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Standardization of theory of mind task battery (TOMTB) in Lagos State

By

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Abstract

Theory of Mind (TOM) is the ability to ascribe mental states to self and to others, and to use these mental states to explain and predict behaviours in everyday life. The Theory of Mind Task Battery, (TOMTB) which is a foreign test, was used to investigate and compare Theory of Mind in typical children and children with autism using samples from Lagos State. This study , therefore, focused on the standardization and validation of the test battery. The participants are 585 children of ages 3 to 9 years in nursery and primary schools in Lagos State. (291 male; 294 female). The participants' scores were analyzed using mean scores and standard deviation. The Cronbach's Alpha, Guttman Split-Half and Spearman-Brown's reliability coefficient were also computed for the TOMTB. The results showed that TOMTB is a reliable (Cronbach Alpha 0.88; Guttman Split-Half 0.75; Spearman-Brown 0.73 @ $P<0.05$) and valid instrument, with a correlation coefficient of .91 with the Justification Questions, for the measure of theory of mind skills. The implication of findings from this study is that clinicians, researchers and other stakeholders will be able to use the adapted TOMTB for further investigations and research successfully in Nigeria.

Keywords: **'Theory of mind', Typical, autism, children.**

Introduction

Theory of Mind (TOM) is a branch of cognitive science that investigates mind-reading and mental image formation abilities. These abilities are shared by almost all human beings beyond early childhood (Davis, 2007). Theory of Mind is defined as the ability to attribute beliefs, intents, desires, knowledge, thoughts and plans to oneself and others; and to understand that other people's beliefs, intents, desires, thoughts, plans and knowledge may be different from one's own. TOM is crucial for successful social contact and interaction.

As Premack & Woodruff (1978) originally put it, Theory of Mind is the ability to ascribe mental states (such as listed above) to self and to others, and to use the mental states to explain and predict behaviours in everyday life. That is, representing the mental states is a requirement in predicting other people's behaviour. The development of an effective theory of mind is said to have important consequences on the overall development of children. It helps to enhance their social functioning skills and school success, especially in their ability to communicate well, resolve conflicts with their friends and participate in pretend play with peers, (Dunn, 1963; Astington and Jenkins, 1995). The children with effective development of TOM have been found to be happier, with a good level of commitment to school work (Brunner, 1981; Gordon, 1996). Everybody has this potential, but the manifestation is largely dependent on exercise.

Theory of Mind impairment describes a difficulty with perspective taking. This state is sometimes referred to as mind-blindness. This means that individuals with TOM impairment would have a hard time seeing things from any other perspective than their own (Moore, 2002). Such individuals have difficulty determining the moods, plans, beliefs and intentions of others. They lack an understanding of how their behaviour affect others, and generally have a difficult time with social interactions (Baker, 2003). Although, directions of influence are not so easy to clarify, many researchers (Baron-Cohen, 1995; Baron-Cohen, Leslie and

Frith, 1985) have come to the conclusion that theory of mind impairments form the basis of the social, behavioural and communicative impairments, which characterize Autism Spectrum Disorder (ASD). This has made TOM relevant and central to the study of ASD and the development of effective interventions to build social cognition and appropriate behaviours.

Studies into TOM have shown that very little research has been done among Nigerian people and children with developmental disabilities, especially autism. If any has been done, there is no proper documentation, to the best of the researchers' knowledge. It is, therefore, important to look at the theory of mind as a means to address autism; to investigate how the understanding and application of TOM can help the Nigerian child living with autism.

A wide variety of TOM tests have been developed over the last 25 years (Hutchins, Prelock & Bouyea, 2014). The most common TOM assessment strategy is the Sally-Anne false belief task developed in 1983 by Wimmer and Perner, which largely tested the ability to understand and attribute false beliefs to other people. It shows, if one is capable of recognizing that another person's belief about a matter may be wrong or may be different from his /hers. The skill described above is core to social cognition and seeing things from other people's perspectives. (Wellman, Cross & Watson, 2001). The Theory of Mind Task Battery (TOMTB) was developed by Hutchins, Prelock and Bouyea (2014) to assess different aspects of theory of mind. It was designed to assess the understanding of younger and older children, who vary widely in their cognitive and linguistic abilities. The test is also appropriate for non-verbal individuals with ASD, because respondents can indicate their responses either verbally or through pointing. The Theory of Mind Task Battery consists of 15 test questions within 9 tasks (Tasks A to I). Tasks were presented as short stories, which were arranged in ascending order of difficulty and represented a variety in terms of content and complexity ranging from the ability to identify facial expressions to the ability to infer second-order false

