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Posted Date: 22 January 2025

doi: 10.20944/preprints202501.1670.v1

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 doi:10.20944/preprints202501.1670.v1

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Schizotypal Traits in Children with Autism Spectrum Disorder and the Impact on Social, Emotional and Behavioral Functioning

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Abstract: Background: Schizotypal traits are considered to be clinical and cognitive features of Schizotypal Disorder in children (SDc). These traits are also seen in children and adolescents with high-functioning Autism Spectrum Disorder (ASD). This study examines the influence of schizotypal traits (and their severity) on the capacity of children with ASD to manage emotions, develop relationships with others and adapt in school and family life. **Methods:** The Schizotypal traits of 63 children (6-12 years old) with High Functioning ASD were measured by the Melbourne Assessment of Schizotypy in Kids (MASK). Parents and teachers of the participating children completed the Child Behavior Checklist (CBCL) and Teachers' Report Form (TRF) from the Achenbach System of Empirically Based Assessment and the Aberrant Behavior Checklist (ABC). **Results:** Overall, the results indicated significant correlations between the MASK scores and problems recorded by teachers, such as Internalizing problems (i.e., Anxious/Depressed, Withdrawn/Depressed, & Other problems score) according to TRF and Inappropriate speech score, according to teacher's ABC scales. Schizotypal traits impact the social, emotional, and behavioral functioning of children with ASD at home and school environment. **Conclusions:** The assessment of schizotypal traits in children with ASD provides critical information about a child's functionality and cognitive development, also leading to identification of potential cognitive - neuropsychological endophenotype within ASD with characteristics of both Autism and Schizophrenia spectra. The development of a valid assessment tool is required, as well as the design of targeted interventions to prevent the loss of functionality.

Keywords: Autism spectrum disorder; schizotypy; social functioning; emotional functioning; behavioral functioning

1. Introduction

The term Autism Spectrum Disorder (ASD) describes a unique group of neuropsychiatric disorders characterized by *deviations and delays* in the development of specific skills beginning in the early years of life. The modern classification systems, DSM-5 of the American Psychiatric Association [1] and ICD -11 of the World Health Organization [2], agree that the characteristic-diagnostic behaviors for ASD are recorded in two groups and concern: (1) the presence of deficits in social communication and social interaction and (2) the restricted, repetitive patterns of behavior, interests,

 doi:10.20944/preprints202501.1670.v1

and activities, even if other conditions may be present such as motor coordination disorder, language disorder, specific learning disorder.

Schizotypy is a theoretical concept that describes a continuum of personality characteristics (schizotypal traits) with a factor structure consisting of three identifiable factors: 'cognitive-perceptual,' 'interpersonal,' and 'disorganized' [3,4]. These factors correspond to the 'positive,' 'negative,' and 'disorganized' dimensions of schizophrenia [5,6]. However, Stefanis et al. [7], proposed a four-factor model in which 'positive schizotypal' traits were further divided into a 'paranoid' factor and a 'cognitive/perceptual' factor. The present study is designed based on the two MASK factors: 'Social/pragmatic' and 'Positive schizotypal' [8].

The phenotypic expressions of both autism and schizophrenia spectrum disorders are thought to span a continuum, ranging from mild subclinical levels in the general population to severe clinical manifestations [9]. The present study is designed based on the model of *the fully dimensional approach* which is outlined by Claridge and colleagues as cited in [5]. *The fully dimensional approach* suggests that schizotypy (*schizotypal traits*) is on a continuum applying to all members of the population. It views schizotypy as a spectrum of 'natural central nervous system variations', which in their extreme manifest as vulnerability to mental illness [5].

Psychiatric comorbidity of Autism Spectrum Disorder

According to the US Centers for Disease Control and Prevention's Autism and Developmental Disabilities Monitoring (ADDM) Network, an autism watchdog, the prevalence of ASD for the year 2020 is estimated at 1 in 36 children aged 8 years (ADDM Community Autism Report, 2023) [10] with an estimated prevalence increase of 317 % since 2000. ASD is diagnosed more frequently in men than women in all age groups [11,12]. The estimated prevalence of ASD in Greece is 1,15% with males/females ratio, 4,14:1 and approximate mean age at diagnosis of six years and one month [13].

ASD is an extremely heterogeneous category in terms of the severity of behaviors but also in the range of comorbid conditions that can be neurodevelopmental, organic and psychiatric. Several possible causal associations between medical conditions and autism have been reported from time to time in the literature, as with multiple sclerosis, Fragile X syndrome, Prader-Willi syndrome, epilepsy and autoimmune disorders [14]. Clinical experience suggests that a wide variety of psychiatric disorders occur in ASD [15]. In recent years, the issue of psychiatric comorbidity in ASD has gained increasing relevance as the DSM-5 now allows additional diagnosis in individuals with ASD [16].

Simonoff et al. [17], in one of the major epidemiological studies in ASD, recorded one comorbid disorder in 77% of the study group and two or more in 41% of that group, where 29% includes social phobia, 28% attention-deficit/hyperactivity disorder (ADHD), 28% Oppositional Defiant Disorder and 1,4% depression - dysthymia. Hossain et al. [18] in an systematic search (*umbrella review*) revealed a high rate of comorbid psychiatric disorders including anxiety, depressive, bipolar and mood disorders, schizophrenia spectrum, suicidal behavior disorders, ADHD, disruptive, impulse-control and conduct disorders. The prevalence of schizophrenia spectrum and other psychotic disorders was inconsistent and with wide ranging differences from 4% to 67%. Zheng et al. [19] in a systematic review and meta-analysis demonstrated that the prevalence of schizophrenia was significantly higher in individuals with ASD than in controls and the prevalence of ASD in individuals with schizophrenia ranged from 3.4 to 52%.

Association between Autism spectrum disorder and Schizophrenia spectrum disorder.

