

Differential Diagnosis between Autism Spectrum Disorder and Hyperlexia in a Jordanian Sample

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This study investigated whether children with Autism Spectrum Disorder (ASD) and children with Hyperlexia (HLX) differ in social interaction and pragmatic language, repetitive behaviors, sensory processing, and the decoding–comprehension gap. A comparative cross-sectional design was employed involving 80 children aged 4–10 years; 40 children diagnosed with ASD and 40 children with HLX recruited from specialized centers in Amman, Jordan. Data were collected using the Social Responsiveness Scale–Second Edition (SRS-2), Repetitive Behavior Scale–Revised (RBS-R), Short Sensory Profile (SSP), and standardized assessments of decoding, reading comprehension, and listening comprehension, from which decoding–comprehension discrepancy scores were calculated. Group differences were examined. The findings demonstrated that children with ASD continued to obtain significantly higher scores across all SRS-2 domains than children with HLX, with the largest adjusted effects observed for Social Communication. Also, the group of children with ASD demonstrated significantly higher levels of repetitive behavior on all sub-scales of the RBS-R, especially in the subscale of Sameness Behavior along with significantly higher levels of sensory processing problems in all SSP measures, especially Auditory Filtering. In contrast, children with HLX demonstrated significantly stronger decoding performance and significantly larger decoding–reading and decoding–listening discrepancy scores than children with ASD..

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Introduction

Hyperlexia is a phenomenon of early and natural acquisition of word decoding skills without formal education in reading and before the age of five years, in conjunction with considerable difficulties in language comprehension, pragmatics and social interaction (Silberberg & Silberberg, 1967; Healy, 1982; Grigorenko et al., 2002). While initially regarded as an isolated case of precocious reading, later investigations have found that Hyperlexia is usually diagnosed in people with autism spectrum disorder (ASD) and serves as a representative example of an uneven cognitive profile (Burd & Kerbeshian, 1985; Grigorenko et al., 2002; Ostrolenk et al., 2017). Such association has been generating debates about whether Hyperlexia can be considered as a separate syndrome or as a developmental profile within the autism spectrum.

Autism Spectrum Disorder is a heterogeneous neurodevelopmental disorder, which is characterized by persistent deficits in social communication and interaction, as well as restricted and repetitive patterns of behavior, interests and activities (American Psychiatric Association, 2013). The process of language development in ASD patients varies significantly depending on each particular case – some may have profound language problems, while others can exhibit high structural language with considerable pragmatic deficits (Peppé et al., 2007; Andreou & Skrimpa, 2020; Atkin & Lorch, 2006).

The problem of this study is the continuing ambiguity in differentiating between Autism Spectrum Disorder (ASD) and Hyperlexia (HLX), especially in children who have a long-term history of demonstrating early reading skills with language and social problems. In clinical and educational settings, children with Hyperlexia are often mistakenly classified with ASD, or conversely, children with Hyperlexia may not be recognized as having co-occurring ASD because of their advanced decoding and are therefore misdiagnosed and do not receive appropriate intervention plans. This confusion is created by the relative similarity of the observable features

of ASD and HLX (i.e., language delay, pragmatic problems, repetitive behaviors, and sensory sensitivities), but the relative dissimilarity of their respective underlying developmental profiles. Despite a great deal of discussion in the literature, there has been a dearth of empirical studies that directly compare children with ASD and children with HLX across different key domains; this includes social interaction and pragmatic language, stereotypical behaviors and sensory processing, and the amount of the decoding-comprehension gap. Consequently, a need has been identified for systematic research to investigate whether or not there is a greater degree of impairment with social and behavioral domains among children with ASD than among children with HLX and whether there is greater discrepancy between decoding and understanding unique to Hyperlexia. Addressing this problem is important for improving the accuracy of diagnosis, refine theoretical understanding, and for making more focused clinical and educational interventions.

The study therefore addresses three specific research questions. First, do children with ASD have greater difficulties in social interaction and pragmatic language than children with Hyperlexia? Second, are children with ASD more affected by stereotypical behaviors and sensory sensitivity than children with Hyperlexia? Third, does Hyperlexia involve a larger decoding-comprehension gap than ASD? Examining these questions together is important because a comparison restricted to a single domain may overlook the complex and uneven developmental profiles that characterize both conditions. A multidimensional comparison may provide a clearer understanding of the characteristics that overlap between the groups and those that may help distinguish them.