beliefs. The tasks were in a story-book format. Each page had colour illustrations and accompanying text. Memory control questions were included. These questions were designed to assess the children's understanding of the short stories; and must be passed to give credit to the test questions. Some justification questions (JQ) were also included, as desired, to probe the quality and the nature of a child's reasoning behind some given answers. JQs may be used with older children or highly verbal children, who perform well on the tasks, but still show evidence of profound difficulties in social cognition. To establish reliability, Hutchins et. al., (2014) used 55 typical children (25 girls; 30 boys) aged 2 – 12 (M = 5.6). The internal consistency was assessed with the use of Cronbach's alpha to measure homogeneity of the components. The score obtained was alpha .91 at first testing and .94 at second testing, thus, showing inter-task agreement. For validity, Criterion related validity was used. TOM correlated with age showing positive relationship between the two. ($r = .66$, $P < .01$) Age explains 44% of the variance in instrument scores.

Statement of the problem

Theory of mind is relevant and central to the study of ASD and the development of effective interventions to build social cognition and appropriate behaviours in this group. TOM testing started with the study of autism (Doherty, 2008). Many of these come in form of short stories followed by questions that require well-developed TOM skills to be correctly answered. These tests are usually based on the assumption that one of the most important milestones in TOM development is the ability to recognize that others can have beliefs about the world that are wrong. One of such tests is Sally and Anne's false belief test (Baron-Cohen et. al., 1986). It has however, recently been found that these tests are not sufficient to determine theory of mind skills in its entirety. It was, therefore, suggested that comprehensive testing of TOM should consider the multiple components and dimensions that constitute TOM skills (Malle,

2008).

The TOMTB (Hutchins et. al., 2014) was developed to give a broader and more varied picture of children's theory of mind functioning at different ages. This test had however not been used in Nigeria and on Nigerian children before now. Therefore, to investigate how the understanding and application of theory of mind can help the Nigerian child, there was a need to adapt and standardize the foreign TOMTB.

Purpose of Study

In order to use the TOMTB in Nigeria successfully, there was a need to standardize and validate the instrument for Nigerian use, making use of Nigerian participants. This study was conducted to establish local norms for the test battery.

Research Questions

1. Will the norms found for the edited TOMTB in Nigeria differ significantly from those obtained from America?
2. Will the standardized instrument be valid?
3. Will the standardized instrument be reliable?

Hypotheses

The following research hypotheses guided this study:

1. Nigerian norms for the TOMTB will differ significantly from those obtained from America.
2. The standardized test instrument will be found to be valid.
3. The standardized test instrument will be reliable.

Method

Participants

The participants were 585 children (291 boys, 294 girls) ranging in age from 3 to 9 years old from four nursery and primary schools in Lagos State, including two public schools. The schools were randomly selected from the twenty Local Government Areas in Lagos State.

Procedure

Permission was sought and granted by the authors of the instrument (TOM Task Battery) for the researchers to edit and modify the task battery for Nigerian use. The modifications include changes such as using common Nigerian names (e.g. Bola for Brynn, Ebuka for Russ, Jumai for Jasmine) and using terms common to the average Nigerian (e.g. Angry for mad; Boots for Rollerblades). Some other terms were, however, left unchanged, e.g. statue, happy, sad, basketball, because they are common vocabulary used by the average Nigerian individual. Modifications in names were done by asking children to make a list of five of their friends' names. The names with the most frequencies were selected. Modifications in 'terms' were done by showing children different pictures on paper and asking them to name them.

