

The Impact of Social Context on Preschoolers' Flexibility

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Abstract

The current study investigates whether social interaction without communication between partners may influence preschoolers' flexibility. Fifty-three 5 year old Singaporean children were randomly assigned to three conditions of a block sorting task (Fawcett & Garton, 2005): playing individually, cooperating with another player, and competing against another player. To control for individual differences, before the block sorting task children were given four cognitive tasks testing vocabulary, short-term memory, and executive function, as well as two affective scales on mood and motivation. Separate one-way Analysis of Variance (ANOVA) showed that although they performed the same on the cognitive tasks and the affective measures, children in the competition condition sorted blocks along significantly more dimensions compared to children in the individual condition. These results suggest that preschoolers' flexibility is sensitive to social contexts.

Introduction

Cognitive flexibility, or "switching", is the ability to switch between representations based on changing relevant cues in the environment (Jacques & Zelazo, 2005). It is one of the major components of executive function, which refers to the processes required for the conscious control of thought, emotion, and action (Miyake et al., 2000; Zelazo, Qu, & Müller, 2005). Cognitive flexibility plays an essential role in the acquisition of language (Deak, 2003), arithmetic skills (Bull & Scerif, 2001), theory of mind (Müller, Zelazo, & Imrisek, 2005), and interpersonal interactions (Bonino & Cattclino, 1999). Hence, it is important to develop cognitive flexibility at an early stage.

Flexibility improves during preschool years (Zelazo et al., 2005). For example, Blaye and Bonthoux (2001) have shown that 5-year-olds are more flexible than younger preschoolers. With a categorization task, they have found that 3-year-olds can spontaneously group objects, but they only rely on one criterion, which usually is the most salient one at the moment of testing. Four-year-olds can use a thematic criterion to group objects, but they often fail to switch to a different criterion. Five-year-olds are more able to respond to the specific demands of the task and classify objects based on the context. Similar results have been obtained with the Dimensional Change Card Sorting task (DCCS; Zelazo, 2006), a widely used executive function task. In this task, children are asked to sort cards by one dimension (e.g., color) and then switch to the other dimension (i.e., shape in this case). Zelazo's group have found that by 4 years of age, children are able to sort cards by one dimension but fail to switch to the other dimension, whereas by 5 years of age, children are able to switch the two sorting dimensions. Nevertheless, 5-year-olds still experience difficulties when the task involves three dimensions (Jacques & Zelazo, 2001; Zelazo, Müller, Frye, & Marcovitch, 2003).

Block sorting is another way to examine the development of flexibility (Fawcett & Garton, 2005; Garton & Pratt, 2001). For preschoolers, this task uses a 3 (color) x 2 (shape) x 2 (size) combination of blocks that can be sorted in six different ways. For 7-year-olds, width dimension is added, which creates 14 possible ways of sorting. Children are asked to sort blocks in as many ways as possible. It was found that out of a maximum of 6 possible sorts, 4-year-olds could sort between 0 and 4 correct sorts; out of a maximum of 14 possible sorts, 6- to 7-year-olds could sort between 0 and 9 correct sorts. These indicate that flexibility is developing rapidly during preschool years; however, even old preschoolers still lack flexibility. This is possibly because flexibility largely relies on the dorsolateral prefrontal cortex, which does not become mature until late adolescence (Bunge & Zelazo, 2006).

Nevertheless, working with another person can improve a number of children's abilities including categorization, free recall, utilization of strategies, and understanding of questions (Burton, 1941; Foley & Ratner, 1998; Garton & Pratt, 2001; Perlmutter, Behrend, Kuo, & Muller, 1989; Vygotsky, 1978). Teaming up with another person may facilitate children's performance both cognitively and affectively. Cognitively, working with another person may increase children's awareness of the essential goal of the task as well as the other individual's perspectives and problem-solving methods. Such awareness may be integrated into children's own awareness and further facilitate their behavioral control. Affectively, working with another person may increase children's enjoyment of the activity. Such suggestions are consistent with functional magnetic resonance imaging (fMRI) studies in adults. Compared to playing a game independently, playing with another person seems to be associated with more brain activity in the frontoparietal network, which is related to executive function and theory of mind, and the anterior insula, which is related to autonomic arousal and feelings of reward (e.g., Decety, Jackson, Sommerville, Chaminade, & Meltzoff, 2004; Rilling, Gutman, Zeh, Pagnoni, Berns, & Kitts, 2002).

Likewise, working with another player can increase children's flexibility. For instance, Burton (1941) asked a preschooler to play a peg-board game until the child felt bored, at which point a second child was brought in to play the game with the first child. In this situation, it was found that the previously bored child continued to play the game for one-third of the initial play time. Similarly, compared to playing alone, a preschooler would play with a set of toys for a longer period of time and play with the toys in a greater variety of manners when teaming up with another child (Perlmutter et al., 1989; Simmel, Baker, & Collier, 1969).

