, supporting deeper learning and concept formation (Kulhavy & Stock, 1989; Shute, 2008). Feedback tends to improve performance in moderately difficult tasks but can be less effective or even detrimental in very easy or very hard tasks (Vollmeyer & Rheinberg, 2005). Confidence typically decreases as task difficulty increases, because overconfidence or underconfidence can distort learning (Ackerman & Thompson, 2017; Roderer & Roebers, 2010). Metacognitive sensitivity also tends to decline on challenging tasks (Burson et al., 1997; Shekhar & Rahnev, 2020). In this regard, Zimmerman's (2000) self-regulated learning model shows clear links to feedback, metacognitive judgment, and difficulty level. Zimmerman and Kitsantas (2014) found that formative feedback improved self-regulated learning processes, especially goal-setting, strategy use, and self-evaluation. Pajares and Graham (1999) found that students' metacognitive self-evaluations were strong predictors of self-regulated learning strategy use and academic performance. Together, feedback and metacognitive judgment form a reciprocal system that determines how effectively individuals regulate cognition, adapt to task demands, and achieve optimal performance.

The Present Study

Based on the reviewed literature, feedback plays an essential role in cognitive task performance, while metacognition also contributes significantly. Both feedback and metacognitive judgment are related to task difficulty. However, most studies have examined these variables in isolation. The present study aims to investigate how three factors—feedback, task difficulty, and metacognitive judgment—interact to explain cognitive task performance. In this study, we use Raven's Progressive Matrix as a measure cognitive task performance. The term progressive refers to how the test is organized and progressively harder across sets of items. This allows the test to gradually challenge the individual's reasoning ability and distinguish between different levels of cognitive ability. Overall, we formulated the following research questions.

Research Questions

1. Does feedback play a role in cognitive task performance?
2. Does metacognitive judgment contribute to explain cognitive task performance?
3. Does cognitive performance change with different task difficulty level?
4. Do feedback, task difficulty, and metacognitive judgment jointly contribute to cognitive task performance?

Method

Participants

A total of 60 university students (38.3% male and 61.67% female) were taken for this study. The age range of them were between 20 to 25 years. Most of their fathers were businessman (53.4%) and few were employee (46.6%). Most of the mothers were housewife (78.4%) and few were employee (21.6%). Participants were randomly assigned into two groups – feedback and no feedback group. Each group consisted of 30 participants.

Measures

Shortened Raven's Progressive Matrices Test

Raven's Progressive Matrices (RPM) is a non-verbal test developed by Raven (1936) to measure abstract reasoning and fluid intelligence (i.e., the ability to solve new problems without relying on prior knowledge). In this study the shortened RPM used, which was developed by van der Elst et al. (1994). The shortened Raven SPM comprise 36 items (sets B,C,D) rather than 60 items (sets A, B, C, D, and E) which reduce the test administration time by about 40% (Bouma et al., 1996). It relies on shapes and patterns rather than language or culture-specific knowledge, it is considered a culture-fair measure of intelligence. The test presents a series of visual patterns with a missing piece, and the individual must select the correct piece that completes the pattern. RPM represents consists of several sets or levels, each increasing in complexity. In this study, level B, C, D were used. We recognized B as low task difficulty level, C as a medium task difficulty level and D as a high task difficulty level. Proportion of correct responses were considered as dependent variable.

Metacognitive Judgment

After completing each set of Raven's Progressive Matrices, participants provided a metacognitive judgment of confidence regarding their performance. Confidence was measured on a 4-point Likert-type scale: 1 = I am guessing, 2 = I am slightly confident, 3 = I am moderately confident, 4 = I am very confident.

Procedure

The experiment was conducted in the university laboratory, where participants were seated and tested individually. Each participant first received a detailed instructions. They then completed the Raven's Progressive Matrices. This test was presented using Microsoft PowerPoint. After completing each set of the Raven's test, participants in the feedback group were provided with feedback indicating the number of correct responses, whereas participants in the no-feedback group received no information about their performance. After each set of the Raven's Progressive Matrices, participants completed a metacognitive judgment question. Following this, participants were given a five-minute break before proceeding to the next level.

Data Analysis

Data was analyzed in a 2× 3×2 three-way mixed ANOVA, taking feedback (present vs absent) as between subject-factor, and task difficulty (high vs medium vs low) and metacognitive judgment (high vs low) as within-subject factor. SPSSv26 for windows were used for analysis. We also reported the effect size of each parameter (η2).