Permissions were obtained from the authorities of all the schools that were used in this study to allow their students participate in the study. The instrument was in form of a booklet with different short stories showing pictures and accompanying texts. It was administered to the children one-on-one, with the test booklet on a table and the administrator sitting beside the child inside quiet empty room(s) assigned by the schools. The administrator ensured that there was a familiar face around; this helped to remove stranger anxiety; and calmed the children. The test was introduced to the participants as an activity by stating "I want to read some short stories to you and ask you some questions about the stories. You can answer by

telling me or pointing to the answer". The participants were not allowed to read along to avoid a shift of focus to reading. For each page, the administrator read verbatim and pointed to the images corresponding to the text. This was done at a slow and relaxed pace. The Task Battery had 9 tasks (A-I) and 15 test questions, which were arranged in ascending order of difficulty. These represented a variation in content and complexity ranging from the ability to identify facial expressions, to the ability to infer second-order false beliefs. The score form was completed during the administration in a covert manner, so as not to distract the participants. On the average, it took 15 minutes to complete the edited TOM Task Battery booklet. The test instruments were scored following the instructions provided in the manual.

TOMTB - The total score was the number of correct responses to test questions. Children do not receive credit, when the associated control question was not passed. Scores ranged from 0 to 15 with higher values indicating greater theory of mind performance.

Justification Questions – An ordinal scale was used here. Values reflected variation in the completeness/ correctness of a response where:

1 = 'no response; "I don't know"; or clearly incorrect response.

2 = incomplete response with no reference to mental states (e.g., wanting, thinking, knowing)

3 = a complete correct response.

Results

The Statistical Package for the Social Sciences (SPSS) computer software was used to analyze the data obtained. To obtain the norms for the test instrument, descriptive statistics were used to compute the mean and standard deviation of the scores of participants on the instrument. To establish the reliability of the edited TOMTB, Cronbach alpha, Guttman split-half and Spearman Brown analyses were computed. The Criterion analysis and the Discriminant analysis were used to establish the validity for edited TOMTB; and the

concurrent validity was established by correlating the TOMTB with the JQ.

Table 1: Means and Standard Deviation of the Scores of the Participants on TOMTB by Age

Age	N	Mean	Std. Deviation
3 years	73	3.81	2.152
4 years	115	5.37	1.948
5 years	128	6.52	2.163
6 years	90	6.86	2.102
7 years	73	9.56	2.533
8 years	61	11.34	2.581
9 years	45	10.76	2.165
Total	585	7.22	3.237

The results in Table 1 show the mean total score by age and standard deviation of the participants. The means show an increase with age, establishing a developmental trend in theory of mind development and performance. Table 1 represents the norms reported for Nigerian samples in TOMTB; these are the mean scores of the participants. They form the benchmark of expected performance for total score of participants for further studies in Nigeria. Therefore, scores lower than the established norm, for each age, indicate a lack of; or an emerging theory of mind skill, while scores equal or higher than the norms indicate a developed theory of mind skill.

Figure 1: Graph showing the Mean Scores of the Participants on TOMTB across Ages

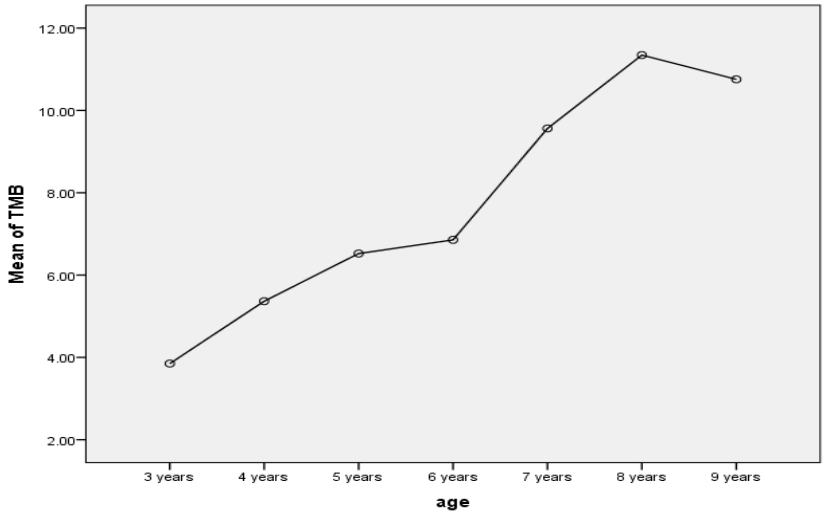


Figure 1 above shows a graphic representation of developmental trend in TOM performance.