However, it is unclear whether playing with another player cooperatively and competitively have similar impacts on flexibility, especially if players are not allowed to verbally communicate with each other. Fawcett and Garton (2005) found that 6- to 8-year-olds' performance on the block sorting task can be improved when collaborating with another child. However, such improvement was only significant when the pairs were allowed to talk to each other. While actively cooperating, children have more opportunities to view the blocks from different perspectives and take the suggestions from other players. This suggests that verbal communication is essential for the facilitation effect during cooperation. Hence, without verbal communication, (passive cooperation), preschoolers may not benefit from playing with a partner.

On the other hand, unlike cooperation, during competition, opponents seldom communicate or exchange perspectives with each other. In addition, unlike adults and older children, competition does not decrease preschoolers' intrinsic motivation. For instance, Butler (1989) found that in a competitive atmosphere, while first and fourth graders showed lower interest afterwards, young preschoolers aged 4 and 5 actually showed a greater interest in the task. It seems that during comparison, preschoolers become more engaged in the task and tend to observe their competitors more (Butler & Ruzany, 1993; Mosatche & Bragonier, 1981). Hence, even without verbal communication, during competition, preschoolers may benefit from playing with a competitor and become more flexible. This proposition has yet to be tested.

Thus, the current study investigates whether social context, such as cooperating with or competing against another player without communication, may influence 5-year-olds' flexibility. A between-subject design was used. To control for individual differences, children's vocabulary, memory span, and executive function were tested as well.

Method

Participants

Fifty Singaporean children ($M = 66.13$ months, $SD = 3.11$, *Range*: 60 – 71 months; 24 girls) participated the study. All children were recruited from a database of parents who expressed interest in participating in the research, and the children received stationery as tokens of appreciation.

Materials

The Block Sorting. Adapted from Fawcett and Garton (2005), this task is a measure of cognitive flexibility. The task consisted of 12 blocks which can be sorted according to three basic dimensions, namely co-

four (orange, yellow, blue), shape (circular, square), and size (small, large). A total of 6 possible sorts can be derived – by colour (3 piles), by shape (3 piles), by size (2 piles), by colour/shape (6 piles), by shape/size (4 piles), by colour/size (6 piles). Children’s performances were scored by the number of accurate sorts and the complexity of sorting dimension.

The Peabody Picture Vocabulary Test, Fourth Edition (PPVT-IV; Dunn & Dunn, 2006). This task is a measure of receptive vocabulary. Participants were asked to select one picture out of four that best represents the meaning of a stimulus word presented orally.

The Digit Span task (Davis & Pratt, 1996). This task measures the development of short-term memory. Children are asked to repeat a set of numbers after the experimenter.

The Less is More task. This task was adapted from Boysen and Berntson (1995) and Carlson, Davis and Leach (2005). It is a reverse-reward contingency task and measures children’s inhibitory control under conflicts. Children are shown two boxes with two and six treats (stickers or marbles) respectively. In order to obtain big rewards, children have to point to the box with small rewards. There are 16 trials in total. The final score is the proportion of trials in which the child chooses the box with the smaller number of treats. Children were tested either individually or with a second experimenter as a partner.

The Dimensional Change Card Sort (DCCS; Frye, Zelazo, & Palfai, 1995). This task is a measure of rule switch. Children are asked to sort cards that can be sorted by two dimensions, color or shape. Children who successfully sort 5 out of 6 trials during both pre- and post-switch phases are considered to have successfully switched sorting dimensions, and are scored as “pass”.

The Motivation Scale. This scale includes five pictures of a cartoon boy (or a girl when the participant is female) posing in five postures: 1) the boy spreading his arms out to a near 180 degree to show that he “really really wants”; 2) the boy spreading his arms out to an angle of approximately 60 degrees to show that he “really wants”; 3) the boy spreading his arms out slightly leaving only a palms’ distance to show that he only “wants a little bit”; 4) the boy using his fingers to show his desire with a small space between the thumb and the index finger to depict he only “wants a little, little bit”; and 5) the boy folding his arms to indicate that he “does not want it”. Children were asked to point to the picture that best illustrated how much they wanted to play the game(s).

The Mood Scale. This scale includes five cartoon facial expressions, illustrating a number of emotional states: very happy, happy, neutral, sad, and very sad. Children were asked to point to the face that best reflected how they felt at that moment.

Design

A between-subject design was used. Children were randomly assigned to three conditions: self, cooperation, and competition conditions (see Table 1 for the details). To control for individual differences in vocabulary, memory span, and executive function, children were given four control tasks: the PPVT, the Digit Span, the Less is More, and the DCCS. To control for individual differences in affective states, children were asked to use the Motivation Scale and the Mood Scale to report their motivation and mood states at three time points: after warm-up and before starting the study, after the demonstration but before the real test of the block sorting task, and after the Block Sorting task.

