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Procedia - Social and Behavioral Sciences 69 (2012) 477 – 486

Procedia
Social and Behavioral Sciences

International Conference on Education and Educational Psychology (ICEEPSY 2012)

The Relationship between Metacognition and Self-regulation in Young Children

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Abstract

The purpose of this study was to explore the relationship between theory of mind (ToM) (intention and false belief), metacognition, and self-regulation in preschool children. A related purpose was to investigate the gender and age differences. The sample of the study consisted of 87 preschool children in Southern Egypt. The instruments consisted of two theory-of-mind tasks (intention and false-belief situations), three tasks of metacognition and self-regulation (puzzle arrangement and sorting tasks). Metacognition and self-regulation tasks were evaluated using The Checklist of Independent Learning Development (CHILD, Whitebread et al., 2009). Correlations, *t*-test, and stepwise multiple regression analyses, using SPSS 18.0, were employed to answer the questions of the study. The results indicated no gender differences in the overall performance on the study variables. A developmental effect was found in favour of the older children in the intention task, puzzle arrangement task, and the total score of ToM. The second task predicted the false-belief task. The findings of the study are discussed and further venues for future research in this area are suggested.

Selection and peer-review under responsibility of Dr. Zafer Bekirogullari of Cognitive – Counselling, Research & Conference Services C-crcs.

Keywords: Metacognition; self-regulation; theory of mind; preschool

1. Introduction

Research on metcognition is generally characterized by two major frameworks in the field. The first framework proposed by Flavell (Flavell, 1979; Flavell, Miller, & Miller, 1993), and later elaborated by Hacker (1998), introduces metacognition as composed of metacognitive knowledge and metacognitive experiences, and goals and strategies as well. Metacognitive knowledge includes task, person, and strategy components. Metacognitive experiences include feelings of understanding and drive of strategy implementation. These strategies

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Selection and peer-review under responsibility of Dr. Zafer Bekirogullari of Cognitive – Counselling, Research & Conference Services C-crcs.
doi:10.1016/j.sbspro.2012.11.436

are used to promote goal attainment (Dunlosky, 1998). Flavell et al., (1993) concluded that metacognitive knowledge refers to monitoring while matcognitive experiences refer to self-regulation.

Self-regulation is defined as "the ability to manage one's behavior, so as to withstand impulses, maintain focus, and undertake tasks, even if there are other more enticing alternatives available" (Boyd, Barnett, Bodrova, Leong, & Gomby, 2005, p. 3). Self-learning is an important factor in effective learning and academic achievement (Chang, 2007). Self-regulated learning is important due to the new demands that individuals encounter with the increasing knowledge. It is necessary to learn strategies and techniques to acquire and adapt the new knowledge (Fuchs et al., 2003) and to successfully transition from preschool to kindergarten (Stormont, Beckner, Mitchell, & Richter, 2005; Webster-Stratton, Reid, Stoolmiller, 2008). Metacognition emerges from an early age (Neslon & Narnes, 1994). Children in the age of 3 to 5 show evidence of metacognitive and self-regulatory abilities (Whitebread et al. , 2005a, 2005b, 2007). Children aged 3-6 years are able to voluntarily internalize self-regulation. On the other hand (Bronson, 2000). Metacognition in young children is very limited and they scarcely monitor their memory and problem solving (Flavell, 1979). Children aged 3 or 4 years could show an awareness of the relative ease of two tasks (Flavell, Green, & Flavell, 1995). However, research pertaining to strategic behavior or aligned with the theoretical self-regulation model is not practically existent for children from 0-6 years of age and that research on self-regulated learning is even less common (Amate, 2003).

Some researchers have concluded that young children find a difficulty in using their metacognitive knowledge to regulate their cognitive ability because they did not acquire the constant abstract knowledge about the functioning of cognitive processes; that is, the theory of mind (Flavell et al., 1995). Age has an effect on several metacognitive tasks in school-age children and by the age of 3, children are constantly able to show some early metacognitive skills such as the use of the verbs 'think' and 'know' (Kuhn, 2000). Whereas research on young children have often emphasized on their limitations in metacognition and self-regulation, other researchers concluded that methodological difficulties have led to the underestimation of the abilities of young children (Whitebread et al., 2009). The reason of these difficulties has been the over-reliance on children's verbal abilities and from the limitations of young children's working memory abilities as well. Again, some researchers argued that metacognitive knowledge tends to flourish constantly as a function of age and schooling (Weinert & Schneider, 1999).