Table 2: Comparison of American and Nigerian Benchmarks for TOM

Age	America (Vermont)		Nigeria	
	N	M (Std Dev.)	N	M (Std Dev.)
3	4	3.5 (0.7)	73	3.81 (2.2)
4	6	8.5 (3.5)	115	5.4 (2.0)
5	8	11.8 (3.3)	128	6.5 (2.2)
6	9	11.5 (2.1)	90	6.9 (2.1)
7	7	12.4 (1.1)	73	9.6 (2.5)
8	5	12.8 (3.0)	61	11.3 (2.6)
9	5	12.4 (2.1)	45	10.8 (2.2)

In Table 2, both the American benchmark (Hutchins et. al., 2014) and the newly established benchmark in Lagos, Nigeria show an increase in total mean scores, thereby confirming a developmental trend in theory of mind performance. A slight drop was observed, however, in the mean score of the 9-year olds in both cases.

Reliability and Validity

In order to establish the reliability of the TOM Task Battery, Cronbach's Alpha, Guttman Split-Half reliability coefficient and Spearman Brown reliability coefficient were computed on participants' scores. The results are presented in Table 3 below:

Table 3: Reliability Coefficients of TOMTB

Cronbach's Alpha	0.88
Spearman-Brown Coefficient	0.75
Guttman Split-Half	0.73

*Significant at $P < .05$

Table 3 shows that the edited TOMTB has significantly high internal consistency Cronbach's Alpha Coefficient of .88, Split-Half reliability coefficient of .73 and Spearman Brown reliability coefficient of .75. The edited TOMTB is reliable.

Criterion Validity

The criterion validity of TOMTB with the justification questions was established by using Pearson's Product Moment Correlation to correlate the scores of the participants in TOMTB and the Justification Questions (JQ). The result is presented in Table 4.

Table 4: Correlation Matrix of Participants' scores on edited TOMTB and Justification Questions (JQ)

Measures	TOMTB	JQ
TOMTB	1	
JQ	.91**	1

** Correlation is significant at 0.01 level (1 tailed)

The result in Table 4 shows that TOMTB has positive and significant correlation coefficients

of .91** with JQ. This result establishes the criterion validity for the edited TOMTB.

Discriminant Validity

The discriminant validity of TOMTB was established by using intercorrelation of items correlation by discriminating between male and female. The results are presented in Tables 5, 6 and 7 below:

Table 5: Inter item Correlation Matrix

	Test 1	Test 2	Test 3	Test 4	Test 5	Test 6	Test 7	Test 8	Test 9	Test 10	Test 11	Test 12	Test 13	Test 14	Test 15
Test 1	1.00														
Test 2	.34	1.00													
Test 3	.14	.25	1.00												
Test 4	.19	.25	.42	1.00											
Test 5	.28	.24	.30	.27	1.00										
Test 6	.13	.18	.11	.18	.11	1.00									
Test 7	.04	.06	.10	.07	.08	.11	1.00								
Test 8	.08	.11	.15	.17	.12	.08	.35	1.00							
Test 9	.13	.16	.14	.17	.18	.32	.07	.08	1.00						
Test 10	.15	.21	.22	.21	.23	.20	.12	.20	.20	1.00					
Test 11	.12	.22	.23	.24	.22	.20	.23	.29	.20	.37	1.00				
Test 12	.11	.22	.22	.22	.20	.20	.19	.28	.20	.41	.84	1.00			
Test 13	.10	.20	.20	.21	.18	.20	.22	.31	.21	.36	.73	.87	1.00		
Test14	.10	.22	.23	.24	.21	.23	.21	.26	.18	.51	.42	.44	.38	1.00	
Test 15	.08	.17	.19	.18	.17	.21	.24	.24	.13	.32	.32	.31	.31	.49	1.00

Table 6: Summary Item Statistics

	Mean	Minimum	Maximum	Range	Maximum / Minimum	Variance	N of Items
Item Means	.482	.144	.947	.803	6.583	.088	15

Table 7: Summary of Canonical Discriminant Functions

Function	Eigenvalue	% of Variance	Cumulative %	Canonical Correlation
1	.030[a]	100.0	100.0	.170

The eigenvalue is .030 at 100% variance.

