



Review Article

Interrelationships between Theory of Mind and Language Skills in Children with Cerebral Palsy: A Review of the Literature

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ABSTRACT

Background: Theory of Mind (ToM) is an essential component of communication with the others and social understanding. Cognitive structures, such as language, working memory, and executive functions play a special role in understanding the others' minds. Thus, given importance of the role of language skills in development of ToM and the previous research findings regarding the restricted capacity of children with cerebral palsy (CP) in development of their ability to understand others' thoughts and feelings, this review study was designed to mainly evaluate the influence of language on ToM in children with CP.

Methods: For this purpose, initially, electronic databases (PubMed, Scopus, PsycINFO, MEDLINE, Embase, and Web of Science) were searched from September 1 to 30, during 2000-2020. Search was done focusing on the English-written papers using a combination of keywords including: "Cerebral Palsy, Theory of Mind, Mentalization, and Language" to identify relevant studies from 2000 to 2020.

Results: A total of 978 publications were identified according to the initial search criteria. After reviewing abstracts, titles, and references of the identified papers, 10 potentially relevant papers were selected. Based on assessing their full-text, 7 papers completely met the inclusion criteria.

Conclusion: Given that children with CP have not been addressed by numerous investigations to date, there is limited information about their ToM skills and the role of other different components of ToM development. Therefore, further research should be carried out to investigate this issue. The combined findings of the reviewed papers showed that language skills had an effect on capacity to elaborate ToM competence in children with CP. This review study paves the path to the future common research on children with CP and underlines importance of using a methodology, in which ToM performance is studied in concert with a detailed investigation of speech and motor impairments.

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Introduction

Social cognition refers to emotion processing, social perception, and attributional style. It appears to be a multi-

dimensional construct of neurocognitive capacity, allowing us to understand both the others' emotions and points of view [1]. One of the most effective ways of recognizing social cognitive domain is through theory of mind (ToM). ToM is an essential component of communication with the others and social understanding [2].

At a very general level, there are crucial prerequisites for development of this mentalizing capacity. Suggested

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cognitive structures, such as language, working memory, and executive functions have been reported to play a special role in understanding the others' minds [3]. There has been an increase in clinical and research practice regarding this concept to measure quality of ToM of patients with neurodevelopmental impairments [4]. Therefore, the current review study was designed (1) to review ToM abilities in children with cerebral palsy (CP) and (2) to evaluate the influence of language skills on the advanced ToM in children with CP.

The Concept of ToM

Based on the research by Jolly and Humphrey, the central role of cognitive capacities was redesigned in primates beyond the needs for everyday feeding and ranging [5, 6]. In other words, this multi-faceted concept goes through distinction and differentiation between self and the others and allows them to identify the others who cooperate or try to defect [7]. After pioneering observations in comparative studies of animal cognition by Premack and Woodruff, the term "ToM" was firmly established as a central notion regarding the child's development for understanding the other person's mind and action [8].

As humans and social creatures, we live in complicated social worlds to make and keep bonds of friendship with other people [9]. One of crucial factors in social cognition and interpersonal relations is mentalization, mind reading, or ToM. ToM is a psychological concept that is referred to an individual's ability to represent and understand another person's psychological perspective by taking mental states including desires, beliefs, intentions, and feelings in a given social situation [10]. Interestingly, as reported in other previously published studies, understanding of mind, both in self and the others, depends on factors like working memory, executive function, social-linguistic intelligence, language, and social environment [11].

Interrelation between Language and ToM Development

Assessment of ToM in children has traditionally focused on determining how language elaborates ToM competence. A combination of language abilities and cognition is suggested to be used as a means of communication enabling children to take part in and make sense of verbal communication [12]. On the other hand, for representing mental states, children have to obtain sufficient conversational experience, mental state vocabulary, and syntactic processing of complex sentences to understand task contexts and receive instructions concerning ToM components. Indeed, according to the general language hypothesis, the child has to have a linguistics system that can handle a certain level of representational complexity by learning semantic and pragmatic inferences [13].

Semantic inferences consist of retrieval of general and background knowledge and interpretation of what the speakers say. In addition, acquisition of pragmatic inferences refers to retrieval of contextual-specific information and interpretation of what the speakers imply [14].

Given importance of the role of language skills in development of ToM and the previous research findings in restricted capacity of children with CP for development of their ability to understand the others' thoughts and feelings, this review study was designed to mainly evaluate the influence of language skills on ToM in children with CP.

Methods

Data Sources

For this purpose, initially, electronic databases (PubMed, Scopus, PsycINFO, MEDLINE, Embase, and Web of Science) were searched by two authors from September 1 to 30, during 2000-2020. Search was done focusing on the English-written papers using a combination of keywords including: "Cerebral Palsy, Theory of Mind, Mentalization, and Language" to identify relevant studies from 2000 to 2020.

Inclusion/ Exclusion Criteria

The search yielded a large set of records, in which only abstracts and references were initially screened for clear eligibility. Studies were included if:

- 1) They were published in peer-reviewed journals in English.
- 2) Participants were children with CP.
- 3) Participants were assessed for language ability in order to evaluate the relationship between ToM and language skills.