The present study is important in being the first to address a persistent diagnostic and conceptual problem in the field of neurodevelopmental disorders in systematically distinguishing between Autism Spectrum Disorder (ASD) and Hyperlexia across multiple developmental domains. By comparing children with ASD and children with Hyperlexia on the social

communication, repetitive behavior, sensory processing and decoding-comprehension patterns in the context of a Jordanian, Arabic-speaking culture, the study provides empirical evidence that provides clarification on areas of comparison and contrast between these two profiles. The findings contribute to the literature theoretically by both supporting current views of Hyperlexia as a distinct developmental profile which is characterized by a marked dissociation between decoding and comprehension but not necessarily a splinter skill within ASD. Clinically, the study offers useful markers that can be used in differential diagnosis and limit the risk of misclassification. Educationally, it underlines the relevance of establishing the difference between mechanical decoding and functional comprehension in planning interventions. Moreover, by expanding this line of research to a non-Western context, the study suggests to increase the cross-cultural generalizability of existing models. It provides a call for the significance of using multidimensional assessment as a way of understanding the complex developmental profiles.

Current conceptual models of Hyperlexia go far beyond the traditional definition of precocious reading skills. Modern reviews stress that Hyperlexia should rather be seen as a multifaceted developmental profile involving an exceptionally wide dissociation between word decoding and language comprehension abilities than as a singular skill or a distinct diagnostic disorder (Ostrolenk et al., 2017; Oliveira & Rangni, 2021). This new interpretation reflects the recognition that extraordinary word-decoding skills co-occur with difficulties in oral language, pragmatic communication, and socialization. Thus, contemporary literature tends to describe Hyperlexia as one of the distinctive developmental phenotypes occurring against the background of the neurodevelopmental condition called Autism Spectrum Disorder (ASD) (Treffert, 2011; Ostrolenk et al., 2017).

First evidence that individuals with severe language impairments might still show remarkable reading skills was provided by historical clinical observations. Early reports

described cases of children able to read fluently despite their severe difficulties in expressive language and communication (Mehegan & Dreifuss, 1972; Elliott & Needleman, 1976). Later studies showed that hyperlexic reading is not caused by memorizing visual shapes of words. On the contrary, many children use word decoding strategies comparable to those of typically developing readers such as reading of new or irregular words (Aaron, 1995; Nation, 1999). However, comprehension is often significantly more impaired, especially at the level of sentences, discourse, and pragmatics leading to the typical decoding-comprehension dissociation (Healy, 1982; Goldberg & Rothermel, 1984; Kistner et al., 1988).

Substantial heterogeneity of children with Hyperlexia led to the suggestion of several developmental subtypes of the condition. Previously proposed types included Hyperlexia occurring as an isolated developmental phenotype, Hyperlexia associated with ASD, and Hyperlexia accompanied with other neurodevelopmental or genetic conditions (Healy & Aram, 1986; Temple & Carney, 1996; Grigorenko et al., 2002). Developmental trajectories are different even in the case of ASD. For example, there are children whose language comprehension and communication skills show improvement with time while others have persistent decoding-comprehension discrepancy (Siegel, 1984; Sparks, 2001; Ng, 2021). This finding emphasizes the heterogeneity of Hyperlexia.

Contemporary theoretical approaches have also contributed to understanding Hyperlexia by interpreting it as an alternative developmental path in autism. According to the neurocognitive models, written language as a structured and visual system may provide some autistic children with an alternative way to acquire language without many social aspects of speaking (Motttron et al., 2013; Ostrolenk et al., 2025). Indeed, studies showed that many children with ASD have unusual interests in letters and numbers in their early years and these interests can lead to better memory consolidation, language acquisition, and cognitive development

if properly stimulated (Happé & Vital, 2009; Meilleur et al., 2015; Bal et al., 2022). Moreover, large-scale clinical studies revealed that this early fascination with symbols occurs more frequently in ASD than previously supposed (Ostrolenk et al., 2024) while qualitative investigations suggested that letters and numbers are also used to regulate emotions, organize activities, and express oneself rather than read (Ostrolenk et al., 2025).

Decoding–comprehension gap is the central cognitive characteristic of Hyperlexia. Theoretical explanations always argue that extraordinary word-recognition abilities develop separately from oral language comprehension, inferencing, and pragmatic language (Ostrolenk et al., 2017; Singh, 2023). This assumption is also supported by empirical research showing that decoding and comprehension depend on partly separate cognitive and linguistic processes and they can develop differently in ASD (Peristeri et al., 2024). Thus, good early reading skills cannot be seen as indicators of functional literacy and adequate language development, especially in neurodevelopmental conditions. Multilingual studies also showed that decoding–comprehension dissociation is a universal rather than language-specific phenomenon (Oliveira & Rangni, 2021).

