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# Developmental Differences in Overconfidence: When do Children Understand that Attempting to Recall Predicts Memory Performance?

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***Abstract:*** *Young children are typically overconfident regarding both the physical and cognitive abilities. This overconfidence may be due to development underpinnings. Two experiments investigate overconfidence in 1st – 6th grade students. It was found that not until 4th grade did students overconfidence begin to wane. We discuss these findings in the context of metacognition.*
***Kewords:*** *metamemory, metacognition, overconfidence*

Young children are overconfident in their abilities (e.g., Plumert, 1995; Plumert & Schwebel, 1997; Schneider, 1998; Stipek, Roberts, & Sanborn, 1984). Not only are children overconfident in the physical abilities, but in their cognitive abilities as well. Moreover, not only are they overconfident in their ability they are also unaware of their overconfidence. The goal of the current investigation was to begin to understand when children become aware of their limits of their memory ability. Put differently, we attempted to answer the question, When do children begin to use metacognition?

Multiple studies have demonstrated that children are overconfident in terms of performance on physical tasks (e.g., Plumert, 1995; Plumert & Schwebel, 1997; Schneider, 1998; Stipek et al., 1984). This overconfidence is not limited to physical performance, but is also found in prediction of cognitive task performance (e.g., Cunningham & Weaver, 1989; Flavell, Friedrichs, & Hoyt, 1970; Schneider, 1998; Shin, Bjorklund, & Beck, 2007; Yussen & Levy, 1975). Although overconfidence declines with age (Schneider &Pressley, 1997), grade school students and even adults still show overconfidence in their memory performance (e.g., Lipko, Dunlosky, Rawson, Swan, & Cook, 2007; Schneider, Visé, Lockl, & Nelson, 2000), which in turn can lead to poor self-regulation and performance (Thiede, 1999).

Lipko, Dunlosky, and Merriman (2009) demonstrated that even after repeated practice on the same memory task, preschoolers displayed marked overconfidence. In a series of three experiments, Lipko et al. required children to study 10 pictures, predict how many they would be able to recall, and then attempt to recall the pictures. In the first experiment, the preschoolers demonstrated overconfidence on the first trial and the overconfidence persisted across three trials. In attempt to rule out a *wishful thinking hypothesis*, the second experiment required children to predict their own and another child's ability to recall the 10 pictures. The children were overconfident in recall performance whether predicting their own or another child's performance. In the third experiment, a portion of the children postdicted (recalled their previous performance) on previous trials before predicted their performance for the next trial.

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Across five trials, even when their postdictions were accurate, prediction overconfidence remained.

In each of Likpo et al.'s (2009) three experiments the mean age of the children was 5 year, 0 months or less. These findings motivated us to examine the development of metamemory. The question driving this investigation is: Developmentally, when do children begin to make accurate predictions of performance on the simple memory task? We conducted two experiments with 1st -6th grade children in an attempt to answer this question.

## EXPERIMENT 1

### PARTICIPANTS

Two hundred and thirty nine 1st through 4th grade students enrolled in a single public school in the city of Muscat, Oman participated in the study. The school cooperates with the College of Education, Sultan Qaboos University in many matters such as teacher education field experiences. The public school system in Oman does not collect data regarding race or ethnicity, as the government does not reinforce identification of this type of diversity.

### MATERIALS AND PROCEDURE

The researchers trained six teachers at the elementary school to collect data for this study. Children were tested individually in a quiet room in their school. Every child was asked to count to ten before beginning the experiment to ensure the children understood how many pictures there were and were then asked a small number of practice questions to ensure they could compare quantities of a small groups of items. The task was then explained to the child.

The task began with the experimenter placing 10 4 x 6-inch colored pictures of familiar objects on the board (the lists of pictures were always presented in the order. The pictures were chosen from the language curriculum from each of the four grades and pilot testing determined that the pictures were highly familiar to school-age children. As each picture was placed on the board, the children were asked to name it. After all 10 pictures had been presented the children were given 10 s to study the pictures. They were then asked, ''How many of these pictures do you think you are going to be able to remember once I cover them up (Prediction)?" The pictures were covered with a large piece of white paper, and the children were asked to recall as many of the pictures as possible (Recall). After 60 s, the children were asked to stop trying to recall pictures and the pictures were uncovered. After uncovering the pictures, the experimenter told the children the number of pictures they had recalled.

## RESULTS

Although gender is not a focus of the current research, analyses were first conducted with gender as a factor. The main effect of gender and all interactions including gender were not significant and therefore are not discussed further. Two participants data were dropped from the analyses because their recall accuracy was zero. Both participants were in 1st grade.

Table 1 presents the means and standard deviations for Predictions, Recall, and Calibration. Prediction accuracy (calibration) was calculated as predicted recall – actual recall. Higher values indicate greater overconfidence. Because calibration is derived from prediction and recall magnitudes, we present analysis of these values first. An ANOVA revealed significant overall effects of grade on recall $F(3, 235) = 30.47$, $p < .001$, $MSe = 67.95$. A Tukey's HSD post-Hoc analysis indicated that each successive grade was significantly better at the memory task (recall) than the preceding grade. These findings are consistent with the existing literature regarding the development of working memory (e.g., Dempster, 1981).

