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Cross-Cultural Analysis of Theory of Mind Development in Children with Autism Spectrum Disorder, Down Syndrome, and Typical Development

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Abstract

This study aimed to investigate the development of Theory of Mind (ToM) in children with Autism Spectrum Disorder (ASD), Down syndrome, and typical development from Iran and Sweden. Participants between the ages of 6 to 12 were assessed using various ToM tasks. Additionally, the study explored the correlation between children's behavioral problems, as reported by teachers and parents, and their ToM performance. Furthermore, the influence of family socioeconomic status on children's ToM understanding was examined. The research revealed that cultural factors played a partial role in specific ToM tasks during childhood, but not across the entire ToM construct in the studied groups. Introduction: Theory of Mind (ToM) refers to the ability to understand and attribute mental states, such as beliefs, desires, and intentions, to oneself and others. It plays a crucial role in social interactions and is an essential aspect of cognitive development in children. This study aimed to explore the influence of cultural factors on ToM development in children with Autism Spectrum Disorder (ASD), Down syndrome, and typical development. Methodology: The participants consisted of 74 native speakers from Iran and 66 from Sweden, falling within the 6 to 12 age range. They were divided into three groups based on their developmental profiles: children with ASD, children with Down syndrome, and typically developing children. ToM tasks were administered to measure their ToM abilities across all orders of complexity. Results: The study found that cultural factors partially influenced specific ToM tasks that children developed during their childhood. However, this effect was not observed across the entire ToM construct for any of the studied groups. The findings suggest that cultural differences might impact certain aspects of ToM development, but they do not have a universal effect on ToM understanding in the studied populations. The results also revealed a strong correlation between children's behavioral problems, as reported by teachers, and their ToM performance. However, this correlation was not significant when considering parents' perspectives. This discrepancy highlights the importance of considering multiple informants when assessing children's behavior and social cognition. Furthermore, the study examined the relationship between family socioeconomic status and children's ToM understanding. Surprisingly, no clear link was found in any of the studied groups, suggesting that socioeconomic status may not be a determining factor in ToM development among these children. Conclusion: In conclusion, this cross-cultural analysis provides valuable insights into the development of ToM in children with Autism Spectrum Disorder, Down syndrome, and typical development from Iran and Sweden. Cultural factors were found to have a partial influence on specific ToM tasks developed during childhood, while family socioeconomic status did not appear to be significantly linked to ToM understanding in these groups. The study also underscores the importance of considering different perspectives when evaluating children's behavior and social cognition. Further research is warranted to explore other potential factors that may impact ToM development in diverse populations.

Keywords: Autism spectrum disorder; Down syndrome; Intelligence quotient; Theory of mind; Socioeconomic status; ASEBA

Introduction

Theory of Mind understanding and socioeconomic status Dunn, Brown, et al. claim that the social world mediates key conceptual advances observed in social cognition tasks [1]. As Autism Spectrum Disorder (ASD) is the most common neurodevelopmental disorder, children with it are unable to communicate and behave socially [2]. Due to this, ASD children sometimes have trouble expressing themselves socially and communicating with strangers, leading to a decline in their social and communication abilities. To replicate the original experiment, real people will enact the dolls by Leslie and Frith [3].

Materials and Methods

Participants

The study initially included a diverse sample of 155 children, with 86 participants from Iran and 69 from Sweden. After excluding 140 schoolchildren, the final sample consisted of 74 Iranian children (43

boys and 31 girls) and 66 Swedish children (33 boys and 33 girls) aged between 6 and 12 years. In Iran, there were 24 children diagnosed with Autism Spectrum Disorder (ASD), 24 with Down Syndrome (DS), and 26 Typically Developing (TD) children from Tehran and Karaj. Likewise, in Sweden, the study included 26 children with ASD, 18 with DS, and 22 typically developing children from Stockholm and Goteborg. The participants were sourced from a total of 23 different locations, encompassing clinics, centers, normal schools, and special-needs schools in Tehran and Alborz, Iran. Similarly, the typically developed, down syndrome, and ASD Swedish children were selected from regular schools in Stockholm and Goteborg, with both typically developed and Down syndrome children recruited from regular schools known as Sarskolan in Sweden. By including children from various locations and educational settings, the study aimed to obtain a comprehensive representation of the cross-cultural and educational factors that might influence Theory of Mind development in children with different neurodevelopmental profiles.

