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RESEARCH ARTICLE

Theory of mind and emotional expressions in children with autism spectrum disorder

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Abstract
Humans are inherently social creatures, and successful interaction within social environments depends on the capacity to rapidly and accurately anticipate and interpret the behavior of others. This skill is developed by inferring unseen mental states, including emotions, intentions, and beliefs—a process known by various terms such as theory of mind. It is important to recognize that some children exhibit impairments in this ability, which can lead to emotional difficulties. This impairment is especially prominent in children diagnosed with autism spectrum disorder, where there is a marked difficulty in comprehending and interpreting facial expressions, impacting their social communication. Emotions play a pivotal role in social interaction and communication. Through facial expressions and tone of voice, one can understand the psychological state of others, which contributes to the process of empathic resonance (or emotional empathy). Emotions develop from birth, moving from simple forms, such as reading faces, to complex forms, which involve inferring emotions from situations and desires.

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Introduction

This complex process requires a high cognitive competence called Theory of Mind. It allows us to infer what is not seen, interpret behavior, and place it in the correct context. However, children with autism spectrum disorder suffer from a clear deficit in logical reasoning and the use of pragmatic language, in addition to a deficiency in the emotional aspect, where they are noted to have emotional blunting and a lack of understanding of facial expressions and body language, which weakens their interaction process and leads to a developmental delay compared to their typically developing peers. Thus, what are the causes of this blunting, and what is its relationship to the Theory of Mind?

1. Autism

The term autism first appeared with the scientist Bleuler in his description of the manifestations of social withdrawal in schizophrenia. Then, Autism Spectrum Disorder (ASD) emerged as a distinct disorder by the scientist Kanner in 1942 while describing a set of behavioral and emotional symptoms in eleven children, followed by the research of Asperger in 1943.

Autism is defined as a neurodevelopmental disorder that appears in the early years and exhibits deficits in social communication and interaction, in addition to restricted interests and activities (DSM-5: 2013). It is a deficit that affects the way a child interacts with others and includes: social interaction, social communication, and imagination. It is a neurobiological disorder that affects verbal and non-verbal interaction and communication, in addition to stereotypical behaviors (Berkhissa: 2021).

According to the previous definitions, we conclude that autism is a neurobiological condition that appears in the first three years of a child's life and affects the communicative and interactive aspects, which hinders proper development and causes a delay compared to typically developing peers.

Characteristics of Autism:

- **Linguistic Characteristics:** Individuals with ASD suffer from linguistic problems; they either lack speech or use a limited set of words, including echolalia and repetition (Safwat, 2019: p. 74).
- **Social Characteristics:** Individuals with ASD suffer from isolation and lack of interaction during play, inability to understand jokes and deception, and lack of interest in others (Al-Jabli, 2015: p. 30).
- **Behavioral Characteristics:** Restricted interests, repetitive activities, tantrums, and self-injurious behaviors (Al-Jabli: 2015, p. 32).

2. Theory of Mind (ToM)

The term Theory of Mind first appeared in 1978 by the scientists Woodruff and Premack in their article "Does the Chimpanzee Have a Theory of Mind?" where they conducted a study on the chimpanzee to determine the possibility of predicting certain behaviors based on desires and intentions (Salih Imam, 2010: p. 99). This experiment was a new addition to the field of psychology, which prompted specialists to introduce this concept into neuropsychology, psychopathology, and social psychology.

The concept of Theory of Mind refers to the ability to attribute mental states to oneself and others (Premack, 1978). It is also the ability to track the mental states of people and anticipate their behavior in a social context (Sandra, 2000).

It is the ability to interpret and predict the behavior of others (Baron-Cohen, 2002). Moreover, it is a set of interconnected concepts and tasks for interpreting and predicting the behavior of others based on internal psychological states (Kit Yeung, 2023).

Thus, Theory of Mind is a cognitive mental ability that allows a person to interpret and explain mental states such as intentions, desires, reactions, and feelings, with the aim of interpreting and predicting behavior and thereby facilitating social interaction.