Although schizophrenia and autism are now regarded as two distinct conditions, they share a common history. Early assumptions of continuity between severe childhood psychiatric disturbance and adult schizophrenia were based on the severity of the two disorders. Autism was initially described as infantile psychosis and for a long time was approached as a form of schizophrenia until Kolvin (1971) in the UK was able to separate the two conditions and record their differences [20]. According to the DSM-5, the Schizophrenia Spectrum and Other Psychotic Disorders are defined by symptoms in at least two of the following five domains: delusions, hallucinations, disorganized thinking (speech), grossly disorganized or catatonic behavior and negative symptoms. The negative

 doi:10.20944/preprints202501.1670.v1

symptom domain consists of five key constructs: blunted affect (reduced range of emotions, lacking facial expression), alogia (reduction in quantity of words spoken), avolition (reduced goal-directed activity due to decreased motivation), asociality (social withdrawal), and anhedonia (reduced experience or expression of pleasure) [21].

Autism and Schizophrenia spectra resemble each other. With regards to the negative symptoms, many adults with ASD show symptoms such as lack of interest in socializing, flat and restricted affect, inability to show emotions, restriction of facial expressions, diminished eye contact, poor speech, slow movement. Also, some individuals with high-functioning ASD sometimes have difficulties that resemble the positive symptoms such as thought disorder (i.e., poor reality testing, cognitive slippage, perceptual distortions) [22,23]. However, children with ASD can develop psychotic symptoms in adolescence [24].

Both Autism and Schizophrenia Spectrum conditions involve complex developmental models manifested by deficits in social interaction, communication, executive function and sensorimotor gating [25,26]. Both are extremely heterogeneous, polygenic and are considered among the most heritable disorders in Psychiatry (50-80% heritability) [27,28]. However, high rates of heritability are reported and among these disorders, that is, high rates of Autism Spectrum Disorder are described in children of parents suffering from Schizophrenia, high percentages of Autism (ASD traits) in siblings of children with early-onset Schizophrenia, as well as increased rates of Schizophrenia spectrum disorders in parents of children with ASD. [29]. Studies of Copy number variants (CNVs) and other rare alleles have shown overlap between autism and schizophrenia and suggest that may share underlying pathogenic mechanisms [21]. Also, both have extensively been associated with impairments in functional brain connectivity and brain neuroimaging studies show corresponding correlations between the two disorders. Finally, for both conditions, shared genetic and environmental risk factors have been identified [30].

Children with Autism Spectrum Disorder and Schizotypal traits

Although the “true schizophrenia” occurring in the context of ASD is uncommon, a subgroup of individuals within ASD may be at an increased risk of developing psychotic disorders [14]. It is established from the modern literature as well as from the clinical practice that children and adolescents with a diagnosis of ASD may present traits or even meet the criteria for the diagnosis of Schizotypal personality disorder or Schizotypal disorder in children (SDc). The incidences of schizophrenia spectrum were significantly higher than the comparison group across all three subtypes of autism-spectrum disorder [31]. Schizotypal disorder is categorized within the Schizophrenia Spectrum Disorders and its manifestation is recognized as early as childhood. Schizotypal Disorder in Childhood (SDc) has been recognized and described for a long time, but recently it was officially classified within the DSM-5 and ICD-11. Diagnostic criteria of schizotypal disorder according to the DSM-5 consist of a pervasive pattern of social and interpersonal deficits such as: bizarre fantasies (magical thinking) and preoccupations, odd behavior, odd thinking and speech (e.g. vague, casual, metaphorical, over-elaborated or stereotyped), unusual perceptual experiences, paranoid ideation, disturbed affect, ideas of reference, difficulty making and keeping friends, anxiety and mood disturbances [32,33].

Regarding the influence of Early-onset schizophrenia (EOS) on the level of children’s functionality, it is already known from the literature that is one of the most devastating psychiatric disorders with a serious impact on development, more pronounced early neurodevelopmental abnormalities and poorer prognosis and treatment response [34].

There are many different reasons for children and adolescents with autism and psychosis to become socially and behaviorally disturbed. In ASD difficulties have been observed with social communication and interaction, characterized by a tendency to engage in repetitive stereotyped patterns of immature / unusual behaviors. These problems are likely the result of rigid thinking style and problems with social cognition, empathy, motor coordination and sensory processing [27]. In SPD, which is included within the schizophrenia spectrum, social interaction deficits and solitary tendencies have been recorded, which are related to thought disorder, magical thinking, odd speech

 doi:10.20944/preprints202501.1670.v1

and ideation, preoccupations with bizarre fantasies and interests [8]. Both situations can be at risk in psychosocial terms. Children don't have the skills they need to cope in a new environment like a school and they fail to face difficulties and challenges. This results in being judged and discriminated by others [35].

There has been relatively little research on how schizotypal traits affect the functioning of children with Autism Spectrum Disorder. Abu - Akel et al. {36] studied the impact of comorbid autism and schizotypal disorder in children on socio-pragmatic skills and executive functioning (i.e., intra-/extra –dimensional set-shifting task) in a group of a total 67 (6–12-year-old) children, 15 with autism, 8 with schizotypal disorder and 12 with comorbid autism, schizotypal disorder as well as 32 typically developing children. According to the results the performance of the comorbid group (dual diagnosis) on socio-pragmatic skills was superior to the groups diagnosed with autism and schizotypal disorder separately. This could indicate the existence of some kind of cognitive mechanism which works in a compensatory manner when autism and schizophrenia spectra coexist [36].

Current objectives

Functional impairment is a defining characteristic of both autism spectrum disorder (ASD) and schizophrenia spectrum disorders (SSD), as outlined in the DSM-5 and ICD-11. However, the relationship between these conditions within individuals and the potential impact of their co-occurrence on functional outcomes remains unclear.

Previous studies [36,37], have explored various models to understand the joint effects of autistic and psychotic symptoms, yielding contrasting results that range from functional benefits to adverse effects. Recent evidence indicates that the functional benefits of co-occurring ASD traits and positive SSD symptoms may depend on the severity of the symptoms [38].

The aim of the current study is to investigate the impact of such co-occurrence on social, emotional and behavioral functioning by studying children diagnosed with ASD who also exhibit features of SSD as are the schizotypal traits, of different severity (that means even when the criteria for SPD diagnosis are not met).

