International Electronic Journal of Elementary Education
Vol. 2, Issue 1, October, 2009.

Children's metamemory: A review of the literature and implications for the classroom

Kristen KARABLY
Georgia State University, United States

Karen M. ZABRUCKY*
Georgia State University, United States

Abstract

In this paper we examine the development of children's metamemory and provide practical implications of research findings for the classroom. In the first part of the paper we define and discuss the global concept of metacognition, the component processes of metacognition and the importance of each component to children's learning. We then examine the development of children's knowledge about memory and ability to monitor memory (i.e., metamemory). We focus, in particular, on seven major research themes: children's metamemory develops with age and experience, younger children are less aware than older children of the benefits of categorization on recall, younger children use different strategies than older children, children's causal attributions may affect metamemory, instructional interventions must be appropriately timed, children will show more strategy transfer when explicit instructions are provided and children overestimate their memory ability. We discuss implications of these major themes for teachers of young children.

Keywords: Metamemory, Metacognition

Introduction

Children come to school from a variety of backgrounds and with varying degrees of knowledge. Teachers are often faced with challenges involved in

* Correspondence may be sent to Karen M. Zabrucky, Department of Educational Psychology and Special Education, P.O. Box 3979, Atlanta, GA, 30302-3979, U.S. (zabrucky@gsu.edu; phone: 404-413-8040).

ISSN:1307-9298

www.iejee.com

teaching children the information and skills they need to know to be successful. Although student learning is the main priority in every classroom, teachers are not always appropriately informed about how to facilitate student learning. It is common for teacher training programs to involve courses that emphasize content and delivery of information and skills that are required of students. However, there appears to be less emphasis on educating future teachers about the process of student *learning* (Borowski & Muthukrishna, 1992). Teachers who understand and apply principles involved in the cognitive processes of learning are more effective at instructing and more effective at teaching students how to learn than those who simply understand and deliver content (Schneider, 2008).

The ultimate goal in the education of children is to help students become self-sufficient learners. According to theorists and researchers, successful self-sufficient learners are self-regulating (Butler & Winne, 1995), motivated, possess a wide body of knowledge and skills, and demonstrate ownership in learning situations. Not only will such children find it edifying to ask questions and seek out information, they will also be able to monitor their own cognitive performance and be able to determine whether they have acquired new information sufficiently. This ability to monitor, control and assess one's own thinking is known as metacognition (Flavell, 1979). Sophisticated learners must be metacognitively mature in order to determine if learning is taking place, or if more work must be done to master a skill or understand a concept (Flavell, Miller & Miller, 2002). Attention is increasingly being paid to the importance of metacognitive skills in self-regulated learning (Eflkides, 2008; 2009).

One component of children's metacognition is their metacognitive knowledge (Flavell, 1979). Metacognitive knowledge includes the knowledge children have regarding the role of person, task, and strategy variables in cognition, is relatively stable in content and is a part of children's developing declarative knowledge (Efklides, 2008; 2009). Teachers can increase children's ability to learn, in part, by helping them become aware of person, task, and strategy variables that affect cognition. Indeed some investigators (e.g., Pintrich 2002) have called upon teachers to explicitly teach children metacognitive knowledge.

Another component of children's metacognition involves their metacognitive experiences, which include their ability to assess or evaluate their progress on cognitive tasks *as well as* their ability to use strategies to regulate progress in a systematic manner. Again, teachers can increase children's ability to learn by helping them become aware of the importance of assessing ongoing cognitive processes during tasks and teaching them strategies for improving their performance when evaluative processes indicate problems (see Bjorklund, Dukes, & Brown, 2009, for a further discussion). It is clear that metacognitive knowledge as well as metacognitive experiences are related to learning (Bjorklund, et.al, 2009; Dunlosky & Metcalf, 2009: Schneider, 2008).

In this paper we focus on the development of metamemory skills and provide some practical information regarding how current research findings can be applied in the classroom. First, we provide an explanation of metamemory. Second, we discuss the importance of metamemory skills. Finally, we review major research findings and themes in the field of metamemory, accompanied by practical applications and suggestions for teachers.

Metamemory

Metamemory, or knowledge of and control of one's memory, has been a topic of interest since the concept was first introduced and defined by Flavell (1971) in response to the question, "What is memory development the development of?" His response (and the introduction of the term, metamemory) to this question was "It seems in large part to be the development of intelligent structuring and storage of input, of intelligent search and retrieval operations, and of intelligent monitoring and knowledge of these storage and retrieval operations- a kind of 'metamemory', perhaps" (p. 277). Thus, the concept of metamemory was established for future researchers to investigate.

Weed, Ryan, and Day (1990) provide a more thorough and updated definition of metamemory, stating that "Metamemory has been operationally defined, alternatively, as (a) verbalizable knowledge of person, task, and strategy variables affecting recall; (b) as self-regulation; and (c) as the effects of instructions incorporating executive control components or metacognitive acquisition procedures (p. 849)." As Weed et al.'s (1990) definition indicates, metamemory is believed to incorporate two major components. First, metamemory concerns stable knowledge of the variables that affect one's memory. This stable knowledge includes knowing about person, task, and strategy variables. These variables constitute (1) an understanding that the size and/or quality of a person's memory is affected by individual ability (person variables), (2) the relative difficulty of a task (task variables) and (3) the relative effectiveness of different strategies (strategy variables). An example of person knowledge is knowledge that at one point in time, someone may remember one idea but be unable to remember something else. An example of task knowledge is the knowledge that a more difficult task (such as remembering a list of 15 words) will be harder to remember than a simpler task (remembering four words). Strategy knowledge is the knowledge that grouping related words together may be more effective than rehearsal (repeating the list over and over) when attempting to remember a long list of words.

Stable knowledge is typically assessed using questionnaires. Some researchers (Schneider, 1986; Short, Schatschneider & Friebert, 1993; Weed, Ryan & Day, 1990) have used questionnaires that have already been developed while others (Andreassen & Waters, 1989; Henry & Norman, 1996; O'Sullivan, 1996; Schneider & Sodian, 1988) have created their own to

fit the needs of a study. Both types of questionnaires are designed to glean information about a person's knowledge regarding memory. For example, O'Sullivan's (1996) study of children's metamemory about the influence of conceptual relations on recall sought to determine if children were aware of the impact of knowledge on memory. To learn about a child's metamemory, the researcher asked, "What did you do to try to remember the words?" and "What helped you most to remember, something you did, something about the words or something else?" (pp. 8-9).

