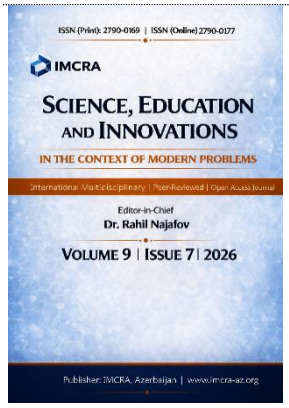

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RESEARCH ARTICLE

Integrating Theory of Mind Concepts into Visual Perception Training for Children with Autism Spectrum Disorder: A Theoretical and Cognitive-Developmental Framework

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Abstract

Autism Spectrum Disorder (ASD) is a complex neurodevelopmental condition characterized by persistent impairments in social communication, restricted behavioral patterns, and atypical sensory processing. While contemporary autism research has predominantly focused on socio-cognitive dysfunctions, increasing evidence suggests that abnormalities in visual perception constitute a fundamental component of the autistic phenotype and may significantly influence social cognition and adaptive functioning. Visual perceptual difficulties in children with ASD frequently involve deficits in gaze processing, facial emotion recognition, visual discrimination, spatial integration, and visual memory, all of which may interfere with the interpretation of socially relevant information. Within this context, Theory of Mind (ToM) has emerged as one of the most influential frameworks for understanding social cognition in ASD. Traditionally, ToM research has concentrated on the ability to infer mental states such as beliefs, intentions, desires, and emotions. However, the successful development of these abilities relies substantially on accurate visual processing and the interpretation of visual-social cues. Consequently, impairments in visual perception may contribute to broader socio-cognitive difficulties commonly observed in ASD populations. The present theoretical study proposes an integrative cognitive-developmental framework that extends Theory of Mind concepts into the domain of visual perception training for children with ASD. By conceptually adapting ToM-related constructs—including emotion recognition, gaze cueing, visual perspective taking, appearance–reality distinction, and false-belief reasoning—the article introduces a structured model for enhancing visual perceptual skills through socially meaningful cognitive tasks. The proposed framework emphasizes the reciprocal relationship between perceptual processing and social understanding and argues that strengthening visual perceptual competencies may facilitate the later development of higher-order socio-cognitive abilities.

The study contributes to contemporary autism intervention literature by offering a novel interdisciplinary perspective that bridges sensory-perceptual training with Theory of Mind–based cognitive approaches. Furthermore, it provides a conceptual foundation for future experimental and clinical investigations aimed at developing evidence-based intervention programs targeting both perceptual and socio-cognitive functioning in children with ASD.

Citation

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1. INTRODUCTION

Autism Spectrum Disorder (ASD) is a multifaceted neurodevelopmental condition characterized by persistent deficits in social communication, restricted patterns of behavior and interests, and atypical sensory processing mechanisms. Over the past decades, ASD has become one of the most extensively investigated developmental disorders due to its increasing prevalence and its profound influence on cognitive, emotional, and adaptive functioning across the lifespan. Contemporary diagnostic and neuropsychological research consistently indicates that individuals with ASD experience substantial socio-cognitive difficulties, particularly in interpreting social cues, understanding emotional expressions, and engaging in reciprocal interpersonal interactions.

Within the field of autism research, social cognition has traditionally occupied a central position. One of the most influential theoretical frameworks explaining these social difficulties is Theory of Mind (ToM), which refers to the capacity to attribute mental states—including beliefs, intentions, emotions, and desires—to oneself and others in order to explain and predict behavior. Deficits in ToM have frequently been associated with the core social impairments observed in ASD, particularly difficulties related to emotion recognition, perspective taking, social inference, and understanding communicative intentions. Consequently, ToM has become a dominant explanatory model in developmental psychology and autism studies.

Despite the substantial emphasis placed on socio-cognitive deficits, growing evidence suggests that sensory and perceptual abnormalities constitute equally significant dimensions of ASD. In particular, visual perception has emerged as a critical area of investigation due to its central role in processing environmental and social information. Children with ASD frequently demonstrate atypical visual processing patterns, including abnormalities in eye contact, facial scanning, visual attention allocation, visual discrimination, spatial processing, and interpretation of facial expressions. Such perceptual differences may substantially limit the child's ability to extract meaningful social information from visual environments, thereby contributing to broader social and communicative impairments.

Recent neuropsychological and neuroimaging studies have further highlighted the close interrelationship between sensory-perceptual functioning and social cognition in ASD. Researchers increasingly argue that atypical visual processing may precede and influence later socio-cognitive difficulties by disrupting the perception and interpretation of socially relevant cues. For example, impairments in gaze processing, facial emotion recognition, and visual perspective taking may directly interfere with the development of Theory of Mind abilities. This perspective suggests that social-cognitive deficits in ASD cannot be fully understood independently of underlying perceptual mechanisms.

Within this context, the present theoretical study proposes an integrative perspective that conceptually extends Theory of Mind constructs into the domain of visual perception training for children with Autism Spectrum Disorder. Rather than viewing ToM exclusively as a higher-order social-cognitive ability, this article argues that several ToM-related concepts—such as emotion recognition, gaze cueing, appearance–reality distinction, false-belief reasoning, and visual perspective taking—may also function as cognitively meaningful tools for strengthening visual perceptual skills. Accordingly, the study introduces a theoretical framework that links socially grounded cognitive tasks with visual perception training processes.

The primary objective of this article is to develop a conceptual and cognitive-developmental model that demonstrates how Theory of Mind concepts may be adapted to enhance visual perceptual competencies in children with ASD. By integrating perceptual and socio-cognitive dimensions within a unified framework, the study seeks to contribute to contemporary autism intervention literature and to provide a theoretical basis for future empirical and clinical investigations targeting both sensory-perceptual and social-cognitive development.