Theory of Mind

The research on the ToM has been dominating in cognitive developmental studies over the past 20 years especially the focus on children's understanding of conflicting mental representations as reflected in false belief and appearance-reality tasks. Theory of mind (ToM) indicates the children's ability to attribute several mental states to themselves and to others (Astington, 2003). Understanding the ToM can be attributed to children who can use the knowledge of their own and others' cognitive states and others' behaviors as well (Carlson, Moses, & Breton, 2004). ToM involves the understanding that individuals have subjective mental states (i.e. desires, intentions, and beliefs) that can interpret and predict behavior. The mental reasoning skills inherent in the theory of mind can help foster abilities such as displaying empathy (Barr, 2006) and interpreting jokes (Leekam, 1991).

Authors have believed that an important shift in ToM takes place between 3 and 5 years of age when children start to understand that they, like other people, can hold and act on false beliefs (Astington, 1991; Wellman, Cross, & Watson, 2001). ToM is considered as self-regulation in the social domain. A significant milestone in the ToM development is the ability to attribute false beliefs. The most famous typical false-belief task is the 'Sally-Ann Transfer Task' (Baron-Cohen et al., 1985). Authors believed that by the age of 4 or 5, young children are able to confidently pass the false-belief task (Wellman et al., 2001). Children, by this age, possess a representational understanding of the mind. Another task of the ToM, used in this study, is the intention (Olson & Astington, 1993) where participants are required to recognize attention in others. Like the false-belief tasks, children recognize intention in others by approximately 3 or 4 years of age (Astington, 1991).

Relationship between Metacognition, Theory of Mind, and Self-Regulation

Authors investigated different forms of preschoolers' self-regulation. For example, Jahromi and Stifter (2008) investigated the relationship between cognitive self-regulation, as measured by executive functioning (EF), and social self-regulation (ToM), as measured by false beliefs tasks. They found relationships among emotional, behavioral, and cognitive self-regulation. Preschoolers' self-regulation was related to their performance on false-belief tasks and EF predicted false-belief understanding. Cognitive self-regulation occurs between 3 and 6 years of age where young children exhibit significant gains in the ability to use rule-based reasoning and to monitor their behavior (Diamond & Taylor, 1996; Frye, Zelazo, & Palfai, 1995). Authors believed that a relationship exists between EF and the children's ability to understand false beliefs (Hughes, 1998; Carlson & Moses, 2001). In this

sense, children's understanding of false beliefs shows that they can differentiate between reality and the beliefs of others and adopt these several representations of events, even if they are conflicting, in their mind at once (Wellman et al., 2001). This ability emerges approximately around the age of 4 (Astington, 2003).

Lockl and Schneider (2007) believed that to make connections between ToM and later development, it would be worth studying the ToM competencies under the broader concept of metacognition. Since metacognition regulates any cognitive activity, it consists of several components of an individual's cognition including ToM competencies. They investigated young children's (ages 3, 4, and 5 years) development of language, theory of mind, and later metamemory. Metamemory is the knowledge about memory and executive skills and is a subcomponent of metacognition. Researchers concluded that ToM could benefit if viewed from a broader context of metacognition (Flavell, 2000; Kuhn, 1999, 2000). Kuhn (1999, 2000) developed a model to connect the ToM to metacognition. She argued that metaknowing is a term that includes any cognition that has cognition, either one's or others' knowledge. In general, research investigating both ToM and metacognition have a common ground, that is, children's knowledge about the understanding of mental phenomena.