2. Materials and Methods

Participants

The research sample included 63 children between 6 to 12 years old with Autism Spectrum Disorder in accordance with the diagnostic criteria for ASD in DSM-5 (American Psychiatric Association, 2013) with or without schizotypal characteristics consecutively coming for assessment (initial evaluation or follow – up) to the outpatient Autism Spectrum Disorders (ASD) clinic for children at the Department of Child Psychiatry, at a university-affiliated children's hospital in a major city, during the years 2017 to 2020.

Procedure

Parents of children fulfilling the study criteria were fully informed on the research procedure and had to submit written informed consent. Thereafter a thorough social developmental and psychological history was taken from candidates' families. Demographic and socioeconomic status were also registered in a special "registration form" created by the researcher. Full anonymity and privacy was secured during the registration of the results.

Initially, the children were assessed by a child and adolescent psychiatrist in order to ensure Autism Spectrum Disorder diagnosis according to the diagnostic criteria of DSM-5. In addition, the Greek version of the Wechsler Intelligence Scale for Children-3rd edition - WISC-III was administered by a psychologist along with a battery of diagnostic tools and questionnaires in Greek as described below.

The inclusion criteria for the study were as follows: Participants were required to have a diagnosis of Autism Spectrum Disorder, with severity levels categorized as either level 1 ("requiring support") or level 2 ("requiring substantial support"). These levels reflect the degree of support

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needed in daily life and the extent to which autistic traits differ from neurotypical expectations. Additionally, participants needed to have a Full Scale Intelligence Quotient (FSIQ) score of more than 70, based on the WISC-III assessment. Exclusion criteria included a diagnosis of any other neuropsychiatric disorder, such as ADHD, or neurological conditions, such as epilepsy. Furthermore, participants could not be taking any medications, such as psychotropic or antiepileptic drugs, that might affect cognition. Finally, a good knowledge of the Greek language was essential to ensure participants could understand and provide reliable responses to interviews and questionnaires.

Measures

Clinical Tools

For the purpose of the research a battery of diagnostic tools and questionnaires in Greek are given to children, parents and teachers, described below:

WISC-III (Wechsler Intelligence Scale for Children - third edition - Wechsler, 1992). The WISC-III is considered as the most valid and reliable psychometric tool for assessing the intellectual ability for children and adolescents aged between 6 and 16 years old. It comprises two scales, Verbal and Performance (non-verbal). Each scale contains subtests. The Verbal subtests are: Vocabulary, Similarities, Arithmetic, Information and Comprehension. The Performance subtests are: Object, Assembly, Coding, Block design, Picture arrangement, Picture completion. The WISC provides standard scores on Verbal IQ, Performance IQ and Full scale IQ [39].

The Melbourne Assessment of Schizotypy in Kids – MASK (Jones, H. P., Testa, R. R., Ross, N., Seal, M. L., Pantelis, C., & Tonge, B. (2015). The MASK is a semi-structured assessment that was developed to measure Schizotypal Personality Disorder (SPD) features in children between 5 and 12 years old [8]. The MASK obtains information about symptomatology of the three sources, specifically, the child, their parents, and the clinician. It comprises three components: Background Interview, Child Clinical Interview and Clinical Presentation Checklist.

The *Background Interview* is conducted with the parent of the child and provides information about the child's schizotypal symptoms.

The *Child Interview* is semi-structured and consists of questions that explore features of childhood SPD. This type of assessment helps children who may be anxious or embarrassed about their thoughts, or have pragmatic difficulties interfering with language comprehension. The *Clinical Presentation Checklist* includes 57 observable features of childhood SPD that are assembled within nine domains: Social anxiety, Social skills, Motor abilities, Language/Thought/Ideation, Fantasy/Magical thinking, Unusual perceptual experiences, Behavior, Attention and Affect. Each item is rated on a Likert scale (Never, Sometimes, Often, and Always) by the child's clinician only after obtaining information from both the child and the parent(s).

Jones et al. [8], noted that MASK was shown to have psychometric properties with high internal consistency (Cronbach alpha coefficient for the 57 MASK items was 0.98. Alpha coefficients for the nine subscales of the MASK were as follows: social anxiety (0.86); social skills (0.94); motor abilities (0.92); language/thought/ideation (0.93); fantasy/magical thinking (0.86); unusual perceptual experiences (0.85); behavior (0.88); attention (0.93); and affect (0.73)) and high inter-rater reliability (0.98). Finally, it is noted that Total MASK score was excellent at distinguishing SPD as described in accordance with the criteria in DSM-5. A factor analysis revealed two MASK factors: Social/pragmatic and Positive schizotypal (Jones et al, 2015). Social/pragmatic factor and Positive schizotypal factor were associated with SPD, but only the Social/pragmatic factor was associated with ASD. The results showed high internal consistency for the MASK which can provide a reliable measure of schizotypal symptoms across groups of SPD, ASD, and typically developing children. Also, Jones et al. (2015) noted satisfactory convergent validity between the MASK and behavior rating scales: The Behavioral Assessment System for Children-Second Edition (BASC-II) [40] and The Conner's Rating Scale-Revised (CRS-R) [41].

In the present study, all Cronbach's α reliability coefficients were above the acceptable limit (0.7), indicating acceptable reliability of the MASK scale. Cronbach alpha coefficient for the 57 MASK items was 0.95. Alpha coefficients for the nine subscales of the MASK were as follows: social anxiety (0.78);

 doi:10.20944/preprints202501.1670.v1

social skills (0.86); motor abilities (0.95); language/thought/ideation (0.88); fantasy/magical thinking (0.93); unusual perceptual experiences (0.85); behavior (0.70); attention (0.72); and affect (0.78).

Behavior Rating Scales:

Achenbach System of Empirically Based Assessment - ASEBA / school-age assessment forms: 6-18 years old (Achenbach, 2001). The Achenbach System of Empirically Based Assessment (ASEBA) is a comprehensive system of instruments for assessing abilities, adaptive functioning and behavioral, emotional, social, and thought problems of people of various ages (from age 1½ to 90+ years). Achenbach's questionnaires are universally accepted and used widely for children and adolescents. The purpose of using them was to assess the children's strengths and problems in diverse environments and obtaining information from the different sources (parents and teachers).