Stable knowledge about memory affects, and is affected by, experiences with remembering (Cavanaugh & Perlmutter, 1982). As children encounter different experiences, they also learn *how* they learn. As they internalize these lessons, they are gaining stable knowledge. Yussen and Bird (1979) were among the early researchers interested in determining what sort of stable knowledge exists in young children. They examined whether four- and six- year old children were able to understand the impact of length and noise (task variables), age (person variable), and time on memory performance. Results of the study showed that children as young as four understood that these variables had an effect on the cognitive domains of memory, communication, and attention. In addition, six-year olds possessed more stable knowledge about the variables than four-year olds, suggesting that children gained stable knowledge through experience.

Chi (1987) contends that differences in stable knowledge due to age are attributable to the different ways that children use information (as opposed to differences in the amount of knowledge they possess). Chi provides an example regarding the way that children know how to categorize information. At first glance, it seems that children are unable to categorize groups of words as effectively as adults. However, they may, in fact, be categorizing such words differently. As youngsters learn new vocabulary, they may "file" the new word, temporarily, in an area that is not hierarchically logical to adults. However, over time, such vocabulary may work its way into a more common semantic structure. Thus, to an adult, stable knowledge regarding categorization may seem to be lacking, whereas really, it is just different and possibly evolving. Still, the evidence to date suggests that children's metacognitive knowledge systematically develops throughout childhood (Schnider, 2008).

The second component of metamemory involves the monitoring of one's memory. Memory monitoring involves an individual's ability to judge how well he/she is performing on a memory task *as well as* the ability to use strategies to improve performance. It is the ability to spontaneously check and test one's performance during and after such a task (Flavell, Miller, & Miller, 2002). This ability to monitor and regulate one's memory is also referred to procedural metamemory (see Efklides, 2008; 2009; Lockl & Schneider, 2002).

Memory monitoring is typically assessed using the following three research paradigms (Schneider, 2008; Schneider & Lockl, 2008): Ease of Learning Judgments (EOLs), Judgments of Learning (JOLs), and Feelings of Knowling (FOKs). EOL judgments are judgments made by a learner before a task (Lockl & Schneider, 2002) regarding how easy or difficult they believe a learning task will be. JOLs are judgments made during or after a task (Lockl & Schneder, 2002) regarding how well the learner believes he/she will perform or has performed. FOKs refer to one's ability to recognize an item even if he/she may not be able to recall it (Wellman, 1977). As discussed in more detail later, most investigators have found improvement in children's judgments as they proceed through elementary school.

The Relationship between Metamemory and Memory

Researchers (Flavell, 1971; Henry & Norman, 1996; Koriat, Goldsmith & Pansky, 2000; Pressley, Borowski, & O'Sullivan, 1980; Wellman, 1977) have investigated the notion that metamemory and memory are related. The idea that metamemory and memory are related stems from the very nature of metamemory itself. Metamemory involves both the knowledge that certain variables affect one's memory (stable declarative knowledge) and the ability to monitor and regulate one's memory (procedural memory). Theorists believe that a person who has these abilities will be better at remembering than a person who does not. Many researchers have explored metamemory-memory correlations. Correlations have been documented between both stable knowledge and memory (Henry & Norman, 1996; O'Sullivan, 1996; Schneider & Sodian, 1988; Short, Schatschneider, & Friebert, 1993) and monitoring ability and memory (Koriat, Goldsmith & Panshy, 2000; Schneider, 1998; Wellman, 1977).

An example of a study documenting metamemory/memory correlations is one conducted by Henry and Norman (1996). Henry and Norman examined the relationships between stable knowledge about memory and memory performance in young children. To determine children's knowledge about memory, the researchers administered a questionnaire pertaining to person, task, and strategy variables. Questions were asked to determine the extent of the children's stable knowledge. Results showed that stable knowledge was, indeed, related to free recall and memory span.

Schneider and Sodian (1988) also found correlations between children's metamemory and their memory performance. These researchers examined children at four-, five-, and six-years of age to determine if children could identify and use retrieval cues in a memory-for-location task. Children were shown ten toy houses, each affixed with a picture of a common item (police car, ball, flower, key, etc.). The children's task involved placing small pictures of people in each of the ten houses and later remembering which person was in each house. "People" consisted of a doctor, policeman, dancer, etc. Successful completion of the task involved remembering where each

"person" was. This could be accomplished by placing people in houses that contained items matching their role (e.g., the policeman would be placed in the house with the police car). Results showed that children's strategy knowledge was correlated with their memory performance. Children who chose to match the items were able to remember the location of the people better than those who did not.

Wellman (1977) investigated feeling-of-knowing in kindergarten, first-, and third-grade children and determined that children who were successful at monitoring were also successful at remembering. To test FOK, the researcher showed pictures to children and asked them if they knew the name of each picture. If a child could not think of the name of the picture, the researchers asked whether he/she would be able to recognize the name of the object from a list of possible names. Responses were compared to actual memory accuracy. Wellman found that monitoring accuracy was related to performance and that older children were better at predicting than younger children.

Studies of metamemory-memory correlations provide information that is useful to both teachers and students. It seems clear that improving children's metamemory knowledge and skills may improve memory. Unfortunately, there is limited information available for teachers regarding ways to foster and improve metamemory skills. Thus, the following information is provided as a guide for teachers who want to be aware of important research findings and apply them in the classroom. Seven major themes about the nature of metamemory have been identified. These findings include:

- Children's metamemory develops with age and experience
- Younger children are less aware than older children of the benefits of categorization on memory
- Younger children use different strategies than older children
- Children's causal attributions may affect metamemory
- Instructional interventions must be appropriately timed
- Children will show more strategy transfer when explicit instructions are provided
- Children overestimate their memory ability

Children's metamemory developments with age and experience

According to Schneider and colleagues (Schneider, 2008: Schneider & Pressley; 1997), as children age their metamemory improves. Several investigators (Bjorklund & Zeman, 1982; Lovett & Flavell, 1990; Moynahan, 1978; O'Sullivan, 1996; O'Sullivan, Howe, & Marche, 1996; Schneider, 1986; Wellman, 1977; and Yussen & Bird, 1979) have documented developmental changes in children's metamemory knowledge and monitoring. As previously described, Wellman (1977**)** examined the way kindergartners, first-graders, and third-graders monitor their own recognition ability. In

this study, the researcher asked children whether they recognized and could name certain pictures. For pictures that a child could not name, he or she was asked about the likelihood that he/she would be able to correctly recognize the name of the object if it was presented to them. Third-graders were significantly better at accurately assessing their feeling-of-knowing than were younger children and kindergartners were only slightly better than chance at correctly assessing their FOK.