2. LITERATURE REVIEW

2.1 Visual Perception in Autism Spectrum Disorder

Visual perception represents a fundamental cognitive process through which visual stimuli are organized, interpreted, and transformed into meaningful representations of the surrounding environment. This multidimensional process enables individuals to identify visual characteristics such as shape, color, size, spatial orientation, and movement, thereby facilitating adaptive interaction with environmental and social contexts (Bekhit et al., 2024). Contemporary cognitive neuroscience further conceptualizes visual perception as a complex integration of perceptual subskills, including visual discrimination, visual-spatial perception, visual-motor integration, visual sequencing, visual closure, figure–ground perception, and visual memory (Simmons et al., 2009).

Within Autism Spectrum Disorder (ASD), atypical visual processing has emerged as one of the most significant dimensions of sensory dysfunction. Although ASD has historically been conceptualized primarily as a disorder of social cognition and communication, increasing empirical evidence suggests that sensory-perceptual abnormalities constitute a central component of the autistic phenotype (Thye et al., 2018). Numerous studies have documented abnormalities in visual attention, visual tracking, facial processing, visual discrimination, and sensory integration among children with ASD (Bekhit et al., 2024; Milne & Griffiths, 2007).

Research findings indicate that children with ASD frequently demonstrate impairments in the registration, processing, and interpretation of visual sensory input. Although visual acuity may remain physiologically intact, the cognitive interpretation of visual information often differs substantially from typical developmental patterns (Abu Niel et al., 2025). Such atypical perceptual processing may manifest through avoidance of eye contact, hypersensitivity to light or movement, fixation on object details, and difficulties in integrating fragmented visual information into coherent wholes (Milne & Griffiths, 2007). In addition,

impairments in visual memory and visual-spatial processing have been consistently reported among autistic populations (Salhi, 2022).

Furthermore, studies have shown that individuals with ASD may experience deficits in facial recognition, emotional interpretation, color differentiation, and visual-spatial orientation (Mohamed & Saleh, 2016). These perceptual abnormalities may significantly interfere with adaptive social functioning because visual information constitutes one of the primary channels through which humans interpret emotions, intentions, and interpersonal signals (Mitchell & Phillips, 2015). From this perspective, atypical visual perception may contribute directly to the socio-communicative difficulties characteristic of ASD.

However, the literature concerning visual perception in autism remains highly heterogeneous. While some neuropsychological and neuroimaging studies report impairments in early visual processing and global perceptual integration, others suggest that individuals with ASD may exhibit enhanced low-level perceptual functioning and superior visual detection abilities (Chung & Son, 2020; Mottron et al., 2006). Such contradictory findings are not unexpected given the spectrum-based nature of autism and the substantial variability in cognitive and sensory profiles across autistic individuals.

One of the most influential theoretical explanations for atypical visual processing in autism is the Weak Central Coherence Theory, which proposes that individuals with ASD exhibit a detail-focused cognitive style characterized by difficulties integrating local perceptual details into globally coherent representations (Smith et al., 2015). According to this perspective, autistic individuals may demonstrate superiority in local perceptual tasks while simultaneously experiencing challenges in holistic processing and contextual integration. Complementary theoretical models, such as Enhanced Perceptual Functioning Theory, similarly suggest that autistic cognition may involve heightened perceptual sensitivity accompanied by atypical perceptual organization (Mottron et al., 2006).

Recent neurodevelopmental research increasingly emphasizes the interrelationship between visual perception and social cognition in autism. Since a substantial proportion of environmental and social information is processed visually, atypical visual processing may significantly influence the development of interpersonal understanding and adaptive social behavior (Thye et al., 2018). Consequently, visual perception is no longer conceptualized merely as a sensory process but rather as a foundational cognitive mechanism underlying social communication, emotional interpretation, and Theory of Mind development in ASD populations.

2.2 Theory of Mind Concepts in Autism Spectrum Disorder

Theory of Mind (ToM) represents one of the most influential theoretical frameworks for understanding social cognition and interpersonal functioning in developmental psychology. The concept was initially introduced by Premack and Woodruff (1978), who proposed that humans and certain non-human primates possess the cognitive capacity to attribute mental states—including beliefs, desires, intentions, and emotions—to themselves and others in order to explain and predict behavior. Since then, Theory of Mind has become a central construct in autism research due to its close association with socio-communicative functioning.

Contemporary definitions conceptualize ToM as the capacity to understand that other individuals possess mental states that may differ from one's own perspectives, beliefs, and intentions (Flavell, 2004). This ability enables individuals to interpret human behavior within complex social contexts and to engage effectively in reciprocal interpersonal interaction. In Autism Spectrum Disorder, however, numerous studies have demonstrated significant impairments in Theory of Mind abilities across childhood, adolescence, and adulthood (Offek & Segal, 2022; Polónyiová et al., 2024).

The relationship between autism and ToM deficits was initially emphasized by Baron-Cohen, Leslie, and Frith (1985), who argued that socio-communicative impairments in autistic children stem largely from difficulties in attributing mental states to others. According to this perspective, autistic individuals may experience challenges understanding emotions, intentions, beliefs, sarcasm, deception, and perspective taking because of impairments in mental-state reasoning (Fisch, 2013). Consequently, Theory of Mind deficits have frequently been considered one of the principal explanatory mechanisms underlying social dysfunction in ASD populations.

Traditional Theory of Mind research initially focused on false-belief understanding as a primary indicator of socio-cognitive development (Hollebrandse et al., 2014). However, contemporary research increasingly conceptualizes ToM as a multidimensional construct involving multiple interconnected socio-cognitive abilities acquired progressively throughout development (Wellman & Liu, 2004). These abilities include intention understanding, desire attribution, belief reasoning, emotional recognition, mental-state attribution, knowledge access, visual perspective taking, and joint attention (Broekhof et al., 2015; Fuchs et al., 2024).

