Original Research

A Screening Tool of Social Cognition for Preschool Children

Yu Jin, MD;[1]* Guan Han, MD;[1] Zhaoxi Wang, MD;[2] Xue-Jun Kong, MD;[3] Jin Jing, MS[1]

[1] *Maternity and Child Health, Public Health School, Sun Yat-sen University, Guangzhou, China*
[2] *HarvardSchool of Public Health, Boston, MA*
[3] *Beth Israel Deaconess Medical Center, Boston, MA*

Theory of Mind (TOM) tests can be used to assess the development of children's social cognition has received. However, currently there is no Chinese version of TOM tests as screening tools for identification of children who are likely to have communication disorders and for early detection of ASD. Based on a Japanese version of TOM tests, we modified to form a Chinese Version and investigated its reliability and validity among 1095 preschool children in Guangzhou, China. The results demonstrated that the Chinese version of TOM test had good psychometrics properties, with adequate reliability and validity. In particular, the TOM test is appropriate for assessing the social cognition level of Chinese children.
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INTRODUCTION

Since 1980s, social cognition has been defined as the ability to understand social objects including a person's inner world, interpersonal relationships, social groups, and social norms, and the capability of self-adjusting behavioral adaptability after making a judgment and speculation.[1] In the past few decades, the development of children's social cognition has received special attention, and the system of assessing basic cognitive ability has also been established. With the interactions between genetic and environmental factors, children's brain function has strong plasticity. We still have the opportunity take effective interventions to rebuild or improve it if we identify a deficit early. Meanwhile, research on the neuropsychological mechanism of children's communication disorder is increasing, with the consideration of social cognition, which provides information regarding prevention and treatment of these conditions.

In social cognition research, the development of theory of mind (TOM) test mainly focuses on exploring the social barriers of individuals with autism spectrum disorders (ASD). Earlier studies implementing similar assessments to autistic children find that the understanding and inference of psychological status in most of autistic children is behind the children with typical development. Applying TOM test in general population of developing children allows early screening socially delayed children resulting in early intervention and improved prognosis.

The TOM was first developed by Premack and Woodruff.[2] Through non-verbal experiments on chimpanzees they proposed that primates have theory of mind that is individuals have capability of understand their own and others' mental states, including recognition of beliefs, emotions, intentions and desires and other mental states, and thus make predictions of others' behaviors. Based on TOM, Steerneman[3] had designed a set of TOM tests for children, which were successfully validated in in European children in 1999.[4] Meanwhile a Japanese version of TOM tests was developed as a standard method for testing children's social cognition abilities in developmental behavioral pediatrics and kindergartens in Japan in 2002.[5] At that time, there is no Chinese version of TOM tests as screening tools for identification of children who are likely to have communication disorders and for early detection of ASD. Considering the current increasing needs for early detection and intervention of children with socially delayed in China, we modified the Japanese version of TOM test according to Chinese culture and conducted a pilot study among 90 children (3-6 years old) in Guangzhou, China. The results showed that the development of inference ability of Chinese children is similar to that of Japanese children, suggesting that TOM tests will be suitable for use in China.[6]

In this study, based on previous studies, we first developed a Chinese version of TOM tests by revising the Japanese version to customize it to the Chinese cultural environment, especially for the real life of early childhood. We then conducted pilot trails in Guangzhou, the provincial capital of Guangdong, China. The findings of these trials allowed us to understand more about the developmental level of social abilities of children, and provide early screening and detection for children who are experiencing communication disorders, so as to provide intervention and thus improve the prognosis. Meanwhile this is the first study to test the validity of psychometric properties of a Chinese version of TOM tests in China, thus allowing assessment of an important area of development in children.

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***Corresponding Author:** Maternity and Child Health, Public Health School, Sun Yat-sen University, 74 Zhongshan RD 2, Guangzhou, China 510080. (Email: jinyu@mail.sysu.edu.cn)

METHODS

Subjects

We used a stratified cluster sampling method to select 9 kindergartens, including 4 provincial, 3 municipal and 3 private kindergartens, from 8 districts of Guangzhou, China. With parental approval, we recruited children who did not exhibit behavioral problems or language delay. The educational levels of parents were from primary school to college or higher. Majority of families are nuclear families or extended families. The proportion of the immigrant children was less than 20%, consistent with that of Guangzhou (the immigration rate is 20.1% in 2005, with 56.84% came from other provinces).[7]

Two weeks after the initial test, we randomly selected one kindergarten (165 children) for a second round test.

