

Alexithymic and autistic traits in children and adolescents: A systematic review of the current state of knowledge

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Potheini Vaiouli¹ , Olivier Luminet² and Georgia Panayiotou¹

Abstract

Research evidence suggests that heterogeneity in emotion processing difficulties in autistic individuals may reflect co-occurring alexithymia. Elevated levels of alexithymia is a robust finding in the adult autistic population but there is a relative poverty regarding the corresponding research in younger populations. The aim of this review is to investigate associations between autism and alexithymia in children and adolescents, so that we can better understand the nature and impact of alexithymia in autistic individuals early on in their lives. Online scientific databases were systematically reviewed for studies on autistic children and adolescents and co-occurring alexithymia. A total of eight studies were identified. Evidence indicated that alexithymia prevalence in autistic individuals is higher compared to their typically developing peers and is closely related to the emotional and social deficits involved in autism but not to the associated cognitive deficits. Main concerns associated with these results are related to the alexithymia assessment measures implemented in each study, their limitations, and potential effects on the validity of findings. This review sheds light on the topic of alexithymia in children and adolescents and underscores the difficulties in conducting this research, while providing insights for research with autistic children and adolescents.

Lay abstract

In this study, we aim to explore the ability of autistic children to process emotions and respond to a range of feelings in relation to a triad of difficulties known as alexithymia, namely children's difficulties to recognize, describe, and distinguish emotions. Alexithymia is common in autistic adults but we know very little about children. To understand this condition better, within a large group of studies, first we study the extent to which alexithymia difficulties are present in autistic children. In reviewing the literature, we also present the assessment measures implemented in each study, their limitations, and potential effects on our understanding of findings. This knowledge will help us understand the extent to which alexithymia is present in autistic children and how it may be related to their emotional difficulties. Also, it will allow us to further detect challenges early on in children's lives so that we recommend interventions that teach autistic children how to recognize, describe, and distinguish emotions in themselves and in others. Such interventions may include family members of autistic children to assist interactions with their child. Supporting children from an early age will help them develop skills that will ready them for school and life and it will enhance their ability to build supportive relationships and meet their fullest potential.

Keywords

alexithymia, autism, children and adolescents, psychometric and assessments

Alexithymia is a multifaceted personality trait in the general population with a dimensional nature (Bagby, Parker, & Taylor, 1994) that negatively impacts affective processing, emotion regulation, and the interpretation and recognition of emotional stimuli (both verbal and nonverbal). It is characterized by three main features: (1) difficulty identifying and describing feelings, (2) difficulty distinguishing between feelings and the bodily sensations, and (3) externally oriented thinking. Since its conceptualization by Sifneos (1973), there has

been a growing interest in its etiology and its strong association with a variety of medical and psychiatric disorders, including autism (Porcelli & Taylor, 2018).

¹University of Cyprus, Cyprus

²UCLouvain, Belgium

Corresponding author:

Potheini Vaiouli, Center for Applied Neuroscience, University of Cyprus, Central Campus (Kallipoleos 75), Nicosia 1678, Cyprus.
Email: vaiouli.potheini@ucy.ac.cy

Autism spectrum disorder (ASD), which is the focus of this work, is a complex neurodevelopmental disorder characterized by a continuum of traits associated with decreased social and emotional competencies (APA, 2013). Although the types and intensity of socio-emotional deficits do not appear to be universal within autistic individuals, emerging evidence suggests that heterogeneity in emotional difficulties may be driven by alexithymia (Bird & Cook, 2013). Elevated levels of alexithymia is a robust finding in autistic adults, with prevalence rates in these samples between 65% and 85%, compared to 10% within the general population (Bird & Cook, 2013; Brewer et al., 2015; Hobson et al., 2020). Systematic reviews exploring alexithymia in autism (Kinnaird, Stewart, & Tchanturia, 2019), along with studies controlling separately for both alexithymia and autism, have indicated that alexithymia is a better predictor than autism for the difficulties shown by autistic individuals in recognizing the emotional content of verbal, auditory, and visual stimuli (Allen, Davis, & Hill, 2013; Cook, Brewer, Shah, & Bird, 2013), in emotion regulation (Costa, Steffgen, & Samson, 2017; Weiss, Thomson, & Chan, 2014), interpersonal relationships (Milosavljevic et al., 2016; Spitzer, Siebel-Jürges, Barnow, Grabe, & Freyberger, 2005), and recognizing complex emotions, including happiness, surprise, and fear (Shamay-Tsoory, 2011; Uljarevic & Hamilton, 2013).