Among these components, facial emotion recognition and gaze processing have received substantial attention in autism research due to their close association with visual perception and social attention. Studies indicate that autistic individuals often experience difficulties interpreting facial expressions, eye gaze, and nonverbal communicative signals, which may substantially limit their social understanding and interpersonal responsiveness (Lee et al., 2014; Morgan et al., 2021). Similarly, impairments in visual perspective taking have been associated with reduced capacity to understand that others may possess perceptual experiences distinct from one's own (Matthias et al., 2015).

Moreover, contemporary developmental models emphasize that several precursor abilities contribute to the emergence of Theory of Mind competencies. These foundational mechanisms include joint attention, gaze cueing, pretend play, and social attention allocation (Broekhof et al., 2015; Semeijn, 2019). Importantly, many of these precursor skills depend heavily on

accurate visual processing and perceptual interpretation. Consequently, visual perception may constitute a critical developmental substrate underlying the acquisition of Theory of Mind abilities.

Collectively, these findings indicate that Theory of Mind should not be conceptualized solely as an abstract socio-cognitive ability isolated from sensory-perceptual functioning. Instead, ToM appears to emerge through complex interactions between perceptual processing, social attention, emotional interpretation, and cognitive integration. This perspective is particularly important in Autism Spectrum Disorder, where abnormalities in visual perception may significantly disrupt the developmental foundations necessary for social-cognitive understanding.

2.3 The Conceptual Gap

Despite extensive research on both visual perception and Theory of Mind in Autism Spectrum Disorder, these domains have frequently been investigated independently rather than within an integrated cognitive-developmental framework. Historically, autism research has primarily emphasized social deficits and communicative impairments, while sensory-perceptual abnormalities have received comparatively less theoretical and clinical attention (Thye et al., 2018). However, growing empirical evidence suggests that atypical sensory processing—particularly within the visual domain—may play a substantial role in the developmental emergence of socio-cognitive dysfunctions in ASD.

Visual processing constitutes one of the principal mechanisms through which individuals interpret social environments. Since approximately 80% of environmental information is processed visually, abnormalities in visual perception may significantly interfere with the interpretation of socially meaningful cues such as facial expressions, gaze direction, gestures, and interpersonal movement (Chung & Son, 2020). Several studies further suggest that autistic individuals exhibit atypical perceptual styles characterized by enhanced local processing and reduced global integration, resulting in fragmented interpretation of complex social scenes (Smith et al., 2015).

From a neurodevelopmental perspective, atypical visual processing may disrupt the acquisition of social-cognitive competencies by limiting access to socially rewarding and predictable visual information (Thye et al., 2018). Consequently, impairments in visual perception may contribute not only to sensory dysfunction but also to broader deficits in social interaction, emotional understanding, and Theory of Mind development. Nevertheless, few theoretical models have explicitly examined how Theory of Mind concepts might be utilized as cognitive tools for enhancing visual perceptual functioning in ASD populations.

The present study addresses this conceptual gap by proposing an integrative framework linking Theory of Mind constructs with visual perception training. Rather than conceptualizing ToM exclusively as a higher-order socio-cognitive capacity, this framework argues that ToM-related concepts—such as emotion recognition, gaze cueing, visual perspective taking, appearance–reality distinction, and false-belief reasoning—may serve as developmentally meaningful mechanisms for strengthening visual perceptual processing.

Accordingly, this study conceptualizes visual perception training as a preparatory developmental framework through which children with ASD may gradually acquire foundational perceptual and social-attentional skills that later support explicit Theory of Mind understanding. By integrating socially meaningful cognitive tasks with visual perceptual exercises, the proposed framework seeks to establish a reciprocal developmental relationship between perceptual functioning and socio-cognitive growth.

METHODOLOGY

Research Design

The present study employed a theoretical-conceptual research design grounded in an interdisciplinary narrative literature review approach. Rather than conducting empirical experimentation or quantitative data collection, the study aimed to develop an integrative cognitive-developmental framework linking Theory of Mind (ToM) concepts with visual perception (VP) training in children with Autism Spectrum Disorder (ASD). The research was primarily exploratory and conceptual in nature, seeking to identify theoretical intersections between socio-cognitive functioning and visual-perceptual processing within contemporary autism literature.

Literature Selection and Analytical Procedure

The conceptual framework was developed through an extensive review and analytical synthesis of scholarly literature related to Autism Spectrum Disorder, Theory of Mind, visual perception, social cognition, sensory processing, developmental psychology, and autism intervention models. Peer-reviewed journal articles, academic books, theoretical studies, neuropsychological research, and developmental-cognitive investigations indexed in major scientific databases—including Scopus, Web of Science, PubMed, SpringerLink, ScienceDirect, and Google Scholar—were examined.

The literature selection process focused primarily on studies addressing:

- visual perception deficits in ASD;
- Theory of Mind development and impairment;
- social attention and gaze processing;

- visual perspective taking;
- sensory-perceptual functioning;
- emotion recognition;
- cognitive-developmental intervention models in autism.

Preference was given to highly cited and internationally indexed publications from psychology, neuroscience, developmental science, special education, and autism research journals.