The gap between metacognition and ToM research

However, far too little attention has been paid to the connection between ToM and metacognition. Authors postulated that this gap is due to several reasons. (Flavell, 2000; Kuhn, 2000). Research on the two variables was conducted on different age groups. Research on ToM was extensively conducted on children up to 6 years. Research on metacognition has largely focused on school-age children. Also, research on metacognition was confined to task-related mental activities whereas ToM research focused on the children's knowledge about the contents of the mind. Finally, research on metacognition stressed on what children know about their mental processes while ToM research has been confined to children's ability to infer other people's minds. Misailidi (2010) posited that this gap might be attributed to the domain of application. ToM research applications have been limited to the social domain while metacognition research was mainly related to the academic domain. Thus, the purpose of the current study is to explore the relationship between ToM, metacognition, and self-regulation. The study was guided by the following questions:

1. Are there any gender differences in ToM, metacognition, and self-regulation?
2. Are these any age differences in ToM, metacognition, and self-regulation?
3. What is the relationship between ToM, metacognition, and self-regulation?
4. Could any of the metacognition tasks predict ToM tasks?

2. Method

Participants

The sample of this study consisted of 87 preschool-aged children from a metropolitan area in a city located in southern Egypt. Those children were randomly selected from a pool of four kindergarten classrooms. These students were selected from KG1 (first year of kindergarten) and KG2 (second year of kindergarten). The mother language of these children was Arabic. All these students came from a middle socio-economic status. Table 1 summarizes the sample descriptive statistics. The author of this study obtained the consent, to administer the study, from the school district, the parents, and the classroom teachers during the school year 2010/2011.

Tools

Theory of Mind. Three tasks were used to assess the ToM and self-regulation for the children in this study. A composite score was obtained by summing all the scores obtained by the children in the three tasks. This composite score represented the ToM. The false-belief task consisted of a famous task originally developed by Baron-Cohen et al., (1985). This story consisted of five pictures that tell a narrative. In the first picture, Sally and Ann are introduced. Sally has a marble and Ann has a basket. In the second picture, Sally puts her marble in a box. In the third picture, Sally left the scene. In the fourth picture, Ann took the marble from the box and placed it into the box. In the fifth picture, the children are asked where Sally, when she returns, will look for her marble. A child who understands that other people may have a false belief will answer that Sally will look in the box because this is the place where she left her marble in.

The second false-belief task included smarties and pencils task. The child received one point when they understand that Sally will most likely look inside her basket before realizing her marble isn't there. In this task, the children were presented with a snacks bag filled with crayons. The children were asked about the thing in the box or bag. After the children responded, they were told about what was in the bag. Then, the examiner asked the children what they thought the teacher would think was in the box. When children say that others will believe that there are

snacks in the bag, then they hold a false belief. Reponses of the children in both the Sally-Ann task and the snacks-crayons task were scored as correct or incorrect. The child deserves one point in each task when he/she recognizes the teacher would mistakenly presume there was snacks in the box and when he/she recognizes. Accordingly, a child may receive a 0, 1, and 2 on the false-belief task.

The second part of ToM involved intention tasks. Three tasks were selected. In the first task, the children were presented birds with two distinct series of hand-drawn pictures and a narrative related to this picture. The situation involved two girls, one is intentionally feeding the birds with breadcrumbs and the other girl, while eating, dropping crumbs unintentionally and the birds eat them. The children were asked which of the two girls had an intention to feed the birds. Children who understand that intention would refer to the girl feeding the birds in purpose. The second intention task involved two pictures, a boy running toward a swing and another body already swinging. The third measure presented two children, one who was going to paint and another boy painting. Children who understand intention would answer that the child not purposefully performing the task was planning to do so. As in the false-belief task, the three intention tasks were scored as correct or incorrect. A correct response receives one point. A child could receive a score of 0, 1, or 3 on the intention task. Both the intention and false-belief tasks were used by Baron-Cohen et al., (1985) as a valid tool for measuring ToM to secure construct validity. The reliability analysis of the two tasks as measured by Cronbach alpha is .78.

Metacognition and Self-regulation. Before the administration of the tasks, these tasks were shown to experts, professors in early childhood and educational psychology, and in-service early childhood teachers after they have been extensively informed about definitions about metacognition and self-regulation. The experts judged the content validity of those tasks to measure metacognition and self-regulation. Most of the judges contended that these tasks are age-appropriate for preschool children. The first task involved sorting and measured children's ability to predict performance, solve a classification problem, and rate performance. The sorting tasks involved laminated cutouts in four colors (orange, blue, yellow, and green) and three shapes (trucks, boats, and planes). The examiner asked the children if they thought they would be able to sort the cutouts by shape (prediction of performance). After they worked on the task and performance was recorded, they were asked to rate how well they had classified the materials (rate performance). The task was repeated and children were asked to group the materials by color. The third problem-solving task was a matching puzzle. This puzzle was a 4 x 4 square of picture of Disney cartoon characters. The children were presented the task and they were shown the whole pictures and the examiner told them to look carefully for the details in these pictures. The children were shown the four possible pictures they can complete using the puzzle. Then, the examiner asked the children to use the puzzles to create any of the pictures they have just seen.