The study utilized a comprehensive data collection approach to investigate the medical, behavioral, and psychological aspects of the participants, as well as their Theory of Mind (ToM) understanding. The following procedures were implemented to ensure the accuracy and reliability of the data: Parent and Teacher Report: To gain insights into the children's medical history, behavioral problems, and psychological characteristics, parents completed the Child Behavior Checklist (CBCL) questionnaire. Similarly, teachers provided valuable information by filling out the Teacher Report Form (TRF), reporting on the children's behavioral patterns within the school environment. ToM Task Administration: To assess the participants' ToM understanding, various ToM tasks were administered. The author, a native Persian (Farsi) speaker, implemented all tasks for Iranian children, enabling effective communication in their native language and cultural context. For Swedish children, an experienced local research assistant, fluent in Swedish and familiar with the local culture, conducted the tasks either at their schools or homes. In some cases, the author or a local researcher cooperated to ensure consistency and reliability in task administration. To create a focused and distraction-free environment, all participants underwent individual testing. Whether in a quiet room at their schools, clinics, or homes, individual testing aimed to enhance concentration and minimize potential external influences. The author and experienced local researchers conducted the ToM tasks, ensuring precision and adherence to standardized procedures.

Tasks and instruments

The Raven’s Progressive Matrices (RPMs) The Raven’s Progressive Matrices (RPMs), developed by John C. Raven, and was used to assess cognitive abilities in both typical and clinical groups. The Colored Progressive Matrices (CPM) version was administered to all participants, while typically aged children at 12 years old were given the Standard Progressive Matrices (SPM) version. Identical versions of Raven's progressive matrices were used in both Iran and Sweden to establish the children's IQ range. British norms were utilized for the Swedish participants since no Swedish standardization version was available. Previous studies had documented the standardization of the Raven test with Iranian individuals [4-6].

Sally and Anne

Task The Sally and Anne Task, designed by Baron-Cohen, Leslie, and Frith, was used to measure social cognitive ability in the first order of Theory of Mind (ToM). This classic task assesses a person's ability to understand and reason about false beliefs [7].

Smarties tube task

The Smarties Tube Task, developed by Perner and Wimmer was used to evaluate second-order ToM. In this task, a child is shown a tube containing a pen instead of the expected Smarties candies, and their understanding of others' false beliefs is assessed [8].

Representational change test (picture task)

The Representational Change Test, developed by Gopnik and Astington examines children's ability to understand representational change. They are shown animal pictures with different colors, and then the animals are hidden, except for one body part, and the children are asked to identify which animal is still present [9].

The new Theory of Mind (ToM) test

The New Theory of Mind (ToM) Test, formatted by Karen L. Anderson, was used in the study. It includes 20 items for ToM 1, 13 items for ToM 2, and 5 items for ToM 3, assessing various aspects of Theory of Mind understanding.

The TRF and CBCL Behavior Scales 6/18 The Achenbach System of Empirically Based Assessment (ASEBA) was used to assess behavioral competencies and problems in the children. The Child Behavior Checklist (CBCL 6/18) was completed by parents or parent surrogates, and the Teacher Report Form (TRF 6/18) was completed by teachers or other school personnel. Both questionnaires utilized a three-point Likert scale to rate the applicability of each item to the child's behavior [10].