For the purpose of our research school-age forms for ages 6-18 were used: Caregiver Report Form, Child Behavior Checklist - CBCL/6-18 and Teacher's Report Form - TRF/6-18 [42].

Each questionnaire consists of two parts. The first contains a series of questions assessing adaptive behavior, forming three scales on the CBCL– Activities, Social competence and School competence – and five on the TRF – Academic performance, Working hard, Behaving appropriately, Earning, Happy.

The second part contains 112 (CBCL) and 113 (TRF) items describing the child's behavior (at the time of assessment or within the past 6 months) rated on a 3-point scale (0 - Not True, 1 - Somewhat/Sometimes True, 2 - Very True / Often True). These ratings are combined to form eight narrowband subscales or syndromes, two broadband scales and a total problem score. The eight syndromes (*empirically based syndrome scales*) are based on factor analyses and labeled – Withdrawn, Somatic complains, Anxious/Depressed, Social problem, Thought problem, Attention problem, Aggressive behavior and Delinquent behavior. The broadband scales are termed Internalizing and Externalizing. The Internalizing problems scale is composed of Withdrawn, Somatic complains and Anxious/Depressed subscales. The Externalizing problems scale is composed of Aggressive behavior and Delinquent behavior subscales. Items which are not included in any of the subscales are collected under the heading Other problems. The Total problem score measures the overall behavioral and emotional functioning of the child [43].

The content validity of the competence, adaptive and problem item scores has been supported by decades of research and all the findings prove that all items discriminated significantly between demographically matched referred and non-referred children ($p < ,01$). Additional, the Internal consistency, the correlation among the CBCL and TRF scales, and the inter-rater correlations for CBCL/TRF scales were good for most indices and subscales [44,45]. Almost all problem scales significantly discriminated referred and non-referred children [46–48].

Aberrant Behavior Checklist (ABC) (Aman, M.G., Sing. N.N., Stewart, A.W., & Field, C.J., 1985). The Aberrant Behavior Checklist (ABC) is a standardized problem behavior rating scale which can be completed by a variety of informants in different settings e.g. parents and teachers. ABC contains 58 items which form five subscales labeled: Irritability/Agitation/Crying, Lethargy/Social withdrawal, Stereotypic behavior, Hyperactivity/Non-compliance and Inappropriate speech. Each item is scored as 0 (never a problem), 1 (slight problem), 2 (moderately serious problem), or 3 (severe problem).

ABC was shown to have sound psychometric properties with high internal consistency among subscales (mean alpha = 0.91), excellent test-retest reliability (mean r = 0.98), acceptable inter-rater reliability (mean r = 0.63), and moderate correlations with measures of adaptive behavior (mean r = 0.60) [49,50].

Statistical Analysis

Variables were first tested for normality using the Kolmogorov-Smirnov criterion. Quantitative variables were expressed as mean (Standard Deviation) and as median (interquartile range). Qualitative variables were expressed as absolute and relative frequencies. Spearman correlations coefficients were used to explore the association of two continuous variables. In order to adjust for

 doi:10.20944/preprints202501.1670.v1

children's age and gender, partial correlation coefficients were computed. All reported p values are two-tailed. Statistical significance was set at $p<0.05$ and analyses were conducted using SPSS statistical software (version 22.0).

3. Results

Data from 63 children, 6 to 12 years old, were collected. Their *characteristics* as well as their *parents' characteristics*, information on their medical history and their condition are presented in Table 1**.** Most children were males (81.0%) and their mean age was 9.3 years (SD=1.9 years). In most cases (79.0%) parents were married and employed (86.2%). Parental history of a mental disease was present in 60.7% of the children and 36.7% had parents who had used tranquillizers or psychotropic medication during the last year. Also, 96.7% of the children had visited a specialist and the most frequent reason for seeking help was children's unusual behavior. Mean time from children's symptoms' onset was 4.6 years (SD=2.2 years).

Table 1. Sample's characteristics.

	N (%)
Child's characteristics	
Child's gender	
Males	51 (81.0)
Females	12 (19.0)
Child's age, mean (SD)	9.3 (1.9)
Parallel educational support	22 (43.1)
Parental characteristics	
Father's age, mean (SD)	45.2 (7.1)
Mother's age, mean (SD)	42.0 (6.6)
Family status	
Unmarried	5 (8.1)
Married	49 (79.0)
Separated	5 (8.1)
Divorced	3 (4.8)
Employed	50 (86.2)
Family history	
Parental or family history of a mental disease	34 (60.7)
Parental or family history of a serious disease	11 (18.3)
History of drug/ alcohol abuse	3 (5.3)
Parental use of tranquillizers or psychotropic medication during last year	22 (36.7)
Child's use of tranquillizers or psychotropic medication during last year	3 (4.8)
Information on child's condition	
Visited a specialist	59 (96.7)
Reasons for seeking help	
Talking delay	29 (46)
Weird behaviour	40 (63.5)
Anxiety	14 (22.2)
Medical problem	2 (3.2)
Problems associated with relationships or family	1 (1.6)

 doi:10.20944/preprints202501.1670.v1

Information on diagnosis	4 (6.3)
Prescription	5 (7.9)
Assessment	4 (6.3)
Years since symptoms' onset, mean (SD)	4.6 (2.2)
Years knowing childs' developmental disorders, mean (SD)	3.9 (2.6)

Descriptive statistics of the study scales are presented in Table 2. Mean total MASK score was 135.81 (SD= 21.82). Also, mean total CBCL score was 53.21 (SD=26.23) and mean TRF score was 49.94 (SD=31.56).

Table 2. Descriptive statistics of under study scales.

