METACOGNITIVE ASSESSMENT OF VISUAL SEARCH TASKS BY 5TH AND 8TH GRADE CHILDREN

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In order to test if young children (8th and 5th graders) adjust their evaluations based on different sources of performance, we presented them with 2 visual search tasks, a conjunction and feature search. After each task the children performed a performance evaluation on a 7 point scale based on speed and accuracy. The results show no differences in reaction time and mistakes made between the two groups. Evaluation was higher for the feature search when compared to the conjunction search. The task order effect shows participants lowered their self-evaluations depending on which task was performedfirst. Those who performed the feature search first, lowered their assessment for the conjunction search, while those who performed the tasks in reverse order increased their assessment for the feature search. Correlations show a significant positive connection between reaction time and performance evaluation in the conjunction task but not the feature task. The results also show negative connections between performance evaluations and mistakes made in both tasks. These connections are more pronounced for 5th graders. It seems children take into account some but not all performance indicators and younger children base their assessment more on a single indicator. This has further implications for accurate feedback in more complex tasks, especially concerning learning in the context of self-regulated learning.

Keywords: metacognition, visual search, self-regulation, self-evaluation

Introduction

Self-regulation has been described by many different models but there is a general consensus over a core set of processes that make up self-regulated learning: setting challenging goals, selecting strategies, monitoring progress, evaluating achievement and having accurate feedback (Sorić, 2014; Zimmerman, 1989). Metacognition plays a key role in self-regulated learning. Metacognitive knowledge includes everything a student knows about their own mental processes and strategies. Metacognitive processes monitor progress, evaluate strategies, and achievement (McCombs, 1989). The study was designed to test whether children are capable of monitoring their progress and adjusting their evaluations depending on task difficulty. A classical visual search task that consists of two different types

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of search was used. One is a feature search in which the target stimulus differs from distractor stimuli by its defining characteristic. The other is the conjunctive search in which the target and distractor stimuli share main characteristics. In the feature (parallel) search, all stimuli are analyzed at once. The target stimulus "pops-out" among distractors (Treisman & Gelade, 1980). In the conjunctive (serial) search every stimulus needs to be analyzed separately. Serial search results in slower search times and more mistakes for target detection (Gerhardstein & Rovee-Collier, 2002; Wolfe, 1998).

The goal was to determine how task difficulty, order, and objective performance influence metacognitive evaluations of performance in two groups of children. We hypothesized children would significantly adjust their evaluations; lowering them when performing a serial search after a parallel one, and increasing them when the order is reversed. The speed of task performance is usually a significant predictor of metacognitive evaluations so it was expected that reaction time would correlate with evaluations (Redford, et al., 2011). Task difficulty, speed and the number of mistakes represent the most salient indicators of performance (Thompson et al., 2011). It was hypothesized older children would take into account more sources due to maturation and the effects of education on metacognitive skills.

Method

Participants and materials

Two groups of elementary school children: fifth graders (N = 19, 11-12 years old), and eighth graders (N = 21, 13-15 years old). Measurements were conducted individually in a well lit, quiet classroom, on a 15" laptop, running Windows 7. E-Prime v2.0.10.356 was used to present stimuli and gather data.

Procedure

Half of the participants performed the serial search first, followed by theparallel search, while the other halfperformed the task in reverse order. Examples of the two tasks can be seen in Figure 1. Participants simply needed to decide, as fast and accurately as possible, whether the target stimuli (the letter *O*) was present (by pressing the *E* key on the keyboard) or not (by pressing the *P* key) among distracting stimuli (Q in serial, and N in parallel search).