Moynahan (1978) examined the development of other metamemory milestones, seeking to determine if developmental differences existed in first, third, and fifth grade children's ability to judge memory performance and select appropriate strategies for given situations. Children were given paired associate tasks (in which a child must remember which "response" word has been paired with a particular stimulus word in word pairs such as frog-purse or snowman-ring) and were instructed to use one of two strategies, either a simple repetition strategy or an interaction strategy which required children to imagine the two words interacting in some way. After the task, children were asked to reflect on the usefulness of the strategy they were instructed to use. Finally, the children were given a third paired associate task in which they could use any strategy or none at all. Results showed that the older children recognized the effects of strategy use, whereas the younger ones did not. In addition, the older children were more likely than the younger children to attribute success to a particular strategy. Thus, developmental differences were found in children's knowledge that strategies are useful and that some are more beneficial than others.

Yussen and Bird (1979) were among a handful of early researchers interested in understanding the developmental progression of certain aspects of metamemory. In a study of three-, four-, and five-year olds, these researchers looked at children's understanding of the effects of length, noise, time, and age on memory. The children were given a series of pictures and questions that provided scenarios of easy tasks or difficult tasks or situations. For instance, to determine if children had an understanding of "person" variables, they were asked to choose from two pictures that depicted individuals remembering a list of words, either a young girl or a grown woman. Children who could indicate that adults were more likely to remember more words were deemed to have an understanding of "person" variables. The researchers found that children were aware of stable variables and their effects on memory but that older children were considerably more accurate than younger children in regards to metacognition.

Bjorklund and Zeman (1982) also found evidence of developmental progression in metamemory. The researchers conducted a study to determine if remembering familiar information was more likely to elicit knowledge of strategy use than remembering unfamiliar information. First-, third-, and fifth- graders were given memory tasks. The researchers asked

the children a set of questions regarding strategy use either before or after they participated in a recall activity. Next, children were given the recall activity in which they attempted to remember either a list of classmates (familiar information) or a list of somewhat unfamiliar words. Recall for the familiar information was higher for all three groups of children. However, when given the unfamiliar information, fifth graders used a helpful strategy of clustering and performed best on the task. In a subsequent experiment, recall was the same for the first and third graders but was significantly improved for fifth graders who received a thirty-second wait time, indicating that these children used their time to reflect on and choose a strategy. These fifth graders also showed greater clustering ability and consistently claimed that they clustered in a way that the researchers documented. Thus, although all age groups may have used some rudimentary strategies to remember familiar and/or unfamiliar information, only the fifth graders could accurately identify their strategy use.

Lovett and Flavell (1990) were interested in learning if, and at what age, children differentiate between the strategies needed to be successful to memorize vs. comprehend information. The researchers set up tests of memorization (strictly rote memory), memory/comprehension combinations (word memorization), and comprehension (similar to a picture vocabulary test). First- and third-grade children were asked to choose which strategy would be better for either rote memorization or comprehension. Strategies included rehearsal, word definition, and a combination of rehearsal and word definition. They were also asked to identify lists of words that would be easier for comprehension (familiar words are easier than unfamiliar words, regardless of the length of the list of words). Both groups of children had difficulty distinguishing between strategies that would prove most helpful in given situations and both groups were better at identifying memorization than comprehension strategies. However, unlike first-graders, third-graders were beginning to be able to distinguish between comprehension and memory and what strategies would improve each. Thus, according to this study, at some point between the first- and third-grade, children begin to learn the difference between memorization and comprehension and how to focus strategies on each process exclusively.

Schneider (1986) examined the way that children and adults organize information in an attempt to understand if differences were due to changes in children's semantic memory or knowledge base or due to children's deliberate strategy use. He argued that as children grow older their use of deliberate memory strategies does not increase, but in fact, only changes. Schneider modified the traditional sort-recall task to determine if this was true. During a sort-recall task, a child is asked to sort a series of words or pictures to best help him/her remember them later. In this case, second- and fourth-grade children were first shown a video demonstration of four strategies that could be used to aid in memorization. The strategies included rehearsal (saying the words over and over), sorting according to categorical

grouping (animals, vehicles, etc.), naming (simply saying each word aloud), and looking (staring at each picture for some time).

Schnieder found that older children were more likely than younger children (second-graders) to spontaneously cluster or sort the test items. Further, fourth-graders seemed to be more adept at choosing an appropriate and helpful strategy than second-graders. However, younger children did show evidence of deliberate strategy use and metamemory skill. Thus, developmental differences may exist in the *way* that metamemory is applied, and not necessarily in the degree to which it is applied.

O'Sullivan (1996) conducted a study to determine what children of different ages know about conceptual relations and the effects of these relations on recall. The conceptually related terms used in this study included words that were all animals or parts of the body. A list of conceptually distinct words included words that had no obvious, conceptual relationships. O'Sullivan examined first-, third-, and fifth-grade children to determine what age differences existed regarding the influence of conceptual relations on recall. Although all age groups showed improved performance when recalling words from conceptually related lists, the youngest children did not report category use or the use of other deliberate strategies. Third- and fifth-graders, however, reported the use of, and demonstrated strategies such as, rehearsal and categorization. Thus, children develop more sophisticated methods of committing information to memory as they mature.