		Minimum	Maximum	Mean (SD)	Median (IQR)
Mask					
	Total score	99	192	135.81 (21.82)	133 (118 — 147)
	Social/ Pragmatic symptoms	61	110	83.44 (10.28)	84 (76 — 91)
	Positive schizotypal symptoms	33	94	53.25 (15.56)	48 (42 — 58)
WISC					
Verbal intelligence	Subtest Scores	15	77	50.18 (15.45)	50 (40.5 — 62)
	Verbal intelligence Quotient	58	150	104.89 (19.62)	100 (94 — 121)
	Percentile	0.3	125	57.17 (36.46)	57 (21 — 94)
Practical intelligence	Subtest Scores	8	84	45.04 (15.96)	47 (32.5 — 55.5)
	Performance intelligence Quotient	52	148	98.88 (19.62)	101 (86 — 111)
	Percentile	0.1	100	50.68 (34.57)	58 (16 — 79)
Total intelligence	Subtest Scores	35	161	95.21 (28.2)	99.5 (77 — 118)
	Full scale intelligence Quotient	71	148	101.83 (18.4)	100.5 (85.5 — 115)
	Percentile	0	99.9	51.55 (36.34)	54 (14 — 87)
CBCL					
	Activities	0	14.3	8.23 (3)	8 (6 — 11)
	Social/ Pragmatic symptoms	0	11	5.13 (2.52)	5.6 (3 — 7)
	Academic performance	0	8	3.09 (1.65)	3 (2 — 4)
	Total competence	6	28.1	16.44 (5.14)	16 (13 — 20.5)
	Total competence t-score	17	56	32.29 (9.4)	29 (25 — 39)
	Anxious/ depressed	0	19	8.56 (4.27)	8 (6 — 11)
	Withdrawn/ depressed	0	13	4.44 (2.86)	4 (2 — 6)
	Somatic complaints	0	9	1.97 (2.44)	1 (0 — 3)
	Social problems	0	16	6.9 (4.2)	7 (3 — 10)
	Thought problems	0	18	5.83 (3.84)	5 (3 — 9)

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	Attention problems	0	18	8.06 (4.31)	8 (5 — 11)
	Rule-breaking behaviour	0	20	3.43 (3.6)	2 (1 — 5)
	Aggressive behaviour	0	28	8.98 (6.3)	8 (3 — 13)
	Other problems	0	13	5.03 (3.28)	5 (2 — 8)
	Internalizing problems	1	32	14.97 (7.6)	15 (10 — 19)
	Internalizing problems t-score	39	78	64.48 (8.59)	66 (61 — 70)
	Externalizing problems	0	48	12.41 (9.38)	10 (6 — 18)
	Externalizing problems t-score	33	83	58.49 (9.97)	57 (51 — 66)
	Total problems	6	118	53.21 (26.23)	53 (31 — 71)
	Total problems t-score	39	79	63.49 (9.49)	66 (56 — 71)
TRF					
	Academic performance	0	5	2.66 (1.09)	2.8 (2 — 3.2)
	Adaptive performance	7	26	15.39 (4.17)	15 (13 — 18)
	Anxious/ depressed	0	26	7.34 (5.62)	6 (4 — 9)
	Withdrawn/ depressed	0	15	4.73 (3.47)	4 (2 — 7)
	Somatic complaints	0	13	0.84 (2.23)	0 (0 — 1)
	Social problems	0	16	5.23 (3.7)	4 (3 — 8)
	Thought problems	0	17	4.1 (3.93)	4 (1 — 7)
	Inattention	0	22	10.02 (5.91)	10.5 (4 — 14)
	Hyperactivity-Impulsivity	0	21	6.42 (5.75)	5.5 (1 — 9)
	Attention problems	0	43	16.44 (10.51)	17 (7 — 24)
	Rule-breaking behaviour	0	15	2.34 (2.89)	2 (0 — 3)
	Aggressive behaviour	0	30	7.69 (7.56)	5 (2 — 14)
	Other problems	0	12	1.24 (1.82)	1 (0 — 2)
	Internalizing problems	0	49	12.9 (9.19)	11 (6 — 18)
	Internalizing problems t-score	37	91	61.77 (9.98)	62 (56 — 68)
	Externalizing problems	0	40	10.03 (9.91)	7 (3 — 15)
	Externalizing problems t-score	43	82	60.89 (8.91)	61 (57 — 67)
	Total problems	0	177	49.94 (31.56)	50 (26 — 69)
	Total problems t-score	33	93	63 (9.56)	65.5 (58 — 68)
ABC					
Parents	Irritability	0	37	9.74 (7.97)	8 (4 — 14)
	Lethargy/ Withdrawal	0	34	11.69 (9.4)	8 (4 — 18)
	Stereottypy	0	17	4.48 (4.26)	4 (1 — 7)
	Hyperactivity	0	48	13.76 (11.69)	11 (6 — 20)
	Inappropriate speech	0	11	2.66 (2.54)	3 (0 — 4)
Teachers	Irritability	0	28	8.69 (7.46)	6.5 (3 — 13)
	Lethargy/ Withdrawal	0	40	12.4 (8.95)	11 (6 — 17)
	Stereottypy	0	18	4.55 (4.62)	3.5 (0 — 7)
	Hyperactivity	0	37	11.61 (8.65)	10 (6 — 18)

 doi:10.20944/preprints202501.1670.v1

Inappropriate speech	0	12	2.97 (2.82)	2	(1 — 5)

Correlation between MASK and WISC is presented in Table 3. WISC scores were not significantly associated with either the total MASK score or the Positive Schizotypal Symptoms subscale. However, greater sum and percentile of Verbal intelligence and greater sum of Total intelligence were significantly associated with lower score in the Social / Pragmatic symptoms subscale. After adjusting for children's gender and age, correlations were no longer significant.

Table 3. Spearman's' correlation coefficients between MASK and WISC scales.

