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Emotion Recognition a Transdiagnostic Feature in Children and Adolescents with ASD and ADHD: The Humanitarian Perspective

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Abstract

Mental disorders contribute significantly to the overall disease morbidity in the young population on a global basis. This article primarily focuses on two of the most common neurodevelopmental disorders, ASD and ADHD, as several links have been made in literature with regards to the high comorbidity rates, the genetic overlap, and the shared etiological mechanisms. Impairments in facial affect recognition and theory of mind have been reported to be a trans-diagnostic factor in both populations. We aim to tackle the question if on a global basis, emotion recognition interventions could be of benefit to children and adolescents with ASD and ADHD taking into account the universal gap in the mental health services (for children and adolescents), particularly in countries with not so well-developed health care systems and infrastructures.

Keywords: ASD; ADHD; Emotion recognition; Transdiagnosis; Humanitarianism

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Introduction

Mental disorders contribute significantly to the overall disease morbidity in the young population on a global basis. A substantial proportion of the world's health problem in low-, middle-and high-income families arises from mental, neurological and substance abuse conditions [1]. The 'Neurodevelopmental Disorders' included in the latest edition of the Diagnostic and Statistical Manual of Mental Disorders, 5th Edition (DSM-5) [2] are the intellectual developmental disorder (intellectual disability), communication disorders, autism spectrum disorder (ASD), attention deficit hyperactivity disorder (ADHD), specific learning disorder (SLD), and motor disorders. Although, clustered under the same umbrella as discrete entities, empirical evidence indicates a high degree of overlap among them.

Neurodevelopmental disorders originate in childhood, tend to be stable across adulthood, are more frequent in boys than girls [3] and - as all behaviourally defined disorders – diagnosis relies on clinicians' observations and parental reports. The implications of a mental disorder in a child (or adolescent) are substantial. The disorder may interfere with the child's normal development, with the youth's efforts to relate to family and peers, and the achievement of normal developmental milestones such as independence, caring for oneself, obtaining an education, and interacting with peers. As substantial research indicates componential overlaps among several developmental disorders [4] with the same genes contributing to different developmental disorders due to the overlapping of their componential structure, many authors in the last decade [5] have argued for the transdiagnostic perspective of neurodevelopmental disorders. A transdiagnostic perspective refers to intrapersonal cognitive, emotional, behavioural, and physiological processes [6].

Neurodevelopmental disorders occur commonly in industrialized countries. It has been shown that between 14% to 30% of children and adolescents across the globe live with learning-related problems which are severe enough to require special educational support [7]. Developing countries are facing the impact of mental health problems due to limited availability of services and mental health care [8,9]. More than 85% of the population worldwide reside in low- and middle-income countries (having been reported to be 153) [10], and experts [11], predict social decline and economic trap of disease burden to consequentially follow the high incidence of mental illness in low- and middle-income countries. The vicious cycle of the poorest having limited access

to mental health care services and being denied opportunities in employment, prohibits them from escaping poverty.

A great variability has been reported in the provision of mental health cares between high- and low-income countries showing significant differences in the presence of mental health workforce of psychiatrists, psychologists, nurses, and social workers [11]. When compared with global averages of 3.96 psychiatrists per 100 000 people, China reported 2.20 psychiatrists, per 100000 of the population [12] and in the most populous developing countries of Asia and Africa, such as India, Pakistan, Nigeria, Gambia, Kenya, Nepal, and Ethiopia, the ratios reported were 0.29, 0.185, 0.06, 0.10, 0.18,0.36, and 0.08, respectively [12,13]. With regards to child psychiatrists the ratios reported in India and Ethiopia were 0.00 whereas in Kenya and Nepal the ratios reported were 0.01 and 0.003 respectively [12].

Literature Review

This article will primarily focus on two of the most common neurodevelopmental disorders being ASD and ADHD as several links have been made in literature with regards to the high comorbidity rates, the genetic overlap, and the shared aetiological mechanisms. We will discuss the relations of these disorders with respect to the emotion recognition domain of social reciprocity and the underlying trans-diagnostic process. We aim to tackle the question if on a global basis, a simple emotion recognition intervention could be of benefit to children and adolescents taking into account that universal gap in the mental health services for children and adolescents [14], particularly in countries with not so well developed health care systems and infrastructures.