O'Sullivan, Howe, and Marche (1996) conducted an interesting study to examine what children believe about certain aspects of long term retention and how these beliefs change with age. They examined whether children believed that forgetting was more likely to happen with central or peripheral details, and whether newly learned information interferes with remembering previously learned information (a phenomenon known as retroactive interference). Developmental differences in knowledge were found in these children, who ranged in age from preschool to third-grade. As expected, older children were more likely to state that peripheral details were more easily forgotten than central details. They also believed that people are subject to suggestibility and that retroactive interference is possible.

Much of the stable knowledge and monitoring ability classified as components of metamemory improves as children grow older (see Schneider, 2008, for a further discussion). By third grade, children have become aware of influences on memory (Lovett & Flavell, 1990; O'Sulivan, 1996; O'Sullivan, Howe, & Marche, 1996; Schneider, 1986; Wellman, 1977), and can, by fifth grade, apply useful strategies in appropriate situations (Bjorklund & Zeman, 1982; Moynahan, 1978). Teachers should be aware of this progression and have an understanding of what is typical metamemory development for elementary school children. Second-, third-, and fourth-

grade teachers would be wise to point out potential times when strategy use would benefit their students, keeping in mind that children of this age will need guidance. Teachers of fifth graders should also be aware of how well their students are performing on memory-type assessments and identify whether they are using appropriate strategies.

Despite the many findings suggesting that metamemory improves with age, there are also studies that show that some aspects of metamemory may not consistently improve with age, include two memory-monitoring skills: judgements of learning (JOLs) and feelings of knowing (FOKs). Lockl and Schneider (2002) conducted a study to investigate the developmental progression of FOKs as previous research (Butterfield, Nelson, & Peck, 1988; Cultice, Somersville, & Wellman, 1983) had resulted in mixed and inconsistent findings. Lockl and Schneider looked at children's ability to judge their own performance on a recognition test. Children consisted of first-, second-, third-, and fourth-graders. The researchers began by using a vocabulary test to determine words that each child could correctly define. Next, children were asked to rate their confidence regarding the words they had not defined correctly. Confidence levels measured children's confidence that they would recognize the correct answer from a list of options. Findings showed that FOK accuracy was generally low to moderate for all age groups. Lockl and Schneider concluded that there was no evidence that FOK judgments significantly improve over the school-age years.

Schneider, Vise, Lockl, and Nelson (2000) conducted two experiments to examine possible developmental trends that may exist in children's monitoring skills. Kindergartners, second-graders, and fourth-graders were asked to make judgments regarding the likelihood of remembering newly acquired information (JOLs) on a memory test. Children were asked to recall information in one of two ways, either immediately after learning or after being given a two-minute "delay." Prior research (Nelson & Dunlosky, 1991) has demonstrated a clear advantage for adults' performance when they are provided with a delay. Schneider et al. found that, similar to adults, children benefited from a delay and were more likely to provide accurate answers when provided with this delay. In addition, the researchers concluded that there appears to be no evidence that JOLs are affected by a child's age. This research provides practical information to educators by suggesting that students may benefit from being given a delay before being asked to predict his/her readiness for a test.

Younger children are less aware than older children of the benefits of categorization on recall

The findings regarding the developmental progression of metamemory reveal that, unlike older elementary students, younger children are unaware of the beneficial effects of categorizing on remembering. The lack of ability to effectively categorize to aid recall may represent a lack of monitoring ability. A study by Salatas and Flavell (1976) was one of the first to look at the way

children respond to and use categorization as a strategy for remembering. In an experimental group, children were instructed to look at sixteen pictures that were placed into obvious categories in an array. The children were instructed to remember the words and to take notice of the categories. Children in a control group were simply instructed to look at the pictures. Both groups were given a recall test after a short amount of time. Results indicated that children in the experimental group performed significantly better on the recall task. However, children from the experimental group were no more likely than the control group to state that categorization aids recall. Further, knowledge of the beneficial effects of categorization did not necessarily transfer to behavior. In other words, children who claimed that categorization was beneficial were no more likely to categorize on subsequent tasks. Thus, despite the fact that some strategy knowledge regarding categorization existed, the children still did not apply it.

In a similar study (Bjorklund, 1980), kindergarteners, third graders, and sixth graders were instructed to learn lists of words that had been categorized in taxonomic ways and in complementary ways. Taxonomic categories contain groups of words that belong together by group (e.g., animals, tools) while complementary categories are groups of words that belong together due to function or location (e.g., things that go in the kitchen, things that a teacher uses). One group of children was made aware of the existence of categories before the test was given. A second group was not told about the categories but the test-words were presented in clusters, according to groups. A third group of children was not made aware of the categories and words were not presented in particular groups. Kindergarteners understood both taxonomic and complementary groupings but this understanding did not facilitate memorization. Instead, they tended to memorize each word on an "instance-by-instance" basis. Although the kindergarteners performed slightly better when they remembered taxonomically similar words, they were unable to identify the reason. Only the sixth graders were able to consistently identify the categories, regardless of the test condition.

In response to findings that young children are less likely than older children and adults to organize information to be remembered, Bjorklund and Zeman (1982) conducted a study to examine "spontaneous organization" in closer detail. They were interested in finding out more about when children may begin to organize for recall. To do so, the researchers set up an experiment that necessitated organizational strategy, yet created an activity simple enough for young children to complete successfully. Results showed that whereas older children (fifth graders) were able to identify a useful organizational strategy and use it consistently, first and third grade children were more likely to "happen upon" a strategy if they were to use one at all.

Schneider (1986) looked further at this phenomenon, investigating the mechanism(s) behind sorting and categorizing behaviours in children. Schneider studied the conceptual knowledge that second- and fourth-grade

children have and how it affects the way they apply strategies in sort/recall tasks. Results showed that second-graders are relatively unaware of the benefits of clustering and sorting for recall, and that fourth- graders are in the beginning stages of learning the benefits of deliberate memory strategies. Henry and Norman (1996) offer the hypothesis that young children seem to be unaware of the benefits of categorizing because of the way the sort-recall tasks are conducted. They argue that children may not actually have trouble with the task of categorizing (category items are usually obvious, even to young children) but that they may have simply not recognized its usefulness as a memory strategy yet. In other words, young children may be able to "do" the strategy but they may not yet make the connection that it will enhance memory.

