Research : 13

Validation of the Arabic Version of the Theory of Mind Task Battery

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Abstract

The aim of the present study was to translate and assess the reliability and validity of the Theory of Mind task battery designed by Hutchins & Prelock 2010, for use as an assessment of the theory of mind in normally-developing children, such behavior has implications on many aspects of children's life, such as social competence, peer acceptance and early success in school. 367 normally-developing monolingual children ranging in age from 3 to 12 years participated. A back to back translation method was used with the theory of mind task battery. A subset of 49 children participated in a retest 10 to 14 days after the initial assessment. Overall results indicated that the Arabic adaptation of the test can be considered reliable for assessing theory of mind within children. However, analyses of item difficulty indicated some differences between the Arabic adaptation of the theory of mind task battery and the English test, therefore, the arrangement of the tasks was changed and task D (Line of sight) was moved and became the last task tested because it was the most difficult for all ages.

Keywords: Arabic adaptation, Assessment, Children, Reliability, Theory of Mind, Validation.

Introduction

Theory of Mind (ToM) is considered a person's ability to understand his\her own mind and the minds of others, but the term also includes a social-cognitive skill with implications for many aspects of children's functioning, such as social competence, peer acceptance and early success in school (Carlson, Koening & Harms, 2013). ToM also includes understanding of various mental states, as well as the ways in which action is shaped by such mental states and experiences, both in straightforward situations and in complicated ones, where the mind and action are at odds because of forgetting, ignorance, false beliefs, accident, or error (Wellman, Fuxi, & Peterson, 2011).

Two neural systems are involved in processing ToM: one for perceiving others' beliefs and intentions, which is the cognitive component; and one for understanding others' emotions, which is the affective component (Poletti, Enrici, & Adenzatoc, 2012). These components can be differentiated on neural levels,

where the parietal cortex during ToM processing is involved; yet, ToM recruits a network of brain structures, irrespective of the differentiation between the affective and cognitive subcomponents (Bodden, et al., 2013).

According to Mahy, Moses, and Pfeifer (2014, p. 69), "ToM development is driven by an innate neural mechanism dedicated to mental state reasoning. Although experience may be important in triggering this mechanism, it cannot revise the mechanism's basic nature." The development of ToM was conceived as occurring in four phases. Phase 1 starts before the age of two and a half years where children begin to develop some sort of nonrepresentational understanding of perception as well as social referencing and object permanence abilities. Phase 2 occurs between two and a half and 3 years. In this stage, children show some level of understanding of nonrepresentational states such as perception and desire, and can solve simple desire tasks, for example when the children are told about a character who had a choice of either a cookie or a carrot for a snack, then they are asked which of these snacks they would choose for themselves, so if they chose the cookie they will then hear that the character likes the carrot, after that they will be asked to predict which snack the character would choose, generally children pass this phase at an early age. Phase 3 starts at the age of 3 years, where children can understand representational aspects of desire and their perception improves; at this age they can also invoke preliminary accounts of misrepresentation if they are confronted by direct counter-evidence. An example task, children are told about a character who had a choice of looking for her cat under the porch or in the garden, then they are asked where they themselves look for the cat, so if the child thinks the cat is in the garage they will be told that the character in the story thinks that the cat is under the porch, next the children will be asked to predict which one of the locations the story character would choose to look for the cat (Liu, Meltzoff, & Wellman, 2009), and (Gopnik, Slaughter, & Meltzoff, 2014).

Finally, phase 4 begins around 4 years, when children can generalize the notion of representation from perceptual context, and develop a general predictive and applicable notion of false belief, such understanding is usually measured using standard tasks such as the Change in Location or Unexpected Contents, for example children are shown a crayon box that contains candles, then asked what is in the box, after that they will be asked what would another person think is in the crayon box, three year olds would say that that the character would think that the box contains candles, not crayons, while four and five year olds would say the character would think it has crayons inside. (Atancea, Bernsteinb, & Meltzoffc, 2010), and (Gopnik, Slaughter, & Meltzoff, 2014).