However, in spite of the promise inherent in this research area for understanding the emotional and social challenges of autistic individuals, there is a relative poverty regarding the corresponding research in younger populations, that is, children and adolescents (following the World Health Organization (WHO) definition, adolescents corresponds to the period of development roughly between the ages of 10 and 19 years). This constitutes an important gap given the need to ultimately establish the developmental path that links these two traits. Hence, the aim of this review is to investigate associations between autism and alexithymia in children and adolescents, so that we can better understand the nature and impact of alexithymia in autistic individuals early on in their lives. In the following sections, we review research that explores the link between alexithymia and autism, specifically focusing on children and adolescents, to understand better whether there is a downward extension of the strong association established between autism and alexithymia in adults. First, we point to some of the reasons that may have hindered research progress in this domain. Then, in reviewing the literature, we briefly consider the assessment measures implemented in each study, their limitations, and potential effects on the validity of findings. As such, we envision to shed light on the topic of alexithymia in children and adolescence and underscore the difficulties in conducting this research, while we identify points of relevance specifically for future research in autism.

Alexithymia research in autistic children and adolescents

The unexpectedly limited number of published articles in alexithymia among autistic children and adolescents is potentially related to a number of conceptual and methodological factors that may have decreased researchers' enthusiasm about this topic. Reasons that may have caused skepticism among the scientific community include the absence of well-accepted tools for assessing alexithymia in children and adolescents, along with considerations around the construct of alexithymia in younger individuals (see the studies by Bermond, Oosterveld, & Vorst, 2015; Karukivi & Saarijarvi, 2014; and Parker, Eastabrook, Keefer, & Wood, 2010) who may not yet have developed the capacity to be aware of and clearly report on their affective experiences. With regards to testing, there are no established measures that are widely accepted for measuring alexithymia in young people, in a way that clearly captures the same construct as in adults.

Pertaining to alexithymia research specifically in younger autistic individuals, another important consideration has been the overlap between alexithymic and autistic traits. A growing body of research indicates that emotion processing abnormalities in autistic individuals may be explained by co-occurring alexithymia—widely known as the “alexithymia hypothesis” (Bird & Cook, 2013). However, the similarity between the two traits raises questions of multi-collinearity, that is, of measures of autism and alexithymia essentially measuring the same construct, which then cannot be used as explanations of each other.

Based on an initial scoping review, the few studies that have addressed the association between alexithymia and autism in children and adolescents, cumulatively suggest that the link between the two constructs is strong, and that alexithymia could have the same negative consequences in childhood and adolescence as in adulthood (Loas, Braun, Delhay, & Linkowski, 2017). Kinnaird and her colleagues (2019) conducted a meta-analysis to explore alexithymia in autism including both adolescents and adults in their sample (mean age range: 15.33–37.35 years). They reported 49.93% prevalence of alexithymia in the total sample of autistic individuals compared to 4.89% in neurotypical individuals, with possible associations between high levels of alexithymia and symptom severity in groups of autistic adolescents and adults (Kinnaird et al., 2019). Similarly, Oakley and her colleagues (2020) reported that 29.1% of their autistic participants (ages 12–30 years) met the cut-off for clinically relevant alexithymia compared to 4.4% of comparison individuals. Unfortunately, this as well as several of the studies reviewed in the Kinnaird meta-analysis, do not report findings separately for children, adolescents and adults so as to have an overall understanding, and formal comparison, of the degree of association in the different age groups. Finally, research focusing on adolescents and