Performance on the three tasks was evaluated according to the Checklist of Independent Learning Development (CHILD) and drawn from the literature related to the development of children's self-regulation and metacognition (see Whitebread et al., 2009 for details). The checklist consisted of four categories (emotional, prosocial, cognitive, and motivational). Each category consisted of some statements that explain children's behavior when they work on the tasks. Each child was assessed using the checklist statements, consisting of 22 items, on a four-point Likert-type (always, usually, sometimes, and never) scale as observed by two independent raters (research assistants). The correlation coefficient between the teachers' observations on the checklist (as an inter-rater reliability) was ($r = .76$, $p = .05$). For reliability analysis measured by Cronbach alpha, the three tasks had moderate internal consistency (.54, 45, and .67 respectively).

Procedure

After collecting the consent forms from the district, school, and parents who gave permission to the author to conduct his study, the researcher selected one kindergarten school to administer the study. The experiment was conducted on four KG1 and KG2 classrooms. Two classroom teachers, in each class, administered the ToM and problem-solving tasks after a brief training session with the researcher on how to administer the tasks. This two-day brief training session, 2 hours a day, helped the teacher understand the purpose of the research, the wording of the questions, and whether the statements, pictures, and materials were understandable and free of grammatical errors. The classroom teachers told the children in the classroom that they are going to conduct some fun activities and she asked if any of the children would like to participate. Around 90% of the children in each of the four classrooms participated in the study. The assessment tools were individually administered. The whole testing time for the ToM and problem-solving tasks took about 30 minutes to complete for every child. The testing was performed in a quiet area so children will not be affected by the noise.

3. Results

The data were analyzed using the SPSS statistical package V. 18. Means and standard deviations of the ToM tasks and problem-solving task are presented in Table 2.

To answer the first question, independent-samples *t*-test was used to calculate the gender differences between males and females in both KG1 and KG2 on the ToM, metacognition, and self-regulation. For children in KG1, the results showed that no gender differences were detected except for the third task (t = 1.98, p = .000) in favor of females. For children in KG2, the results showed that no gender differences were detected except for the first task (t = .40, p = .05) in favor of males. Overall, no significant gender differences were found either in KG1 and KG2. To answer the second question, independent samples *t*-test was used to explore the age differences in the ToM, metacognition, and self-regulation. No age differences were detected in the first and second tasks. Significant age differences were found in both the intention task and the total ToM score. For the intention task, children in KG2 had higher scores than children in KG1 (t = 4.33, p = .000). Cohen's d = .93 and the effect size d was .42. In the total ToM score, children in KG2 scored higher than children in KG1 (t = 1.16, p = .000). Cohen's d was .34 and the effect size was .17. For the third task, children in KG2 scored higher than children in KG1 (t = 3.17, p = .000). Cohen's d was .68 and r = .32. To sum, children in KG2 were better than children in KG1 in two tasks only, namely, the total score of ToM and the puzzle activity in the metacognitive self-regulation task.

To answer the third question, Pearson Product Moment Correlation was conducted to investigate the relationship between the ToM tasks, metacognition, and self-regulation tasks. As shown in Table 4, the false-belief and intention tasks were significantly correlated to the total ToM score (r = .68 and .80, p = .01, respectively). The first metacognition and self-regulation task was significantly correlated to the second task (r = .87, p = .01). A low correlation (r = .26, p = .05) was found between the second task and the intention task. To answer the fourth question, stepwise multiple regression analysis was used. The three metacognitive tasks were used as a predictor variable. The second task (β = .27, p = .013) accounted for 7% of the variance in the false-belief task.