ToM starts showing in the behavior of children as young as 15 months old, when they are able to imitate behaviors they see and can re-enact the goals and intentions of a person based on unsuccessful acts, for example a child would see that someone is going to push a buzzer but fails to do so, an 18 month old child would be able to imitate that Pearson and push the buzzer even when the Pearson fails to (Meltzoff, 1995). By the age of 2 years, children usually adopt a fundamental aspect of ToM regarding people (but not inanimate objects), as evidenced by their ability to understand some goals and intentions of others (Meltzoff, 1999). By the age of 3 years, children show some competency in dealing with false belief tasks, and by the age of 4 years, their performance on such tasks improves (Leslie, 1994). Yet, three- and 4-year-old children explanations imply a conviction that belief and appearances always match reality, and that there is only one perspective. By the age of 5 years, they can understand the fact that belief and reality are not always the same (Carlson & Moses, 2001).

Children 6 years and older are able to represent wrong beliefs and to construct a deceitful or truthful utterance relative to a person's wrong beliefs. During this period, several other related abilities emerge, such as understanding the absence of knowledge in other people's thinking, constructing deceitful

utterances, and recognizing deceptive plans from critical utterances in the context of conflicting goals (Wimmer & Pemer, 1983). ToM plays an important role in child development and is clearly evident in many activities such as social interaction with peers, adults and younger children; engagement in pretense; and participation in group games such as hide and seek (Wellman & Peterson, 2013).

The development of ToM interrelates with different cognitive abilities such as executive functions. In particular, it has been argued that the development of these functions usually requires conceptual change, which enables specific conceptual orientations to develop that are essential to the development of ToM (Wellman, Cross & Watson, 2001). Language also has an important role in children's conception of mind (Hale & Tager-Flusberg, 2003). A meta-analysis indicated that children's semantics, general language, syntax, and memory for complements are all strongly linked to children's performance on false-belief tasks (Milligan, Astington & Dack, 2007).

Number of siblings also has an effect on ToM: children from larger families perform better on ToM tasks than do children from smaller families, which suggests that the interaction between siblings and/or caregivers and children has a useful effect on the understanding of false belief (Perner, Ruffman & Leekam, 1994). ToM is also affected by culture: for example, children in the United Kingdom and those attending international schools in Hong Kong perform better on ToM tasks than do children attending local schools in Hong Kong (Wang, Devine, Wong & Hughes, in press).

ToM is correlated with certain aspects of human life; for example, children with autism fail to employ ToM in social situations, and this is clear in the behavior these children when they are unable to impute beliefs to others; therefore, they are at a serious disadvantage when having to predict the behavior of others (Baron-Cohen, Leslie & Frith, 1985). They are also unable to manipulate others in simple situations (Sodian & Frith, 1992). Patients with Huntington's disease also exhibit deficits

in ToM (Brüne, Blank, Witthaus & Saft, 2011). Overall, people with ToM deficits tend to show negative and disorganization syndromes (Urbach, Brunet-Gouet, Bazin, Hardy-Baylé & Passerieux, 2013).

ToM is measured by different tasks in different experimental settings. When the participant is required to manipulate other people's knowledge, a sabotage and deception condition is used. In this task, each condition includes a cooperative and a deception trial, and at the end of each trial the participant is asked to explain why a doll deceived or physically hindered the competitor and why she helped the cooperator (Sodian & Frith, 1992). Another commonly used ToM test is the "Smarties task," which uses the deceptive-appearance paradigm. In this task, children are shown a Smarties candy box (or any familiar candy box) and asked about its contents. When children reply "Smarties," the experimenter opens the box and reveals its contents which could be buttons, pencils or any other objects except Smarties. Then the experimenter asks the children to predict another person's response to the original question, "What is in this box?" (Perner, Frith, Leslie & Leekam, 1989).