Attention Deficit Hyperactivity Disorder (ADHD)

ADHD is a widely studied neurodevelopmental disorder highly comorbid with ASD [15]. Inattention, hyperactivity, and impulsivity are main characteristics of ADHD. Fayyad et al. [16] have shown that in Europe approximately the 2.2% of children, adolescents (under the age of 18 years) and adults (aged 18-44 years) live with ADHD, while in Asia, Middle East and Americas this number was approximately 2.8%. School-aged children with ADHD have been reported to suffer from social and emotional deficits, i.e., deficits in emotion regulation [17], inability to effectively appraise the emotional state of others [18] and impairments in cognitive functions, i.e., inhibition, sustained attention, and executive planning [19]. Children with ADHD encounter many social problems, are generally less accepted by peers and lack social skills [20,21]. Factors related to emotional processing, and specifically deficits in emotion recognition, have been discussed to play a key role in the social problems encountered [22].

The 2007 National Survey of Children's health (NCSH) found that one third of the children diagnosed with ADHD had one comorbid condition, 16% had two and, nearly one fifth (18%) had three or more [23]. More specifically, 45% of children with ADHD received the comorbid diagnosis of Learning Disability, 27% Conduct Disorder, 18% Anxiety, 15% Depression and 12% Speech Problems. The respective percentages for children without ADHD were 5%, 2%, 2%, 1% and 3% respectively for the abovementioned disorders. In another study, Elia et al. [24] report the most common co-occurring conditions in children and adolescents with ADHD to be Oppositional Defiance Disorder (ODD) with a rate of 41%, Minor Depression/Dysthymia (MDDD) appearing 22% of the time, and Generalized Anxiety Disorder (GAD) with a rate of 15%. When it comes to learning and writing disabilities, 31% to 45% were diagnosed with a learning disability and ADHD [20]. Boys with ADHD were reported to have ~65% risk of having writing disabilities (compared to 16.5% of boys without ADHD) and girls 57% (compared to 9.4% of girls without ADHD) [25]. Despite researchers having increasingly noted the presence of autistic traits (ASD-like symptoms) in individuals with a primary diagnosis of ADHD [26], autism is not reported as a comorbid condition in any of the above-mentioned studies (nor in any published before 2013) as prior to DSM-IV a child could not be given the dual diagnosis of ADHD and ASD. The social difficulties thus observed in children with ADHD were interpreted as resulting from the symptoms of ADHD, could instead reflect qualitative impairments in the socio-communicative function of ASD [21-27].

ADHD, like other psychiatric conditions such as schizophrenia, is influenced by genetic factors, environmental factors, and the gene-environment interaction where genes can alter sensitivity to environmental risks [28]. A genetic overlap has been demonstrated in population-based studies between ADHD and autistic-like traits [29,30] with the genetic relation emerging when children are at the age of two and persisting until adulthood. The parietal lobes [31], frontal lobes [32], basal ganglia [33], cerebellum [34], and corpus callosum [35] have been consistently linked to cross-sectional anatomical imaging studies of ADHD. Imaging studies of brain physiology further support the involvement of the right frontal-basal ganglia circuitry with a powerful modulatory influence from the cerebellum. Dysfunction in brain areas that have been critically involved in affect perception such as the basal ganglia and prefrontal cortex have also been identified in imaging studies involving people with ADHD suggesting the prefrontal cortex having a predominant role in ADHD [36] with social cognition impairments in ADHD being consistent with a fronto-striatal dysfunction [37]. An open issue concerns the psychotherapeutic treatment on the social cognition impairments in ADHD. Whereas pharmacotherapy results in symptom reduction, it has been argued that psychosocial interventions, should ideally be attempted before or along the introduction of medications into children's treatment plan [38].