Table 1
Instructions Given for Manipulation of Social Contexts

Condition	Instruction Given
Self Condition	“If you do well, you will receive a prize from me.”
Cooperative Condition	“If both of you (together with the 2nd experimenter) do well, both of you will each receive a prize from me.”
Competitive Condition	“If you (looks at child) do well, you will receive a prize from me. If you (looks at second experimenter) do well, you will receive a prize from me.”

Procedure

Each child was tested by one or two female experimenters in a quiet corner of the child's daycare. The total testing time was about 30 minutes. The test order was warm-up, motivation and mood check 1, the four control tasks (i.e., Less is More, PPVT, DCCS, Digit Span), the demonstration of the Block Sorting, motivation and mood check 2, and the real test of the Block Sorting, and motivation and mood check 3. The condition of the Block Sorting and the DCCS dimension were counterbalanced between the participants fully.

Results

The preliminary analysis did not show any gender difference for the Block Sorting task (the number of accurate sorts $F(1, 51) = 2.77, p > .05$; the complexity of sorting dimension demonstrated $\chi^2(1, N = 53) = 2.36, p > .05$). Hence, data for both genders were combined.

Separate one-way analysis of variance (ANOVA) tests did not show any significant condition difference on the control tasks (see Table 2 for the details).

In addition, separate Kruskal-Wallis tests did not show any significant condition differences in terms of children's motivation check 2 and mood states check 2 before conducting the real tests of the Block Sorting task (see Table 3 for the details).

A one-way ANOVA showed that there was a main effect of social context on the number of accurate sorts $F(2, 53) = 5.39, p < .05$. Tukey's HSD test ($p < .05$) showed that the children in the competition condition sorted significantly more blocks ($M = 2.00, SD = 1.33$) than the children in the self condition ($M = 1.06, SD = 0.83$). The children in the cooperation condition ($M = 1.71, SD = 0.85$) did not differ from the children in the other two conditions significantly.

Table 2

Mean (and Standard Deviation) of Performances on the Control Tasks by Condition.

Task	Condition			Condition difference
	Self	Cooperation	Competition	
Less is More	11.29 (4.31)	11.71 (4.17)	10.32 (4.49)	$F(2, 50) = 0.49, p > .05$
Peabody Picture Vocabulary Test	84.06 (10.50)	80.88 (11.67)	85.16 (14.19)	$F(2, 50) = 0.57, p > .05$
Dimensional Change Card Sorting: # of correct trials during post-switch	5.24 (1.99)	3.47 (3.00)	3.37 (2.99)	$F(2, 50) = 2.60, p > .05$
Digit Span	3.47 (1.38)	3.35 (1.27)	3.47 (1.68)	$F(2, 50) = 0.04, p > .05$

Table 3

Mean (and Standard Deviation) of the Ratings on the Motivation and Mood Scales by Condition.

Scale	Condition			Condition difference
	Self	Cooperation	Competition	
Motivation Check 1	4.18 (1.29)	4.06 (1.35)	4.42 (0.84)	$X^2(2, N = 53) = 0.25, p > .05$
Motivation Check 2	4.53 (1.01)	4.06 (1.30)	4.26 (1.10)	$X^2(2, N = 53) = 1.41, p > .05$
Mood Check 1	4.59 (0.51)	4.29 (0.77)	4.42 (1.02)	$X^2(2, N = 53) = 1.58, p > .05$
Mood Check 2	4.47 (0.72)	4.53 (0.62)	4.42 (0.77)	$X^2(2, N = 53) = 0.12, p > .05$

Discussion

The current study has shown that compared to playing alone, children appeared to be significantly more flexible when playing with a competitor; however, without verbal communication, playing with a passive-cooperator did not improve preschoolers' flexibility.

These findings are consistent with previous results that children are sensitive to social context. Children become more engaged and more flexible while playing with other players compared to playing alone (Burton, 1941; Perlmutter et al., 1989; Simmel, Baker, & Collier, 1969).

Verbal communication and exchange of opinions with the competitor are not needed during competition. It is possible that during competition, preschoolers are cautious about their competitor's behaviors (Bulter, 1989; Butler & Ruzany, 1993; Mosatche & Bragonier, 1981). Although children cannot see what their competitor is doing, they may guess what the competitor will do. Such attempts may make preschoolers take various perspectives, which may improve their flexibility. On the other hand, verbal communication and exchange of opinions are essential components of cooperation. In the current study, preschoolers were not allowed to communicate with each other. Furthermore, the cooperator was passive as she did not sort the blocks or make any suggestions. In this case, the preschoolers in the current study did not need to imagine what their cooperator would think or would do. Hence, the presence of the partner did not increase their ability to view the blocks from various perspectives. Consistent with Fawcett and Garton's findings(2005), their flexibility was not improved.

The long-term effect of facilitation associated with co-playing is another aspect deserving further examination. Additionally, the current study was conducted in Singapore, an Asian country with intermingled Eastern and Western cultures. The samples may be unique. Cross-cultural studies are needed to examine this aspect further.

Taken together, the current study adds another piece of evidence that preschoolers' executive function is sensitive to social context.

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