False-belief tasks are also used widely in ToM research, particularly for investigating the development of ToM. The tasks require drawing conclusions about an action or thinking of someone whose beliefs conflict with reality and with the participant's own current knowledge (Wellman et al., 2011), and a prediction of what would the other person would do. This methodology is used with children as young as 18 months (Southgate, 2013). When the research aims to investigate neural correlates of ToM, it employs neuroimaging methods. Such studies have indicated that ToM relies on a specific set of brain regions commonly known as the ToM network (Schaafsma, Pfaff, Spunt & Adolphs, 2015).

Previous studies of the psychometric properties of ToM tasks by Mayes et al. (1996) examined the test-retest reliability of data from 23 children aged 36–71 months (mean age 49.6 months).The children watched three videotaped stories

illustrating a false-belief situation, after each situation the experimenter narrated false belief tasks, and the children were asked to answer questions related to the story. The interval between test and retest was 2 to 3 weeks. The test-retest reliability for the false-belief questions was poor to moderate (Mayes et al., 1996). Muris et al. (1999) examined a ToM task that comprised interviews appropriate for children between 5 and 12 years of age. The test consists of pictures, stories, and drawings about which the child has to answer a number of questions, and it contains three subscales. Seventy normally-developing children participated, 12 of the participants were retested with an 8-week interval between test and retest. Results indicated sufficient test-retest stability.

Hutchins, Prelock & Chace (2008) evaluated a ToM task battery that comprised 16 test questions within nine tasks and different complexity levels. The test was administered twice to 17 children diagnosed with Autism Spectrum Disorder. Test-retest reliability was adequate, and internal consistency was high. Similarly, Devine & Hughes (in press) examined the psychometric properties of a task battery composed of items from Happé's Strange Stories task and Devine and Hughes' Silent Film task. 460 ethnically and socially diverse children between 7 and 13 years old participated by completing the task battery at two time points separated by 1 month. The ToM test exhibited strong test-retest reliability. Clemmensen et al., (2016) studied aspects of validity and reliability of the Danish version of the ToM-storybook Frederik as a measure of ToM deficits. Their results support the validity of this tool because it was able to identify expected ToM deficits at the group level. The test-retest reliability estimate of the ToM-Frederik Total score was also good; therefore, overall, their findings support the validity of the Danish version of the ToM Storybook Frederik as a measure of ToM.

The purpose of the present study is to translate and assess the reliability and validity of the ToM battery task designed by Hutchins & Prelock (2010), for use in assessing ToM in

normally-developing children. To our knowledge, ToM has not been studied in depth in Saudi Arabia, nor in the Arab world in general. We expected the ToM task battery (the Arabic version) to be as valid and reliable as the original version.

Method

Participants

A total of 367 normally-developing children (323 girls, 44 boys), ranging in age between 3 and 12 years (*M* = 8.4) participated. Participants were recruited from 12 schools covering the four main educational sectors (north, south, east, and west) in Riyadh, Saudi Arabia. Most (84%) were Saudi children; the rest represented other Arab nationalities (Egypt, Sudan, Syria, Yemen, Palestine, and Jordan). All participants were monolingual Arabic speakers, grew up in Saudi Arabia and were studying in Saudi public schools.

Measures

***ToM task battery*.** The ToM task battery is designed to assess a range of content and complexity levels across social and cognitive domains (Hutchins, Bonazinga, Prelock, & Taylor, 2008). It comprises ١٥ test questions within nine tasks, and has different complexity levels.