Autism Spectrum Disorder (ASD)

Autism was first described in 1943 by Kanner [39] as a complex biologically based disorder. Social deficits, repetitive behaviours, abnormalities in communication, and cognitive inflexibility predominate in ASD. Due to the absence of a distinct neuroanatomical abnormality and the lack of a specific biochemical indicator, the diagnosis of autism is based on the clinician's behavioural and clinical assessment. Poovathinal et al. [40] conducted a review on the global prevalence of autism based on epidemiological surveys conducted on several countries

worldwide. The review included a total of sixty-six epidemiological studies on autism published from 1966 to 2017. The authors found the prevalence estimate to be on incline in USA and Canada since 2003 (15 epidemiological studies were included in the review), with the most recent estimate from the US Center for Disease Control [41] showing a 15% increase in prevalence following the criteria of DSM-5 (APA, 2013) from 1 in 68 (prevalence rate 1.5%) in 2012 to 1 in 59 children (prevalence rate 1.7%) in 2014. Data from surveys conducted in UK, Scotland, and Ireland (12 epidemiological studies on autism) show the mean prevalence to be 9.4/10,000 with an increase in the prevalence having been noted since 2000 [40]. Regarding European countries (13 studies), there was an increase since 1999 with the mean prevalence being 7.3/10,000. Most studies included in Poovathinal et al. [40] were reported from several Asian countries; 14 from China, six from Japan and one from South Korea with the mean prevalence having been estimated to 15.8/10,000. The prevalence in Gulf countries (Kuwait, Oman, Saudi Arabia, UAE, Qatar and Bahrain) was 4.3/10,000 and in Africa 25.7/10,000, while in South America and west Asia 9.6/10,000 and 10.0/10,000 respectively. The global mean prevalence of autism based on the studies considered in the Poovathinal et al. [40] review was estimated to be 26.7/10,000 which was considerably lower compared to the prevalence of 61.9/10,000 reported for ASD in a systematic review conducted by Elsabbagh et al. [42]. Whereas Poovathinal et al. [40] considered in their review only prevalence reports on autism excluding spectrum conditions, Elsabbagh et al. [42] included all pervasive developmental disorders (PDDs), including autistic disorder. It is important to mention that in many regions of the world including Africa, prevalence estimates are either preliminary or unavailable, some well-controlled studies have reported figures substantially higher than the ones reported here [43,44], and the prevalence of ASD in many low- and middle-income countries is so far unknown.

At the present time, genes are thought to account for 7% to 8% cases of autism [45] with gene deletions, gene mutations, copy number variants (CNVs) and other genetic abnormalities having been linked to autism [46]. None, nevertheless, accounts for more than a small fraction of cases and while this fraction is expected to increase as genetic research advances, genetic factors will not be still able to explain key epidemiological and clinical features of autism, suggesting that early environmental exposures are also a contributing factor. Amygdala is a key brain structure in neurodevelopmental disorders [47]. On average, the amygdala appears to be initially larger in autistic than typically developed (TD) children but does not undergo the same preadolescent increase in volume that takes place in typically developing children. In 2009 Kleinhans and colleagues [48] found evidence of reduced amygdala habituation to faces in people with ASD, with the degree of reduction being related to the severity of their social impairments. It is the trajectory of amygdala development rather than the ultimate size nevertheless that seems to be most influencing factor [47]. With amygdala having a modulatory role in social behaviour, it also contributes to a network of brain structures involved in social cognition including facial emotion recognition [49].

The role of emotion in autism has been debated for the past 60 years with social reciprocity deficits being considered a core feature in ASD. The criteria for diagnosis according to DSM-5(APA, 2013) include persistent deficits in social communication and social interaction across multiple contexts including deficits in social-emotional reciprocity, deficits in nonverbal communicative behaviour used for social interaction and deficits in developing, maintaining, and understanding relationships; restricted, repetitive patterns of behaviour, interests, or activities and the presentation of symptoms in the early developmental period. Whereas currently no treatment has been shown to cure ASD-along with the pharmacotherapy available-several interventions have been developed and studied for use with young children. These interventions aim at reducing the symptoms, improving children's daily living skills and cognitive ability, and maximizing children's ability to participate and function in their environment [50].