Studies were excluded if language ability was not assessed. Publications on the other atypical and healthy population were excluded. Furthermore, publications in the form of conference abstracts were also excluded, since these are not primarily informative on particulars of ToM.

Results

In-depth Review of the Included Papers from 2000 to 2020

A total of 978 publications were identified with respect to the initial search criteria (Figure 1). After screening abstracts, titles, and references by two authors who were engaged in the field of linguistics independently of one another, 10 potentially relevant papers were identified. Based on reviewing their full-text, 7 papers completely met the inclusion criteria [15-21]. Related titles and abstracts were reviewed to evaluate the influence of language skills on ToM in children with CP. However, 6 of the studies supported the hypothesis that language plays a critical role in production of ToM abilities among children.

Studies' Characteristics

The seven identified papers had all investigated ToM and language in children with CP. In two studies [15, 19], children's corrected age was equal to 5.05 -15 years old. In two studies [15, 17], the study groups were similar to each other, in which 14 children with CP were compared with 14 healthy controls. Dahlgren et al., [15, 17] in two

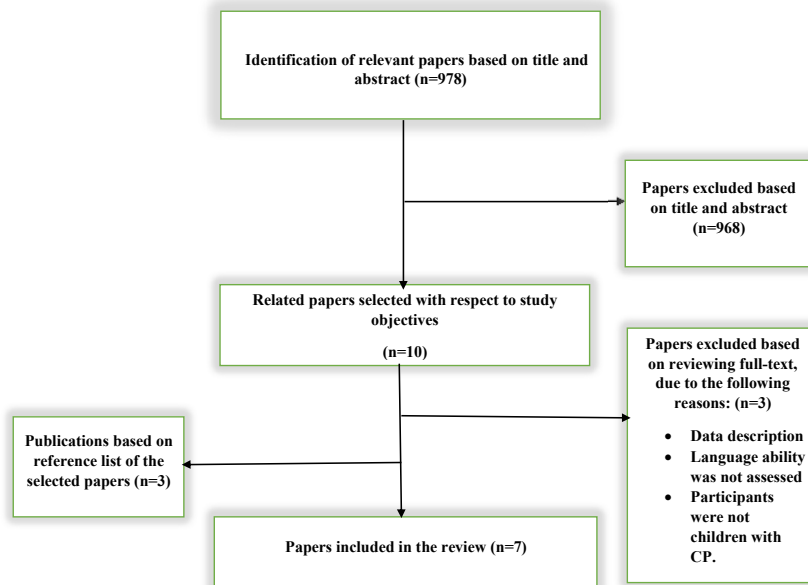


Figure 1: Flow chart of the included studies

Table 1: Studies evaluated Theory of Mind (ToM) and language among children with Cerebral Palsy (CP)

Study	Participants	Mean age (SD)	ToM measurement	Language measurement	Aim of the study	Results
Dahlgren et al., (2003) [15]	14	10.86 (3.30)	False belief test	SIT; NM; Bliss	For investigating performance in ToM tasks in relation to verbal ability	Significant association between ToM and language skill
Falkman et al., (2005) [16]	6	6.3, T ₁ 10.2, T ₂	False belief test; pretend; perception; desire tasks	SIT	For studying the relationship between spoken language and ToM development	Significant association between ToM and language skill
Dahlgren et al., (2010) [17]	14	9.0	False belief test; thought picture	PPVT; TROG; NM	For exploring the role of language in development of ToM	Significant association between ToM and language skill
Holck et al., (2010) [18]	10	7.11(1.58)	Thought picture	PPVT; TROG	For investigating the ability to make inference in terms of language ability	Significant association between ToM and language skill
Sundquist & Ronnberg (2010) [19]	14	10.64 (1.93)	False belief test; SIT; picture arrangement task	TROG; PPVT	For assessing the correlation between ToM development and language skill	No significant association between ToM and language skill
Caillies et al., (2012) [20]	10	9.3	False belief test	ECOSSE	For characterizing the language ability through understanding of ToM functions	Significant association between ToM and language skill
Clarke et al., (2012) [21]	4	4.05	False belief test	Derbyshire Language Scheme	For assessing the correlation between ToM development and language skill	Significant association between ToM and language skill

SIT: Verbal comprehension test at semantic level; NM: A test of syntactic knowledge; Bliss: A test of communicative competence; PPVT: Peabody picture vocabulary test; TROG: The test for reception of grammar; ECOSSE: A French standardized test; Derbyshire Language Scheme: A test of language comprehension

studies, investigated the same children with the same outcome measures. Therefore, these two papers were considered as one study. All six studies [15, 17-21] were cross-sectional studies in the area of ToM, but one study by Falkman et al., [16] was of a longitudinal design to closely follow development pattern of ToM.

Assessment Procedure

There are both subjective and objective measures of ToM and language (Table 1). The first subjective measure was of “Change in Location” – first -order false belief task type, called as Sally-Anne task [22]. In this task, the child was told a story about two characters. Person A placed a ball under a box and went out of the room. Then, the ball was taken by person B and was placed under another

box. When person A returned, three questions were asked from the child, such as “where is the ball now?”, “where was the ball at first?”, and “where will person A look for the ball?” [15-17, 19, 21].