Results

Descriptive Statistics

Mean and standard deviation of difference group performance are presented in Table 1. All reported cognitive performance and metacognitive judgment values were approximately normally distributed. Figure 1 illustrates group differences in performance across levels of task difficulty, while metacognitive judgment showed no effect on performance regardless of feedback.

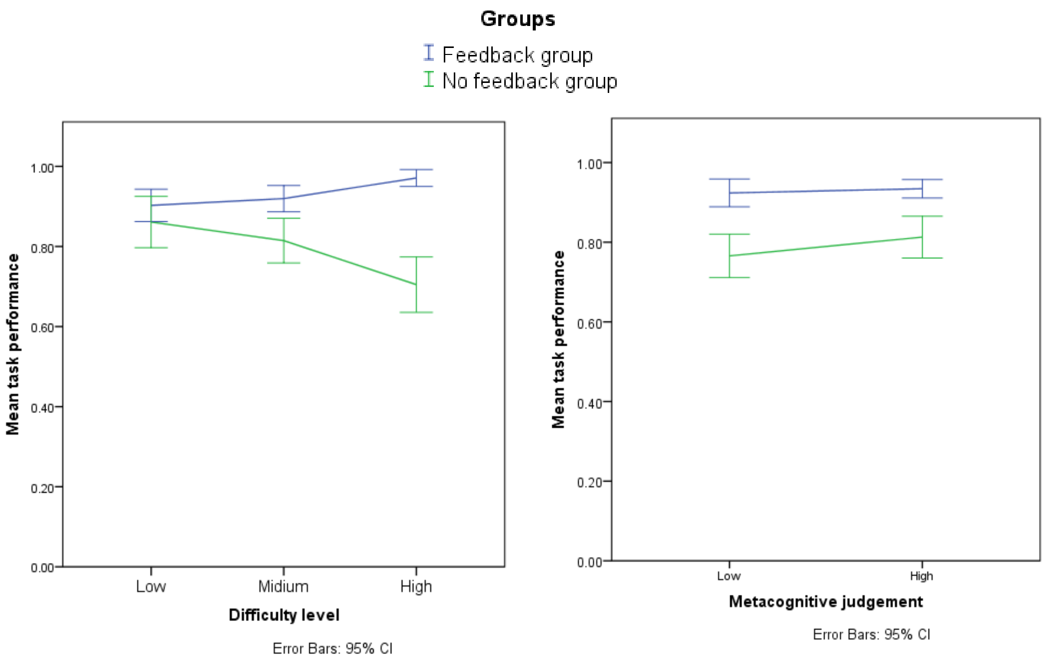
Table 1

Descriptive Statistics of the Measure

Feedback	Difficulty level	Confidence level	Mean	Std. Deviation
	Low	Low	.910	.109
		High	.902	.001
Yes	Middle	Low	.904	.958
		High	.938	.774
	High	Low	.957	.726
		High	.978	.048
	Low	Low	.675	.246
		High	.908	.113
No	Middle	Low	.851	.086
		High	.779	.191
	High	Low	.721	.157
		High	.686	.219

Figure 1

Line Charts for Cognitive Task Performance



Note. Error bar represents 95% confidence interval.

Three-way Mixed Analysis of Variances (ANOVA)

Before final analysis, we checked whether baseline performance differed between feedback and no feedback group (t = .993, df = 58, p= .325). To see the effect of feedback, task difficulty, and metacognitive judgement on cognitive task performance, data were analyzed in a three-way mixed ANOVA. The sphericity assumption was not violated for the main effect of feedback, task difficulty, and metacognition. Therefore, no correction was applied.

Results showed that the main effect of feedback on task performance was significant, $F(1,168) = 30.994$, $p < .001$, $\eta^2 = .156$), in which participants who received feedback *(M = .93, SD = .09)* outperformed those who did not *(M = .79, SD = .18)*. But the main effect of task difficulty ($F(2,168) = 0.894$, $p = .411$, $\eta^2 = .011$) and metacognition ($F(1,168) = 1.010$, $p = .316$, $\eta^2 = .006$) had no effect on cognitive task performance. We got only one interaction effect where we can see the interaction between feedback and difficulty level was significant, $F(2,168) = 5.733$, $p = .004$, $\eta^2 = .064$. However, we did not find any other significant interaction effect between the variables *($p > .05$)*.