Emotion recognition in ADHD and ASD: The trans-diagnostic factor

The construct of social reciprocity according to Constantino and Frazier [51] includes the constructs of: social communication (interaction), social awareness (understanding the appropriate way to react in social situations), social motivation (the desire to communicate and interact with others), social cognition (attributing perspective to others) and responding in an appropriate manner in social settings. As this article focuses on the emotion recognition skills and deficits in children with neurodevelopmental disorders and specifically autism and ADHD, we will focus on one's ability to recognize the emotions of others (i.e., interpreting emotional signals), which belongs to the social cognition component of social reciprocity.

The genetic, environmental, and developmental risk factors that ASD and ADHD share motivated the American Psychiatric Association to allow the concurrent diagnosis for these two conditions in the same individual for the first time (APA, 2013). Research has shown that many children with a primary diagnosis of ASD demonstrate symptoms of ADHD (estimates ranging from 31 to 95%) and 15-25% of children with primary diagnosis of ADHD have ASD symptoms [52]. Co-morbid ASD in ADHD is hence common and might potentially contribute to social cognitive impairment. It has been furthermore suggested that 50-72% of the contributing genetic factors in these two conditions overlap [53] and that *"both disorders are expressions of one overarching disorder, with ADHD being the milder expression"* [54].

Facial expressions have significant communicative functions; any changes in the facial muscles help disentangle meaning, control the conversational flow, provide information as to the speaker/listener's emotional state and inform about intention [55]. Understanding others' emotional facial expressions is a significant social-cognitive skill which helps to modulate one's behaviour: for example, is a friend frightened or excited at the sight of a dog, is an observer becoming upset or surprised by an act of bravado?

Abnormalities in the recognition of facial expressions have been associated with poorer prognosis in a range of psychiatric

conditions in both children [56] and adults [57] with researchers arguing for wide-reaching and long-term detrimental effects upon social behavior [58]. Although different child and adolescent clinical populations having been found with deficits in facial expression recognition such as children diagnosed with Down syndrome [59], schizophrenia [60], conduct disorders [61], ADHD [62], and depressive disorder [63], autism is perhaps the most widely studied area in terms of developmental psychopathology and emotional deficits. With ASD and ADHD being highly comorbid conditions with common aetiological mechanisms [64] and diagnostic symptoms, researchers have argued that facial affect processing deficits [65] and theory of mind [65] are also common in both conditions.

The authors of a meta-analytic review [66] which included 48 studies and 980 participants, found individuals with ASD to have deficits in emotion recognition where participant age, IQ and task's demand did not influence performance. All six emotions (fear, sadness, anger, disgust, surprise, happiness) showed negative effect sizes for people with ASD and for all emotions (i.e., fear, sadness, anger, disgust, surprise) but happiness the 95% confidence intervals were entirely in the negative range, suggesting that children and adults (mean age of participant's ranged from 6 to 41 years) with ASD experienced difficulties in the recognition of these emotions. In a systematic review focusing on children and adolescents with ADHD, the authors [67] analyzed results of 38 studies and found in a large amount of studies children with ADHD to have performed worse on facial emotion recognition than typically developing children. The authors argued children with ASD and ADHD to share similar social cognitive deficit patterns.

Bora and Pantellis [68] compared visual emotion recognition in ADHD and ASD and suggested that impairments were present in ADHD, although in potentially milder form than in ASD. Both clinical groups performed worse than typically developing children. The authors conducted a meta-analysis involving 17 studies comparing ASD with ADHD and 44 studies comparing ADHD with typically developing children. The authors found facial and vocal emotion recognition and theory of mind abilities to be significantly impaired in ASD with the most robust facial emotion recognition deficits to be evident in anger and fear. ADHD participants also performed significantly more poorly than healthy controls in ToM (d=0.45) and facial (d=0.44) and vocal emotion recognition(d=0.40). The authors also found, the emotion recognition deficits of participants with ADHD to be very subtle leading them to suggest that the general cognitive impairment contributed to the social cognitive deficits in ADHD.

A recent systematic review focusing on facial emotion recognition skills in children and adolescents with ADHD found that 18 out of 25 studies included in the review, reported deficits in emotion recognition skills compared to typically developing children. Across the studies fear was found to be the least recognised followed by anger, surprise, disgust, and happiness [69].