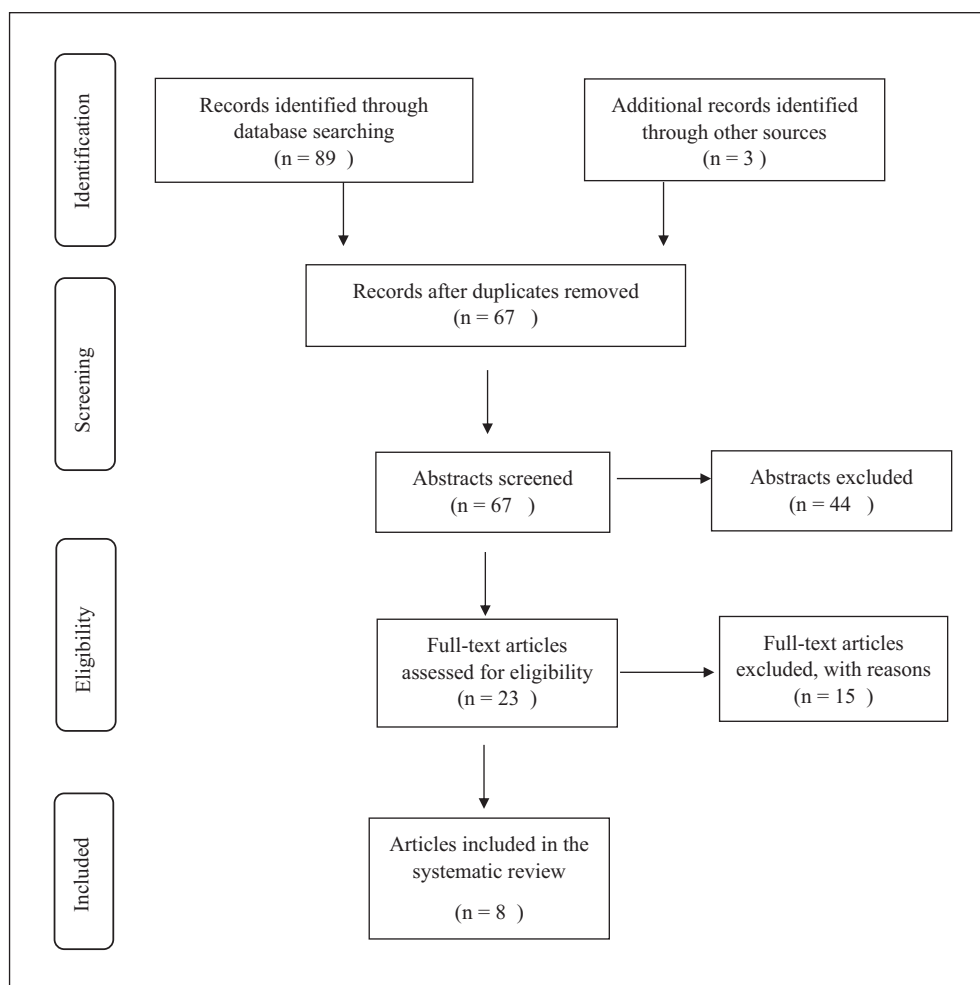


Figure 1. Flowchart of the study selection process.

children with autistic and alexithymic traits has indicated that, similar to the adult population, alexithymia is more prevalent among autistic adolescents and children compared to their typically developing peers (i.e. 55% vs 16% in Milosavljevic et al., 2016) on both self- and parent-report measures (Griffin et al., 2016).

In the following sections, we review the limited research that exists on alexithymia in autistic children and adolescents within the autism spectrum, with the aim to identify the possible connections between alexithymic and autism characteristics. Toward this direction, we consider evidence on the total scores of alexithymia scales versus a facet approach in the existing literature, we describe the degree of association where possible and call for further research in domains that would shed further light on this topic.

Methods

The study was conducted according to PRISMA guidelines (Moher, Liberati, Tetzlaff, & Altman, 2009) and we followed the 27-item checklist (Supplemental

Appendix A) and the four-phase flow diagram (Figure 1) to ensure transparent reporting in the systematic review.