Table 2
Fixed Effects ANOVA Results

Feedback	Difficulty level	Confidence level	*Mean*	*Std. Deviation*	Effect	*F* ratio	*df*	η^2
Yes	Low	Low	.9100	.10976	F	30.994	.000	.156
		High	.9024		DL	.894	.411	.011
Yes	Middle	Low	.9038	.9577	MJ	1.010	.316	.006
		High	.9379	.7738	F x DL	5.733	.004	.064
Yes	High	Low	.9570	.7258	F x MJ	.211	.646	.001
		High	.9780	.04786	DL x MJ	1.368	.257	.016
					F x DL x MJ	2.334	.100	.027
No	Low	Low	.6750	.24566	F	30.994	.000	.156
		High	.9075	.11303	DL	.894	.411	.011
No	Middle	Low	.8500	.08577	MJ	1.010	.361	.006
		High	.7793	.19081	F x DL	5.733	.004	.064
No	High	Low	.7206	.15661	F x MJ	.211	.646	.001
		High	.6864	.21904	DL x MJ	1.368	.257	.016

Note. df = Degree of freedom, $\eta^2_{=}$ *Partial Eta Squared.*, F= Feedback, DL= Difficulty Level, MJ = Metacognitive Judgement.

Discussion

The study examined how feedback, task difficulty, and metacognitive judgment influence cognitive task performance. A three-way mixed ANOVA showed that only feedback contributes to explain task performance, in which the feedback group outperformed the no-feedback group. A significant interaction between feedback and task difficulty indicated that feedback was especially beneficial on harder tasks. However, metacognitive judgement showed no effect on task performance.

Feedback and Cognitive Task Performance

Feedback plays a significant role in cognitive task performance, participants in the feedback group outperformed those without feedback. Feedback provides learners with information about their progress, helping them identify errors, adjust strategies, and strengthen effective responses. In line with our findings, we found consistent evidence in prior studies. Such as feedback improves accuracy and enhances reasoning ability (Unsworth, 2016; Zhang et al., 2018). Different forms of feedback (i.e., knowledge of results, knowledge of correct response, or elaborated feedback) significantly enhance cognitive task accuracy compared to the no feedback group (Kuklick et al., 2023). Brummer et al. (2024) also showed in their meta-analysis that any simple feedback (e.g., verification or knowledge of result) is more effective to improve learning performance than no feedback. These findings also support the idea that feedback is a catalyst for improvement, guiding individuals toward better performance and more accurate self-monitoring.

Metacognitive Judgment and Cognitive Task Performance

Performance tends to decline when participants hold strong confidence accompanied by negative or inaccurate thoughts. This suggests that confidence enhances performance only when it is supported by positive or accurate self-assessment (Moreno et al., 2021). In contrast, the present findings indicated that metacognitive judgment did not significantly influence cognitive task performance. Similarly, Fleming and Daw (2017) reported that high but well-calibrated confidence is associated with greater metacognitive sensitivity, which facilitates effective self-monitoring and performance improvement.

The current findings, therefore, diverge from some earlier research and support the notion that the influence of metacognitive judgment on performance is not universal. One possible explanation is the presence of overconfidence, where confidence is miscalibrated relative to actual ability. Kleitman and Stankov (2007) found that self-confidence is linked to metacognitive processes and cognitive accuracy, and that miscalibration can account for performance errors across tasks. Metacognitive judgments not only reflect performance but also shape it.

Task Difficulty and Cognitive Task Performance

Task difficulty is a central factor that shapes cognitive task performance. Anderson et al. (2011) found that moderate task difficulty fosters engagement and higher learning gains, while excessive difficulty leads to disengagement and poor performance. However, results showed null effect of task difficulty on cognitive task performance. The cognitive task performance heavily depends on the ceiling or floor Effects (Smoleń & Chuderski, 2015). Participants might perform well regardless of task complexity if it is too easy. Everyone struggles equally if the task is too difficult; therefore, differences are not noticeable. In this study, task difficulty alone was not significantly related to cognitive task performance, but when considering feedback, task difficulty matters.