Sinzig and colleagues [65] employed the Frankfurt Test and Training of Social Affect (FEFA) [70] to assess facial affect recognition in children with autism and ADHD. The FEFA uses faces and eye-pairs as target material and comprises 50 photographs of faces and 40 photographs of eye-pairs according to the ''pictures facial affect'' and the six basic emotions of Ekman and Friesen [71]; happiness, sadness, fear, anger, disgust, and surprise. Participants of the study were 21 children with autism + ADHD, 19 with a diagnosis of autism only, 30 with only ADHD, and 29 typically developing children. The authors found facial affect recognition to be impaired in children suffering from ADHD symptoms only and, Autism + ADHD. Children with ADHD were impaired on both facial affect recognition and recognition of emotion from eye-pairs when compared to TD children. Children with Autism + ADHD were worse in the recognition of happiness (eye-pairs) and surprise (faces) when compared to both TD children and Autistic children. Children with ADHD scored lower on the recognition of happiness (eye-pairs) when compared to TD children.

Semrud-Clikeman et al. [72] found that children with ASD were worse at understanding emotional cues in a videotaped vignette compared to children with ADHD with both nevertheless performing significantly worse than typically developing children. Waddington et al. [73] conducted a study utilising factor mixture modelling with aim to study the heterogeneity and comorbidity of ASD and ADHD. Participants were children and adolescents with ASD (N=89), ADHD (N=111), comorbid ASD + ADHD (N=64), their unaffected siblings (N=69), and controls (N=220). Reaction time and accuracy of emotion recognition of visual and auditory emotion recognition were measured using the Identification of Facial Emotions (IFE) task and the Affective Prosody (AP) task from the battery of the Amsterdam Neuropsychological Tasks (ANT). The authors found emotion recognition impairments to be similarly frequent in ADHD as in ASD and ADHD + ASD with 23.8% of ADHD patients, 17.2% of ASD patients and 25.1% of patients with comorbid ADHD + ASD falling into the weakest performing class, i.e., the class with the highest symptom levels for ASD, ADHD, and related behaviors and the weakest visual and auditory emotion recognition abilities. Despite the mechanisms underlying poor emotion recognition in ASD and ADHD being possibly partly dissimilar, on a performance level both groups register poorly other people's emotional expressions hence social difficulties in daily life [73].

Oerlemans et al. [74] conducted a study assessing the recognition of facial emotion and affective prosody in children with ASD, ADHD and their unaffected siblings. Participants were 90 children with ASD (43 with and 47 without ADHD), 79 ASD unaffected siblings and 139 controls aged 6-13 years. Stimuli consisted of digitized photographs of a human face depicting either a neutral expression or one of eight different types of emotion (happiness, sadness, anger, fear, disgust, surprise, shame, contempt) and children were asked to judge whether the presented photograph showed the target emotion or not by clicking a mouse button. The authors selected for this study four target emotions: happiness, sadness, anger and fear. With regards to affect prosody recognition stimuli consisted of spoken sentences with a neutral content, presented through a headphone. Sentences were spoken in a happy, sad, angry, or frightened intonation. Children were asked to verbally identify the emotion with which the sentence was spoken. The results revealed that the recognition of both facial

emotion and affective prosody was impaired in children with ASD and aggravated by the presence of ADHD. A significant group effect was found for accuracy. Pair wise comparisons revealed a significantly worse performance of children with ASD compared to controls and analyses per emotion revealed a significantly worse performance of children with ASD and unaffected siblings compared to controls on the recognition of happiness. No group differences were found for accuracy on the other emotions. Significant group effects were also found for speed and analyses per emotion revealed significant differences between children with ASD and controls on happiness, sadness, anger, and fear, with ASD probands performing worse than controls. With regards to affective prosody recognition a significant group effect was found for accuracy and analyses per emotion revealed a significant group difference between probands and controls on the auditory recognition of sadness and between probands and unaffected siblings on the auditory recognition of anger. A significant group effect was found for speed and analyses per emotion revealed significant differences between ASD children and controls on the recognition of happiness, sadness, anger, and fear and between unaffected siblings and controls on the recognition of fear. The performance of unaffected siblings was at an intermediate level, as they performed somewhat worse than the controls and better than the children with ASD.