The Hollingshead 4 factor index of Socioeconomic Status (SES)

The Hollingshead 4 Factor Index of Socioeconomic Status (SES) was employed to measure family socioeconomic status. It considers parents' education level, profession, and occupation status, which are code-rated on predetermined scales to calculate social status. The education and occupational codes are scored on specific scales and then multiplied by respective values, with the final SES score obtained through a predetermined formula [11].

Data analysis

The present investigation employed IBM SPSS Statistics version 25 (IBM Corp) to execute the statistical analyses. The examination of sociodemographic characteristics and sample variables entailed the utilization of descriptive analysis. Concurrently, the computation of measures such as mean and standard deviation for quantitative variables, as well as frequency and prevalence for categorical variables, was performed. To elucidate disparities amidst distinct cohorts in their performance on Theory of Mind (ToM) tasks, the analytical framework of analysis of variance (ANOVA) was invoked. Subsequent to the identification of significant variations through ANOVA, post-hoc contrasts were effectuated using the Bonferroni test to discern specific inter-group disparities while appropriately addressing the concern of multiple comparisons.

Additionally, the assessment of associations among variables was facilitated through the employment of the one-way ANOVA. Likewise, the exploration of the intricate interplay between the

indicators of ToM aptitude and social constructs, specifically internalizing and externalizing scales of the Achenbach System of Empirically Based Assessment (ASEBA), in conjunction with socioeconomic strata, was quantified *via* both ANOVA and calculation of the correlation coefficient. The predetermined threshold for statistical significance was established at $\alpha = 0.05$ [12].

Results

In response to the examined dataset concerning internalizing and externalizing disorders, the Achenbach System of Empirically Based Assessment (ASEBA) was enlisted to capture evaluations from both parental and pedagogical perspectives within each distinct cohort. Notably, our analysis unveiled a discernible proclivity wherein scales appraising cogitative and societal predicaments evinced a more accentuated congruence with Theory of Mind (ToM) outcomes. Bolstering the empirical underpinning across a majority of assessments, conspicuous disparities emerged within the strata of social problems, cogitation-related quandaries, internalizing proclivities, and externalizing manifestations, as evidenced by the Teacher's Report Form (TRF). A notable divergence emerged, however, as the Child Behavior Checklist (CBCL) exhibited a paucity of substantive fluctuations across the spectrum of variables under scrutiny.

As initially hypothesized, the geographical parameter was operationalized vis-à-vis the ToM tasks. Nevertheless, this influence exhibited task-specific propensities, pertinently diverging from a comprehensive sway over the entire ToM construct. In consequence, none of the Sally and Anne tasks registered statistically significant affinities with the country of origin, inclusive of S_A_R (χ^2 (1) = 1.550, P = .213), S_A_M (χ^2 (1) = 1.512, P = 0.219), and S_A_C (χ^2 (1) = 0.125, P = 0.724). Similarly, the Smart_FT (χ^2 (1) = 7.553, P = .006) and Smart_RQ (χ^2 (1) = 27.296, P = 0.001) subscales, alongside the Smart_N subscale (χ^2 (1) = 0.906, P = .341), manifested uniform positivities. Correspondingly, the analytical investigation of False Belief and Representational Change (Repr_FB) elucidated a conspicuous absence of correlative concordance with the geographic determinant (χ^2 (1) = 0.034, P = 0.853), while substantial linkages surfaced concerning both the scores associated with Representational Change-Question (Repr_Q) (χ^2 (1) = 7.038, P = 0.008) and Representational Change-Reality (Repr_RD) (χ^2 (1) = 23.939, P < 0.001).

Subsequent examinations yielded no substantive basis for establishing a salient nexus between country of origin and scores encapsulating the discrete tiers of the New Theory of Mind task. This encompassed the NTT_1 subscale (T = 0.296, P = .441), NTT_2 (T = 0.996, P = 0.743), and NTT_3 (T = 2.325, P = 0.508). Comprehensive details of these findings are accessible in Table 1.