In a study of preschoolers' classification styles, Bjorklund and Zaken-Greenberg (1981) found that four- and five-year old children do not necessarily benefit from the same methods of categorizing as older children. Specifically, sorting taxonomically did not benefit preschool children the way it did older children. In this study, preschool children who sorted in complementary ways outperformed those who sorted taxonomically, on certain recall tasks. Four- and five-year olds were given word lists and instructed as to how they should group the words prior to memorization. Half of the children sorted taxonomically and the other half sorted nontaxonomically. Half of each of these groups sorted the words once prior to testing and the other half sorted two times (the same way both times) prior to testing. Although children in the taxonomic group outperformed those in the nontaxonomic group on the one-sort activity, the opposite was true for the two-sort activity. The researchers attributed this to a novelty effect. When searching for ways to associate the words, the children were elaborating enough to commit the words to memory. These results point to what may be another qualitative difference between older and younger children's metamemory.

Teachers should be aware that during the elementary school years children become aware of organizational strategies, learn to apply them and will eventually use them spontaneously. Due to the fact that using organizational strategies becomes increasingly important as children mature and face more challenging academic classes in middle and high school (when more difficult memorization tasks will be required), the acquisition of strategies is an important accomplishment. It may be helpful for teachers to point out situations where organization is helpful and encourage students to use it. For instance, science and social studies are two subjects where memorization skills are necessary. If asked to memorize a group of animals from the animal kingdom, students may consider grouping them according to size or colour. Experimenting and practicing with grouping and categorization may be a helpful way to learn about strategy use.

Younger children use different strategies than older children

As noted earlier, young children (under the age of seven years) do not necessarily show a connection between the use of simple strategy use (categorization), memory performance, and metamemory (Henry and Norman, 1996). However, there is evidence that young children engage in and benefit from different strategies than older children. Henry and Norman (1996) examined the relationship between the use of simple strategies, memory performance, and metamemory in four- and five-year old children. The researchers used a nonverbal questionnaire to determine children's predictions about their own memory abilities. This questionnaire consisted of a series of pictures of people trying to remember different items. Children were asked to point to pictures that showed easy or hard remembering tasks. Children were also given tests of free recall and memory span.

Henry and Norman monitored the strategies that children used during the free recall and memory tasks. Children who used a verbal naming strategy during presentation in the recall task performed better than those who did not. The verbal naming strategy consisted of the child naming each object as it was presented to him/her. Of particular importance was the point at which the children verbalized, or named, the stimuli. Those who named the stimuli at recall but not presentation were less successful than those naming at presentation only. Henry and Norman hypothesized that this phenomenon may be a result of the way that children encode information to be remembered.

Baker-Ward, Ornstein, and Holden (1984) came to a similar conclusion in their study of four-, five-, and six-, year olds. These researchers were interested in learning about the existence of deliberate memory strategies in young children and how they differ from the more commonly known strategies of older children and adults (e. g., rehearsal and categorization). Children were provided with a group of toys. Children in the experimental group were told to do anything they wanted to with the toys in order to help remember them. Children in the control condition were only told to play with the toys. The children's behaviours were recorded for analysis. Children who were in the "remember" condition played with the toys considerably less than those who were not asked to remember. They also used their time to name the objects and visually examine them. Baker-Ward et al. concluded that naming and visual inspection are likely to be precursors to the more sophisticated strategies of older children. Further, the deliberation and "studiousness" of the children suggests that they made efforts to remember, perhaps helping them develop a respect for strategy use. Thus, the "naming" strategy found during the younger years may be practice for the more sophisticated strategies found in older children.

Naming objects or words to be remembered may be an important first step in developing other, more effective, memory strategies. One way that teachers may interpret and use this information is to encourage young children to reflect upon this practice (naming stimuli at presentation) and recognize that it is helpful. According to Schneider and Sodian (1988),

children who engage in metacognitive behaviours are more likely to use strategies and display successful memory behaviour. Thus, encouraging a child to reflect upon the use of this strategy, albeit a simple one, may be helpful in both encouraging metacognitive thinking and encouraging the use of the strategy itself.

Children's causal attributions may affect metamemory

Teachers who are interested in fostering strong metamemory skills in order to increase strategy use and recall in the classroom should be aware of children's causal attributions. Weed, Ryan, and Day (1990) conducted a study and proposed a model regarding the way that both metamemory and causal attributions relate to recall. In their study, the researchers examined the effects of various measures of metamemory and academic causal attributions on recall. Fourth-graders were given an IQ test, a general test of metamemory (questionnaire regarding knowledge about strategy use), a test of task-specific metamemory (children were asked how to study for a recall test), a questionnaire regarding academic causal attributions (children were asked about their motivational orientation), and a free recall test. Children who believed that effort and strategy play a more substantial role than luck in learning situations tended to be the most successful on the free recall task. Weed, Ryan and Day's results emphasize that students must be reminded that success in such situations is under their own control.

O'Sullivan (1996) found that causal attributions differed depending on the age of the child. In a study of the influence of conceptual relations on recall, O'Sullivan found that first-graders were more likely than third- and fifth- graders to attribute success to general, rather than specific, attributions. General attributions included "phonological or spelling characteristics of the words, trying or working hard, attributions focused on the subject's brain, mind, eyes, and ears" (p. 15). These general attributions were less apparent in the older children who displayed "attributions to the presence of categories in the word list" or "attributions to the subject's use of specific mnemonic strategies" (p. 15). These findings suggest that the general attributions of younger children may be eventually phased out by more specific, metamemorial knowledge and functioning.

Researchers have also studied the causal attributions that children have regarding how strategies work. Fabricius and Cavalier (1989) examined the influence of such beliefs on children between the ages of four and six. They found that as children mature, they develop more sophisticated or well-developed theories about the ways that organization and labelling work in remembering. Children who gave "mental" explanations regarding the helpfulness of labelling said that labelling helped them remember because they could repeat the word over and over or visualize it. Children who gave "perceptual/behavioural" explanations said that labelling allowed them more time to hold on to the information. Fabricius and Cavalier provide a possible interpretation of their findings, stating that the process of explaining the

usefulness of a strategy may help the child develop a stronger belief in that strategy, thus, increasing the likelihood of using it again. A similar explanation was given by O'Sullivan, March, and Howe (1996), who suggested that children may not be able to control their use of deliberate strategies until they are able to explain their beliefs about strategy use.