Feedback, Task Difficulty and Metacognitive judgment in Relation to Cognitive Task Performance

This study also revealed that feedback, task difficulty, and metacognitive judgment together did not influence cognitive task performance. This suggests that performance in the given cognitive context may be relatively stable across variations in feedback conditions, levels of task difficulty, and metacognitive judgments. Possible explanations may include the robustness of participants' cognitive strategies or limited sensitivity of the task to these manipulations. While task difficulty has often been shown to modulate performance by influencing cognitive load and attentional resources (Sweller, 1988; Paas & van Merriënboer, 1994), the absence of a significant effect in the present study may imply that participants were able to maintain stable performance across varying levels of cognitive demand. Furthermore, although metacognitive judgment is typically associated with performance monitoring and strategy adjustment (Koriat, 1997; Dunlosky & Metcalfe, 2009), their impact may depend on the availability of accurate internal cues or the opportunity to use feedback effectively. The current findings therefore align with studies reporting weak or inconsistent links between metacognitive monitoring and task outcomes under conditions of limited feedback utility or constrained task variability (Bjork e al., 2013). Taken together, the results suggest that the influence of feedback, task difficulty, and metacognitive judgment on cognitive task performance may be context-dependent rather than universal.

Limitations

The study was limited by its sample size, which restricts the generalizability of the findings to other populations. Confidence ratings on a 4-point scale may not have fully captured the nuances of metacognitive monitoring. Moreover, only Raven's Progressive Matrices were used, limiting the applicability of the results to other cognitive domains. Finally, the study focused solely on immediate performance; long-term retention and transfer were not assessed.

Implications of the Study

The study demonstrates that feedback enhances cognitive performance, particularly on difficult tasks, whereas metacognitive judgment alone had no significant effect. These findings underscore the importance of integrating feedback with thoughtful task design to optimize performance. In clinical contexts, combining feedback with metacognitive awareness may help clinicians tailor interventions based on patients' confidence–performance gaps. For instance, Basch et al. (2017) found that real-time feedback improves quality of life and survival among cancer patients, while Barkley (2015) identified feedback as an "external executive function" aiding behavioral regulation in attention deficits hyperactivity disorder. In educational and training settings, structured feedback can enhance learning, accelerate skill acquisition, and reduce errors on complex tasks. Similarly, athletes and performers may benefit from immediate, task-specific feedback coupled with metacognitive reflection to refine strategies and improve outcomes.

References

Ackerman, R., & Thompson, V. A. (2017). Meta-reasoning: Monitoring and control of thinking and reasoning. *Trends in Cognitive Sciences, 21*(8), 607–617.

Anderson, M., Bucks, R. S., Bayliss, D. M., & Della Sala, S. (2011). Effect of age on dual-task performance in children and adults. *Memory & Cognition, 39*(7), 1241-1252.

Arnold, D. H., Clendinen, M., Johnston, A., Lee, A. L., & Yarrow, K. (2024). The precision test of metacognitive sensitivity and confidence criteria. *Consciousness and Cognition, 123*, 103728.

Basch, E., Deal, A. M., Dueck, A. C., Scher, H. I., Kris, M. G., Hudis, C., & Schrag, D. (2017). Overall survival results of a trial assessing patient-reported outcomes for symptom monitoring during routine cancer treatment. *Jama, 318*(2), 197-198.

Bjork, R. A., Dunlosky, J., & Kornell, N. (2013). Self-regulated learning: Beliefs, techniques, and illusions. *Annual Review of Psychology, 64*, 417–444. https://doi.org/10.1146/annurev-psych-113011-143823

Bouma A., Mulder J., Lindeboom J. (1996). Neuropsychologische diagnostiek: Handboek [Neuropsychological assessment: Manual]. Lisse, Netherlands: Swets & Zeitlinger.

Brummer, L., de Boer, H., Mouw, J. M., & Strijbos, J. W. (2024). A meta-analysis of the effects of context, content, and task factors of digitally delivered instructional feedback on learning performance. *Learning Environments Research, 27*(3), 453-476.

Butler, Deanna L., & Winne, Philip H. (1996). Feedback and self-regulated learning: A theoretical synthesis. *Review of Educational Research, 65*(3), 245–281.

Chitac, I. M. (2022). The feedback fallacy in learning: Making practice and interdisciplinarity count. *Network Intelligence Studies, 10*(19), 13-23.

Dunlosky, J., & Bjork, R. A. (Eds.). (2008). *Handbook of metamemory and memory*. Psychology Press.

Flavell, John H. (1979). Metacognition and cognitive monitoring: A new area of cognitive–developmental inquiry. *American Psychologist, 34*(10), 906–91.

Fleming, S. M., & Lau, H. C. (2014). How to measure metacognition. *Frontiers in Human Neuroscience, 8*, 443.