Conceptual Framework Development

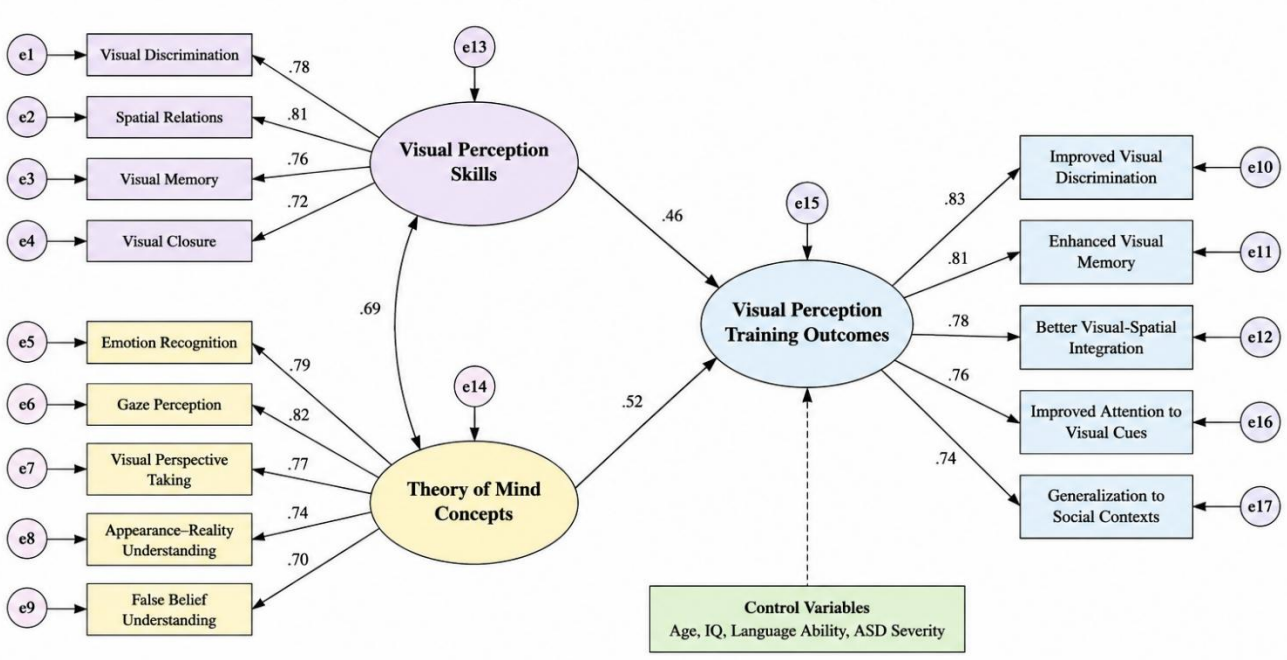
Following the literature review, the study applied a thematic analytical approach to identify conceptual relationships between Theory of Mind constructs and visual-perceptual skills. Key ToM-related concepts—including emotion recognition, gaze cueing, false-belief understanding, visual perspective taking, appearance–reality distinction, and joint attention—were systematically analyzed in relation to specific visual perception components such as visual discrimination, visual closure, spatial relations, visual memory, figure–ground perception, and eye–hand coordination.

Based on this synthesis, a conceptual intervention framework and a proposed training model were developed to demonstrate how Theory of Mind concepts may be adapted into socially meaningful visual perception exercises for children with Autism Spectrum Disorder.

Nature and Scope of the Study

This study is theoretical and conceptual rather than experimental. Therefore, the proposed framework should be interpreted as a developmental and intervention-oriented model intended to guide future empirical, clinical, and educational investigations. The study does not claim clinical effectiveness but instead provides a theoretical foundation for subsequent experimental validation and intervention design in the fields of autism research, cognitive development, and special education.

Figure 1. Structural Equation Model (SEM) of the Relationship Between Theory of Mind Concepts and Visual Perception Training Outcomes in Children with Autism Spectrum Disorder



Notes. Standardized path coefficients are shown. All latent constructs are measured by their respective observed indicators.
e1–e17 = error terms.

Caption:

The figure illustrates the proposed theoretical Structural Equation Model (SEM) explaining the interrelationship between Theory of Mind (ToM) concepts, visual perception skills, and visual perception training outcomes in children with Autism Spectrum Disorder (ASD). The model conceptualizes visual perception skills and ToM-related constructs as interconnected latent variables contributing to the enhancement of perceptual and socio-cognitive functioning. Observed indicators include visual discrimination, spatial relations, visual memory, emotion recognition, gaze perception, visual perspective taking, appearance–reality understanding, and false-belief reasoning. The model further demonstrates how these constructs collectively

influence training outcomes such as improved visual discrimination, enhanced visual memory, better visual-spatial integration, increased attention to visual cues, and generalization to social contexts. Control variables include age, IQ, language ability, and ASD severity.

Source:
Developed by the authors based on the theoretical frameworks of Theory of Mind and visual perception in Autism Spectrum Disorder (Baron-Cohen et al., 1985; Flavell, 2004; Mitchell & Phillips, 2015; Chung & Son, 2020; Thye et al., 2018).

3. Extending Theory of Mind Concepts to Visual Perception Training in Children with Autism Spectrum Disorder

3.1 Conceptual Relationship Between Theory of Mind and Visual Perception

Theory of Mind (ToM) refers to the cognitive capacity to attribute mental states—including beliefs, intentions, desires, emotions, and motivations—to oneself and others in order to interpret, explain, and predict behavior (Flavell, 2004; Fadda et al., 2024). Within developmental psychology and autism research, ToM has long been considered one of the central mechanisms underlying social cognition and interpersonal functioning. Individuals with Autism Spectrum Disorder (ASD) frequently demonstrate impairments in Theory of Mind abilities, which may significantly interfere with social communication, emotional understanding, and adaptive interaction throughout the lifespan (Offek & Segal, 2022; Polónyiová et al., 2024).

From a cognitive-developmental perspective, the acquisition of Theory of Mind depends fundamentally on the individual's capacity to perceive, interpret, and integrate socially meaningful visual information. Mental-state understanding is not developed in isolation from perceptual processing; rather, it emerges through continuous interaction with visually mediated social environments. As Tsoukalas (2018) argues, understanding others as intentional beings requires the ability to interpret behavioral and perceptual cues, particularly facial expressions, gaze direction, and eye movements. The eyes, in particular, constitute one of the most important visual sources of socio-emotional information because they communicate emotions, intentions, attentional focus, and interpersonal meaning.