4. Discussion

The purpose of this study was to explore the relationship between ToM, metacognition, and self-regulation in preschool children. Four questions guided the research in this study. The first question investigated the gender differences in ToM, metacognition, and self-regulation. Overall, no significant gender differences were found either in KG1 and KG2. The results of this study are consistent with the previous literature. A few researchers posited that gender differences are observed in the social-cognitive functioning. For example, some authors concluded gender differences in preschool are manifested in the ways children think about social problems and solve social conflicts (Musun-Miller, 1993; Walker, Irving, & Berthelsen, 2002). However, a few researchers posited that girls seem to be efficient in determining the intention of others (Putallaz, Hellstern, Sheppard, Grimes, & Glodis, 1995) which might presume that they are more intuitive than boys. Charman, Ruffman, and Clements (2002) found weak gender differences in the false-belief understanding in preschoolers. Few researchers have studied gender differences in theory of mind understanding. An exception to that is the work of Charman et al. (2002) who found weak gender differences in false-belief understanding in preschool children. The results of this study are not consistent with those that found that girls are better than boys in self-regulation (Murphy et al., 1999; Stifter & Spinard, 2002).

The second question investigated the age differences in the ToM tasks, metacognition, and self-regulation. Children in KG2 were better than children in KG1 in two tasks only, namely, the total score of ToM and the puzzle activity in the metacognitive self-regulation task. This results corroborates the findings of Wellman et al. (2001) who concluded that older children were more competent in their performance in the false-belief task. Research investigating the individual differences in the ToM is scarce. Research investigating the age differences in the ToM tasks is scarce. Different authors posited that there is a considerable development of ToM between 3 and 5 years of age (Wellman et al., 2001; Zelazo, Muller, Frye, & Marcovitch, 2003). Welch-Ross, Diecidue, and Miller, (1997) found that when children get through a standard task of ToM, which requires to comprehend conflicting mental representations (e.g. it was presumed that a box of crayons contained crayons before it is shown that it in fact had candles), they are less likely to experience misinformation.

The third question investigated the relationship between ToM, metacognition, and self-regulation. Moderate to high significant correlations were found between the intention task and the first and second task of the metacognition, and self-regulation task,. This finding is consistent with other studies which found a relationship between executive function, an important aspect of cognitive self-regulation, and ToM (Carlson, Moses, 2001; Carlson et al., 2002; Perner & Lang, 2002, Colvert, Custance, & Swettenham, 2002; Zelazo, Jacques, Burack, & Frye, 2002). Also, the findings among problem-solving tasks and between problem-solving tasks and self-regulation tasks are confirmed by other studies (Das, Naglieri, & Murphy, 1995). The metacognitive self-regulation task was

difficult for the children in this study. The ability of planning, an important ability adopted by the self-regulation model in this study, was not satisfactory enough as authors concluded that young children's poor planning ability was due to their limitations in integrating the elements of strategies for effective recall (Ellis & Siegler, 1994).

This finding is consistent with Jahromi and Stifter (2008) who concluded that young children with better performance on executive function had higher scores on false-belief tasks. This result is also consistent with the previous literature (Carlson & Moses, 2001; Carlson et al., 2004; Flynn et al., 2004) which supported the argument that children who had better performance on several cognitive measures of self-regulation also had better on theory-of-mind tasks. Further research studies are needed to explore the direction of relationship between ToM and metacognition. This research is important either in relation to revise the existing models of metacognitive development or delineating the effects of the preschool metacognitive achievements on potential development (Misailidi, 2010).

Developmental research shows that metacognitive skills are less accurate in young children (Kuhn, 2000). Whitebread et al. (2009) concluded that while studies with young children have focused on the children's limitations in metacognition and self-regulation, other research studies showed that methodological difficulties, such as the use of think-aloud techniques, led to the underestimation of children's abilities. Part of these methodological difficulties came from the over-reliance on children's verbal abilities. For weak performance on the theory-of-mind tasks especially the false-belief, some researchers concluded that young children may have a clear understanding of false belief, however, they fail the false-belief task due to the language demands in the task (Bloom & German, 2000; 1992; Premack & Premack, 1995).