In addition to literacy, behavioral traits also provide important criteria to distinguish Hyperlexia from ASD. Studies previously found deficits in social reciprocity, pragmatic language, and social motivation as core characteristics of ASD (Andreou & Skrimpa, 2020). While children with Hyperlexia experience some pragmatic language problems, these difficulties are less severe and less pervasive than in ASD (Ostrolenk et al., 2017; Ng, 2021). Likewise, although both children with Hyperlexia and ASD can have restricted/repetitive behaviors, they are usually more generalized in the former case and more restricted to specific interests like letters, numbers, or written symbols in the latter (Treffert, 2011).

Atypical sensory processing is another important factor. Atypical sensory responsiveness is a core

feature of ASD linked with significant functional impairment in multiple domains (Baptistello et al., 2023). Children with Hyperlexia may also have sensory sensitivities but it appears that these are less pervasive and can be rather attributed to attention to structured visual/linguistic information than sensory processing problems (Ostrolenk et al., 2017).

There are some gaps left in the research on Hyperlexia despite many advances. Most of previous studies were focused either on single aspects such as reading skills, language development, or behavioral characteristics. Relatively few investigations considered social communication, repetitive behaviors, sensory processing, and decoding–comprehension differences at the same time. Moreover, there is only scarce evidence from Arabic-speaking populations limiting generalizability of these developmental profiles to different languages and cultures.

Methodology

A quantitative comparative cross-sectional research design was used to explore differences between children with Autism Spectrum Disorder (ASD) and children with Hyperlexia (HLX) in terms of social communication, repetitive behavior, sensory processing, and literacy skills. The described research design allowed comparing two naturally existing clinical groups without manipulating any research variables. ANCOVA was used as an analysis method to compare the performance of different groups while controlling for age, nonverbal IQ, and sex, thus reducing the effect of potentially confounding variables on the results.

The sample of the current study consisted of 80 Jordanian Arabic-speaking children between 4 and 10 years old; 40 of them were diagnosed with ASD, and 40 were diagnosed with Hyperlexia. Children were recruited from four special centers located in Amman, Jordan: Jordanian Academy for Autism (n = 36); SCADD – Scientific Center of Autism and Developmental Disorders (n = 18); Atlas Al-Sharq Center for Autism (n = 14); Jordanian Autism Society (n = 12). Participants were included into the sample if they had a

previous clinical diagnosis of ASD or Hyperlexia and were native Arabic speakers. Individuals with severe neurological disorders, untreated visual and auditory impairment, and health issues that could significantly affect their cognitive and language abilities were excluded. Previous diagnoses of ASD were made by multidisciplinary clinical teams based on the criteria of DSM-5 (American Psychiatric Association, 2013). Children diagnosed with Hyperlexia demonstrated the ability to decode words along with significant discrepancies in word decoding and oral language comprehension as described in the contemporary literature (Ostrolenk et al., 2017).

Participants were tested using standardized tests with good psychometric characteristics. Social communication was assessed via the Social Responsiveness Scale-Second Edition (SRS-2); repetitive behaviors – through the Repetitive Behavior Scale-Revised (RBS-R); and sensory processing was measured using the Short Sensory Profile (SSP). Literacy skills were measured using the standardized tests for word decoding, reading comprehension, and listening comprehension; decoding-comprehension discrepancy scores

were calculated. The research protocol was approved by the ethical committee prior to data collection, and informed consents were obtained from the parents/legal guardians of all participants. Before testing hypotheses, assumptions of ANCOVA such as normality, homogeneity of variances, linearity, and homogeneity of regression slopes were verified and considered valid. IBM SPSS Statistics Version 29 was used for all statistical analyses. Statistical significance was set at $p < .05$, and effect sizes were reported using partial eta squared (partial η^2).

Results

Social Communication and Pragmatic Language

The first set of analyses tested the differences between ASD children and HLX children regarding social communication and pragmatic language with the help of Social Responsiveness Scale-Second Edition (SRS-2). First, the descriptive statistics will be provided, followed by the results of the analysis of covariance (ANCOVA), in which age, nonverbal IQ, and sex were controlled.

Table 1: Descriptive Statistics for Social Responsiveness Scale-Second Edition (SRS-2) Scores by Diagnostic Group

SRS-2 Domain	ASD <i>M</i> ± <i>SD</i>	HLX (n = 40) <i>M</i> ± <i>SD</i>
Social Awareness	68.60 ± 7.90	57.30 ± 6.60
Social Cognition	74.20 ± 8.50	60.40 ± 7.20
Social Communication	77.70 ± 9.20	62.90 ± 7.60
Social Motivation	70.40 ± 8.10	59.50 ± 7.00
Restricted Interests and Repetitive Behavior	73.30 ± 8.80	63.60 ± 7.40
Total SRS-2	75.30 ± 8.60	61.50 ± 7.30