WISC		Total MASK score		Social/ Pragmatic symptoms		Positive schizotypal symptoms	
		rho	P	rho	P	rho	P
Verbal intelligence	Subtest Scores	-0.26	0.057	-0.27	**0.048**	-0.20	0.138
	Verbal intelligence Quotient	-0.19	0.158	-0.21	0.111	-0.11	0.400
	Percentile	-0.26	0.118	-0.35	**0.030**	-0.14	0.393
Practical intelligence	Subtest Scores	-0.08	0.547	-0.20	0.147	-0.04	0.759
	Performance intelligence Quotient	-0.05	0.712	-0.09	0.499	-0.05	0.739
	Percentile	-0.27	0.104	-0.29	0.087	-0.32	0.054
Total intelligence	Subtest Scores	-0.21	0.112	-0.27	**0.042**	-0.17	0.221
	Full scale intelligence Quotient	-0.20	0.128	-0.22	0.087	-0.14	0.282
	Percentile	-0.18	0.276	-0.25	0.123	-0.12	0.462

Correlation between MASK and CBCL scales is presented in Table 4. Greater Aggressive behavior and more Externalizing problems, according to CBCL, were significantly associated with greater Total MASK score. Also, greater score in Withdrawn/depressed subscale was significantly associated with greater score in Social/ Pragmatic symptoms subscale. CBCL scores were not significantly associated with Positive schizotypal symptoms subscale. However, after adjusting for children's gender and age the correlations of total MASK score with aggressive behavior and externalizing problems score became indicative, $r_{partial}$= 0.23, p=0.073 and $r_{partial}$=0.23, p=0.078 respectively, while the correlation with t -score of externalizing problems became non-significant, p>.05. Also, after the adjustment, the correlation between Withdrawn/ depressed subscale and Social/ Pragmatic symptoms subscale became non-significant, p>.05.

Table 4. Spearman's' correlation coefficients between MASK and CBCL scales.

	Total MASK score		Social/ Pragmatic symptoms		Positive schizotypal symptoms	
CBCL	rho	P	rho	P	rho	P
Activities	0.11	0.381	0.08	0.537	0.17	0.183
Social/ Pragmatic symptoms	0.06	0.626	0.14	0.283	0.04	0.732
Academic performance	0.02	0.882	0.03	0.821	0.06	0.616
Total competence	0.08	0.513	0.10	0.425	0.13	0.295

 doi:10.20944/preprints202501.1670.v1

Total competence t-score	0.08	0.522	0.10	0.426	0.12	0.341
Anxious/ depressed	0.23	0.075	0.18	0.170	0.18	0.154
Withdrawn/ depressed	0.23	0.075	0.25	**0.050**	0.12	0.329
Somatic complaints	-0.01	0.948	0.15	0.233	-0.10	0.451
Social problems	0.14	0.288	-0.01	0.945	0.17	0.187
Thought problems	0.18	0.158	0.16	0.209	0.07	0.585
Attention problems	0.23	0.074	0.07	0.586	0.19	0.127
Rule-breaking behaviour	0.15	0.245	-0.01	0.927	0.15	0.234
Aggressive behaviour	0.25	**0.048**	0.10	0.458	0.23	0.073
Other problems	0.10	0.450	0.08	0.544	0.10	0.455
Internalizing problems	0.22	0.086	0.22	0.091	0.14	0.257
Internalizing problems t-score	0.20	0.119	0.20	0.109	0.13	0.297
Externalizing problems	0.25	**0.050**	0.09	0.489	0.22	0.091
Externalizing problems t-score	0.25	**0.046**	0.08	0.532	0.24	0.061
Total problems	0.21	0.094	0.09	0.466	0.18	0.160
Total problems t-score	0.22	0.079	0.10	0.445	0.19	0.136

Correlation between MASK and TRF scales is presented in Table 5. Greater Anxious/ depressed score and more Internalizing problems, according to TRF, were significantly associated with greater Total MASK score. Moreover, greater scores in Anxious/ depressed, Withdrawn/ depressed, other problems subscales (e.g. enuresis, desires for the opposite sex, torturing animals, defecating outside the designated toilet area, overweightness, talking too much etc.) and more Internalizing and total problems were significantly associated with greater score in Social/ Pragmatic symptoms subscale. Greater Adaptive performance was significantly associated with greater score in Positive schizotypal symptoms subscale. After adjusting for children's gender and age, total MASK score remained significantly correlated with Anxious/ depressed score ($r_{partial}$=0.28, p=0.028), Internalizing problems score ($r_{partial}$=0.26, p=0.043) and internalizing problems t-score ($r_{partial}$=0.27, p=0.039). Additionally, after adjusting for children's gender and age, Social/ Pragmatic symptoms subscale remained significantly correlated with Anxious/ depressed ($r_{partial}$=0.29, p=0.023), Withdrawn/ depressed ($r_{partial}$=0.26, p=0.042), other problems ($r_{partial}$=0.26, p=0.043) subscales and more Internalizing ($r_{partial}$=0.31, p=0.018 for raw score and $r_{partial}$=0.31, p=0.015 for t-score) and total problems ($r_{partial}$=0.25, p=0.050 for raw score and $r_{partial}$=0.27, p=0.040 for t-score). The association between Adaptive performance and Positive schizotypal symptoms subscale, after adjusting for children's gender and age, became indicative, $r_{partial}$=0.24, p=0.064.

Table 5. Spearman's' correlation coefficients between MASK and TRF scales.

	Total MASK score		Social/ Pragmatic symptoms		Positive schizotypal symptoms	
TRF	rho	P	rho	P	rho	P
Academic performance	0.17	0.181	0.09	0.493	0.17	0.199
Adaptive performance	0.18	0.173	0.02	0.886	0.28	**0.028**
Anxious/ depressed	0.28	**0.027**	0.31	**0.014**	0.22	0.091
Withdrawn/ depressed	0.13	0.310	0.26	**0.044**	-0.04	0.740
Somatic complaints	0.13	0.322	0.14	0.275	0.04	0.755
Social problems	0.11	0.374	0.13	0.315	0.11	0.381
Thought problems	0.13	0.317	0.24	0.060	0.03	0.797

 doi:10.20944/preprints202501.1670.v1

Inattention	0.08	0.520	0.11	0.396	0.00	0.969
Hyperactivity-Impulsivity	0.16	0.221	0.21	0.100	0.03	0.804
Attention problems	0.15	0.239	0.19	0.130	0.04	0.782
Rule-breaking behaviour	0.08	0.534	0.00	0.985	0.05	0.682
Aggressive behaviour	0.13	0.331	0.13	0.324	0.06	0.671
Other problems	0.13	0.305	0.26	**0.044**	0.03	0.827
Internalizing problems	0.26	**0.045**	0.32	**0.013**	0.13	0.304
Internalizing problems t-score	0.25	**0.046**	0.32	**0.010**	0.12	0.337
Externalizing problems	0.15	0.255	0.12	0.334	0.08	0.542
Externalizing problems t-score	0.15	0.256	0.12	0.350	0.08	0.513
Total problems	0.20	0.124	0.27	**0.032**	0.07	0.579
Total problems t-score	0.19	0.130	0.29	**0.024**	0.06	0.655