ASD patients have been suggested to demonstrate a primary emotion recognition deficit whereas patients with ADHD more general information processing difficulties [73]. Barkley [74] argued that while children with ASD show less knowledge of the correct social behavior compared to typically developing children (i.e., have knowledge deficits), children with ADHD have the knowledge but do not do what they know (i.e., have performance deficits). The result nevertheless is that on a performance level the emotion recognition deficits presented in both groups interfere in their everyday life social interactions [75].

Interventions and the humanitarian perspective of emotion recognition

As back as in 1977, the World Health Organization (WHO) recommended every country across with world having a National Plan for Child Mental Health. Despite the International Association for Child and Adolescent Psychiatry and allied Professions endorsing WHO's recommendation in 1992 [76], wide variations were noted in development of the related documents to the policies and programs. For example, among the 66 reporting countries only 6.3% of African as against 66.7% of European countries reported the presence of a child and adolescent mental health program and 0% of low income and 78% of high-income countries reported having a document related to policy on child and adolescent mental-health [77]. In the majority of countries outside of the Americas and Europe a system of services for child and adolescent mental health does not exist, the few services available are mostly based in hospitals, the presence of a child psychiatrist is in the range of 1 to 4 per million and the potential of having professionals trained in psychology, education and social work is not utilized for children and adolescents' mental health care [78]. Considering that research has found a strong link on the emotion recognition deficiencies in children with ADHD and ASD in studies conducted in the Western world, this section outlines some interventions developed throughout the years aiming for the improvement of children's affect recognition. Despite being out of the scope of the current paper to provide a review of the available interventions in children with ASD and ADHD, some of interventions focusing on children with ASD are outlined below as to serve as some examples.

Rice et al. [79] examined the extent to which FaceSay®, a computer based social skills intervention, could increase the affect recognition, understanding another's perspective, and social skills of school aged children with ASD. Participants were 31 children with autism ranging in age from 5 years to 11 years. The authors found a significant improvement in autistic children's emotion recognition skills post-intervention and a significant difference in post-test Theory of Mind score between the experimental and control groups. The experimental group furthermore showed increased positive interactions with peers, post intervention compared to children in the control condition.

Solomon et al. [80] implemented a 20-week, group-based program for children age 8-12 with ASD targeting deficits in emotion recognition, executive functioning, and Theory of Mind. Through didactic instruction and *in vivo* practice, the program focused on emotional awareness, empathy, conversational skills, non-verbal cues, and individual as well as individual and group problem solving. Compared to the wait-list control group, the authors found an increase in the problem-solving ability of children with ASD and an increased ability to recognize facial expressions. Similarly, [81] administered a group-based intervention focusing on the social skills of 46 teenagers aged 13-18 years old, where the 12-week training course (60-90 mins per week) the structured formal curriculum covered the importance of feelings, nonverbal cues, eye contact, negotiation, conversation skills, and social etiquette. The results indicated post intervention improvements in participants' social competence and decreased scores on measures of problem behaviors.

Williams, Gray and Tonge [82] recruited 55 children with autistic disorder, aged 4-7 years. Participants in the intervention group watched a DVD 'Transporters' designed to teach them emotion recognition skills whereas the control group watched a DVD of 'Thomas the Tank'. The Transporters was an animated and narrated children's television series consisting of 15 five-minute episodes portraying 15 key emotions, including the six basic emotions and nine more complex emotions and mental states (e.g. excited, unfriendly, proud, and jealous). Participants were assessed on their ability to complete basic emotion recognition tasks, mindreading, and theory of mind (TOM) tasks before and after the 4-week intervention period, and at 3-month follow-up. Children with autism showed improved performance in the identification and matching of the expressions of anger compared to the control group, with only the improvements in matching (but not in identifying) being maintained at follow-up.

Bauminger [83] reported on a school-based program delivered weekly to 15 students with HFA over the course of an academic year. The curriculum involved instruction in prerequisite social

concepts, affective education, and social-interpersonal problem solving targeting specific social skills. The authors found an increase in understanding simple and complex emotions between the pre and post assessments as well as significant improvements in problem solving ability.