Task A (Emotion recognition) aims to test the ability to identify emotions associated from four different facial expressions (happy, sad, mad, and scared). In Task B (Desire-based emotion), children's understanding of desire is assessed by asking them to infer an emotion based on a character's desire. Task C (Seeing leads to knowing) measures more advanced abilities involving the inference of belief-based emotion, reality-based emotion, and second-order belief-based emotion. Task D (Line of sight) targets the ability to infer a perception-based belief, i.e., the ability to understand that people in different positions may see different things. Task E (Perception-based action) uses the classic false-belief change-location task to test the ability to understand that perception influences behavior. Task F (Standard false-belief task)

assesses the ability to infer a desire-based belief in the context of an unexpected change of location. Task G (Belief- and reality-based emotion and second-order emotion task) evaluates the understanding that beliefs, along with events contrary to beliefs, can cause emotion. Task H (Message-desire discrepant task) assesses the ability to infer the belief of someone else when interpreting a statement of desire in the context of a change in location. Task I (Second-order false-belief task) involves thinking about what someone else thinks about what someone else thinks, and it includes the element of a false belief (Hutchins & Prelock, 2010).

Procedures

The approval of the ToM task battery's authors was secured to translate and standardize the test on an Arabic population, after which a back to back translation was conducted by Arabic – English bilingual academics in King Saud University.

The names of characters were changed to suit most Arab cultures, and certain situations as well; for example, "birthday" was changed to Eid Alfiter (the festival celebrated after the holy month of Ramadan), because not all people in Saudi Arabia celebrate birthdays. The approval of the Ministry of Education in Saudi Arabia was also taken to conduct this research in Saudi schools, and to recruit the child participants. Children were recruited from 12 schools (8 elementary and 4 preschools). The test, which takes 15 to 25 minutes to complete, was administered in a familiar, quiet room in the school. The researcher first told the childe "I am going to read you some short stories, and then I will ask you some questions about these stories. You can answer me by pointing to the pictures or by using words." As soon as the child pointed at or verbally expressed an answer, the researcher entered the child's response on the answer form. To calculate test-retest reliability, 49 participants were retested on the ToM battery with an interval of 10 to 14 days.

Results

Item-total correlations of the Arabic version of the ToM task battery are shown in Table 1.

Table 1 Item-total correlations for the Arabic version of the ToM task battery

Item number	Correlation coefficient	Sig	Item number	Correlation coefficient	Sig
1	0.362	٠.٠1	9	0.340	٠.٠1
2	0.497	٠.٠1	10	0.494	٠.٠1
3	0.404	٠.٠1	11	0.282	٠.٠1
4	0.468	٠.٠1	12	0.403	٠.٠1
5	0.406	٠.٠1	13	0.478	٠.٠1
6	0.412	٠.٠1	14	0.381	٠.٠1
7	0.207	٠.٠1	15	0.395	٠.٠1
8	0.208	٠.٠1			

Table 1 shows that all 15 ToM questions are valid and that all correlation coefficients are significant at $p < .001$.

Test-retest reliability results for the first (T1) and the second (T2) testing are shown in Table 2.

Table 2 Test-retest correlations

ToM	n	Cronbach's alpha for first testing (T1)	Cronbach's alpha for second testing (T2)	Correlation of (T1) and (T2)
	15	0.728	0.692	0.687

As Table 2 indicates, internal consistency at (T1) and (T2) were both moderate to high, as was the correlation between the two. $p = .001$ this result indicates that the test is reliable and can be used for normally-developing children 3 to 12 years of age.

Descriptive and Normative Data

Item difficulty. Each item in the ToM task battery was tested for its difficulty (showing in table 3). This analysis is necessary to ensure that both easy and difficult items are included, and, insofar as possible, to order the tasks from easiest to most difficult.

Table 3 Difficulty index of all items, by task, for the ToM task battery

Task	Item number	% who answered correctly
A	1	95.1 %
	2	90.5 %
	3	89.6 %
	4	87.2 %
B	5	91.3 %
C	6	82.3 %
D	7	21.8 %
	8	15.8 %
E	9	58.3 %
F	10	59.7 %
G	11	76.8 %
	12	59.1 %
	13	59.7 %
H	14	71.7 %
I	15	50.4 %

Table 3 shows that the most difficult task in the ToM battery was Task D, which assesses the ability to infer perception-based beliefs (Line of sight task). In this task, only 21.8% of participants answered item 7 correctly and only 15.8% answered item 8 correctly, while all other items were answered correctly by more than 50% of the children. Hence, the line of sight task will be moved to the end of the battery in the Arabic adaptation of the test.