Correlation between MASK and ABC scales is presented in Table 6. Greater teacher's score in Irritability and Inappropriate speech subscales were significantly associated with greater total MASK score. Social/ Pragmatic symptoms were not significantly correlated with ABC subscales. Furthermore, greater teacher's score in *Inappropriate speech subscale* was significantly associated with greater score in Positive schizotypal symptoms subscale. Parents' ABC scores were not associated with MASK scores. After adjusting for children's gender and age, total MASK score remained significantly associated with Inappropriate speech subscale, $r_{partial}$=0.35, p=0.007, while its association with Irritability subscale, became indicative, $r_{partial}$=0.24, p=0.067. Moreover, after adjusting for children's gender and age, the correlation between Positive schizotypal symptoms subscale and Inappropriate speech subscale remained significant, $r_{partial}$=0.27, p=0.040.

Table 6. Spearman's correlation coefficients between MASK and ABC scales.

		Total MASK score		Social/ Pragmatic symptoms		Positive schizotypal symptoms	
ABC		rho	P	rho	P	rho	P
Parents	Irritability	0.09	0.488	-0.04	0.757	0.10	0.437
	Lethargy/ Withdrawal	0.05	0.698	-0.03	0.819	0.03	0.796
	Stereottypy	-0.04	0.747	-0.06	0.646	-0.03	0.798
	Hyperactivity	-0.01	0.919	-0.12	0.372	0.02	0.899
	Inappropriate speech	0.22	0.085	0.08	0.531	0.23	0.076
Teachers	Irritability	0.25	**0.049**	0.19	0.139	0.15	0.250
	Lethargy/ Withdrawal	0.01	0.909	0.09	0.472	-0.09	0.488
	Stereottypy	0.14	0.284	0.16	0.228	0.02	0.855
	Hyperactivity	0.08	0.526	0.07	0.592	-0.02	0.883
	Inappropriate speech	0.34	**0.007**	0.21	0.108	0.25	**0.050**

4. Discussion

The present study aimed to explore how schizotypal traits impact the social, emotional, and behavioral functioning of children with Autism Spectrum Disorder. In the studied group of 63 children most children were males (81.0%) which is in agreement with the ratio of boys to girls as

 doi:10.20944/preprints202501.1670.v1

recorded in the literature (see systematic review and meta-analysis by Loomes et al., 2017, [51]). By observing the characteristics of the parents it seems that a large percentage (60.7%) of the children had parental or family history of a mental disease, while 36.7% had parents who had used tranquillizers or psychotropic medication during the last year. These findings reflect the significant impact a child with autism has on the family, including elevated levels of psychiatric symptoms among parent [52–54].

In the present study, the children's behavior was recorded by their parents and teachers. An interesting finding of the present study is that there is a difference in the way children's behaviors are recorded by parents and teachers in the school setting.

Overall, from the correlations between the above clinical tool MASK and the Checklists the results report that 1) *Total MASK score* is significantly correlated with Internalizing problems and Anxious/ depressed score, according to TRF 2) *MASK Social / Pragmatic symptoms score* is significantly correlated with Internalizing problems, Total problems, Anxious/Depressed, Withdrawn/Depressed and Other problems score, according to TRF 3) *MASK Positive schizotypal score* and *Total MASK score* are significantly associated with Inappropriate speech score, according to teacher's ABC scales.

In the literature there are studies that document gaps in the way parents and teachers understand the child's behavior [55]. However there are not sufficient studies about behavioral problems in students with ASD in relation to inter-rater agreement in multi-informant reports such as parents and teachers using Child Behaviour Checklist (CBCL) and Teacher Rating Form (TRF) [56]. Kohler (2013) [57], investigated parent versus teacher reports on behavior of neurotypical children and came to the conclusion that agreement between parents and teachers was poor with parents reporting more problematic behavior compared to teachers. Zope (2024) [58], investigated parent versus teacher reports on behavior of pediatric cancer survivors and recorded that parents had higher ratings of child-internalizing problems, but lower ratings of overall social skills than teacher ratings. In the same study parent-teacher agreement was higher for reports of externalizing symptoms. Roussos et al. [44], in the context of the standardization process for the CBCL and TRF questionnaires for Greek children aged 6–12, examined the correlations between parents' and teachers' ratings of problem behaviors for boys and girls. The study revealed that, for boys, parents and teachers exhibited the highest correlations on the Externalizing dimension. Specifically, the Aggressive Behavior scale demonstrated the strongest correlation between CBCL and TRF among the narrow-band scales, followed closely by the Attention Problems scale. For girls, a high correlation was observed only on the Attention Problems scale.

MASK & TRF relation

A significant correlation was found, after adjusting for children's gender and age, between *Social / Pragmatic symptoms subscale* and Internalizing problems, mainly regarding syndromes: Anxious/ depressed, Withdrawn/ depressed and Other problems. Additionally, *Total MASK score* also remained significantly correlated with Internalizing problems and Anxious/ depressed syndrome.

This suggests that children with higher schizotypal traits, as measured by the MASK have problems which are described by the following two TRF subscales. According to the Anxious/ depressed subscale, the child cries a lot, has fears (certain animals, situations, places), is afraid of going to school, feels the need to be perfect, feels unloved, feels worthless or inferior, nervous, fearful or anxious, feels overly guilty, easily embarrassed and/or worries. According to the Withdrawn/ depressed subscale, there is very little for the child to enjoy, would rather be alone than with others, refuses to talk, keeps things to self, is too timid, underactive (slow moving or lacks energy), sad (depressed) and/or withdrawn (doesn't get involved with others).

The role of social pragmatic difficulties in the development of internalizing symptoms in children with ASD appears to be significant. Pragmatic language impairments can cause a child to misinterpret social cues and interactions. These challenges in social understanding may lead to feelings of insecurity, which, in turn, are likely to contribute to heightened anxiety [59,60].