Descriptive statistics for the SRS-2 domains of children diagnosed with Autism Spectrum Disorder (ASD) and Hyperlexia (HLX) are shown in Table 1 below. In all the domains, it was found that children with ASD had significantly higher mean scores compared to children with HLX. The largest mean differences were observed for Social Communication ($M = 77.70$,

$SD = 9.20$ vs. $M = 62.90$, $SD = 7.60$), Social Cognition ($M = 74.20$, $SD = 8.50$ vs. $M = 60.40$, $SD = 7.20$), and the Total SRS-2 score ($M = 75.30$, $SD = 8.60$ vs. $M = 61.50$, $SD = 7.30$). Similar patterns were observed for Social Awareness, Social Motivation, and Restricted Interests and Repetitive Behavior. Standard

deviations were comparable across the two diagnostic groups

Table 2: ANCOVA Results for SRS-2 Domains After Controlling for Age, Nonverbal IQ, and Sex

SRS-2 Domain	F(1, 75)	p	Partial η^2
Social Awareness	34.80	<.001	.317
Social Cognition	48.20	<.001	.391
Social Communication	59.50	<.001	.442
Social Motivation	27.60	<.001	.269
Restricted Interests and Repetitive Behavior	24.10	<.001	.243
Total SRS-2	47.00	<.001	.385

An ANCOVA procedure, where age, non-verbal IQ, and gender served as covariates to ascertain whether the noted differences could be found even when demographic and developmental variables were controlled for, was undertaken. It is clear from Table 2 that there were statistically significant differences between the two groups, namely ASD and HLX, in all SRS-2 covariates. The largest adjusted group effect was found for Social Communication, $F(1, 75) = 59.50$, $p < .001$, partial $\eta^2 = .442$, followed by Social Cognition, $F(1, 75) = 48.20$, $p < .001$, partial $\eta^2 = .391$, and the Total SRS-2 score, $F(1, 75) = 47.00$, $p < .001$, partial $\eta^2 = .385$. Significant differences also remained for Social Awareness, $F(1, 75) =$

34.80, $p < .001$, partial $\eta^2 = .317$, Social Motivation, $F(1, 75) = 27.60$, $p < .001$, partial $\eta^2 = .269$, and Restricted Interests and Repetitive Behavior, $F(1, 75) = 24.10$, $p < .001$, partial $\eta^2 = .243$.

Repetitive Behaviors and Sensory Processing

The second set of analyses concerned group differences in terms of repetitive behaviors and sensory processing. First, the descriptive statistics will be presented regarding Repetitive Behavior Scale–Revised (RBS-R) and Short Sensory Profile (SSP), followed by the results of ANCOVA with age, nonverbal IQ, and sex controlled.

Table 3: Descriptive Statistics for Repetitive Behavior Scale–Revised (RBS-R) Scores by Diagnostic Group

RBS-R Subscale	ASD (n = 40) <i>M</i> $\pm$ <i>SD</i>	HLX (n = 40) <i>M</i> $\pm$ <i>SD</i>
Stereotyped Behavior	73.00 $\pm$ 10.00	61.00 $\pm$ 9.00
Self-Injurious Behavior	63.00 $\pm$ 11.00	57.00 $\pm$ 9.00
Compulsive Behavior	69.00 $\pm$ 10.00	59.00 $\pm$ 8.00
Ritualistic Behavior	71.00 $\pm$ 9.00	62.00 $\pm$ 8.00
Sameness Behavior	75.00 $\pm$ 10.00	63.00 $\pm$ 8.00
Restricted Interests	72.00 $\pm$ 9.00	61.00 $\pm$ 8.00
Total RBS-R	72.00 $\pm$ 8.69	60.00 $\pm$ 7.60

Descriptive statistics of the RBS-R subscales for children diagnosed with ASD and HLX are presented in Table 3 below. Children with ASD had higher average values than those with HLX in all repetitive behavior categories. The greatest

mean differences were found in the areas of Sameness Behavior ($M = 75.00$, $SD = 10.00$; $M = 63.00$, $SD = 8.00$); Stereotyped Behavior ($M = 73.00$, $SD = 10.00$; $M = 61.00$, $SD = 9.00$); Restricted Interests ($M = 72.00$, $SD = 9.00$; $M =$

61.00, $SD = 8.00$); and the Total RBS-R scale ($M = 72.00$, $SD = 8.69$; $M = 60.00$, $SD = 7.60$). Similar findings were also made for the following

categories: Compulsive Behavior, Ritualistic Behavior, and Self-Injurious Behavior.