It is very important that teachers help students become aware of their attributions for success or failure in memory situations. Children who are aware of their attributions may be more likely to reflect upon and modify their own behaviours. Teachers can help children reflect by asking them questions about their memory and what they attribute their success to. Further, children must be reminded that success is under their own control and that using deliberate memory strategies can lead to success.

Instructional intervention must be appropriately timed

The findings of O'Sullivan (1996) and Weed, Ryan, and Day (1990) suggest that young children may be prone to relying on older causal attributions instead of their developing metamemory. These children may benefit from a teacher prompting them to rely on their developing metamemory skills. The findings of Weed, Ryan, and Day (1990) echo those of Andreassen and Waters (1989), who conducted a study to determine if and when children plan to organize information to be remembered in a free recall task. Metamemory assessments were given to first- and fourth-graders either before or after a free recall task was assigned. Results showed that older children planned to use deliberate memory strategies and could benefit from prompts prior to the activity. Younger children did not plan ahead of time. Andreassen and Waters concluded that the process of learning to intentionally plan to use strategies begins with the recognition of strategy use during the activity and that this process may be developmental in nature. These findings can be applied to the classroom by reminding teachers that children must be given prompts if they are to be expected to use certain strategies. Such prompts may be necessary for far longer than prompts given for other cognitive tasks. Young children should not be expected to retain strategies simply because they have previously been successful.

Children will show more strategy transfer when explicit instructions are provided

Studies have shown that children do not spontaneously use memory strategies that have proven to be successful in the past (Schneider, 1985). In early studies (Brown, Campion, & Barclay, 1979; Brown, Campione, & Murphy, 1977) researchers determined that children do not necessarily generalize learned strategies to new situations. Older children are better able than younger children to maintain strategies under some circumstances. Several researchers (Ghatala, 1986; Levin, Pressley, & Goodwin, 1986; Ghatala, Levin, Pressley & Locico, 1985) have investigated

the ways that strategy training must be conducted in order for children to benefit and effectively transfer strategy use.

It would appear that simply showing children how to use an appropriate strategy does not effectively lead to the transfer of the strategy in future situations (Borowski & Muthukrishna, 1992; Pressley, Levin, Ghatala, 1984; Pressley, Ross, Levin, Ghatala, 1984). Ghatala, Levin, Pressley, and Lodico's (1985) study of second-graders provides evidence that monitoring training must be included in strategy-transfer training for maintenance to occur. In their study, the researchers examined three groups of second- graders. One group was given strategy-monitoring training, which included a lesson in the importance of using useful strategies to improve memory performance. A second group was given the choice of using one of two strategies that were taught and encouraged to reflect on the affective qualities of the strategy instead of its effectiveness (e.g. how much fun it was). A third group was used as a control and was not given instructions about the strategies presented. Although all children chose a strategy to use on a final memory test, only the strategy-utility group indicated that the one they chose was the best because it was the most effective in the past. Further, this group maintained the strategy over a long period of time, as opposed to the other two groups. Strategy maintenance resulted in the highest recall levels after a nine-week interval. These findings point to the importance of teachers including thorough metacognitive/monitoring components in training sessions when training for strategy use, transfer, and maintenance. Teachers must specifically point out the way that a strategy is useful in order for children to understand the full benefit of that strategy.

Ghatala, Levin, Pressley, and Goodwin (1986) conducted a similar study to determine the best way to train second-graders to select and use strategies. The children were divided into either "training" conditions or "information" conditions. In the "information" conditions, children were provided with information regarding how well certain strategies worked, in addition to participating in a training session. In the "training" condition, three groups of children were given different combinations of training sessions. One group received the "three-component" training series. This consisted of assessment (children were encouraged to reflect on the usefulness of the strategy they practiced), attribution (children were encouraged to attribute success to the use of the strategy), and selection (children were encouraged to select the best strategies using what they learned from the experience). A second group received a "two- component" training series consisting of assessment and attribution only. A third group received only the assessment-training portion. A final group of children was used as a control and did not receive training. Ghatala et al. emphasized that the "information" group was provided with explicit information regarding strategy effectiveness whereas the children in the training group had to figure out the effectiveness of the strategies on their own.

Results showed that only the "three-component" training group performed better than the control group. However, this was only true when the researchers prompted the children to "think-back" to what they had previously learned during training. The researchers attribute this success to the importance of the "selection" component, in which children had to judge the effectiveness of a strategy. Ghatala et al. emphasized the importance of "think-back" prompts. Ghatala (1986) further emphasized that direct instruction in one or more strategies does not sufficiently teach a child to use that strategy. Instead, the training must include monitoring-training. This monitoring-training is essential for ensuring maintenance.

Teachers should be aware that children do not automatically benefit from specific types of prompts or instructions to use strategies. Training children to use a strategy may only benefit them during an immediate task. Simply teaching a strategy and requiring students to practice it may not have any long-term effect on the children's ability to use the strategy in the future. Instead, children must be taught monitoring skills, coupled with specific strategies. Borkowski & Muthukrishna (1992) advise that teachers use explicit instruction to make strategies, "overt, sensible, and purposeful" (p. 488).

Children overestimate their memory ability

Investigations of children's memory and metamemory have shown that a number of developmental differences exist. One such differences includes young children's tendency to overestimate their memory ability (Dunlosky & Metcalfe, 2009; Scheider, 1985; Scheider & Lockl, 2002). In an early metamemory study, Flavell, Friedrichs, and Hoyt (1970), determined that young children (preschoolers and kindergarteners) were likely to overestimate the number of pictures they would be able to remember. However, by the age of seven, children were much more able to accurately predict their memory span. In a similar study, Yussen and Levy (1975) examined prediction accuracy in preschoolers, third-graders, and college students. The researchers found that preschoolers would overestimate the number of pictures they could remember despite having recently been reminded of their tendency to overestimate. Third-graders were more realistic about the number of pictures they could remember and college students were the most accurate.