	Country	$\bar{X}$and (SD)	(T)	Sig.
NTT_1	Iran (68)	10.43 (4.198)	-0.296	0.441
	Sweden (63)	10.65 (4.473)		
NTT_2	Iran (68)	4.24 (2.666)	-0.996	0.743
	Sweden (63)	4.70 (2.650)		

Table 1: Statistical analyses of correct and incorrect answers on new ToM task in terms of first and second orders. **Note:** NTT1-2 (New ToM test _second-third).

			Country		
			Iran	Sweden	Total
NTT_3	0	Number	47	36	83
		% NTT_3	56.60%	43.40%	100.00%
		% Country	68.10%	57.10%	62.90%
		% Total	35.60%	27.30%	62.90%
	1	Number	11	16	27
		% NTT_3	40.70%	59.30%	100.00%
		% Country	15.90%	25.40%	20.50%
		% Total	8.30%	12,1%	20.50%
	2	Number	8	7	15
		% NTT_3	53.30%	46.70%	100.00%
		% Country	11.60%	11.10%	11.40%
		% Total	6.10%	5.30%	11.40%
	3	Number	3	4	7
		% NTT_3	42.90%	57.10%	100.00%
		% Country	4.30%	6.30%	5.30%
		% Total	2.30%	3.00%	5.30%
	Total	Number	69	63	132
		% NTT_3	52.30%	47.70%	100.00%
		% Country	100.00%	100.00%	100.00%
		% Total	52.30%	47,7%	100.00%

Table 2: Frequencies and percentages of correct and incorrect answers on new ToM task in terms of tired order. **Note:** NTT_3 (new ToM test- third order).

Given the outcome of our predictive hypothesis concerning the interrelation between Socioeconomic Status (SES) and Theory of Mind (ToM) scores, it is discernible that elevated strata of familial occupation and educational attainment do not substantiate predictive efficacy vis-à-vis enhanced performance in the domain of ToM tasks.

Discussion and Conclusion

Empirical validation unequivocally substantiates that the Child Behavior Checklist (CBCL) and the Teacher's Report Form (TRF), serving as sophisticated tools for behavioral assessment encompassing thought and social problem scales, evince a validated nexus with Theory of Mind (ToM) scores as perceived through the lens of educators. Conspicuous differentials in scores among subject groups have been firmly established, albeit conspicuously absent within the purview of parental assessments, which, in contrast, fail to yield any salient discriminative trends. Consequently, it becomes evident that children demonstrating higher scores tend to exhibit comparatively less adept performance within the domain of ToM tasks. This discernible pattern underscores that these scales, as adjudicated through teacher evaluations, harbor a more robust congruence with ToM outcomes, a phenomenon potentially attributed to educators' propensity to contextualize social dynamics within the educational milieu, particularly in daily interactions, while such complexities might be less overtly manifest within the domestic

sphere. Succinctly stated, elevated scores within the realms of cognitive and social domains, as assessed through teacher evaluations, align with suboptimal manifestations of ToM skills [13-15].

Significantly, the impact of cultural context upon ToM is intricately entwined with specific task modalities, rather than comprehensively encapsulating the multifaceted construct of ToM. Interestingly, our preliminary prognostications find partial validation across specific tasks, encompassing the realms of representational change inquiries, both in terms of conceptual and real-world dimensions, alongside discernible links with the Smarties false belief and reality questions-all of which exhibit discernible interplays with the variable of national origin. An array of cross-cultural inquiries further bolsters the connection between cognitive antecedents and the comprehension of false beliefs, yielding task-specific proficiencies [16-19].

Within the developmental landscape of children, irrespective of contextual settings, the discernible relationship between Socioeconomic Status (SES) and ToM scores remains notably elusive, a discernment corroborated by a series of established studies (Dunn, Brown et al.; Pears and Moses). Notably, the exploration into the role of familial SES as an influencer of children's ToM advancement, as discerned from antecedent scholarly works, reveals a lack of unequivocal linkage in their early exposés [1,20,21].

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