Similarly, gaze cueing and visual attention allocation—both considered foundational precursors of Theory of Mind—depend heavily on visual-perceptual functioning (Morgan et al., 2021). The ability to detect and interpret gaze direction allows children to identify relevant social stimuli and engage in joint attention processes, which are themselves critical for later social-cognitive development. Consequently, atypical visual processing may significantly limit access to socially meaningful information and contribute to broader Theory of Mind impairments in children with ASD.

Theoretical models such as Simulation Theory further emphasize the role of visual perception in social cognition. According to this perspective, children develop mental-state understanding by simulating the perspectives and experiences of others while continuously adjusting these simulations according to contextual variables, including visual perspective and perceptual orientation (Rakoczy, 2017). This process highlights the central importance of visual perspective taking as a prerequisite for understanding mental states and interpersonal intentions.

Recent neurodevelopmental research increasingly supports the assumption that sensory-perceptual functioning and social cognition are deeply interconnected systems rather than independent domains (Chung & Son, 2020; Thye et al., 2018). In this context, visual perception may be conceptualized as a developmental gateway through which children acquire the perceptual foundations necessary for later socio-cognitive understanding. Deficits in visual discrimination, visual integration, gaze perception, and visual attention may therefore interfere not only with sensory processing but also with the development of Theory of Mind competencies.

Accordingly, the present theoretical framework proposes that Theory of Mind concepts and activities may be systematically adapted to serve as cognitive tools for enhancing visual perception skills in children with ASD. Rather than viewing ToM exclusively as a higher-order social-cognitive ability, this perspective conceptualizes ToM-related constructs as perceptually grounded mechanisms capable of supporting visual information processing, social attention, and perceptual integration. Through repeated exposure to socially meaningful visual tasks, children may gradually strengthen foundational perceptual competencies that later facilitate more advanced socio-cognitive functioning.

3.2 A Conceptual Framework for Visual Perception Training Based on Theory of Mind

The present framework proposes that several Theory of Mind constructs may be functionally integrated into visual perception training programs for children with Autism Spectrum Disorder. Specifically, ToM-related concepts are adapted to target distinct visual-perceptual subskills, thereby establishing a reciprocal developmental relationship between perceptual processing and social cognition.

Table 1. Integration of Theory of Mind Concepts into Visual Perception Skills Training

Visual Perception Skills	Theory of Mind Concepts	Conceptual Extension Logic
Visual Discrimination	• Emotion recognition • Intention	Emotion recognition and intention attribution require the identification of subtle visual differences in facial expressions, gaze direction, and action-related cues. Training children to detect micro-expressions and socially

	understanding through visual cues	meaningful facial details enhances sensitivity to fine visual distinctions and strengthens visual discrimination abilities.
Spatial Relations	• Deception understanding • Visual perspective taking	Both deception understanding and visual perspective taking involve reasoning about object location, visibility, and spatial manipulation. These processes require children to evaluate how visual scenes differ across perspectives, thereby enhancing spatial mapping and object-location processing.
Visual Closure	• Appearance–reality distinction • Gaze cueing • Reading the mind in the eyes • Mental-state inference from partial visual cues	Theory of Mind tasks involving incomplete or ambiguous social information require children to infer emotions, intentions, or meanings from partial visual stimuli. Such processes parallel visual closure abilities by strengthening the capacity to cognitively complete fragmented visual information.
Visual Memory	• False-belief understanding	False-belief tasks require children to remember prior visual states, compare them with current visual representations, and mentally reconstruct earlier situations. These processes directly strengthen visual memory retention, updating, and sequential recall abilities.
Visual Coping and Cognitive Flexibility	• Visual perspective taking	Visual perspective-taking tasks require flexible shifts between self-oriented and other-oriented viewpoints. Such cognitive transitions improve adaptive visual processing, perceptual flexibility, and context-sensitive interpretation of visual scenes.
Figure–Ground Perception	• Unexpected-content understanding • Social attention allocation	Unexpected-content tasks require selective attention to socially relevant visual cues while inhibiting irrelevant background stimuli. Training social attention through gaze tracking and gesture interpretation improves figure–ground differentiation and attentional filtering.
Eye–Hand Coordination	• Joint attention • Appearance–reality distinction	Joint-attention activities involve coordinated gaze following, visual tracking, and motor responses. These processes strengthen synchronization between visual input and motor execution, thereby improving eye–hand coordination and perceptual-motor integration.

The proposed framework conceptualizes visual perception training as a cognitively and socially grounded developmental process. By integrating Theory of Mind concepts into perceptual exercises, the model seeks to strengthen socially meaningful visual processing while simultaneously supporting the gradual emergence of higher-order socio-cognitive competencies. Importantly, this framework does not assume that children with ASD must first acquire advanced abstract mental-state reasoning before benefiting from Theory of Mind–related activities. Instead, it proposes that perceptually simplified and socially embedded ToM tasks may function as preparatory developmental mechanisms that facilitate both visual perception and later socio-cognitive understanding.

Consequently, this integrative approach contributes to contemporary autism intervention literature by bridging sensory-perceptual training with socio-cognitive developmental theory. It further provides a conceptual basis for future experimental and clinical investigations aimed at evaluating the effectiveness of Theory of Mind–enhanced visual perception interventions for children with Autism Spectrum Disorder.

3.3 A Conceptual Model of Theory of Mind–Based Visual Perception Skills Training

To extend Theory of Mind (ToM) concepts into visual perception (VP) training, it is necessary to identify the cognitive intersection between socio-cognitive understanding and perceptual processing. Although ToM is traditionally associated with higher-order social cognition, many of its core components depend on the accurate perception, interpretation, and integration of visual information, including gaze direction, facial expressions, body orientation, object location, and perspective-dependent visual scenes (Baron-Cohen et al., 1985; Flavell, 2004; Mitchell & Phillips, 2015; Morgan et al., 2021). Therefore, ToM-related tasks may be adapted into structured perceptual exercises that target specific VP skills while preserving their socio-cognitive relevance.