Information sources and search strategies

Electronic searches. To identify studies that examined the impact of alexithymia in autistic children and adolescents, we conducted a literature search using a series of pre-determined keywords. PsycINFO, EBSCO, EMBASE, and Scopus databases were searched from inception to December 2020, with the goal to identify studies that investigate alexithymia and autism in younger age groups. The search terms were categorized in the following areas: (1) alexithym*, (2) child* & adolescent*, (3) autism*, (4) measure*, and (4) assess*s. The following equations: Alexithym*AND (autism*) AND (assess* OR measure*) were included in titles or abstracts and/or the body of the article. Search terms replicated those used in previous studies exploring the impact of alexithymia in autistic children and adolescents.

Table 1. Data from studies on alexithymia and autism included in this review..

| Authors | Participants | | Focus | Measures | |
|---|--------------|----------------|---|----------------------------|----------------------|
| | N | Age (years) | | Alexithymia | Autism |
| Arellano et al. (2018) | 39 | 14–17.9 | Gaze behavior | TAS-26 BVAQ-AB | N/A |
| Costa, Steffgen, & Vögele (2019) | 35 | 3–13 | Parent–child interaction | AQC | ADOS ADI |
| Costa et al. (2017) | 48 | 3–13 | Expressive incoherence | AQC | ADOS, ADI |
| Griffin, Lombardo, & Auyeung (2016) | 25 | 8–13 | Alexithymia traits in ASD | CAM-PR CAQ-SR TAS-20 | AQ child SRS2 |
| Kloosterman, Parker, & Summerfeldt (2009) | | M = 18 | Traits of alexithymia and ASD | TAS 20 | AQ |
| Milosavljevic et al. (2016) | 12 | M = 16 | Internalizing, social cognition, sensory modulation | TAS-20 | ADI-R; ADOS-G SRS |
| Schaller & Rauh (2017) | 47 | 14–17.11 | Social cognition | TAS-26 | ADOS ADI-R SRS |
| Trevisan, Bowering, & Birmingham (2016) | 35 | 7–11 and 12–13 | Emotional facial expression | CAM-PR | AQ |

TAS: Toronto Alexithymia Scale; BVAQ-AB: Bermond–Vorst Alexithymia Questionnaire; N/A: not available; AQC: ADOS: Autism Diagnostic Observation Schedule; ADI: Autism Diagnostic Interview; ASD: autism spectrum disorder; CAM-PR: Children's Alexithymia Measure parent-report; CAQ-SR: Children's Alexithymia Questionnaire self-report; AQ: Autism Spectrum Quotient; SRS: Social Responsiveness Scale; ADI-R: ADI-revised; ADOS-G: ADOS-generic.

Community members were not involved in this review.

Other searches

Once the relevant articles containing the search terms were identified, another search was conducted by the first author, in which she followed reference lists and citations from the identified articles to locate any additional articles relevant to the topic of interest.

Eligibility

Inclusion criteria. Inclusion criteria were (1) full text available in English, (2) published in a peer review journal, (3) including empirical findings on alexithymic and autistic children and adolescents, (4) including at least one direct scale for measuring alexithymia (compared to assessing emotional awareness or other related constructs), (5) participants under 19 years of age. The age range was decided as such to specifically capture research conducted within the special focus of this review—that is, explore alexithymic and autistic traits in children (3–13 years age group) and adolescents (14–19 years age group). The cut-off age range was decided following the WHO (2000) definition of adolescents as individuals in the 10–19 years age group.

Exclusion criteria. Articles were excluded when: (1) the study did not clearly indicate that the sample included autistic participants, (2) it did not include at least one alexithymia measure, and (3) participants were older than 19 years of age. For studies with a sample that straddled

this cut-off (i.e. 18–24 years) a decision was made to exclude them from this review, unless the participants had a mean age of 19 years or younger. In these cases, we decided to specify, where possible, the findings separately for the sample of interest (under 19 years of age). Reviews and position articles were excluded from this review. Interestingly, there seems to be a growing interest in exploring alexithymic traits in caregivers of children with autism, having the child's diagnosis as a variable. In these studies, children's alexithymic traits were not assessed and thus they were excluded from this review.

Selection process

The selection process is summarized in Figure 1. After excluding duplicates, the titles of articles were screened for relevance. Abstracts of titles, which appeared to meet the criteria were then screened. Full texts were retrieved if the abstract indicated that inclusion criteria were met, or if there was no sufficient information in the abstract to warrant a decision. Full texts were reviewed and those that did not meet the inclusion criteria were excluded with reasons.