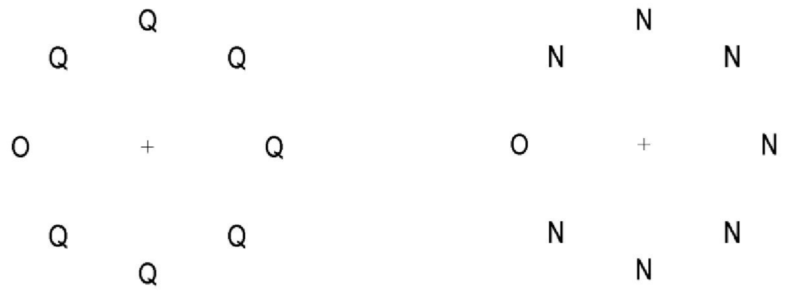

Figure 1. Examples of stimuli for serial (on the left), and parallel (on the right) search tasks

Each individual measurement followed the same procedure: 1500 ms during which fixated on a cross, after which the stimuli were presented until participants made their decision. Each search task consisted of 32 trials (half with the target present).After completing the entire block participants made an evaluation of performance using the scale in Figure 2. They were told to „*evaluate how well they did based on speed and accuracy*".

Figure 2. Performance evaluation scale

Results

A 2x2 analysis of variance was calculated to determine the effect of grade level and task type on decision time. The only significant effect was task type (F(1,38)= 264.39, p < .01). The parallel search was significantly faster than the serial search regardless of grade level. Wilcox matched pairs testshowed significantly more mistakes were made during serial search regardless of grade level (Z = 2.87, p < .01). These findings are in line with previous research and the difference in task difficulty. A 2x2x2 analysis of variance was calculated to determine the effect of grade level, task type and task order on subjective performance evaluations. Grade level had no effect; there was no significant difference in evaluations between the two groups. The main effects of task order (F(1,36) = 34.21, p < .01), and task type (F(1,36) = 7.53, p < .01) influenced performance evaluations with no significant interactions.

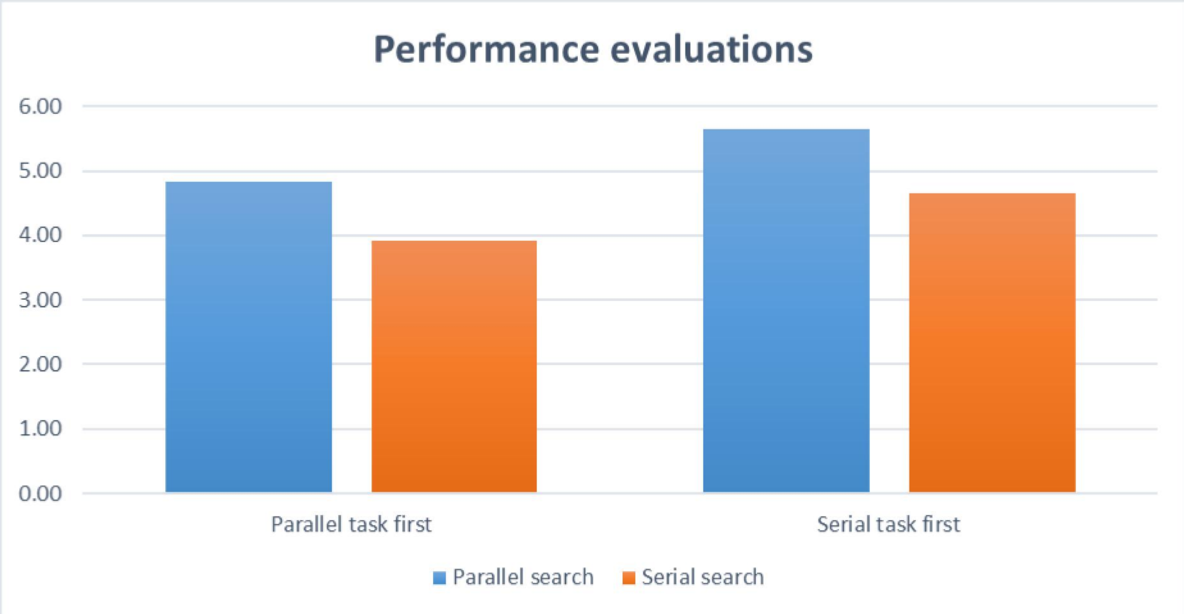

Figure 3. Task type and task order influence on performance evaluations

Participants rate their performance on the parallel search as better when compared to the serial search, regardless of order. Performance evaluations are greater when the serial search precedes the parallel search than when the order is reversed. It is obvious participants adjust their evaluation based on task order. Groups equally rated their first task, which indicates the tasks themselves were novel to the participants. Later adjustments are therefore a result of differential experience during the two tasks.

