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Abstract: This study investigated symbolic play in 12 children with autism and 12 children with typical development and compared theories that consider either theory of mind, executive function or central coherence to be causally involved in the development of symbolic play in autism. Children with autism demonstrated significantly less symbolic play than their typically developing peers and had significant deficits in theory of mind and central coherence measures but not executive function measures. A tentative conclusion is that symbolic play deficits in autism are more associated with theory of mind and weak central coherence.

July 20, 2011

Editor-in-Chief
Research in Autism Spectrum Disorders

Subject: Submission of a manuscript for evaluation

Dear Editor:

Enclosed for your consideration is an original research article, entitled
"Cognitive deficits and symbolic play in preschoolers with autism."

In this manuscript, we reported the first study on evaluating three accounts of cognitive deficits, namely an impaired theory of mind, executive function deficit and a weak central coherence, is causally involved in symbolic play of preschoolers with autism. We believe that our findings could be of interest to the readers of Research of Autism Spectrum Disorders because they bring new evidence that theory of mind and central coherence are associated with symbolic play deficits in young children with autism.

Sincerely yours,

Grace Lam on behalf of the authors

Cognitive deficits and symbolic play in preschoolers with autism

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REPLIES TO THE REVIEWER

1. Research highlights and keywords are added to the abstract.
2. The reference is changed in the text. The citation should be Libby, Powell, Messer and Jordon (1997).

We thank the reviewer for noting weaknesses in our paper. We have revised the paper to address all the listed points, and hope that we have done this satisfactorily.

Cognitive deficits and symbolic play in preschoolers with autism

Abstract:

This study investigated symbolic play in 12 children with autism and 12 children with typical development and compared theories that consider either theory of mind, executive function or central coherence to be causally involved in the development of symbolic play in autism. Children with autism demonstrated significantly less symbolic play than their typically developing peers and had significant deficits in theory of mind and central coherence measures but not executive function measures. A tentative conclusion is that symbolic play deficits in autism are more associated with theory of mind and weak central coherence.

Keywords: Symbolic play; theory of mind; central coherence; executive functions; preschoolers with autism

Highlights:

- We compared theory of mind, executive functions and central coherence in explaining symbolic play deficits in preschoolers with ASD.
- We found that preschoolers with autism performed significantly worse than children with typical development in symbolic play, theory of mind and central coherence.
- An impaired theory of mind and weak central coherence are more associated with symbolic play performance among children with ASD.

1. Introduction

Delays or abnormal functioning in symbolic play is an important diagnostic criterion for Autistic Disorder (DSM-IV; APA, 1994). Past studies found that children with autism have less frequent spontaneous pretend play, and the behaviors were repetitive, stereotypic, with less novelty and lack of variety (Baron-Cohen, 1987; Hammes, & Langdell, 1981; Rutherford, & Rogers, 2003). They could not appreciate pretense as their typically developing peers or those in other clinical groups; in specific, children with autism would not substitute one object for another object.

Pretend play is conventionally classified into two forms: functional and symbolic. Past research has shown that children with autism were not readily engaged in spontaneous symbolic play in which the child was required to treat an object or a situation as if it was something else (e.g., using a banana as a telephone) (Jarrold, Boucher, & Smith, 1996). Symbolic play is regarded as a sophisticated type of pretend play that develops around 24 months of age and eventually becomes more elaborated later on (Fein, 1981; Jarrold, Boucher, & Smith, 1994; Nicolich, 1977). Given the marked impairments in symbolic play among children with autism, theories explaining cognitive impairments in autism should be able to account for the difficulties in pretend play. In this study, we sought explanations from three prevalent postulations namely an impaired “theory of mind” (ToM), executive function deficit (EFD) and a weak central coherence (WCC).

According to ToM, deficits in pretend play among children with autism are results of an impaired functioning of metarepresentation. Pretend play requires a child to decouple the primary representation from its pretend

representation (Leslie, 1987). As in the case of taking the banana as a telephone, a child must temporarily give up the idea that banana is a fruit so that he/she can talk on it as though it is a telephone. The ability to decouple is necessary for a child to take certain things as “true” and act accordingly in response to pretend beliefs and inferences. Several studies on typically developing children support the notion that ToM is crucial to pretend play. For example, children with higher scores in false-belief tasks were more likely to engage in pretend play with other children (Astington, & Jenkins, 1995). Note that to date, there were very few studies trying to evaluate the relationship between ToM and pretend play in autism (Rutherford, & Rogers, 2003; Rutherford, Young, Hepburn, & Rogers, 2007). For instance, Rutherford and Rogers (2003) suggested a weak relationship between joint-attention ability (a prerequisite of ToM) and pretend play in young children with autism. However, a recent longitudinal study by Rutherford and colleagues (2007) showed that joint-attention ability significantly predicted pretend play performance.