2.1. Development of Theory of Mind:

Studies by Cohen, Frith, and Hall confirmed that the age of 4 years is the age at which Theory of Mind is established, unlike Piaget, who confirmed that the age of 7 is the age at which a child takes the perspective of others (Cohen, 2000). Children are born equipped with the precursors of Theory of Mind and it develops later. Its development can be illustrated as follows:

- Around the first year: The child distinguishes between happy and sad faces.
- Between 12 and 20 months: Acquires words that express the emotional state.
- From the second to the third year: Has the ability to understand the feelings of others.
- At the age of three: Can distinguish between imagination and reality.
- Between the ages of three and four: Possibility of succeeding in the False Belief task.
- From four to seven years: Success in the Second-order Belief task (Mitwalli: 2021).

2.2. Assessment of Theory of Mind:

Theory of Mind is divided into two tasks:

- **Cognitive Theory of Mind:** Includes tasks related to perception, attention, and language. It can be inferred through the following tasks:
  - First-order False Belief task, distinguishing the appearance of things, and inferring belief based on perception.
  - Second-order Belief task.
- **Affective Theory of Mind (Emotional ToM):** Includes the following tasks:
  - Recognizing emotion through faces, inferring emotion based on desire, inferring emotion based on belief, and inferring emotion through tone of voice and body posture (Sulayman, 2021).

Here, the child is given a set of stories about a specific emotion and is asked to infer the result of the emotion and express it either verbally or using facial gestures.

2. Emotional Expressions

2.1. Emotions:

Definitions of emotions vary among specialists. They are an internal state that is translated at the bodily level (Polz, 2024). It is an internal response to an external stimulus that appears on the physiological side.

2.2. Emotional Expressions:

It is the ability to express the internal side and point to it, either verbally or non-verbally:

- Basic Emotional Expressions: they are universal and shared by all individuals. It includes sadness, anger, joy, and fear (Rahmoun: 2020).
- Social Emotional Expressions: Specific to defined social situations.

2.3. Forms of Emotional Expressions:

- **Verbal**: Explicitly stating them: I am angry, you are happy...
- Facial Expressions: They are among the most widespread and used expressions. Studies by (John Sweetnan, 2018; Boussetta, 2012; Yuan Li, 2023) confirmed that facial expressions are the most used in social interaction and through which emotions can be recognized.
- **Tone of Voice:** Using vocal pitch to express and distinguish emotion.
- **Body Movements:** Posture and use of the body and hands.
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2.4. Emotional Expressions in Autism:

Since the early studies by Kanner on the subject of autism, the first observations were of emotional blunting and emotional rigidity: "They showed no reaction or specific facial expression, as if they were in a world of their own," (Kanner, 1942).

The problem for children with ASD is their suffering from the severity of emotional disturbances and the inability to understand facial expressions. A study by Golan et al. (2008), which aimed to identify emotional expressions through images in children with ASD, showed that children with ASD have a severe delay in understanding emotional expressions. Additionally, studies by Hakoda (2018), Al-Arabi (2018), and Youb (2017) found that children with ASD have difficulties in understanding sensory inputs and emotional expressions, especially facial expressions.

In a study by Thania (2018) comparing children with Autism Spectrum Disorder and Deaf children, results showed differences between the two groups in emotion perception.

Boussetta's (2021) study proved that the task of face perception in children with ASD is slow compared to typically developing children.

Polz's (2024) study on 61 individuals with ASD confirmed that children with ASD have difficulty recognizing emotions based on observing faces.

The child with ASD has extreme difficulty in understanding and translating non-verbal messages and gestures, which researchers attribute to a deficiency in Theory of Mind.

The experiments conducted by Baron-Cohen in the field of autism sparked a revolution when he explained the social and emotional deficit in autism. He hypothesized that children with ASD suffer from mind-blindness. He conducted a comparative study between Down Syndrome and Autism on Theory of Mind tasks which showed a deficit in Theory of Mind in autism that was not related to intelligence.

Then, his colleague Frith applied the Sally-Anne test to individuals with ASD. The results indicated that children with ASD fail the test, especially the First-order False Belief task (Cohen, 2000).

Youb's (2017) study found that Theory of Mind tasks are low compared to Down Syndrome.

A 2024 study comparing Autism and Bradley Syndrome found a deficit at the level of Theory of Mind.