Table 4: Descriptive Statistics for Short Sensory Profile (SSP) Scores by Diagnostic Group

SSP Modality	ASD (n = 40) $M \pm SD$	HLX (n = 40) $M \pm SD$
Tactile Sensitivity	65.00 $\pm$ 10.00	58.00 $\pm$ 9.00
Taste/Smell Sensitivity	61.00 $\pm$ 10.00	56.00 $\pm$ 9.00
Movement Sensitivity	63.00 $\pm$ 9.00	57.00 $\pm$ 8.00
Under-responsive/Seeks Sensation	68.00 $\pm$ 9.00	61.00 $\pm$ 8.00
Auditory Filtering	70.00 $\pm$ 10.00	62.00 $\pm$ 9.00
Low Energy/Weak	64.00 $\pm$ 9.00	59.00 $\pm$ 8.00
Visual/Auditory Sensitivity	67.00 $\pm$ 9.00	60.00 $\pm$ 8.00
Total SSP	66.00 $\pm$ 9.00	59.00 $\pm$ 8.00

Table 4 presents the descriptive statistics for the Short Sensory Profile (SSP) modalities for children with ASD and HLX. Children with ASD consistently demonstrated higher mean scores across all sensory processing domains than children with HLX. The largest mean differences were observed for Auditory Filtering ($M = 70.00$, $SD = 10.00$ vs. $M = 62.00$, $SD = 9.00$), Under-responsive/Seeks Sensation ($M = 68.00$, $SD = 9.00$ vs. $M = 61.00$, $SD = 8.00$), and Visual/Auditory Sensitivity ($M = 67.00$, $SD = 9.00$ vs. $M = 60.00$, $SD = 8.00$). Comparable

differences were also observed for Tactile Sensitivity, Taste/Smell Sensitivity, Movement Sensitivity, and Low Energy/Weakness.

Follow-up Tests (Per Domain)

To further examine the differences observed between the ASD and HLX groups, follow-up analyses were conducted using analysis of covariance (ANCOVA) while controlling for age, nonverbal IQ, and sex. Separate analyses were performed for the RBS-R subscales and SSP modalities.

(A) RBS-R Subscales

Table 5: ANCOVA Results for Repetitive Behavior Scale–Revised (RBS-R) Subscales After Controlling for Age, Nonverbal IQ, and Sex

RBS-R Subscale	F(1, 75)	p	Partial η^2
Stereotyped Behavior	35.20	<.001	.319
Self-Injurious Behavior	7.80	.007	.094
Compulsive Behavior	27.00	<.001	.265
Ritualistic Behavior	25.30	<.001	.252
Sameness Behavior	39.00	<.001	.342
Restricted Interests	37.50	<.001	.333
Total RBS-R	38.60	<.001	.340

After controlling for age, nonverbal IQ, and sex, significant differences between the ASD and HLX groups remained across all RBS-R subscales

(Table 5). The largest adjusted group effect was observed for Sameness Behavior, $F(1, 75) = 39.00$, $p < .001$, partial $\eta^2 = .342$, followed by the

Total RBS-R score, $F(1, 75) = 38.60, p < .001$, partial $\eta^2 = .340$, and Restricted Interests, $F(1, 75) = 37.50, p < .001$, partial $\eta^2 = .333$. Significant differences were also identified for Stereotyped Behavior, $F(1, 75) = 35.20, p < .001$, partial $\eta^2 =$

.319, Compulsive Behavior, $F(1, 75) = 27.00, p < .001$, partial $\eta^2 = .265$, Ritualistic Behavior, $F(1, 75) = 25.30, p < .001$, partial $\eta^2 = .252$, and Self-Injurious Behavior, $F(1, 75) = 7.80, p = .007$, partial $\eta^2 = .094$

(B) SSP Modalities

Table 6: ANCOVA Results for Short Sensory Profile (SSP) Modalities After Controlling for Age, Nonverbal IQ, and Sex

SSP Modality	$F(1, 75)$	p	Partial η^2
Tactile Sensitivity	11.60	.001	.134
Taste/Smell Sensitivity	6.20	.015	.076
Movement Sensitivity	11.00	.001	.128
Under-responsive/Seeks Sensation	15.20	<.001	.168
Auditory Filtering	15.80	<.001	.174
Low Energy/Weak	7.40	.008	.090
Visual/Auditory Sensitivity	15.10	<.001	.168
Total SSP	15.30	<.001	.170

The adjusted analyses presented in Table 6 demonstrated that significant differences between the ASD and HLX groups persisted across all SSP modalities after controlling for age, nonverbal IQ, and sex. The largest adjusted effect was observed for Auditory Filtering, $F(1, 75) = 15.80, p < .001$, partial $\eta^2 = .174$, followed by the Total SSP score, $F(1, 75) = 15.30, p < .001$, partial $\eta^2 = .170$, and both Under-responsive/Seeks Sensation and Visual/Auditory Sensitivity, which produced identical effect sizes (partial $\eta^2 = .168$). Significant group differences were also observed for Tactile Sensitivity, $F(1, 75) = 11.60, p = .001$, partial $\eta^2 = .134$, Movement Sensitivity, $F(1, 75) = 11.00, p = .001$, partial $\eta^2 = .128$, Low

Energy/Weakness, $F(1, 75) = 7.40, p = .008$, partial $\eta^2 = .090$, and Taste/Smell Sensitivity, $F(1, 75) = 6.20, p = .015$, partial $\eta^2 = .076$.