EFD appears to be related to deficit in pretend play because pretend play requires a person to disengage (mentally inhibit) from certain facts, to create new scenarios (generativity) and to shift attention (Jarrold et al., 1996). Few studies have addressed relations between EF and pretend play abilities. Rutherford and Rogers (2003) investigated play maturity, joint-attention and EF in young children with autism. Evidences suggested that executive functions were significantly correlated with symbolic play. However, in another study by Dawson and colleagues (Dawson, Meltzoff, Osterling, & Rinaldi,

1998), no significant relationship was found between symbolic play scores and scores of EF measures.

Central coherence is the perceptual tendency to weave fragmented information into a whole, or for higher level of meaning at the expense of memory for details. People with autism exhibit weak central coherence, meaning that details are processed and retained at the expense of global configuration and higher level of meaning. On this account, children with autism have pretend play deficits because they are unable to derive high-level meaning and therefore process faces or toys as fragments regardless of the play contexts. To our knowledge, there is no known study exploring the relation between WCC and pretend play in the current literature.

There are two research questions in this study: (1) Do preschoolers with autism demonstrate significantly less symbolic play as compared to their typically developing peers? (2) Which of the three models (ToM, EF or WCC) are more associated with symbolic play performance in young children with autism?

2. Method

2.1 Participants

The experimental group (AD) comprised 12 children with diagnosis of autism spectrum disorder (ASD) from a licensed psychologist. They were recruited through local agencies providing services for children with AD. The control (TD) group included 12 typically developing children recruited through convenient sampling. The two groups of children were matched on sex, chronological age, non-verbal intelligence and verbal intelligence. Table 1

summarized the demographic characteristics of the two groups. The non-verbal intelligence scores illustrated that all participants with ASD functioned within normal range of intelligence.

2.2 Measures

2.2.1 Peabody Picture Vocabulary Test – Third Edition (PPVT-III; Dunn, & Dunn, 1997)

The 204-item test of receptive vocabulary was translated into Cantonese and administered according to the standard procedures.

2.2.2 Raven's Colored Progressive Matrices (RCPM; Raven, Court, Raven, 1976)

In this 36-item test, a target visual matrix with one missing part was presented in each item. Children were asked to select, from six to eight choices, the part that best fit the matrix.

2.2.3 Sally-and-Anne False-Belief Test

Two dolls, named Sally and Anne, were introduced and placed sitting on the table, facing the child. The test involved the child who witnessed Sally putting a marble in her blue container, and later while she was away, Anne took her marble and hid it in his own black container. The child, therefore, needed to appreciate that since Sally was absent when the marble was being removed, she would still believe it was in its original location, i.e., the blue container.

The child was then asked the question “Where will Sally look for her marble?”

A pass was scored only if the child answered “The blue container”, or pointing

to it. The comprehension question “Where is the marble really?” followed to make sure that he/she understood what was being asked. Finally, the child was asked the memory question, “Where is the marble really?” A pass score was given if the child answered all the questions correctly.

2.2.4 M&M False Belief Test

The child was shown a candy box and then asked what it contained. After he/she replied, the box was then opened and to reveal what it actually contained – a pencil. The child was then introduced the puppet, who has never seen the box, and was invited to guess what the puppet thinks was within. A pass was scored only if the child responded “candy”.

2.2.5 Block Design

Two black-and-white patterns were presented the child. Each pattern was constructed from nine cubic blocks. All blocks were identical, showing the same six faces each. Each pattern was displayed in turn, together with a random arrangement of the nine component blocks and the child was told, “Look at this pattern. You can make the same pattern out of these blocks. The faces of the different blocks are identical.” The child was then given unlimited time for the task and was allowed to self-correct a misplacement. Each trial was timed until successful completion. The dependent measure was the mean time for completing the two trials.

2.2.6 Two-puzzle Task

This is a refined version of the task used by Frith and Hermelin (1969). In this task, central coherence is operationally defined as the ability to apply an integrated picture as clue to complete a puzzle as fast as possible. Puzzle 1 was cut into rectangular picture puzzle pieces with straight edges. In the contrasting condition, Puzzle 2 is a blank black puzzle with typically jagged. Completion times were recorded. The dependent measure for this task was derived from the time spent on the Puzzle 2 minus that on the Puzzle 1. Larger score indicated higher tendency to process information coherently.