Mean and standard deviation of total score by age. Data on the mean total score by age can be used as a general benchmark of expected performance (Hutchins & Prelock, 2010). The means and standard deviations of the total score by age for the Arabic version are shown in Figure 1.

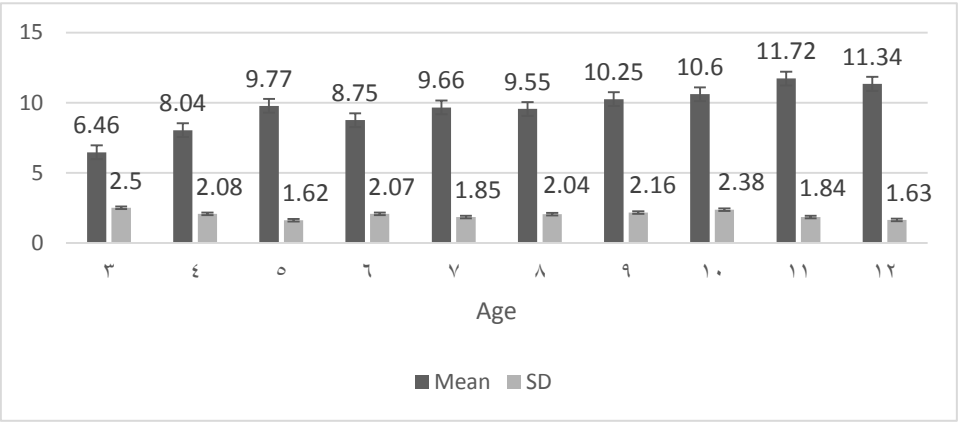

Figure 1 Means and Standard Deviations of total score, by age

As the table indicates, ToM develops and progresses over time, with mean scores generally improving year upon year, as seen in figure 1. The mean standard deviation for this adaptation of the test was *SD* = 2.00.

Discussion

The aim of this study was to assess the reliability and validity of the ToM battery task designed by Hutchins & Prelock (2010) by measuring test-retest reliability and internal consistency after the test was translated and adapted to fit the Saudi and Arab culture. Internal consistency of the adapted version was significantly high, and the Cronbach's alpha of .70 indicated acceptable reliability (Tavakol & Dennick, 2011). Taken together, the results support the use of this version for assessing ToM with normally-developing children in Saudi Arabia.

Results also show that ToM develops gradually over the years, which is in line with previous studies that show steady improvement and the emergence of a number of abilities by the age of 6 years that make ToM stronger than at earlier ages (Wimmer & Pemer, 1983; Leslie, 1994; Gopnik et al., 2014).

Analyses of item difficulty indicated some differences between the Arabic adaptation of the ToM task battery and the English test. Therefore, in comparison with the original test by

Hutchins & Prelock (2010), our arrangement of the tasks will be changed to place Task D (Line of sight) as the final task because this task was the most difficult for all ages. Henceforth, the Arabic adaptation of the ToM test will be as follow; Task A: Emotion recognition, Task B: Desire-based emotion, Task C: Seeing leads to knowing, Task D: Perception-based action, Task E: Standard false-belief task, Task F: Belief- and reality-based emotion and second-order emotion task, Task G: Message-desire discrepant task, Task H: Second-order false-belief task, and the final task is Task I: Line of sight.

Limitations of this study include the small number of participants, particularly in the younger ages. Hence, the use of a larger number of participants and inclusion of greater socio-cultural and geographic diversity in the country are advised for future research. ToM work would also be advanced by studies of this instrument elsewhere in the Arab world, and with children affected by conditions such as autism and deafness. Despite this limitation, the Arabic adaptation of the test overall can be considered a reliable instrument for assessing ToM with normally-developing children.

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