According to the literature, 'internalizing' behaviors like withdrawal, anxiety and depression are common in individuals with ASD [61]. Depression and Anxiety are among the most frequently

 doi:10.20944/preprints202501.1670.v1

co-occurring disorders in individuals with ASD, especially in those with higher functioning autism who are able to articulate their challenges [62,63]. 40% of youth with ASD are estimated to experience a comorbid anxiety disorder and 10% meet criteria for a mood disorder [64,65]. On the other hand, internalizing disorders significantly affect quality of life by worsening ASD symptoms and disrupting social functioning [66,67]. In the past decade, psychosocial interventions and treatments, such as Cognitive Behavioral Therapy (CBT) adapted for the ASD population, have been developed [64].

MASK & ABC relation

After adjusting for children's gender and age, a significant correlation was found between *Positive schizotypal symptoms subscale* and *Inappropriate speech subscale* of teacher's ABC. Additionally, *Total MASK score* remained significantly correlated with *Inappropriate speech subscale*. This suggests that children with higher schizotypal traits, as measured by the MASK, exhibit inappropriate speech compared to their classmates in the school setting and in a given situation.

The presence of schizotypal traits appears to further impact the social and academic development of school-age children with ASD, with social and pragmatic difficulties being more evident in the school setting. This may be because, in the school environment, children are directly compared to their peers in terms of both academic performance and functional abilities within the same context and timeframe.

Schizotypal Personality Disorder (SPD) is classified within the schizophrenia spectrum in both the DSM-5 and the ICD-11 as part of a continuum of psychotic disorders. It is already known from clinical experience and research that communication disturbances are a common symptom of schizophrenia and related to disturbance of thought process [68,69]. Several different types of communication disturbances have been identified in the speech of schizophrenia patients and in people at-risk for schizophrenia [70].

SPD is characterized by thought disorder, paranoia, social anxiety, derealization, transient psychosis, and unconventional beliefs. Persons with SPD frequently interpret situations as strange or having unusual meanings, with paranormal and superstitious beliefs being common. They may also display socially unexpected behaviors, such as odd or eccentric dress. In conversations, they might react unusually by not responding, talking to themselves, or exhibiting peculiar speech mannerisms [71]. In present study, we reached similar conclusions, as higher positive schizotypal symptoms were found to correlate significantly with inappropriate speech observed in the school setting.

Referring to the historical construct of schizotypy as introduced by Meehl in 1964, it is evident that thought disturbances (Meehl named them as *cognitive slippage)* was the most dependable indictor of schizotypy and it was a primary manifestation of a schizophrenia diathesis [72]. Snitz et al. [73], in a meta-analytic review provided evidence that cognitive deficits are present in the small to medium effect size range in unaffected adult first-degree relatives of schizophrenia patients. Reliable group differences were still found on tasks of language. These findings are highly significant as cognitive deficits may serve as indicators of genetic susceptibility to schizophrenia and are considered potential endophenotypes for the illness.

The findings of the current study regarding the impact of varying degrees of schizotypal traits on the social, emotional, and behavioral functioning of children with ASD contribute significantly to the existing literature.

Limitations of the study

A significant limitation of the present study is that it did not include data on neurotypical children and children with Broader Autism Phenotype (BAP) (*autistic traits*) or other diagnoses. The study of distinct control groups with various diagnoses, such as ASD only, schizotypy only, and co-occurring ASD and schizotypy, would have allowed for a more rigorous examination of how autistic and schizotypal traits correlate and interact, and how this interaction is captured in behavior, emotion, and functioning.

 doi:10.20944/preprints202501.1670.v1

An additional limitation is that the study's relatively small sample size may restrict its ability to detect subtle effects or interactions between multiple and complex variables. However, this limitation can ultimately be overcome as the study was originally designed based on the dimensional approach model where each individual receives a score on a continuous scale of psychological distress without a cut-off point to define a boundary between those with and without a presumed illness.

5. Conclusions

In conclusion, our findings highlight the need for further research regarding the phenomenological, genetic, imaging and environmental overlaps of schizophrenia and autism spectra. Research shows that the large clinical heterogeneity of the spectrum suggests multiple underlying causes with different developmental manifestations.

There is a need to design longitudinal studies to clarify the developmental trajectories of autistic and schizotypal traits. It is important to study the development of children who exhibit odd and/or intense imagination and confusion between reality and fantasy, and to gain a deeper understanding of these characteristics in order to identify those who may develop psychosis as they grow older.

Distinguishing children with autism who also exhibit schizotypal characteristics presents both diagnostic and therapeutic challenges. The ultimate goal is to determine the "nature" of the symptoms in this group of children. They might be classified as one of the following: an "endophenotype" within the autism spectrum, a "comorbid condition" involving both autism and schizophrenia, or a "phenotypic variant" of a Very early-onset schizophrenia (VEOS).

It is essential to develop accurate standardized psychometric tools for the co-assessment of autism and schizophrenia traits and to design targeted personalized interventions to prevent emotional distress and the development of additional dysfunctional behaviors. The goal is to ensure better functionality and quality of life for children and their families.

Author Contributions: Conceptualization, E.T., K.P., N.S., C.P., and EC.K.; methodology, EC.K, E.T, K.P., A.P., N.S., C.P .; formal analysis, EC.K., E.T.,and K.P ; investigation, E.T., EC.K, V.N .; resources E.T., V.N. and K.P.; data curation, EC.K, .E.T., and K.P; writing—original draft preparation, E.T., EC.K., and K.P; writing—review and editing, E.T, K.P., EC.K, A.P., N.S., C.P, V.N;.; supervision, K.P, N.S., and C.P.; All authors have read and agreed to the published version of the manuscript.

Funding: This research received no external funding.

Institutional Review Board Statement: The study was conducted according to the guidelines of the Declaration of Helsinki, and approved by the Ethics Committee of Aghia Sophia Children's Hospital (714/10/1/2018).

Informed Consent Statement: Informed consent was obtained from all subjects involved in the study.

Acknowledgments: The authors would like to thank the participating families.

Conflicts of Interest: The authors declare no conflict of interest.

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