2.2.7 Wisconsin Card Sorting Test (Heaton, 1981)

This test was administered according to the standard procedures. In the present study, the numbers of categories completed and perseverative errors provided measures of cognitive flexibility and cognitive rigidity respectively.

2.2.8 Pretend play

Two spontaneous play trials, each 5-minute long, were arranged for each participant and recorded on videotapes. Play was scored using time-interval analysis (Libby, Powell, Messer, and Jordan, 1997). The play was rated as symbolic play if it followed three criteria (using an object as if it was something else; attributing properties to an objects as if they were present; making reference to something that was absent as if it was present) at every 15-second interval (based on the work of Baron-Cohen, 1987; Leslie, 1987; Lewis, & Boucher, 1988; Urgerer, & Sigman, 1981). There were altogether 40 play sequences in two play trials. Symbolic play was indexed by the total number of symbolic play acted in the 40 play sequences.

2.3 Procedures

Parental consent was sought before assessment for each child. All assessments were conducted individually by trained experimenters in a quiet room. The order of assessments was counter-balanced. The whole assessment duration was around one hour to avoid fatigue and inattention.

3. Results

Means and standard deviations for symbolic play and measures of ToM, WCC and EF for the two groups were presented in Table 2.

Group difference on symbolic play

ANCOVA was performed to reveal any group difference on symbolic play after statistically controlling for verbal IQ. There was significant differences in symbolic play scores [$F(1,23) = 4.36, p < 0.05$]. The AD group demonstrated significantly fewer symbolic play acts than the TD group when verbal ability was taken into account.

3.1 Group differences on ToM, WCC and EF

It was of our interests to examine group differences on other variables of cognitive mechanisms. On ToM, chi-square test indicated that there was a marginal significant difference for the Sally-and-Anne Task [$\chi^2(1, 23) = 3.00, p = 0.08$] and no significant difference for the M&M Task. The data suggested that the AD group performed less well than the TD group in detecting false beliefs.

On WCC, *t*-tests revealed significant difference on the two-puzzle task [$t(1,23) = 2.29, p = 0.03$] and marginally significant difference was found on the block design task [$t(1,23) = 1.71, p = 0.10$]. The AD group performed significantly better than the TD group in processing piecemeal information, suggesting the likelihood of weaker central coherence.

There were no significant differences on EF measures, indicating that both groups were alike on cognitive flexibility and rigidity.

3.2 Correlations among the variables of interests

Table 3 displayed the correlations between symbolic play, verbal ability, non-verbal IQ, ToM, WCC and EF. Briefly, symbolic play scores were significantly correlated with the Two-puzzle task which was a measure of central coherence. However, symbolic play was not significantly associated with other measures. Comparatively, symbolic play was likely to be associated with ToM measures and central coherence measures but weakly correlated with EF measures.

4. Discussion

In line with previous research, the present investigation provided evidences that children with ASD show deficits in symbolic play, when compared with typically developing peers (Baron-Cohen, 1987; Jarrold et al., 1994; Stahmer, 1995). Our data also suggests that, among various competing cognitive theories in explaining pretend play deficit, the lack of theory of mind and weak central coherence seem to be causally related to symbolic play deficits.

Symbolic play, a type of imaginary play, has been suggested as an autism-specific deficit as children with other developmental disorders tend to show comparable amount of play with typically developing children (Ruthford et al., 2007). It is argued to be linked with a number of important developmental achievements such as social skills, emotional regulations and language abilities (Casby, 2003; Lindsey & Cowell, 2003; Pellegrini, 1985). Considerable amount of work has been devoted to develop effective intervention strategies to promote play skills in young children with ASD (e.g. Jarrold et al., 1996; Lewis & Boucher, 1988). A better understanding of the underpinning cognitive impairments associated with symbolic play thus contributes to the development of effective intervention as well as play development in children with typical development.

There is evidence that receptive language is highly related to pretend play ability among typically developing children (Fein, 1981). It should be noted that children with ASD in our study performed very similarly in both verbal and non-verbal IQ to the group with typical development. It is thus more confident to argue that the observed deficit in symbolic play is due to deficit in cognitive mechanism rather than the inability to understand verbal instructions and produce verbal responses in the play trails. Our data also suggests that among high-functioning and verbal young children with ASD, symbolic play frequency is less than their typically developing peers.