Table 2

Performance evaluation correlations with decision time and number of mistakes

	Decision time (Pearson correlations)		Number of mistakes (Gamma correlations)	
	Parallel search	Serial search	Parallel search	Serial search
5^{th} grade	.18	$.45^{*}$	$-.71^{**}$	$-.81^{**}$
8^{th} grade	.32	.26	-.03	$-.43^{*}$
Total	.24	$.38^{*}$	$-.32^{*}$	$-.64^{**}$

$^{*}p<.05$; $^{**}p<.01$

Analyses (Table 2) show positive correlations between performance evaluations and decision time alongside negative correlations with the number of mistakes made. Participants evaluated their performance better when performing slower, but making fewer mistakes. It is an unexpected result as other studies show that the time spent on the task is negatively correlated with metacognitive evaluations of performance and confidence (Bajšanski et al., 2014).

Discussion

Results show the expected effects of task difficulty on decision time and the number of mistakes made with no grade level effect. A simple visual search task was chosen to show clear effects with clearly different levels of difficulty. It was expected of participants to adjust performance evaluations depending on what order they completed the experiment. Children of this age are capable of adjusting evaluations based on previous experience and task difficulty, showing a degree of online monitoring required for self-regulated learning. Studies on adults show speed is a positive predictor of metacognitive assessment but the relationship is negative in our sample. Participants favoured accuracy over speed, even though they were explicitly instructed to evaluate their overall performance. Younger children seem to associate performance with a single indicator (accuracy in this case) more than older children. Perhaps this indicates a trend towards including information from more sources in the older group. Even on a simple psychomotor task, such as a visual search, children at the elementary school level are not able to incorporate more sources of information and effectively monitor progress. This probably poses an even bigger problem while tackling new materials and more complex school tasks. The results emphasize the importance teachers have when giving accurate, constructive feedback.

Conclusion and future directions

Based on these results we can conclude that children require accurate feedback to effectively monitor their performance which has been proposed as one of the most important tasks in modern education. Teachers play a vital role for the development of these skills so that students can accurately assess their ability, monitor their progress, and adjust strategies. The visual search task is artificial from an educational perspective, but it serves as a pilot study, and a small sample size also lowers the possibility of generalization. Future research should examine whether children are better at integrating information about performance for more complex and familiar tasks in a school setting.

Literature

Bajšanski, I., Močibob, M. & Valerjev, P. (2014). Metacognitive judgments and syllogistic reasoning. *Psychological Topics, 23*(1), 143-165.

Gerhardstein, P. & Rovee-Collier, C. (2002). The development of visual search in infants and very young children.*Journal of Experimental Child Psychology, 81*, 194-215.

McCombs, B.L. (1989). Self-regulated learning and academic achievement: A phenomenological view. In Zimmerman, B.J & Schunk, D.H (Eds), *Self-Regulated Learning and Academic Achievement* (pp. 51-82). New York: Springer-Verlag.

Redford, J.S., Green, S., Greer, M., Humphrey, M. & Thiede, K.W. (2011). Exploring metacognitive accuracy in visual search. *Memory and Cognition, 39*, 1534-1545.

Sorić, I. (2014). *Samoregulacija učenja.* Zagreb: Naklada Slap.

Thompson, V.A., Turner, J.A.P. & Pennycook, G. (2011). Intuition, reason, and metacognition. *Cognitive Psychology, 63*(3), 107-140.

Treisman, A.M. & Gelade, G. (1980). a feature-integration theory of attention. *Cognitive Psychology, 12*, 97-136.

Wolfe, J.M. (1998). What can 1 million trials tell us about visual search? *Psychological Science*, *9*(1), 33-38.

Zimmerman, B.J. (1989). Models of self-regulated learning and academic achievement. In Zimmerman, B.J & Schunk, D.H (Eds), *Self-Regulated Learning and Academic Achievement* (pp. 1-26). New York: Springer-Verlag.