Haddara, N., & Rahnev, D. (2022). The impact of feedback on perceptual decisionmaking and metacognition: Reduction in bias but no change in sensitivity. *Psychological Science, 33*(2), 259– 275.

Hammer, R., Tennekoon, M., Cooke, G. E., Gayda, J., Stein, M. A.,Booth, J. R. (2015). Feedback associated with expectation for largerreward improves visuospatial working Memory performances in children with ADHD. *Developmental Cognitive Neuroscience, 14*, 38–49.

Hattie, John, & Timperley, Helen. (2007). The power of feedback. *Review of Educational Research*, 77(1), 81–112.

Kleitman, S., & Stankov, L. (2007). Self-confidence and metacognitive processes. *Learning and Individual Differences, 17*(2), 161-173.

Koriat, A. (1997). Monitoring one's own knowledge during study: A cue-utilization approach to judgments of learning. *Journal of Experimental Psychology: General, 126*(4), 349–370.

Kuklick, L., Greiff, S., & Lindner, M. A. (2023). Computer-based performance feedback: Effects of error message complexity on cognitive, metacognitive, and motivational outcomes. *Computers & Education, 200*, 104785.

Kulhavy, R. W., & Stock, W. A. (1989). Feedback in written instruction: The place of response certitude. *Educational Psychology Review, 1*(4), 279–308.

Luo, T., & Liu, C. (2023). The impact of feedback on metacognition: Enhancing in easy tasks, impeding in difficult ones. *Consciousness and Cognition, 116*, 103601.

Moreno, L., Briñol, P., & Petty, R. E. (2021). Metacognitive confidence can increase but also decrease performance in academic settings. *Metacognition and Learning, 17*(1), 139-165.

Nelson, T. O., & Narens, L. (1994). Why investigate metacognition. *Metacognition: Knowing About Knowing*, *13*, 1-25.

Paas, F. G., & Van Merriënboer, J. J. (1994). Instructional control of cognitive load in the training of complex cognitive tasks. *Educational Psychology Review, 6*(4), 351-371.

Roderer, T., & Roebers, C. M. (2010). Explicit and implicit confidence judgments and developmental differences in metamemory: An eye-tracking approach. *Metacognition and Learning, 5*(3), 229-250.

Shekhar, M., & Rahnev, D. (2020). The nature of metacognitive inefficiency in perceptual decision making. *Psychological Review, 128*(1), 45–70.

Shute, Valerie J. (2008). Focus on formative feedback. *Review of Educational Research, 78*(1), 153–189.

Smolen, T., & Chuderski, A. (2015). The quadratic relationship between difficulty of intelligence test items and their correlations with working memory. *Frontiers in Psychology, 6*, 1270.

Souchay, C., & Isingrini, M. (2004). Age related differences in metacognitive control: Role of executive functioning. *Brain and Cognition, 56*(1), 89-99.

Sweller, John. (1988). Cognitive load during problem solving: Effects on learning. *Cognitive Science, 12*(2), 257–285.

Thorndike, E. L. (1927). The law of effect. *The American Journal of Psychology, 39*, 212– 222.

Unsworth, S. (2016). Early child L2 acquisition: Age or input effects? Neither, or both? *Journal of Child Language, 43*(3), 608-634.

van der Elst, W., Ouwehand, C., van Rijn, P., Lee, N., Van Boxtel, M. P. J., & Jolles, J. (2013). The shortened Raven Standard Progressive Matrices: Item response theory–based psychometric analyses and normative data. *Assessment, 20*(1), 48–59.

Veenman, M. V. J., Van Hout-Wolters, B. H. A. M., & Afflerbach, P. (2006). Metacognition and learning: Conceptual and methodological considerations. *Metacognition and Learning,1*(1), 3–14.

Vollmeyer, R., & Rheinberg, F. (2005). A surprising effect of feedback on learning. *Learning and Instruction, 15*(6), 589–602.

Wang, L., & Yang, J. (2021). Effect of feedback type on enhancing subsequent memory: Interaction with initial correctness and confidence level. *PsyCh Journal, 10*(5), 751–766.

Zhang, Z. V., & Hyland, K. (2022). Fostering student engagement with feedback: An integrated approach. *Assessing Writing, 51*, 100586.

Zimmerman, B. J. (2000). Attaining self-regulation: A social cognitive perspective. In M. Boekaerts, P. R. Pintrich & M. Zeidner (Eds.), *Handbook of self-regulation* (pp. 13–39).