Data collection. The following data were extracted from each study: authors, year of publication, sample characteristics (sample size, gender, and age of the participants), alexithymia measures, autism diagnosis, additional autism measures, type of article, and main question of the study. They are summarized in Table 1.

Results

The initial search identified 67 unique articles. After screening (see Figure 1 for search process), a total of eight articles were found to meet the eligibility criteria. Table 1 describes the characteristics of the studies included in this review, focusing on the characteristics of the participants, the aim of the study, and the measures implemented for assessing both alexithymic and autistic traits. These studies were reviewed using the following three categories, which were identified based on the studies' foci and results: (1) correlations between autism, its core characteristics, and alexithymia; (2) emotional difficulties and the presence of alexithymia; and (3) production and categorization of emotions. Regarding the age range of the participants, four of the studies included older adolescents in their sample (14 to 17 years of age). Only three of the studies included children in their sample, with an age range of 3–13 years, indicative of the limited amount of research in this age range. One study included young adults (Kloosterman et al., 2009). A decision was made to include this study because the mean age of the participants was below 19 years, ($M_{\text{age}} = 18.40$; $SD = 0.66$) although no information could be extracted separately for those participants below 19 years of age.

To measure alexithymia, six out of the eight studies used only one assessment measure and for three of them, that measure was Toronto Alexithymia Scale-20 (TAS-20). Milosavljevic et al. (2016) used the TAS-20 along with the parent-rated Social Responsiveness Scale (SRS; Constantino et al., 2003), but the latter is not an alexithymia measure. Arellano and her colleagues (2018) used TAS-20 along with Bermond–Vorst Alexithymia Questionnaire (BVAQ-AB), an instrument that has not been validated for adolescent population yet. Only Griffin and his colleagues (2016) implemented a battery of both self-report and parent-report measures specifically designed to assess alexithymia in children. As noted above, the variety of assessment tools of alexithymia utilized reflects the absence of a validated “golden standard” for adolescents and children. The TAS-20 was developed for adults, and its validity for younger populations, especially children under the age of 13, has not been empirically established (see the study by Loas et al., 2017). The terminology is not adapted to be age-appropriate, and the concepts assessed are abstract, with no evidence that they can be understood by young children in the same way as by adults (Parker, Eastabrook, Keefer, & Wood, 2010). Similarly, the tools used by Griffin et al. (one self-report and one parent-report alexithymia scales) are specific to children and adolescents but they have been used little beyond the studies that developed them, while it is unclear if parent measures are appropriate for describing alexithymia in one's children. The absence of

well-established and accepted measurement methods of alexithymia in children and adolescents (with or without autism) should introduce some caution in the interpretation of the results that follow.

Correlations between autism, its core characteristics, and alexithymia

Four of the studies included in this review (see Table 1 for details) reflected a growing interest in the shared and unique characteristics of alexithymia and autism in younger age groups. For this purpose, a battery of self- and other-report measures were implemented to explore associations between alexithymia and the emotional development of children in the autism spectrum as well as explore alexithymia and autism as a continuum of traits that inversely affect social and emotional competencies of children. Beyond the total scores on alexithymia, three of these studies (Kloosterman et al., 2009; Milosavljevic et al., 2016; Schaller & Rauh, 2017) also reported on their participants' scores on the three subscales of alexithymia, as measured by TAS-20 and TAS-26 when presenting the significantly higher alexithymia scores for the autistic groups compared to their control groups. The results are similar to the ones found in the adult literature: Children and younger adolescents that scored higher on autistic traits also scored higher on alexithymia, irrespective of measure utilized, compared to the participants classified low in autism (Griffin et al., 2016; Kloosterman et al., 2009; Milosavljevic et al., 2016). All three studies reported significantly higher alexithymia scores for the autistic groups for the two subscales of alexithymia (Difficulty Identifying Feelings, Difficulty Describing Feelings) but not for the third one, that is Externally Oriented Thinking.