Therefore, there is difficulty in recognizing facial affect in individuals with ASD, which affects their social interaction and communication. Some studies specifically found that individuals with ASD suffer from difficulty in processing cognitive empathy, which is the personal understanding of others' feelings, and on the emotional side. Data indicates differences in affective empathy, as individuals with ASD vary in their ability to emotionally resonate with others' feelings.

Furthermore, individuals with ASD may have difficulty recognizing facial affect, which impacts their ability to understand and respond to emotions. Neuroimaging studies have observed that individuals with ASD exhibit different neural activation during facial affect recognition compared to non-autistic individuals. This suggests differences in the neural processing of facial expressions in those with ASD.

Generally, autism is associated with difficulty in recognizing facial affect and processing emotions. Some researchers believe that this difficulty may be more pronounced in children with ASD who have a deficit in Theory of Mind. This hypothesis is supported by some studies that found a correlation between Theory of Mind and difficulties in recognizing facial affect. Another study found that females with ASD have the ability to detect physical differences in facial expressions but face difficulties in recognizing the dynamic effect of the face (Harrison, 2023).

Overall, more research is still needed to better understand the relationship between emotion processing, empathy, and difficulties in autism. This research can contribute to the development of effective therapeutic strategies for people with ASD, enhancing their social interaction and overcoming their communication difficulties.
Researchers have shown that, compared to Down syndrome controls and typically developing children, autistic children suffer from a significant impairment in False Belief tasks. Researchers tested 20 children with autism on the Sally-Anne test, where the ASD group was compared to a group of children with Down Syndrome, aged 10/11 years, 2:11.
Researchers found that 80% of the group with autism failed this test, while 86% of children with Down Syndrome, who had lower verbal and nonverbal mental ages, succeeded in the test, as did 85% (23/27) of typically developing children aged between 3/5 and 5/9 years. Additional studies have replicated the finding that most individuals with autism fail tasks that require them to understand false beliefs.
A study examining children with autism spectrum disorder (ASD) who possess high IQ (SIQ) compared to those with High-Functioning Autism (HFA) revealed notable differences between the groups. According to Ramadan's research (2019), children with high IQ demonstrated fewer intelligence.
Research indicates that facial expressions present greater ambiguity for individuals with autism. Findings from Grazzani's study (2024) confirm that by age 10, both low- and high-functioning children with autism experience similar difficulties in recognizing emotions through facial expressions.
Further research has shown that individuals with autism face particular challenges when emotional stimuli are briefly presented or more subtle in nature. While skills in recognizing basic and typical emotional expressions tend to improve with age among individuals with autism, even adults may continue to struggle with more transient or nuanced emotional expressions. Evidence suggests that individuals with autism may never reach the same level of proficiency in emotional recognition that is typically demonstrated by neurotypical adults.

Conclusion: Further research remains essential to deepen our understanding of the relationship between emotion processing, empathy, and the challenges associated with autism. Such investigations could significantly contribute to the development of effective therapeutic approaches that enhance social interaction capabilities and address communication difficulties for individuals on the autism spectrum.
autistic traits and achieved higher verbal IQ scores compared to the HFA group. Additionally, the HFA group exhibited more severe theory of mind deficits when compared to children with ASD who were matched with typically developing controls in terms of both nonverbal and verbal.

Ethical Considerations

This study was conducted in accordance with ethical standards for research involving human participants. Participation was voluntary, and informed consent was obtained from the parents or legal guardians of all children involved in the study. The confidentiality and anonymity of participants were strictly maintained, and all data were used solely for scientific research purposes. The study procedures complied with the ethical principles of the Declaration of Helsinki and institutional research guidelines. The authors also confirm the originality of the work and that the manuscript has not been published previously nor submitted elsewhere for publication.

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Author Contributions

- **Benahmidi Yazid Ibrahim El Khalil**: Conceptualization, research design, data collection, data analysis, manuscript drafting, and final approval of the manuscript.
- **Lakhal Mustapha**: Methodological supervision, data interpretation, critical revision of the manuscript, and final approval.

All authors have read and approved the final version of the manuscript and agree to be accountable for all aspects of the work.

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Conflict of Interest

The authors declare that there are no conflicts of interest regarding the publication of this paper.

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