In the proposed model, the social aspects of ToM are not removed; rather, they are simplified and reorganized to support foundational visual perception skills in children with Autism Spectrum Disorder (ASD). This approach is particularly relevant because atypical visual processing in ASD may affect children's ability to interpret socially meaningful visual cues and may contribute to broader difficulties in social cognition, joint attention, emotion recognition, and perspective taking (Chung & Son, 2020; Smith et al., 2015; Thye et al., 2018). Accordingly, the model conceptualizes visual perception training as a preparatory

developmental pathway through which children may strengthen perceptual competencies that later support more advanced ToM abilities.

Table 2. Proposed Model for Theory of Mind–Based Visual Perception Training in Children with Autism Spectrum Disorder

Visual Perception Skill	Theory of Mind Concept	Proposed Task	Training Instructions
Visual Discrimination	**Emotion recognition**	The child is presented with images of faces expressing basic emotions, such as happiness, sadness, anger, fear, and surprise.	The child is asked to identify the emotion and distinguish subtle differences in facial details, including the eyes, eyebrows, mouth shape, and facial tension. This task strengthens fine visual discrimination while simultaneously supporting facial emotion recognition, a core component of social cognition (Lee et al., 2014; Mitchell & Phillips, 2015).
Visual Discrimination	**Intention understanding through visual cues**	The child is shown pictures of a person looking toward a table containing several objects, such as candy, toys, books, or food.	The child is asked to infer which object the person wants by observing gaze direction, head position, body orientation, and pointing cues. This task trains the child to discriminate socially meaningful visual signals that convey intention and attention (Broekhof et al., 2015; Morgan et al., 2021).
Spatial Relations	**Deception understanding**	The child is presented with shapes of different sizes, orientations, and positions. Some shapes are arranged to create misleading visual impressions, such as a small object appearing larger because it is placed closer.	The child identifies spatial relationships such as larger/smaller, closer/farther, overlapping/separate, and front/behind. This task supports resistance to misleading visual cues and strengthens spatial reasoning, which is relevant to appearance–reality and deception understanding (Wellman & Liu, 2004; Hollebrandse et al., 2014).
Spatial Relations	**Visual perspective taking**	A visual scene is presented with objects arranged around a table or another central object.	The child is asked to describe how the scene appears from another person's viewpoint, such as the therapist's or a pictured character's perspective. This task requires mental transformation of spatial arrangements and supports visual perspective taking, which is frequently considered a perceptual foundation of ToM (Matthias et al., 2015; Rakoczy, 2017).
Visual Closure	**Appearance–reality distinction**	The child is shown half-drawn or incomplete images of animals, objects, or faces. The missing halves are placed among distractors.	The child matches the incomplete image to its correct missing part. The task supports visual closure by requiring the child to complete fragmented visual information while also distinguishing between what something appears to be and what it actually is (Flavell, 2004; Wellman & Liu, 2004).
Visual Closure	**Reading the mind in the eyes**	The child is shown images containing only the eye region of different faces. Several incomplete face options are provided.	The child matches the eye region to the correct face or emotional expression. This task combines partial-cue interpretation with visual closure and supports attention to the eye region, which is central to emotion recognition and mental-state inference (Baron-Cohen et al., 2001; Tsoukalas, 2018).
Visual Memory	**False-belief understanding**	A modified visual version of the Sally–Anne task is used. An object is placed in one location and then moved while one character is absent.	The child recalls the original location of the object and compares it with its current location. Trials may gradually increase in complexity. This task strengthens visual memory, sequential recall, and updating of visual representations within a false-belief framework (Baron-Cohen et al., 1985; Hollebrandse et al., 2014; Perner et al., 1989).

Copying / Visual-Motor Integration	**Visual perspective taking**	The therapist shows a shape, letter, arrow, or geometric pattern from a specific viewpoint.	The child copies the figure as it appears from the therapist's perspective, even when it appears reversed or rotated from the child's own viewpoint. This task strengthens visual-motor integration, mental rotation, spatial flexibility, and perspective-dependent visual processing (Matthias et al., 2015; Simmons et al., 2009).
Hand–Eye Coordination	**Joint attention**	The child is presented with a path-tracing activity in which an animal character must reach a target, such as food, a home, or another animal.	The therapist indicates the correct path using gaze, pointing, or verbal direction. The child traces the path accurately with a pencil while remaining within the line boundaries. This task integrates gaze following, joint attention, visual tracking, and fine motor coordination (Broekhof et al., 2015; Morgan et al., 2021; Vivanti et al., 2017).

The proposed model is designed to function as a structured bridge between perceptual training and socio-cognitive development. Each activity targets a specific visual perception skill while simultaneously activating a ToM-related construct. For example, emotion-recognition tasks are not used only to teach emotional labels; they also require careful discrimination of facial features, eye movements, and mouth configuration. Similarly, false-belief tasks are not used solely to assess mental-state reasoning; they may also be adapted to strengthen visual memory, object-location recall, and sequential updating of visual information (Baron-Cohen et al., 1985; Wellman & Liu, 2004).

This model is also consistent with contemporary autism research suggesting that sensory-perceptual processing and social cognition are reciprocally connected rather than fully independent domains (Chung & Son, 2020; Thye et al., 2018). Atypical visual perception may restrict the child's access to socially meaningful information, while reduced social attention may further limit opportunities for perceptual learning from faces, gaze, gestures, and interpersonal scenes (Dawson et al., 2005; Senju & Johnson, 2009). Therefore, interventions that combine visual perception training with socially meaningful ToM tasks may provide a more developmentally coherent approach than programs targeting each domain separately.