Instrument and Procedure

The Chinese Version of Theory of Mind Test (TOMT)[5]

This test includes tasks to comprehend crying expression and false belief, and usually takes 5 to 10 minutes to complete. The false belief task is in the form of storytelling, with the examiner manipulating props. After each part of the story is finished, the children answer some questions related to the story. The examiner records the answers and scores the results. Graduate students and advanced undergraduate students were trained as examiners. After the inter-rater consistency reached 90%, they were allowed to test the children.

(1) False belief—Unexpected Location Test, two trials.

Trial 1: First arrange the scene: a closet and a box are placed in front of a wooden house on the left and right side, respectively. Story is that doll A puts her hat in the closet, and then goes into the house. Another doll B comes and moves the hat into the box then he left. Then, A comes out of the house to look for her hat. Child is asked 3 questions (each right answer got 1 point, total of 3 points) First question: "Where should A go and look for her hat?" The correct answer is "closet", (for A hadn't seen her hat being moved into the box and she will think her hat is still in the closet. This idea is a false belief which is inconsistent with the facts). Second question: "Where is the hat now?" The correct answer is "in the box". The third question: "Where did A put her hat before she went into the house?" The correct answer is "in the closet". (The latter two questions were to confirm that child has remembered the story).

Trial 2: Change by using animal dolls, Rabbit's crayon is moved into the square box by Winnie. It is originally put in a round box. And similar questions are asked.

(2) False belief—Unexpected Contents Test(Smarties Box Test), one trial.

Let the child guess what's in the box that has a picture of children drawing pictures. Whether or not they get the right answer, open the box and tell them it is crayon. Then take out the crayons and put scissors into the box. Close the box and ask three questions. First question: "What's in the box originally?" The correct answer is "crayons" (to be sure the child remembered what was in the box originally). Second question: "What's in the box now?" The correct answer is "scissors". (The first two questions were to confirm that child has remembered the story).Third question: "If you ask Mom (or someone else who is not present), what's in the box, how will Mom answer?" The correct answer is "crayons" (child should infer that someone who has not seen the change will assume that what is in the box is related to the picture on the box, this is a false belief). Each right answer got 1 point, total of 3 points. This test is more difficult than the unexpected location test.

(3) The Recognition of Crying Expression and Attribution.

Show child a picture with a crying boy on it and ask, "What happened to the boy?" (To identify the expression) "Why he is doing so?" (Expression attribution—prediction) if the answers are "crying", "he was been scolded", "he has been beaten" or "he is hungry" or another reasonable explanation it would be regarded as a correct answer. Each right answer of one question can get one point, with total of 2 points.

The sequence of TOMT was 1) Unexpected Location Test A, 2) Expression Understanding Test, 3) Unexpected Content Test (Smarties Box Test B), and 4) Unexpected Location Test B.

Table 1. The months of age and numbers of each age level.

Age Group	Age (Month)	Average age ($\chi \pm SD$)	Male	Female
1	36～41	40.5±1.4	43	55
2	42～47	45.7±1.6	94	74
3	48～53	51.6±1.7	96	95
4	54～59	57.6±1.8	98	73
5	60～65	63.4±1.7	107	100
6	66～71	69.4±1.8	74	74
7	72～78	74.5±1.4	53	59
Total		56.7±10.6	565	530

RESULTS

Findings of Chinese

TOM Tests

This study recruited 1132 children and 1095 (97% children completed the tests, including 565 boys and 530 girls participated. They were divided into 7 groups with each group representing six months. The average age in months is shown in **Table 1**, The distribution of male and female in each group was comparable (χ^2 = 4.98, P > 0.005). The family socioeconomic statuses were: poor 4%, average 66%, above 25%, and rich 5%.

The results of Chinese TOMT were summarized in **Figure 1**. The older the child, the higher the score. The accuracy of Recognition of Crying Expression (blue line) and Attribution (pink line) was higher than the False Belief test, and the accuracy of Unexpected Location test (red and yellow lines) was higher than the Smarties Box test (purple line).