Two studies took the important step of reporting specific associations between alexithymia and specific aspects of autism, including (1) theory of mind abilities, (2) social cognition, and (3) social–emotional processing abilities. Significantly elevated levels of alexithymia were found in relation to social–emotional processing abilities (emotion cognition and impaired emotion recognition) in the autistic groups (Milosavljevic et al., 2016; Schaller & Rauh, 2017). These findings suggested that within the groups of autistic individuals (1) alexithymia total scores were associated with poorer emotion recognition abilities but not with theory of mind ability (Milosavljevic et al., 2016); (2) statistically significant differences emerged between alexithymic and non-alexithymic participants on the social, imagination, and communication domains of autism, but not on the attention to details and restricted interests domains, as measured through the Autism Spectrum Quotient subscales (Kloosterman et al., 2009); and (3) alexithymic participants with autism compared to their typically developing peers

presented statistically significant differences on their social responsiveness abilities (total score and subscales of the Social Responsiveness Scale; SRS: German version: Bolte and Poustka, 2008) but not on their theory of mind abilities (Schaller & Rauh, 2017).

Collectively, though scarce and derived from different samples and methodologies, this evidence indicates that alexithymia is closely related to the emotional/social deficits involved in autism but not to the associated cognitive deficits. That is, the significance of alexithymia total scores together with the two emotional facets (difficulty identifying feelings and difficulty describing feelings) pinpoints to the associations with the emotional deficits of autistic individuals while lack of significant evidence on the externally oriented thinking facet weakens the associations between alexithymia and cognitive challenges of autistic individuals. This is in line with the conceptualization of alexithymia as pertaining to emotional difficulties. However, it is important to note that the age range of the participants (mostly younger adolescents with only one study including children 8–13 years of age), and the use of adult, self-reported scales posit some limitations to the findings. Also, an important next step would be to explore further specific facets of alexithymia in relation to autistic traits, beyond the total alexithymia and autism scores. That would allow to study the co-occurrence of the two constructs with emphasis on their respective facets and dimensions and the individual differences that emerge. Finally, the focus on the trajectory of alexithymia traits in younger individuals may be strengthened by exploring the trajectory of alexithymia in children and adolescents along with the ability of autistic children and adolescents to validly respond to the alexithymia measures.

Emotional difficulties and the presence of alexithymia

Emotional difficulties of autistic children in identifying and expressing emotions are well established in the literature. Costa and her colleagues (2017, 2019) conducted two different studies to explore the role of alexithymia in the emotional abilities of children (3–13 years old) with and without autism. Alexithymia was assessed through an adaptation of the self-report Alexithymia Questionnaire for Children (AQC: Rieffe, Oosterveld, & Terwogt, 2006), which was reformulated to be parent-reported. The authors also included well-established autism measures (Autism Diagnostic Observation Schedule (ADOS) and Autism Diagnostic Interview (ADI)). In the first study (Costa et al., 2017), children's facial expressions were coded during frustration eliciting episodes to measure children's emotional reactivity and their levels of expressive incoherence. In the second study (Costa et al., 2019), frustration eliciting episodes between children and their caregivers were coded to measure (1) children's use of adaptive

emotion regulation strategies during interactions with their caregivers, and (2) different patterns of parental engagement (passive or interactive) with their children. The authors explored in which way alexithymia influenced the occurrence of this incoherence and its role in parent–child interactions and in aspects of autistic children's emotion regulation abilities. This work provides significant preliminary evidence on the elevated levels of alexithymia among autistic children and on the moderating role of alexithymia in autistic children's emotional difficulties, including emotion reactivity (levels of expressive incoherence) and emotion regulation. More importantly, this work adds to a growing body of research of the last decade exploring the prevalence of alexithymia in autistic children.