Given significant differences between the autism group and the control group on the performance in theory of mind and central coherence measures, symbolic play in children with ASD is possibly related to these two theoretical accounts. Difficulties in understanding other people's mind have been linked

to symbolic play deficits because children need to simultaneously hold two competing representations in mind to produce symbolic play (Lesile, 1987). Our results show that children with ASD have difficulties in mentalizing others' people perspective which may contribute to their difficulties in producing symbolic play acts.

To our knowledge, the present study is the initial attempt to explore the link between central coherence and pretend play. Our data shows that children who have fragmented processing of incoming information might have greater difficulties to engage in symbolic play. It is possible that when these children are in a play context conducive to symbolic play, they might engage in piecemeal processing of stimuli around and thus could not engage in meaningful play acts.

It is surprising that there was no group difference on executive functioning measures. Executive functions involve the ability of planning, inhibition, generating new ideas and controlling attentional processes (Pennington et al., 1997). The measure we employed, the WCST, tapped on cognitive flexibility and set shifting ability. It has been argued that inhibition, set shifting and generating new ideas may involve in the process of producing symbolic play (Harris, 1993; Jarrold et al., 1994). The present findings suggest that symbolic play may not relate to set shifting. Further investigation is needed to clarify what specific executive functions play a role in symbolic play.

A limitation of the present study was the small sample size which limits our scope of data analyses. We were unable to perform regression analyses to reveal the predictive relationship between various theoretical accounts and

symbolic play. It is also important to note that our symbolic play measure only allowed us to have frequency data. We were unable to examine the quality and complexity of the symbolic play. Children with ASD are reported to demonstrate repetitive and stereotypic symbolic play (Sigman & Ungerer, 1984).

In conclusion, our findings suggest that young children with ASD tend to have difficulties in symbolic play. Admittedly preliminary, theoretical accounts of theory of mind and central coherence seem to be more associated with such difficulties than executive functioning. More research is needed to clarify what theoretical model can account for symbolic play deficits.

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Table 1

Characteristics of the sample				
	AD		TD	
	Mean	SD	Mean	SD
Age*	6.11	8.23	5.64	1.00
Verbal IQ – PPVT*	70.17	3.51	77.91	3.04
Non-verbal IQ – Raven*	22.83	7.43	24.08	5.70
*No significant difference between two groups as revealed by t-tests (p > 0.05).				

Table 2

Means and standard deviations for symbolic play, ToM, WCC and EF measures

Variables	Measures	AD M (SD) / frequency	TD M (SD) / frequency	t / X	p
Symbolic play	Symbolic play frequency count	4.17 (3.41)	8.50 (5.16)	2.43	0.02
ToM	Sally-and-Anne*	Pass – 6; Fail -6	Pass – 10; Fail - 2	3.00	0.08
	M&M*	Pass – 8; Fail - 4	Pass – 10; Fail - 2	0.89	<i>ns</i>
WCC	Block design	109.95 (59.59)	157.88 (76.38)	1.71	0.10
	Two-puzzle	64.54 (38.50)	118.64 (72.25)	2.29	0.03
EF	WCST – categories completed	2.75 (1.36)	2.67 (1.07)	0.17	<i>ns</i>
	WCST – perseverative errors	8.92 (11.59)	8.33 (6.10)	0.15	<i>ns</i>

*tested by chi-square

Table 3

Intercorrelations among symbolic play, verbal and non-verbal IQ and measures of ToM, WCC and EF

	1	2	3	4	5	6	7	8	9
1. Symbolic play	--								
2. PPVT	.24	--							
3. Ravens	.18	.55**	--						
4. M&M Task	-.27	-.20	.03	--					
5. Sally-and-Anne Task	-.33	-.74***	-.43*	.20	--				
6. Two-puzzle Task	.47*	.27	.39	-.16	-.39	--			
7. Block Design Task	.23	.25	-.03	-.12	-.17	.51*	--		
8. WCST – category completed	-.03	.19	.68**	.23	.03	-.13	-.21	--	
9. WCST – perseverative errors	-.12	-.35	-.64**	-.20	.19	-.08	-.15	-.73***	--

Note: *p < .05; **p < .01; ***p < .001

Highlights:

- We compared theory of mind, executive functions and central coherence in explaining symbolic play deficits in preschoolers with ASD.
- We found that preschoolers with autism performed significantly worse than children with typically development in symbolic play, theory of mind and central coherence.
- An impaired theory of mind and weak central coherence are more associated with symbolic play performance among children with ASD.