Discussion

Consistent with the work of Hutchins et. al., (2014), these results show a developmental trend in the development of 'theory of mind' skills. Norms were obtained for the edited TOMTB for the different ages. The norms obtained were 3.9, 5.4, 6.5, 6.9, 9.6, 11.3 and 10.8 (for ages 3 to 9 years, respectively). The instrument was originally developed and standardized with American samples in Vermont; this study has, therefore, provided the norms for Nigerian (Lagos) samples in the task battery. In comparing the norms established in Vermont and those in this research, it was observed that the norms established were higher in Nigeria only among the 3-year-olds (Ver = 3.5; Nig = 3.9). The norms established for ages 4 to 9 years were observed to be higher in Vermont. (Ver:Nig = 8.5:5.4; 11.8:6.5; 11.5:6.9; 12.4:9.6; 12.8:11.3; 12.4:10.8). It is important to explore the cause(s) for these variations. We will recall that there were 15 test questions within nine tasks, which were arranged in ascending order of difficulty; the implication of this is that the higher the score in the test questions, the higher or better the children's performances should be in language and non-verbal responses. The question: "why did the children from Vermont perform better than their counterparts in Lagos, Nigeria?" can be explained from three perspectives. First, the variation observed on the score of both samples could have something to do with the nine tasks. Second, the

variation may be as a result of the 15 test questions. The third perspective could be attributed to the interpretation of the children to the 15 test questions within the 9 TOM tasks.

These variations were surprising, however, because the Nigerian cultural content is structured in such a way that the higher the ability to read nuances, from implicit to explicit, the better one's chances should be at the TOM tasks. All Nigerian languages are tonal, that is, a word can take different meanings with the tone. In Yoruba language, for example, we have 'owo' (money), 'owo' (trading). This places a higher cognitive demand on the minds of the average Nigerians. That is, they are expected to be more adept at reading minds than the Americans. A very good reference would also be the way our mothers did not need to talk so much. When we were younger, a child only needed to look at the mother's face to understand the message she was passing across. The precise source of that variation can however, only be unraveled through further studies. However, both the Vermont norms and the Nigerian norms showed a developmental trend. It was also observed that the norms for the 9-year olds in both groups dropped slightly. (0.4 for the Vermont norm and 0.5 for the Nigerian norm).

The results also indicated that the edited 'Theory of Mind Task Battery' is reliable. The reliability coefficients obtained (Cronbach Alpha = 0.88, Guttman Split-Half = 0.75, Spearman-Brown = 0.73) were all high and significant ($P<0.05$). This result agrees with the view of Aiken (2003) who submited that the acceptable reliability coefficients for a new test must not be less than 0.70.

The edited TOMTB was found to be a valid instrument, with a correlation coefficient of .91 with the Justification Questions. The criterion validity was, thus, established. The discriminant validity was established by discriminating between male and female, using intercorrelation of items. The eigenvalue is .030 at 100% variance.

The TOMTB was made up of three sub-scales. They are (1) Early sub-scale, which tapped the theory of mind abilities such as emotion recognition and desire-based emotion; (2) Basic

sub-scale, which tapped the theory of mind abilities such as false belief, seeing leads to knowing, line of sight, and understanding pretense); (3) 2nd order false belief and complex social judgement.

The conclusion from the findings of this paper, therefore, is that the adapted Theory of Mind Task Battery is reliable and valid for Nigerian participants. As observed from the results, there was a developmental trend, which is comparable with the Vermont study.

Recommendation

Clinical psychologists, therapists, teachers and other professionals in Nigeria should take the opportunity of the existence of the edited and standardized TOMTB as a useful tool for assessing the theory of mind capabilities of children, in order to design appropriate intervention techniques for those children that might need support, such as, building 'Individual Education Plans', inspiring empathy, making social skills easier to learn, developing tasks like role-playing for children living with autism, and many more.

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