Specifically, analyses on group differences between the autistic and the typically developing groups (Costa et al., 2017) revealed that autistic children were reported by their parents as having more and statistically significant differences in the two emotional facets of alexithymia (describing and identifying feelings) than the control group. That is, consistent with previous work on autistic adults, the study provided evidence according to which children's difficulties related to emotional challenges are better explained by alexithymia than children's diagnostic status. The findings also indicated that alexithymia played a moderating role in the emotional response incoherence of autistic children compared to the control group (Costa et al., 2017). Expressive incoherence is well-documented in autism and is implicated in socio-emotional communicative problems. In their study, emotion incoherence was defined as the mismatch between the valence of the behavior and the valence of the expressed emotion occurring simultaneously. Specifically, evidence suggested that alexithymia moderated the occurrence of positive facial expressions during negative behaviors (Costa et al., 2017). Furthermore, in their second study (Costa et al., 2019), the authors identified that children's levels of alexithymia total score significantly predicted parenting practices (interactive or passive) beyond diagnostic group. In their interpretation of the results, the authors concluded that children's alexithymia reduces parent–child interactions, which in turn affects the development of children's emotional abilities (Costa et al., 2019).

Overall, these findings suggest that alexithymia has a unique contributing variance to the emotional/interpersonal difficulties of autistic children. Undoubtedly, their choice of well-established autism measurement strengthens the findings of the two studies. However, the parent-report measure (AQC-P; CITE), which was used in both studies for measuring alexithymia, was initially designed as a child-report measure and was tested with children of older age than the participating children in this study (Mean age: 11 years compared to this sample of 3–13 years). Still, the results of this study contribute to the

discussion of how the emotional and social abilities of autistic children can be improved by targeting children's alexithymia, including during dyadic (parent-child) interactions.

Production and categorization of emotions

Trevisan and his colleagues (2016) explored the alexithymia hypothesis (Bird & Cook, 2013) as a potential explanation of abnormal production of spontaneous facial expressions in children (7–11 years old) with and without autism. Alexithymia was assessed using the Children's Alexithymia Measure (CAM); the production of spontaneous facial expressions was examined through an automated facial analysis software, while the children watched emotionally salient video stimuli. In the study, higher alexithymia scores were associated with reduced expression production and more neutral expression. Also, consistent with the adult literature, participants in the autistic group scored higher on alexithymia compared to the participants in the typically developing group. Overall, the findings, consistent with the alexithymia hypothesis, suggested that alexithymic traits, but not autistic traits, predicted variance in participants' facial expression production (Trevisan et al., 2016).

Similar results were yielded by the Stylized Animations for Research on Autism (SARA: Arellano et al., 2018) project, which combined three-dimensional (3D) facial animation, eye-tracking, and non-photorealistic rendering (NPR) algorithms to investigate emotion perception deficits in adolescents (14–17 years old) with high functioning autism during a facial emotional categorization tasks, replicating the work of Bird et al. (2010). Alexithymia was assessed through a combination of adult, self-report alexithymia measures: the TAS-26 and the BVAQ (Vorst & Bermond, 2001).

The results partially supported the hypothesis that autistic adolescents show higher levels of alexithymia, but only when the TAS-20 was used (no group differences on the BVAQ-AB), which underscores the potential effects of the assessment tools utilized on findings. Also, alexithymia had only limited or no influence on the gaze behavior of the participants—results that did not reproduce the ones from Bird et al. (2010), something that was attributed potentially to the measurement method by the authors.

Discussion

Findings of the current review reflect the state of the art and limitations in the research on alexithymia in autistic children and adolescents. Despite the methodological challenges in the aforementioned studies, it is important to note that all work included in this review is consistent with previous findings on alexithymia and autism for adults (Liss, Mailloux, & Erchull, 2008). The reviewed studies provide significant preliminary evidence on the elevated

levels of alexithymia among autistic children and adolescents as well as on the moderating role of alexithymia in emotional difficulties, with alexithymia contributing unique variance to autistic children and adolescents' emotional/interpersonal difficulties. Although the results are still limited and uncertain, given the diversity in methods, tasks, and especially measurements of alexithymia utilized, they suggest a downward developmental trajectory of the association between autism and alexithymia, with important clinical implications for younger autistic individuals.

However, the small number of studies and the almost universal practice to implement only one measure (either a self-report or an observer-report one) to assess alexithymic traits, limits our ability to review the existing data for children in terms of structure and factors, and explore how these may reflect on their accuracy to capture alexithymic core elements in children with and without autism. Also, the literature on alexithymia in children and adolescents vastly lags behind the corresponding literature with adults, which has been able to provide much needed validation of alexithymia and its sub-facets through correlations with behavioral, cognitive, and emotional tasks.