Table 1. *Mean and Standard Deviations for Predictions, Recall, and Calibration by Grade*

| Grade | Prediction *M* (*SD*) | Recall *M* (*SD*) | Calibration *M* (*SD*) |
|---|---|---|---|
| 1 | 9.23 (2.18) | 5.38 (1.51) | 3.89 (2.35) |
| 2 | 8.76 (2.25) | 6.01 (1.65) | 2.67 (2.82) |
| 3 | 9.08 (1.99) | 6.97 (1.33) | 2.12 (2.40) |
| 4 | 8.10 (2.29) | 7.83 (1.46) | .27 (2.63) |
| Overall | 8.81 (2.21) | 6.55 (1.75) | 2.30 (2.89) |

ANOVA also indicated a significant effect of grade on JOL's, with $F(3, 235) = 3.27$ $p = .02$, $MSe = 15.56$. Tukey's HSD post-hoc analysis indicated that the difference between 1st and 4th graders was the source of this effect with 4th graders predicting significantly lower performance than 1st graders.

Lastly, an ANOVA indicated an effect of grade on calibration, $F(3, 235) = 20.72$ $p < .001$, $MSe = 135.34$, with post-hoc analyses indicating that 4th graders were more accurate in their predictions than all other grades.

## DISCUSSION

The results of Experiment 1 provide evidence that 4th graders are more accurate in predicting performance on a simple memory test than younger children. However, the results may be partially or fully explained by an artifact of the data. Recall that recall performance was better for older students and JOL's were lower for the older students. Although both were significant, the combination of the two certainly contributes to calibration. Put differently, calibration may be exaggerated by the increase in memory performance and the slightly more realistic prediction of performance. To determine if this effect is in part, explained by this data artifact, we attempted to control differences in working memory by using older students in grade 4th-6th. We expected performance on the memory portion of the task to be similar across students and grades. Therefore, if calibration is better across the grades it is more readily explained by improvement in metacognition, than by improvement in memory performance.

A second goal of Experiment 2 was to determine if familiarity with the objects in the pictures affected students JOL's. We presented children with pictures of unfamiliar objects in Experiment 2 to examine the effect of attempted to remember unfamiliar objects on calibration.

## EXPERIMENT 2

Procedures for Experiment 2 were the same as experiment with one exception. Each child completed the task twice. Once with pictures derived from the language curriculum and once with photos of objects from other cultures that were unfamiliar to the children.[1] Order of familiar vs. unfamiliar trials was counter-balanced across students.

[1] *Objects from other cultures (e.g., a Christmas tree) were pilot tested with a group of 10 6th students from the school. Objects were included if all students in pilot could not name them on sight.*

**Participants**

One hundred and eight one 4th -6th grade students from the same school as Experiment 1 participated in the study. None of the 4th graders from Experiment 1 participated in Experiment 2.

## RESULTS

As with Experiment 1, the main effect of gender and all interactions including gender were not significant and therefore are not discussed further. Analysis of recall demonstrated no difference between in performance across the three grades for total recall, recall for unfamiliar, and familiar pictures (all *F*'s < 1).

Table 2 presents the means and standard deviations for Predictions, Recall, and Calibration by familiarity. A 3 (between subjects: grade) X 2 (within subjects: familiar vs. unfamiliar) repeated measures ANOVA using JOL's indicated a main effect for grade, $F(2, 178) = 9.92$ $p < .001$, $\eta^2 = .10$ with 4th graders providing higher JOL's than both 5th and 6th graders. The same analysis indicated that all students reported higher JOL's for familiar items than for unfamiliar items, $F(2, 178) = 24.72$ $p < .001$, $\eta^2 = .12$.

Table 2. *Mean and Standard Deviations for Predictions, Recall, and Calibration by Grade*

| | Familiar | | | Unfamiliar | | |
|---|---|---|---|---|---|---|
| | Prediction | Recall | Calibration | Prediction | Recall | Calibration |
| Grade | *M* (*SD*) | *M* (*SD*) | *M* (*SD*) | *M* (*SD*) | *M* (*SD*) | *M* (*SD*) |
| 4 | 9.32 (1.55) | 7.25 (1.36) | 2.07 (2.03) | 8.92(1.55) | 6.45 (1.68) | 2.47 (2.38) |
| 5 | 8.52 (1.82) | 7.53 (1.69) | .98 (2.19) | 7.15 (2.31) | 6.47 (1.88) | .68 (2.78) |
| 6 | 8.46 (2.18) | 7.62 (1.99) | .83 (2.32) | 7.89 (2.13) | 6.61 (1.81) | 1.28 (2.52) |
| Overall | 8.76 (2.21) | 7.47 (1.52) | 1.29 (2.23) | 7.98 (2.14) | 6.51 (1.78) | 2.09 (1.39) |

The 3 x 2 ANOVA conducted on calibration indicated a main effect of grade, $F(2, 178) = 8.93$ $p < .001$, $\eta^2 = .09$, but no effect for familiarity, $F < 1$.

We conducted a subsequent analysis to determine if calibration is related to memory performance. The correlation between calibration memory performance was $r = -.58$, indicating that better memory performance was related to lower calibration (or less overconfidence).

## DISCUSSION

The results of Experiment 2 indicate that the improvement in children's prediction accuracy with age in Experiment 1 is not simply an artifact of the data. Further, children with better metacognition also performed better on the memory task. Clearly, it is not possible to infer causation in either direction. However, these findings have important implications for future research. Overconfidence is often linked to poor performance in students. Our results demonstrate that improved accuracy in metacognition is developed overtime and individual differences early in the school years is linked to performance on memory tasks.

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