The accuracy of judging Recognition of Crying Expression test was higher than the Recognition of Crying Attribution. **Figure 1** shows that the accuracy rate reached more than 90% for children older than 3.5 years, and reached 100% for children older than 5 years. More than 50% of 3 years old children could explain the reason for crying; 90% of children older than 6 years could explain the reason for crying.

The accuracy rate of the False Belief test was lower than 20% in children less than 4 years old, and increased gradually after age 4. There was no significant difference of the accuracy rates between trial 1 and trial 2 of Unexpected Locations tests in each age group, (P > 0.05). The pass rate of the Unexpected Locations tests for children at age 5 and older was close to or over 50%. The pass rate for Smarties Box test was over 50% for children older than 5.5 years.

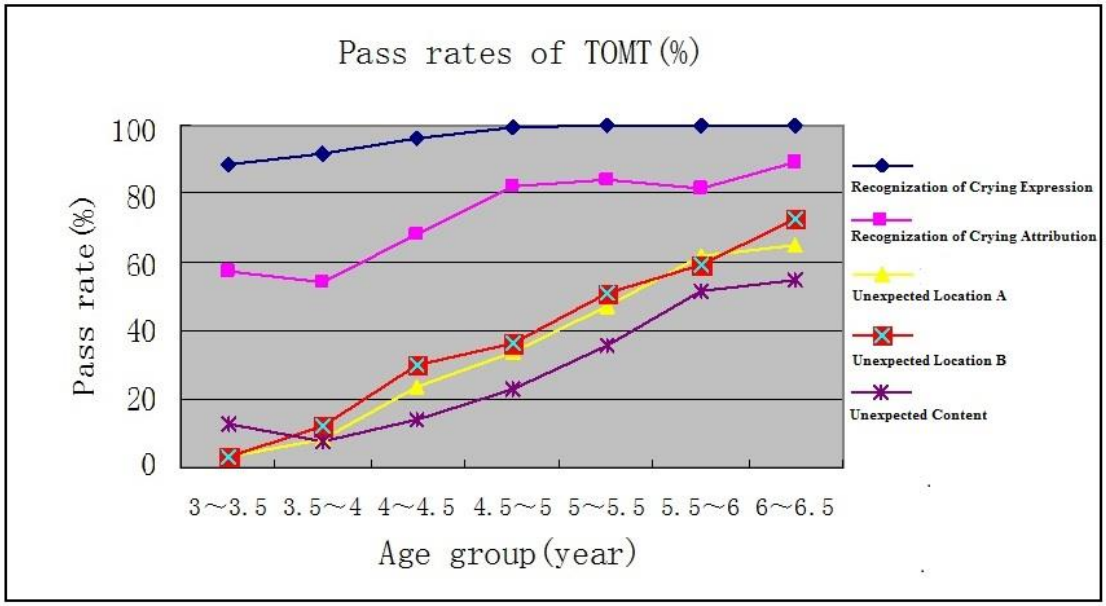

Figure 1. The pass rate of theory of mind test in each group.

Reliability of Chinese TOM Tests

The correlation coefficients (Spearman rank order) between initial test and the second round test in one randomly selected kindergarten (165 children) of Recognition of Crying Expression and Attribution test, trials 1 & 2 of Unexpected Location Test, and Smarties Box Test are 0.98, 0.92, 0.76 and 0.75 (P < 0.01), respectively. The high level of consistency between different rounds of test indicated that Chinese TOM tests had a good stability.

The coefficient of internal consistency (Cronbachs'α) was applied to estimate the internal consistency of Chinese TOM test. The Cronbachs'α for each trial of Unexpected Location tests was 0.83 (P < 0.01), the Cronbachs'α for each of the rest TOM tests was 0.75 (P < 0.01).

The split-half correlation was used to estimate reliability of examiners on test results of 100 children. The Spearman correlation coefficient was 0.95 (P ＜ 0.01).

Validity of Chinese TOM Tests

Content validity requires that each item and dimension of a test is consistent with the content and theme of the test. Spearman correlation coefficient (r) was used to determine the relationship of each item and dimension to the total score.[8,9] We assessed the validity of the contents of the theme of Chinese TOM tests and found that each item and dimension of the Chinese version of TOM tests were correlated (P < 0.01). The correlation coefficients of the two Unexpected Location tests are 0.85 and 0.84, respectively.