Importantly, the model should be applied progressively. Initial tasks should use simple, high-contrast, and familiar visual materials before moving toward more complex social scenes. The therapist may begin with basic discrimination of facial features, shapes, and object positions, then gradually introduce more complex tasks involving gaze direction, intention inference, perspective transformation, and false-belief scenarios. This progression is consistent with developmental accounts of ToM, which suggest that children acquire socio-cognitive understanding through a gradual sequence of increasingly complex concepts, including desire, belief, knowledge access, false belief, and hidden emotion (Flavell, 2004; Wellman & Liu, 2004).

The model also allows for individualized adaptation according to the child's cognitive profile, language ability, ASD severity, attention level, and sensory sensitivity. Since ASD is highly heterogeneous, some children may require additional support in basic visual discrimination, while others may benefit more from advanced perspective-taking and mental-state inference tasks (Mottron et al., 2006; Simmons et al., 2009). Accordingly, the proposed training approach should not be interpreted as a fixed protocol but as a flexible conceptual framework that can guide future intervention design.

Overall, the model suggests that ToM-based visual perception training may serve as a preparatory intervention pathway for children with ASD. By strengthening the perceptual mechanisms that support social attention, emotion recognition, perspective taking, and mental-state reasoning, this approach may contribute to the development of more integrated socio-cognitive functioning. Future empirical research is needed to test the effectiveness of this model through experimental designs, pre- and post-intervention assessment, standardized visual perception measures, and validated ToM tasks.

4. CONCEPTUAL IMPLICATIONS

The present theoretical study sought to examine the conceptual relationship between Theory of Mind (ToM) constructs and visual perception (VP) skills in children with Autism Spectrum Disorder (ASD) and to propose an integrative framework for visual perception training grounded in ToM-related concepts. The findings derived from the theoretical synthesis of previous empirical and conceptual studies indicate that visual perception and Theory of Mind are not isolated developmental domains; rather, they operate through a reciprocal and interdependent cognitive relationship.

One of the principal findings of the study is that several Theory of Mind abilities fundamentally rely on accurate visual-perceptual processing. Core ToM processes such as emotion recognition, gaze cueing, visual perspective taking, false-belief reasoning, and intention understanding all require the child to perceive, discriminate, interpret, and integrate socially relevant visual information (Lee et al., 2014; Morgan et al., 2021; Tsoukalas, 2018). Consequently, deficits in visual perception may significantly interfere with the acquisition and development of social-cognitive competencies in children with ASD.

The literature review further revealed that children with ASD frequently experience atypical visual processing patterns involving difficulties in visual discrimination, visual memory, visual-spatial integration, figure–ground perception, facial processing, and visual attention allocation (Bekhit et al., 2024; Chung & Son, 2020; Milne & Griffiths, 2007). Such impairments may restrict access to socially meaningful visual cues and reduce opportunities for effective interpersonal learning. In this context, the study

findings suggest that visual-perceptual dysfunction may constitute one of the underlying mechanisms contributing to broader Theory of Mind deficits observed in ASD populations.

Another important finding concerns the developmental role of gaze perception and joint attention. The reviewed literature consistently demonstrated that gaze-following abilities, attention to the eye region, and socially directed visual attention function as foundational precursors for both visual perception and Theory of Mind development (Broekhof et al., 2015; Senju & Johnson, 2009). Since many autistic children demonstrate reduced attention to socially relevant visual stimuli, ToM-based perceptual activities may help redirect visual attention toward meaningful social information and thereby strengthen both perceptual and socio-cognitive functioning.

The proposed conceptual model also demonstrated that specific Theory of Mind constructs may be systematically adapted to target distinct visual perception skills. For example, emotion-recognition tasks may enhance visual discrimination through attention to subtle facial differences, while false-belief tasks may strengthen visual memory by requiring the child to recall and compare previous visual states with current visual information. Similarly, visual perspective-taking activities appear particularly relevant for improving spatial relations, mental rotation, and perceptual flexibility (Matthias et al., 2015; Rakoczy, 2017).

The findings additionally suggest that visual closure and figure–ground perception may be strengthened through socially meaningful tasks involving appearance–reality distinction, reading emotions from partial facial cues, and selective attention to socially relevant information. These findings support the assumption that socially grounded cognitive tasks may function simultaneously as perceptual training exercises and socio-cognitive developmental activities.

Importantly, the theoretical synthesis highlighted that the integration of ToM concepts into visual perception training may provide a more developmentally coherent intervention approach than treating perceptual and social deficits as entirely separate domains. Contemporary autism research increasingly emphasizes that sensory-perceptual abnormalities and social-cognitive dysfunctions are neurologically and developmentally interconnected (Smith et al., 2015; Thye et al., 2018). Therefore, interventions that combine perceptual training with socially meaningful cognitive activities may facilitate broader developmental gains in adaptive functioning, communication, and social understanding.

Another notable finding concerns the progressive nature of the proposed intervention framework. The model suggests that children with ASD may benefit from beginning with simplified perceptual tasks involving basic discrimination of shapes, facial expressions, gaze direction, and object location before progressing toward more abstract socio-cognitive tasks such as false-belief reasoning and mental-state inference. This developmental progression aligns with contemporary theories proposing that Theory of Mind competencies emerge gradually through increasingly complex stages of social understanding (Flavell, 2004; Wellman & Liu, 2004).

The study also identified a significant conceptual gap within existing autism intervention literature. Although substantial research has independently examined visual perception deficits and Theory of Mind impairments in ASD, relatively few studies have attempted to integrate these domains into a unified intervention framework. Accordingly, the present model contributes to the literature by proposing a novel interdisciplinary perspective that connects sensory-perceptual functioning with social-cognitive development.

Overall, the findings suggest that Theory of Mind–based visual perception training may represent a promising conceptual pathway for supporting both perceptual and socio-cognitive development in children with Autism Spectrum Disorder. While the present study remains theoretical in nature, the proposed framework establishes a foundation for future empirical investigations examining the effectiveness of ToM-integrated visual perception interventions through experimental, clinical, and educational research designs.