It has been also found that young children may fail the false-belief task due to poor inhibitory control (Carlson, Moses, & Hix, 1998) and the reality bias, which is young children's knowledge about a situation was found to affect their ability to answer correctly (Birch & Bloom, 2003). Researchers might try using other different approaches of measuring metacognitive self-regulation and strategy use in young children. Since the preschool period is a fundamental stage in the individual's life, researchers should investigate these cognitive variables thoroughly in order to develop learning approaches to augment children’s learning. Also, other possible research avenues may include the investigation of the relationship between metacognitive self-regulation and strategy and young children's performance in life-like situations, not just in laboratories, such as play inside and outside the classroom and their interactions with peers and adults.

Limitations

Finally, a number of important limitations need to be considered. First, the current study was limited by a group of preschool-aged children in a city located at southern Egypt. Although the study reached some significant conclusions, yet some limitations exist. Most of the children came from a middle class. Generalizations from this study should be taken with consideration as the SES has an impact on the performance on the theory-of-mind tasks (Cole & Mitchell, 2000) and metacognitive tasks (Wang, 1993). Second, two tasks, the use of the behavioural checklist should be taken with caution as more research is needed to use the qualitative observation with children. The observation tool should have been supported by video recordings in natural settings where children exhibit metacognitive and self-regulatory behaviours.

Implications for policy and practice

ToM is an important factor for children's social understanding and represents an imperative base for school entry. Parents and teachers can enrich children's ToM through pretend play, talking about others' feelings, dispositions and thoughts, listening to stories, and considering others' point of view. As school curricula, nowadays, encourage independent learning, teachers and caregivers should be aware to provide children with appropriate opportunities to use their metacognitive and self-regulatory abilities in a meaningful way. Extracurricular activities should also encourage children's autonomy and ownership of learning.

Table 1
Checklist of Independent Learning Development (CHILD) 3–5

	Always	Usually	Sometimes	Never
Emotional				
Can speak about own and others behaviour and Consequences				
Tackles new tasks confidently				
Can control attention and resist distraction				
Monitors progress and seeks help appropriately				
Persists in the face of difficulties				
ProSocial				
Negotiates when and how to carry out tasks				
Can resolve social problems with peers				
Shares and takes turns independently				
Engages in independent cooperative activities with peers				
Is aware of feelings of others and helps and comforts				
Cognitive				
Is aware of own strengths and weaknesses				
Can speak about how they have done something or what they have learnt				
Can speak about future planned activities				
Can make reasoned choices and decisions				
Asks questions and suggests answers				
Uses previously taught strategies				
Adopts previously heard language for own purposes				
Motivational				
Finds own resources without adult help				
Develops own ways of carrying out tasks				
Initiates activities				
Plans own tasks, targets and goals				
Enjoys solving problems				

Table 2
Characteristics of the Study Sample

Gender		Male		Female	
Grade level					
KG1		N= 20 Age		N = 22 Age	
	M		SD	M	SD
	5.10		.40	5.25	.30
KG2		N= 23 Age		N = 22 Age	
	M		SD	M	SD
	6.3		.20	6.2	.29

Table 3
Descriptive statistics of the ToM and metacognitive tasks

Task	KG1 (N = 42)		KG2 (N = 45)	
	M	SD	M	SD
False belief	1.30	.75	.93	.81
Intention	1.92	1.11	2.75	.61
Total ToM score	3.23	1.63	3.68	.90
First MSR task	3.64	1.44	1.97	1.29
Second MSR task	8.19	1.94	6.31	1.88
Third MSR task	2.09	1.39	3.24	1.92

Note:
First MSR task: first metacognitive self-regulation task, sorting based on shape
Second MSR task: second metacognitive self-regulation task, sorting based on color
Third MSR task: third metacognitive self-regulation task, puzzle arrangement

Table 4
Correlations among the TOM tasks and metacognitive tasks

	False belief	Intention	Total ToM	First MSR	Second MSR	Third MSR
False belief		.09	.68**	.17	.26*	.04
Intention	.09		.80**	-.11	-.05	.13
Total ToM	.68**	.80**		.02	.12	.07
First MSR	.17	-.11	.02		.87**	-.13
Second MSR	.26*	-.05	.12	.87**		-.08
Third MSR	-.04	.13	.07	-.13	-.08	

Note: * Significant at the .05 level
** Significant at the .01 levelMSR: Metacognitive self-regulation

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