The correlation coefficient of Smarties Box test is 0.76. The correlation coefficient of Recognition of Crying Expression and Attribution test is 0.49.

The structure validity refers to the degree to which design ideas comply with the actual measurement results; it evaluates the structure validity by factor analysis.[10] As this study has only 4 subtests, confirmatory factor analysis was used to evaluate the concept of the model and actual data. For this Chinese version of TOM test, χ^2/Df = 3.61, Root Mean Square Error of Approximation (RMSEA) = 0.049, and Comparative Fit Index (CFI) = 0.996.

DISCUSSION

This study is the first to modify a Japanese TOM test into a Chinese version. The Japanese version of TOM tests includes false belief and expression recognition and attribution. Although it is different from Steerneman's TOM tests which was originally designed for European children with props and scenes, this instrument was applied widely in Japan. After it was customized to Chinese culture and evaluated, we found that it is useful in Chinese children to judge their social recognition abilities. The results showed that this Chinese version has excellent reliability and validity, and also found that the proportion of children passed TOM tests increased with age.

The complete rate of consented children was 100%. Testing was carried out by way of storytelling and props. Those props were very attractive to children by vivid color and lovely figure. The requirement of language was quite low, and children could cooperate easily. During the interaction, we could test the children and also observe their behavior. For the above reasons, this Chinese version of the test is quite suitable for young children who are at lower developmental levels.

In terms of reliability, the Cronbachs' α of four aspects of the Chinese version are between 0.75 and 0.85, and high correlations of the total scores were observed between the initial test and the retest. These results suggested the Chinese TOM tests had good reliability.[8]

We evaluated the validity of the Chinese version of TOM tests by content and structure. For content evaluation, the individual components and the total scores of the trials of Unexpected Location tests were highly related, and content of Smarties Box test was moderate related. However, the correlations between the individual components and the total scores of Recognition of Crying Expression and Attribution test were low. Possible reasons include: 1. the scores are different. The score of unexpected locations and contents test is between 0 and 3 points, whereas expression recognition and attribution is between 0 and 2 points. The weight of individual components of the former contribute largely to the total score, this may lead to a lower correlation. 2. This study found that most children acquired the ability of speculating reasonably about the reason for crying between 3 to 5 years of age. Good language ability is required to infer the reason of crying, and language ability affects the test results directly. Thus, language skill has larger impacts on the expression recognition test than on the location and contents tests. We inferred that designing a test without using language skills could help determine when children acquire the ability to infer the reason for crying.

For structure evaluation with confirmatory factor analysis, in actual research a test with χ^2/Df < 5, RMSEA < 0.08, and CFI > 0.9 is considered having ideal structure validity. The fitting results indicated that the Chinese version of TOM test had a good structure validity and is very close to ideal fitting.[8]

We also found that in understating of false belief, along with increasing age. Children start to take a view of the problem from others' standpoint. The rapid development of understanding others' beliefs occurs between 4 and 5.5 years old in Chinese children. This is consistent with Perner and Wimmer's observations in 1985.[11] They first used TOM test to assess children's inference of expression of others, and they thought children started to demonstrate a stable ability to recognize people's mental states from 4 to 5 years old.

We found that the development of theory of mind is highly related to age in Chinese population. With increasing age the passing rates of Chinese version of TOM tests was increased too. At age 6, about half of Chinese children could pass the unexpected contents test. In 1993 Flavell et al. first proposed that the development of TOM can be divided into 3 stages by children's age: the primary stage (mental states recognition), the standard stage (understanding of false belief), and the mature stage (correct socially judgment).[12] During the study of the validity and reliability of the European version of TOM tests, Muris et al. showed that the theory of mind is gradually developed through these stages, with obvious development between age 6 to 7 years.[4] Other studies around the world also demonstrated that psychological inference ability grows with age. This observation is applied as the guidance in individual intervention, as well as in assessing the results of intervention on children.

CONCLUSIONS

The Chinese version of TOM tests is valid and reliable that is in line with psychometric requirements. It is suitable for testing the social cognition development of Chinese children, with the consideration of language level. China is a vast and multi-ethnic country, and the norm of Guangzhou may not represent other regions. Therefore, future studies are warranted to replicate the procedures used in present study in various regions in an effort to establish local norms that may be useful to practitioners in the area. In addition, research on the screening efficacy in clinical and heath care area is needed.

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