Literacy Skills and the Decoding-Comprehension Gap

Finally, the last set of analyses addressed the differences between the groups concerning their literacy skills including decoding, reading comprehension, listening comprehension, and decoding-comprehension discrepancy. The descriptive statistics are first provided, followed by ANCOVA results with age, nonverbal IQ, and sex controlled.

Table 7: Descriptive Statistics for Literacy-Related Measures by Diagnostic Group

Literacy Measure	ASD (n = 40) $M \pm SD$	HLX (n = 40) $M \pm SD$
Decoding	-0.31 ± 0.81	1.61 ± 0.61
Reading Comprehension	-0.61 ± 0.81	-0.21 ± 0.71
Listening Comprehension	-0.51 ± 0.80	-0.11 ± 0.71
Decoding-Reading Gap	0.31 ± 0.61	1.81 ± 0.71
Decoding-Listening Gap	0.21 ± 0.61	1.71 ± 0.71

Table 7 presents the descriptive statistics for decoding, reading comprehension, listening comprehension, and decoding–comprehension gap scores for children with ASD and HLX. Children with HLX demonstrated substantially higher decoding performance than children with ASD ($M = 1.61$, $SD = 0.61$ vs. $M = -0.31$, $SD = 0.81$). In contrast, differences between the two groups in reading comprehension and listening comprehension were comparatively smaller,

although children with HLX consistently obtained higher mean scores on both measures. The decoding–reading gap and decoding–listening gap scores were markedly larger among children with HLX than among children with ASD, indicating a greater discrepancy between decoding ability and language comprehension. Standard deviations were comparable across the two groups.

Table 8: ANCOVA Results for Literacy after Controlling for Age, Nonverbal IQ, and Sex

Literacy Measure	F(1, 75)	p	Partial η^2
Decoding	126.00	<.001	.627
Reading Comprehension	5.20	.025	.065
Listening Comprehension	5.50	.022	.068
Decoding–Reading Gap	96.50	<.001	.563
Decoding–Listening Gap	94.00	<.001	.556

To establish whether these differences persisted even after controlling for demographic and development factors, an ANCOVA analysis was conducted by controlling for the variables of age, nonverbal IQ, and sex. According to Table 8 below, significant group differences persisted on all the variables measured after controlling for the covariates. Of particular importance is that of decoding, $F(1, 75) = 126.00$, $p < .001$, partial $\eta^2 = .627$, which showed better decoding ability for the children with HLX. Another important finding is the significantly high and large adjusted effects of decoding–Reading Gap, $F(1, 75) = 96.50$, $p < .001$, partial $\eta^2 = .563$ and decoding–Listening Gap, $F(1, 75) = 94.00$, $p < .001$, partial $\eta^2 = .556$. Even though there existed significant differences in Reading Comprehension, $F(1, 75) = 5.20$, $p = .025$, partial $\eta^2 = .065$ and Listening Comprehension, $F(1, 75) = 5.50$, $p = .022$, partial $\eta^2 = .068$, the adjusted effects were less compared to those of decoding.

Discussion

The findings demonstrate clear evidence that, despite a number of similarities in developmental characteristics of ASD and HLX, these disorders constitute clinically distinguishable profiles with regard to social communication, repetitive

behaviors, sensory processing, and literacy-related skills. It is worth noting that the differences remained significant after the analysis adjusted for age, nonverbal IQ, and sex of the participants, thus indicating that the differences were not the result of demographic or cognitive factors but reflected real characteristics of the two developmental profiles.

The biggest difference observed between the groups concerned social communication. All subscales of the Social Responsiveness Scale–Second Edition (SRS-2) revealed a substantially greater level of impairments in social communication in the ASD group compared to the HLX group, thus confirming that difficulties in social reciprocity, social cognition, and pragmatic communication are indeed the defining characteristics of autism. This pattern agrees with the diagnostic criteria provided in the Diagnostic and Statistical Manual of Mental Disorders (American Psychiatric Association, 2013) and with the existing literature on the defining behavioral characteristics of autism (Tager-Flusberg et al., 2005; Andreou & Skrimpa, 2020).