5. Conclusion and Future Directions for Research and Practice

Autism Spectrum Disorder (ASD) is characterized by substantial heterogeneity in cognitive, sensory, and socio-communicative functioning. Nevertheless, a considerable body of research indicates that many individuals with ASD experience atypical visual-perceptual processing, including difficulties related to visual discrimination, visual memory, visual-spatial integration, figure–ground perception, gaze processing, and interpretation of socially relevant visual cues (Chung & Son, 2020; Simmons et al., 2009; Thye et al., 2018). Such perceptual abnormalities may significantly influence not only sensory functioning but also broader developmental domains involving communication, social interaction, and adaptive behavior.

The present theoretical study argues that visual perception should not be conceptualized merely as an isolated sensory mechanism; rather, it represents a foundational cognitive gateway through which children acquire environmental knowledge, process social information, and develop interpersonal understanding. From this perspective, visual perception constitutes one of the essential developmental foundations underlying Theory of Mind (ToM) acquisition. Social-cognitive competencies such as emotion recognition, gaze interpretation, intention understanding, visual perspective taking, and false-belief reasoning all depend substantially on the accurate processing and interpretation of visual information (Lee et al., 2014; Mitchell & Phillips, 2015; Morgan et al., 2021).

Accordingly, the integration of Theory of Mind concepts into visual perception training may represent a promising interdisciplinary therapeutic approach for children with Autism Spectrum Disorder. The proposed framework suggests that ToM-related activities may be adapted into perceptually grounded training exercises designed to strengthen visual discrimination, visual memory, spatial relations, visual closure, figure–ground perception, visual attention, and eye–hand

coordination while simultaneously supporting socio-cognitive development. Rather than treating perceptual deficits and social impairments as entirely separate domains, the model conceptualizes them as reciprocally interconnected developmental processes.

The study further contributes to contemporary autism intervention literature by proposing a structured conceptual model linking specific ToM constructs with targeted visual-perceptual skills. Through socially meaningful perceptual activities, children with ASD may gradually strengthen foundational cognitive mechanisms necessary for later social understanding and adaptive interaction. This developmental perspective is particularly important because many autistic children may experience difficulties engaging directly in abstract metacognitive Theory of Mind tasks. Therefore, perceptually simplified and socially embedded activities may provide a more accessible pathway toward socio-cognitive development.

Despite the theoretical significance of the proposed framework, the present study remains conceptual in nature and therefore requires empirical validation. Consequently, one of the primary recommendations for future research is the implementation of experimental and quasi-experimental studies designed to evaluate the effectiveness of Theory of Mind–enhanced visual perception training programs in children with ASD. Future investigations may employ pre- and post-intervention assessment designs using standardized visual-perception measures, Theory of Mind tasks, social-attention evaluations, and adaptive-functioning scales in order to determine the practical impact of the proposed model.

In addition, future research should focus on developing standardized assessment instruments specifically targeting social visual perception in Autism Spectrum Disorder. Existing assessment tools frequently evaluate visual perception and social cognition independently, whereas integrated measures examining socially meaningful visual processing remain limited. The development of such instruments may significantly improve diagnostic precision and intervention planning.

The present study also recommends expanding the application of Theory of Mind–based interventions beyond social cognition alone. Future research may explore how ToM-related concepts can contribute to strengthening broader cognitive domains, including attention regulation, executive functioning, perceptual flexibility, visual-motor integration, and adaptive learning processes. Furthermore, researchers and clinicians are encouraged to develop diverse therapeutic strategies integrating Theory of Mind constructs with sensory-perceptual and visual-processing interventions tailored to the heterogeneous profiles of children with ASD.

From a practical perspective, the involvement of therapists, educators, and parents is essential for the successful implementation of ToM-based visual perception interventions. Since perceptual and social learning primarily occur within everyday interactive environments, collaborative participation among professionals and caregivers may substantially enhance the accessibility, continuity, and effectiveness of intervention programs. Parent-mediated and therapist-guided activities may further facilitate the generalization of perceptual and socio-cognitive skills into naturalistic social contexts.

Overall, the present theoretical framework highlights the importance of reconsidering the developmental relationship between visual perception and social cognition in Autism Spectrum Disorder. By bridging Theory of Mind concepts with visual perception training, this study proposes an innovative interdisciplinary perspective that may contribute to future advances in autism intervention research, educational practice, and developmental rehabilitation.

DECLARATIONS

Ethical Approval and Consent to Participate

This study is a theoretical and conceptual research paper and did not involve human participants, clinical experimentation, personal data collection, or animal subjects. Therefore, ethical approval and informed consent were not required in accordance with institutional and international research ethics guidelines.

Consent for Publication

Not applicable.

Availability of Data and Materials

No datasets were generated or analyzed during the current study because the article is based on a theoretical and conceptual review of existing literature.

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Conflict of Interest

The authors declare that they have no competing interests or conflicts of interest related to this study.

Authors' Contributions

Dr. Latreche Soumia contributed to the conceptualization of the study, literature review, theoretical framework development, analysis, and manuscript writing.
Dr. Lakhal Mustapha contributed to the methodological structuring, conceptual refinement, critical revision, and academic

editing of the manuscript.
Both authors read and approved the final version of the manuscript.

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Declaration of Generative AI and AI-Assisted Technologies in the Writing Process

During the preparation of this manuscript, the authors used artificial intelligence–assisted language tools exclusively for linguistic improvement, grammatical editing, and academic phrasing enhancement. The authors carefully reviewed, revised, and approved all content and assume full responsibility for the integrity, originality, and scientific accuracy of the manuscript.

Data Availability Statement

No primary data were collected for this study. All information analyzed in this article was obtained from previously published scholarly literature cited in the references section.

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