Kail (1990) attributes the tendency for young children to overestimate their memory ability to a lack of knowledge about task variables. Task variables can include the presence of (and lack of) semantic relations in word pairs to be remembered. Such relations may not be considered significant enough to influence memory predictions in young children (Kreutzer, Leonard, & Ravell 1975; Moynahan, 1973). Young children believe that semantically unrelated words are as easy to remember as lists of semantically related words. However, by ten years of age, children understand that semantic relations can play a more important role in

remembering than the number of words to be remembered. Thus, by the age of ten, children may have considerably better-developed stable knowledge and, therefore, may be less likely to overestimate memory ability. Investigators have suggested that children's overestimation of their memory abilities may actually serve an adaptive function (Dunlosky & Mecalf, 2009; Scheider & Lockl, 2002) by keeping them motivated to persist on difficult tasks.

It is important for teachers to understand that young children are likely to believe that they are able to remember more information than they actually can. Children may be unaware of the influence of task variables such as the amount of information to be remembered and the content of information to be remembered. They may be unaware of their limitations, even when directly faced with them. Teachers must realize that repeated practice and experience might not have the same influence on a child's expectation of his/her own memory as that of a child's age. Teachers should also realize that children's overestimation might serve a useful purpose in terms of motivation and persistence on difficult tasks.

Conclusion

Although young children can be strategic and do possess some metamemory skills, they also tend to be somewhat less adept at understanding the many influences on memory and at monitoring their own memory. Research findings from the themes we discussed provide evidence that, with help, children can improve their metamemory skills and, thus, become better learners. Some investigators have stressed the need for more explicit instruction of metacognitive knowledge and skills (Pintrich, 2002) and others have found that effective teaching includes the consistent use of strategy instruction (Schnieder, 2008). It is hoped that the themes provided in the present paper will allow a greater understanding of children's knowledge of memory and memory monitoring skills and provide a greater context for teachers to help their students become more strategic learners.

• • •

Kristen Karably, M.S. is an elementary gifted education teacher in the City Schools of Decatur in Decatur, Georgia, U.S. She has been teaching fourth and fifth grade for ten years. Her research interests include memory and metacognition.

Karen M. Zabrucky, Ph.D. is a Professor of Educational Psychology at Georgia State University, U.S. Her research interests include metacognition, text comprehension and memory, and memory in the real world.

References

Andreassen, C., & Waters, H. S. (1989). Organization during study: relationships between metamemory, strategy use, and performance. *Journal of Educational Psychology*, 81, 190-195.

Baker-Ward, L., Ornstein, P. A., & Holden, D. J. (1984). The expression of memorization in early childhood. *Journal of Experimental Child Psychology*, 37, 555-575.

Bjorklund, D. F. (1980). Children's identification of category relations in lists presented for recall. *The Journal of Genetic Psychology*, 136, 45-53.

Bjorklund, D. F., Dukes, C., & Brown, R. D. (2009). The development of memory strategies. In M. L. Courage & N. Cowan (Eds.). *The Development of Memory in Infancy and Childhood* (pp. 146-175). Hove and New York: Psychology Press.

Bjorklund, D. F., & Zaken-Greenberg, F. (1981). The effects of differences in classification style on preschool children's memory. *Child Development*, 52, 888-894.

Bjorklund, D. F., & Zeman, B. R. (1982). Children's organization and metamemory awareness in their recall of familiar information. *Child Development*, 53, 799-810.

Borkowski, J. G., & Muthukrishna, N. (1992). Moving metacognition into the classroom: "Working models" and effective strategy teaching. In M. Pressley, K. R. Harris, & J. T. Guthrie (Eds.). *Promoting Academic Competence and Literacy in School* (pp. 477-501). Toronto: Academic Press.

Brown, A. L., Campione, J. C., & Barclay, C. R. (1979). Training self-checking routines for estimating test readiness: generalization from list learning to prose recall. *Child Development*, 50, 501-512.

Brown, A. L., Campione, J. C., & Murphy, M. D. (1977). Maintenance and generalization of trained metamnemonic awareness by educable retarded children. *Journal of Experimental Child Psychology*, 24, 191-211.

Butler, D. L., & Winne, P. H. (1995). Feedback and self-regulated learning: A theoretical synthesis. *Review of Educational Research*, 65, 245-281.

Butterfield, E. C., Nelson, T. 0., & Peck, V. (1988). Developmental aspects of the feeling-of-knowing. *Developmental Psychology*, 24, 654-663.

Cavanaugh, J. C., & Perlmutter, M. (1982). Metamemory: A critical examination. *Child Development*, 53, 11-28.

Chi, M. T. H. (1987). Representing knowledge and meta-knowledge: implications for interpreting metamemory research. In R. H. Kluwe & F. E. Weinert (Eds.), *Metacognition, Motivation, and Understanding* (pp. 239-266). Hillsdale, NJ.: Lawrence Eribaum Associates, Inc.

Cultice, J. C., Somerville, S. C., & Wellman, H. M. (1983). Preschoolers' memory monitoring: feeling-of-knowing judgments. *Child Development*, 54, 1480-1486.

Dunlosky, J., & Metcalfe, J. (2009). *Metacognition*. Los Angeles: Sage.

Efklides, A. (2008). Metacognition: Defining its facets and levels of functioning in relation to self-regulation and co-regulation. *European Psychologist*, 13, 277-287.

Efklides, A. (2009). The role of metacognitive experiences in the learning process. *Psicothema*, 21, 76-82.

Fabricius, W. V., & Cavalier, L. (1989). The role of causal theories about memory in young children's memory strategy choice. *Child Development*, 60, 298-308.

Flavell, J. (1971). First discussant's comments: What is memory development the development of? *Human Development*, 14, 272-278.

Flavell, J. H. (1979). Metacognition and cognitive monitoring: A new area of cognitive-developmental inquiry. *American Psychologist,* 34 (10), 906-911.

Flavell, J. H., Friedrichs, A., & Hoyt, J. (1970). Developmental changes in memorization processes. *Cognitive Psychology*, I, 324-340.

Flavell, J. H., Miller, P. H., & Miller, S. A. (2002). *Cognitive Development*. (4th ed.). Upper Saddle River, New Jersey: Prentice Hall.