While children with Hyperlexia also presented with difficulties in social communication, these

difficulties were significantly less pronounced and never reached the extent of impairments in social communication found in ASD. This result is consistent with previous findings demonstrating that while children with Hyperlexia present with pragmatic language disorders, they lack social impairment characteristic of ASD (Ostrolenk et al., 2017; Ng, 2021). In other words, this finding confirms the need for clinicians to differentiate these disorders based on the characteristics discussed and, hence, does not allow interpreting advanced reading ability as a sign of intact social communication. At the same time, the finding demonstrates that HLX cannot be described as a disorder only by the severity of the social difficulties characteristic of ASD.

The most likely explanation of the difference is that HLX and ASD involve different developmental mechanisms related to language and social skills. Despite the common difficulty in pragmatic language, children with HLX retain significantly higher social awareness and social motivation compared to children with ASD. In turn, ASD includes broader difficulties in reciprocal social interaction, social cues interpretation, and flexibility of communication. These differences likely explain why social communication emerged as one of the most distinctive domains despite the common developmental characteristics of the two groups.

Findings related to repetitive behaviors provide an additional distinction between the two disorders. All subscales of the Repetitive Behavior Scale-Revised (RBS-R) revealed significantly higher scores among the ASD group, confirming the defining role of behavioral rigidity in ASD (American Psychiatric Association, 2013). Similar results have been obtained in previous studies describing repetitive behaviors in ASD as pervasive and associated with cognitive rigidity and insistence on sameness (Kanner, 1943; American Psychiatric Association, 2013).

While children with Hyperlexia also demonstrated repetitive behaviors, their overall severity was lower, and the behaviors appeared to

be more focused compared to ASD. This finding agrees with the existing literature on repetitive interests in HLX as being focused on letters, numbers, or other structured visual information rather than being a sign of behavioral rigidity characteristic of ASD (Treffert, 2011; Ostrolenk et al., 2017). In other words, the difference indicates that similar observable behaviors may be associated with different developmental processes. Repetitive behaviors in HLX appear to be a sign of narrow focus on structured information while ASD involves behavioral rigidity.

This conclusion is very important in the context of diagnosis since it shows that the presence of repetitive behavior is not sufficient for diagnosing these disorders and that clinicians should look at the characteristics of the behaviors rather than just the presence or absence of repetitive behaviors themselves. Such an approach will decrease the likelihood of diagnostic ambiguity in children with early reading abilities and repetitive behaviors.

A similar pattern was observed in terms of sensory processing. All subscales of the Short Sensory Profile (SSP) revealed more pronounced problems in sensory processing in the ASD group. The finding confirms the role of atypical sensory responsiveness as one of the prominent characteristics of the autistic phenotype (Motttron et al., 2006; Happé & Vital, 2009; Baptistello et al., 2023).

Children with HLX also showed some sensory sensitivities, but these sensitivities were less pronounced compared to those of the ASD group. The existing literature has suggested that sensory characteristics in HLX may reflect higher attentional engagement with visually or linguistically structured information rather than the widespread sensory dysregulation characteristic of ASD (Ostrolenk et al., 2017). This conclusion is confirmed by the results, as they demonstrate sensory differences in HLX but in terms of lesser pervasiveness and disruptiveness compared to the case of ASD.

The findings related to literacy show once again that the defining characteristic of HLX lies not in

advanced reading abilities per se but in the dissociation between decoding and language comprehension. While children with HLX showed significantly better decoding abilities, no such improvement in reading or listening comprehension was observed, which resulted in a significantly greater discrepancy between decoding and comprehension compared to the ASD group. This finding confirms the opinion that accurate word recognition and language comprehension are two independent but interrelated developmental processes.

The current findings agree with previous descriptions of HLX as a condition in which exceptional decoding ability emerges alongside the persisting limitations in linguistic comprehension (Silberberg & Silberberg, 1967; Healy, 1982; Nation, 1999). Neurocognitive models of HLX similarly propose that decoding and oral language depend on the partially distinct cognitive mechanisms and, hence, may have different developmental courses, especially in neurodevelopmental conditions (Ostrolenk et al., 2017; Peristeri et al., 2024). The current results complement this model by showing that the dissociation holds after adjustment for age, nonverbal IQ, and sex of the participants.

The important implication of this finding is that early decoding ability should not be interpreted as evidence of functional literacy. Even if children demonstrate exceptional decoding, they may still face serious difficulties in language comprehension, inferencing, and practical application of the language in communication. Hence, educational or clinical assessments that base on decoding performance may overestimate language competence. Literacy assessment must include evaluation of both decoding and language comprehension to ensure proper assessment of the language ability of the child.