Dadds et al. [22] conducted a randomized control trial in effort to assess "Emotion-recognition-training" (ERT) with treatment-as-usual (TAU). Participants were 195 children with mean age 10 years old and differential diagnoses (oppositional-defiant and conduct disorders, ADHD, autism, and anxiety and depression); 85 children were allocated to ERT and 105 to TAU. The Emotion Recognition Training (ERT) consisted of the Mind Reading [84] program for training children to accurately perceive and interpret human emotions, embedded in daily parent–child interactional exercises. The program ran for 90 min sessions during which time the therapist worked through the computerized Mind reading program with each child. Analyses on facial emotion recognition found no significant difference between the two groups (ERT and TAU) for facial emotion recognition. The authors nevertheless found the intervention to produce a significant improvement in children with high levels of callous-unemotional (CU) traits; callous-unemotional (CU) traits comprise a temperament dimension characterized by low empathy, interpersonal callousness, restricted affect and a lack of concern for performance [85].

Stitcher et al. [86] assessed the developmental and initial administration of a group-based Social-Competence Intervention (SCI) which targeted the difficulties in the knowledge or correct performance of social skills in 27 children age 11-14 with high functioning autism/Asperger syndrome. The Social Competence Intervention was based on CBI principles and the curriculum addressed participants' idiosyncratic ways of perceiving and understanding emotions, deficits in theory of mind and challenges to executive functioning that inhibit socially competent interactions with others [80]. SCI included five units (each comprised of four-1-h lessons), which were taught in two-week increments. The Diagnostic Analysis of Non-Verbal Accuracy-2, Child Facial Expressions [87] was used to assess emotion recognition accuracy utilizing photos of children. According to the results participants demonstrated a greater ability to correctly identify the emotional state of a pictured child and improvements in their ability to accurately label someone's emotional/mental state by only viewing at the person's eyes.

Ramdoss et al. [88] conducted a systematic review with aim to assess the effectiveness of computer-based interventions (CBI) in the social and emotional skills (e.g. emotional recognition) of individuals with autism spectrum disorders (ASD). Eleven studies involving 12 experiments and a total of 330 participants were included in the review with participants mean age being 13.5 years of age. Positive results were obtained in all studies that assessed the effect of CBI on social skills, with the experimental measures developed by researchers yielding positive results more often and larger effect sizes than standardized, norm-referenced measures. Insufficient information was, nevertheless, provided as to generalization of skills acquired during CBI to real life situations and additional contexts. In 2017 Berggren and colleagues [89] systematically assessed challenges related to generalizability in emotion recognition training in children and adolescents with ASD. 13 studies were included in the review where, participants were predominantly boys with an age span from 4 to 18 years across studies. Despite several studies having indicated that training may improve children's emotion recognition skills, the lack of long-term follow-up assessments and the sparse use of observations in real-life situations led the authors to argue that it is still largely unknown to what extent training effects can be translated to daily social life.

Discussion and Conclusion

Albeit neurodevelopmental disorders being defined as discrete entities in DSM-V (APA, 2013) empirical evidence indicates a high degree of overlap among them. Reports have been published for social cognition and specifically emotion recognition, to be impaired in many disorders including ADHD and ASD as well as disorders that these conditions are comorbid with. Children with ADHD are impaired in a similar manner as many children diagnosed with ASD, with several lines of evidence indicating that these two conditions share common impairments in facial affect recognition and theory of mind. This article took as example the interventions available for children with ASD to show that results are promising. Studies indicate that individuals with ASD could benefit from increased access to emotion recognition training as without intervention, the emotional and social deficits observed in both populations (the feature common in both conditions, i.e., the transdiagnostic feature) can affect children's quality of life in numerous ways, including but not limited to isolation and social rejection. Although, a review of available interventions in both populations was out of the scope of the current review and despite the identification of issues regarding the generalizability of the findings, we would like to stress with this article that considering the high rates of ADHD and ASD across the globe and the trans-diagnostic feature of emotion recognition across these conditions, simple (or complex if applicable) interventions targeting the social cognition domain of children and adolescents in particularly the underdeveloped countries, should remain on volunteers' agenda and communicated either directly to groups of children or the health care/educational personnel (following the train the trainer approach) residing there.

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