Flavell, J., & Wellman, H. (1977). Metamemory. In R. V. Kail, & J. W. Hagen (Eds.). *Perspectives on the Development of Memory and Cognition* (pp. 3-30). Hillsdale, NJ.: Lawrence Eribaum Associates, Inc.

Ghatala, E. S. (1986). Strategy-monitoring training enables young learners to select effective strategies. *Educational Psychologist*, 21, 43-54.

Ghatala, E. S., Levin, J. R., Pressley, M., & Goodwin, D. (1986). A componential analysis of the effects of derived and supplied strategy and utility information on children's strategy selections. *Journal of Experimental Child Psychology*, 41, 76- 92.

Ghatala, E. S., Levin, J. R., Pressley, M., & Lodico, M. G. (1985). Training cognitive strategy monitoring in children. *American Educational Research Journal*, 22, 199-215.

Henry, L. A. & Norman, T. (1996). The relationships between memory performance, use of simple memory strategies and metamemory in young children. *International Journal of Behavioral Development*, 19, 177-199.

Kail, R. (1990). *The Development of Memory in Children*. (3'd ed.). New York: W. H. Freemen and Company.

Koriat, A., Goldsmith, M., & Pansky, A. (2000). Toward a psychology of memory accuracy. *Annu. Rev. Psychol.*, 51, 481-537.

Kreutzer, M. A., Leonard, C., & Ravell J. H. (1975). An interview study of children's knowledge about memory. *Monographs of the Society for Research on Child Development,* 40,1-58.

Lockl, K., & Schneider, W. (2002). Developmental trends in children's feeling-of -knowing judgments. *International Journal of Behavior Development*, 26, 327-333.

Lovett, S. B., & Ravelljhh, J. H. (1990). Understanding and remembering: children's knowledge about the differential effects of strategy and task variables on comprehension and memorization. *Child Development*, 61, 1842-1858.

Moynahan, E. D. (1973). The development of knowledge concerning the effect of categorization upon free recall. *Child Development*, 44, 238-246.

Moynahan, E. D. (1978). Assessment and selection of paired associate strategies: A developmental study. *Journal of Experimental Psychology*, 26, 257-266.

Nelson, T. 0., & Dunlosky, J. (1991) When people's judgments of learning (JOLs) are extremely accurate at predicting subsequent recall: the "delayed-JOL effect". *Psychological Science*, 2, 267-270.

O'Sullivan, J. T. (1996). Children's metamemory about the influence of conceptual relations on recall. *Journal of Experimental Child Psychology*, 62, 1-29.

O'Sullivan, J. T., Howe, M. L., & Marche, T. A. (1996). Children's beliefs about long-term retention. *Child Development*, 67, 2989-3009.

Pintrich, P. R. (2002). The role of metacognitive knowledge in learning, teaching, and assessing. *Theory Into Practice, 41 (4),* 219-225.

Pressley, M., Borkowski, J. G., & O'Sullivan, J. (1980). Children's metamemory and the teaching of memory strategies. In Forrest-Pressley, MacKinnon, Waller (Eds.). *Metacognition, Cognition, and Human Performance* (pp. 111-153). Orlando:

Pressley, M., Levin, J. R., & Ghatala, E. S. (1984). Memory strategy monitoring in adults and children. *Journal of Verbal Learning and Verbal Behavior*, 23, 270-288.

Pressley, M., Ross, K. A., Levin, J. R., & Ghatala, E. S. (1984). Increasing the use of strategy-utility knowledge in children's strategy decision making. *Journal of Experimental Child Psychology*, 38, 491-504.

Salatas, H., & Flavell, J. H. (1976). Behavioral and metamnemonic indicators of strategic behaviors under remember instructions in first grade. *Child Development,* 47, 81-89.

Schneider, W. (1985). Developmental trends in the metamemory-memory behavior relationship: An integrative review. In D. L. Forrest-Pressley, G. E. MacKinnon, & T. G. Waller (Eds*.), Metacognition, Cognition, and Human Performance* (vol. 1, p. 57-109). Orlando, FL: Academic press.

Schneider, W. (1986). The role of conceptual knowledge and metamemory in the development of organizational processes in memory. *Journal of Experimental Child Psychology,* 42, 218-236.

Schneider, W. (1998). The development of procedural metamemory in childhood and adolescence. In G. Mazzoni & T. 0. Nelson (Eds.), *Metacognition and Cognitive Neuropsychology* (pp. 1-21). Mahwah, NJ: Erlbaum.

Schneider, W. (2008). The development of metacognitive knowledge in children and adolescents: Major trends and implications for education. *Mind, Body, and Education,* 2, 114-121.

Schneider, W., & Lockl, K. (2008). Procedural metacognition in children; Evidence for developmental trends. In J. Dunlosky & R.. A. Bjork (Eds.), *Handbook of Metamemory and Memroy* (pp. 391-409). New York: Psychology Press.

Schneider, W., & Pressley, M. (1997*). Memory Development between Two and Twenty* (2nd ed.). Mahwah, NJ: Lawrence Erlbaum Associates.

Schneider, W., & Sodian, B. (1988). Metamemory-memory behavior relationships in young children: evidence from a memory-for-location task. *Journal of Experimental Psychology*, 45, 209-233.

Schneider, W., Vise, M., Locld, K., & Nelson, T. 0. (2000). Developmental trends in children's memory monitoring: evidence from a judgment-of-learning task. *Cognitive Development*, 15, 115-134.

Short, E., Schatschneider, C., & Friebert, S. (1993). Relationship between memory and metamemory performance: a comparison of specific and general strategy knowledge. *Journal of Educational Psychology*, 85, 412-423.

Weed, K., Ryan, E. B., & Day, J. (1990). Metamemory and attributions as mediators of strategy use and recall. *Journal of Educational Psychology*, 849-855.

Wellman, H. M. (1977). Tip of the tongue and feeling of knowing experiences; a developmental study of memory monitoring. *Child Development,* 48, 13-21.

Yussen, S. R., & Bird, E. J. (1979). The development of metacognitive awareness in memory, communication, and attention. *Journal of Experimental Child Psychology*, 28, 300-313.

Yussen, S. R., & Levy, V. M. Jr. (1975). Developmental changes in predicting one's own span of short-term memory. *Journal of Experimental Child Psychology*, 19, 502-508.