The smaller discrepancy in the ASD group suggests a different pattern of language development. Rather than demonstrating exceptional decoding abilities, many children with ASD face general language-related difficulties that affect both decoding and language comprehension, particularly when the

language impairment occurs in conjunction with the other disorders (Cronin, 2014; Peristeri et al., 2024). Although considerable individual variability is possible in both groups, the current findings show that the discrepancy size between decoding and language comprehension is one of the key distinguishing characteristics between HLX and ASD and must be included in differential diagnostic assessment.

The current study makes several contributions to the field of HLX among children with autism. Previous literature has usually addressed literacy, language, social communication, and behavioral characteristics individually, thus not allowing observing the interactions between these domains. Evaluation of social communication, repetitive behaviors, sensory processing, and literacy in the current study allows obtaining a more comprehensive comparison of HLX and ASD. Adjustment for age, nonverbal IQ, and sex increases the interpretability of the findings since it is unlikely that the differences are due to cognitive ability or developmental maturity.

From the theoretical perspective, the current findings confirm the contemporary models of HLX as the distinct developmental profile in the autism spectrum rather than just an unusual ability to read or a splinter skill (Ostrolenk et al., 2017; Ostrolenk et al., 2025). While both groups have language delays and some of the behavioral characteristics, children with HLX demonstrate a specific profile of exceptionally high decoding ability, mild social and behavioral difficulties, and the discrepancy between decoding and language comprehension. This pattern suggests the relative independence of written language development from the language and social abilities, which provides confirmation of the theory of the HLX as the alternative language acquisition route in autism. Far from contradicting the contemporary conception of ASD, the findings complement it by increasing the knowledge of the diversity of ASD.

Finally, the findings have important implications for clinical practice and education. Advanced ability to decode the words should not be interpreted as evidence of proper language

competence, while the language delays and repetitive behaviors do not automatically mean that the child has ASD. Comprehensive differential diagnostic evaluations must include assessments of decoding skills, language comprehension, social communication, repetitive behaviors, and sensory characteristics. Differential assessment may help to plan intervention programs in a more individualized manner. Intervention programs for children with HLX may utilize their decoding skills to increase language comprehension and pragmatic communication skills, while interventions for children with ASD may focus on reciprocal social communication, behavioral flexibility, and sensory processing.

One more strength of the current study is that it expands the evidence on HLX beyond the predominantly Western populations studied before. Comparable social communication, behavioral, sensory, and literacy patterns of Jordanian Arabic-speaking children suggest the existence of the distinguishing characteristics of HLX and ASD in different linguistic and cultural contexts. Although cross-cultural research involving larger and more diverse populations is necessary in the future, the current findings provide preliminary validation of the current neurodevelopmental models in different cultures.

Implications

The findings have important implications for the clinical assessment and education. Differential diagnostic evaluations must include assessment of language comprehension, social communication, repetitive behaviors, sensory characteristics, and literacy in addition to the early reading ability to differentiate between HLX and ASD. Intervention programs must also reflect the different profiles identified in the study. Educational programs for children with HLX may capitalize on the advanced decoding skills to strengthen language comprehension and pragmatics while interventions for children with ASD must continue focusing on the reciprocal social communication, behavioral flexibility, and sensory characteristics.

Limitations of the Study

There are several limitations related to the interpretation of the findings. First of all, the sample included 80 participants from specialized centers in Amman, Jordan. This reduces the ability to generalize the results of the study due to the limited number of participants. Secondly, the cross-sectional design is used in the study that makes possible only the examination of development at a certain point of time but not the study of developmental changes over time. Thirdly, the behavioral assessment and caregiver report can be subjective. Moreover, neurobiological variables like neuroimaging or electrophysiological assessment, and language biomarkers are not assessed. Thus, the exact reasons for the differences are not known. Finally, the findings cannot be generalized to the different cultural and linguistic groups due to the specific conditions under which the study was conducted.

Suggestions for Future Research

In order to make the findings more generalizable to the various contexts, it will be necessary to use bigger and diverse samples from different clinics and educational institutions. It is also required to conduct longitudinal studies to examine the changes of the development of children with Hyperlexia and ASD and find out whether the decoding-comprehension dissociation persists during the development.

Further investigations should combine behavioral assessments and objective measurements of the neurodevelopment such as neuroimaging, electrophysiological techniques, eye-tracking, and language-processing biomarkers in order to determine the reasons of this dissociation. The cross-linguistic investigation involving different orthographies is also required to define the consistency of the findings for various languages. Intervention programs using decoding skills of children with Hyperlexia should be developed and investigated.

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