Regarding measurements, TAS-20 is the most common choice for assessing alexithymia, a choice that has benefits due to the excellent properties and widespread use of this tool in adults, but has been criticized because this is an adult measure that needs further exploration before it is safely used with younger individuals (see the study by Parker et al., 2010). One of the studies implemented the TAS-26, which preceded the development of TAS-20 and is no longer commonly used in the literature for adults. Two studies implemented the AQC (Rieffe et al., 2006) and the Alexithymia Scale for Children (ASC; Fukunishi, Yoshida, & Wogan, 1998), respectively, which are two self-reported measures that were designed following the TAS-20 structure. Finally, only one study implemented the CAM measurement (Way et al., 2010), an observer-report measure to assess alexithymia in children with a uni-dimensional structure, in combination with a self-report measure (ASC; Fukunishi et al., 1998). Creating, standardizing, and using these assessment tools substantially in more research, and also better establishing their utility through cross-associations with behavioral indices of the alexithymia construct is expected to enhance our understanding on the trajectory of alexithymia in autistic individuals with important clinical and research implications.

An additional limitation of the existing research is the low level of granularity regarding the constructs of interest. Only a handful of studies have examined facets of alexithymia beyond the total score obtained from the assessment tool utilized and provided associations with specific facets, emotional abilities, and difficulties making up the ASD diagnosis. This is, in part, again due to the diversity of alexithymia aspects measured by the child scales, the low reliability, and the difficulty in defining

some less observable aspects of alexithymia in young children. However, given the poor results in clearly establishing the alexithymia factors in younger ages and the fact that use of the total score of alexithymia is the most frequently used approach in the adult literature, the recommendation to use only the total of child-oriented measures of alexithymia may help increase reliability for this age group as well, until more information becomes available. Still, that would weaken research in the field, as the facet approach allows to link better the deficits to specific ways of processing emotions (Luminet et al., 2021).

Appropriate early identification of alexithymic traits in autistic children may provide us with important insights on the interplay of the two conditions and the moderating or mediating role of alexithymia in children's emotional abilities. If, as suggested by the alexithymia hypotheses, many of the difficulties of children with ASD can be explained by alexithymia, this provides specific targets for treatment that may prove promising. Also, if alexithymia only explains emotional deficits in a subgroup of autistic children, this may help explain some of the heterogeneity in autism. Furthermore, once the association between alexithymia and autism is clearly established in children and adolescents, we can begin to explore and understand areas where the adult literature is far ahead, but the child literature has barely touched. Domains that have been of importance in the adult literature include alexithymia as a trans-diagnostic disorder and the need for exploring simultaneously biological, cultural, and psychological perspectives of alexithymia to integrate emotional, cognitive, and behavioral dimensions within the same study (Luminet, Bagby, & Taylor, 2018). Other areas that have been of importance in the relevant adult literature and remain entirely understudied in the children and adolescents literature include multi-method approaches with rigorous experimental methods that explore the interplay between gene and environment to further understand the variance within the alexithymic population.

In conclusion, existing studies on alexithymia in autistic children and adolescents are few and limited by certain methodological and conceptual aspects. These mainly relate to the characteristics of the available measures for assessing the alexithymia construct in children and the age range of the participants in the studies. Therefore, there are limited opportunities to review the existing measurements for children in terms of structure and factors and explore how these may reflect on their accuracy to capture alexithymic core elements in children with and without autism. Because of the high prevalence of alexithymia within the adult autistic population, the initial evidence reviewed here deserves to be replicated and extended with larger epidemiological studies, experimental studies to identify the common mechanisms, and developmental, longitudinal studies that will demonstrate how these traits develop and overlap in children and adolescents. We recommend that

further research is devoted to this topic and that efforts are initially dedicated to the validation of tools that are appropriate for this age group to help examine the relation of alexithymia to ASD core social–emotional deficits in young children as well as the developmental course of the association between the two traits.

Declaration of conflicting interests

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ORCID iD

Potheini Vaiouli  <https://orcid.org/0000-0002-6651-8633>

Supplemental material

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