The second subjective measure was of “Change in Location” –second -order false belief task type. For this task, the child was presented with an “Ice cream” story [23]. Person A and person B played in the park where they saw an ice cream van. Then, it was unexpectedly transferred to a new location, from park to church. At the end of the story, the child was asked to say “where is the ice cream van now?” [15, 16, 20].

Two other subjective ToM measures identified in the review study were about assessment of “Unexpected-Content” first -order false belief task type, namely

“Candies” and “Band-Aids” [24]. In each task, the child was asked to say what was in the box before and after the content had been revealed [20]. Yet, in another subjective false belief task, “Misleading Picture”, the child was asked to indicate proper sequence of a series of pictures through visual mode.

There are some objective measures identified in this review study to assess receptive language skills including a Swedish version of Peabody picture vocabulary test (PPVT) [25] and the Swedish version of the test for reception of grammar (TROG) [26]. In three studies, children were asked to listen to a word and point to a picture or select a picture that matches a sentence [17-19].

A test of verbal comprehension, at semantic level, social interpretations test (SIT) [27] was used in two other studies [15, 16]. Participants were assessed about their linguistics capacity pointing to the picture that corresponded to the sentence. Two other studies [15, 17] used an adaptation of a test applied for identification of syntactic correctness developed by Naucler and Magnusson [28]. NM has been created aimed at measuring children’s syntactic ability by pointing at a photograph representing a mother and a little girl in a conversational situation, to specify the one that has made the comment. Two last experiments [20, 21] were based on the French standardized test (ECOSSE) [29] and Derbyshire Language Scheme [30], both of which are considered as a screening test of verbal comprehension.

Main Findings

Even today, many authors seek to investigate the influence of language skills on ToM, especially in children with CP, with possible common dimensions and cognitive mechanisms. Interestingly, out of seven selected studies, six studies with mixed findings [15-18, 20, 21] showed that language skills had an effect on capacity to elaborate ToM competence in children with CP, while one study [19] showed that language skills had no influence on ToM functions of CP group.

The first two studies [15, 17] investigated 14 children with CP who had no access to speech production with a severely restricted capacity to move around freely. The authors reported that children with CP showed impairment on ToM tasks. They concluded that communicative ability and syntactic knowledge are all relevant factors to elaborate complex mental states. In a longitudinal study on 6 patients with CP [16], not only the children had never been able to use any productive speech; but also, all of them were severely physically disabled. Results of the study highlighted that a delay to pass false belief attribution task in the CP group might be related to the impoverished language experience.

In the two other cross-sectional studies [18, 20] on 10 children with CP having speech and physical impairments, an association was found between language skills and ToM. The authors suggested that general language ability as the necessary cognitive capacity had an effect on the relationships between ToM and linguistic knowledge.

Unlike the previous investigations concerning patients with CP [15-18, 20, 21] found an association between difficulties of ToM function and severity of language

impairment, results of the last study [19] revealed no significant difference in ToM performances between children with CP and healthy controls. Consistent with this result, ToM performance of children with CP might not be related to language mechanism.

Table 1 provides an overview of characteristics of the included publications on language and ToM abilities.

Discussion

Providing the evidence regarding the association between language and ToM literature, in this review study, an important clarification was done about deficits of these two core and interrelated social cognitive abilities in children with CP. According to our results, 6 studies [15-18, 20, 21] had reported a direct relationship between ToM performance and language ability in children with CP. On the other hand, results of one study [19] showed that language ability did not influence ToM performance.

However, the first reasonable interpretation for non-significant results of this study could be due to low severity of motor symptoms of CP groups. That is to say, comparing CP group of this study with those having severe speech and motor impairments in the other 6 studies, the children in the study by Sundqvist and Ronnberg [19] had more opportunities for social interaction and engagement independently. In other words, half of the children could move by themselves or without support. Another possible interpretation is that these children were all included in a regular school setting. Furthermore, children in mainstream schools have the opportunity for interacting with their peers who have typical language development [31]. Therefore, learning specialists are suggested to consider these related aspects in order to diagnose and treat deficits of ToM in children with CP.

There were some limitations in the present review study. For instance, some of the included papers had not mentioned different determinants of ToM, such as working memory or different executive functions in children with CP. Therefore, clearly, there is a need to investigate ToM in all patients with CP based on the relationship between various cognitive capacities, in routine neuropsychological assessment. An effort should be made to validate measurements of both ToM and language performance in order to describe more details of this relationship. Moreover, knowledge of such a relationship would be beneficial to develop strategies in order to alleviate social maladjustment in children with CP.

Conclusion

As a whole, increasing the understanding about such links paves the path to the future common research on children with CP and underlines importance of using a methodology, in which ToM performance is studied in concert with a detailed investigation of speech and motor impairments. This has important implications for exploring interventions to help the children with CP in reflecting on their own and other’s mental states in everyday -life situations i.e., friendships, home life, leisure activities, and classroom learning.

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