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Characteristic Neuro-Linguistic Styles in Young Arabic Speaking Children Diagnosed with ASD

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Abstract

Evaluations of all Arabic speaking children age 3–9.0 years with significant speech delays or impairments, referred to a community based, child development center in the public health care system during a 5-year period were reviewed.

Use of an inordinate degree of words and expressions in Fossha version of classical Arabic, mainly used in the media, children's literature and formalized venues, as well as in English, was highly associated with ASD, especially among those who were both more intelligent (IQ> 70), as well as older (greater than 4 years), (Pearson 7.29, Fisher 2-tailed test, $p = 0.015$).

The use of "out of context" speech embedded in ordinary Arabic vernacular was associated with a higher degree of speech stereotypy ($p < 0.001$) among children with ASD, and unrelated statistically to the number of hours of screen viewing time, jargoning or associative speech.

Idiosyncratic speech choices reflect neuro-linguistic mechanisms in social communication- impaired youngsters.

Keywords

autism, language disorder, arabic, communication disorder, pragmatic

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Introduction

Autism spectrum disorder (ASD) is a complex neurodevelopmental disorder with impact on lifelong functioning. From an epidemiological point of view, ASD has become one of the fastest growing of all developmental disabilities, and the most significant in scope.[1-2] Indeed, incidence figures continue to mount across the globe, including children from all societies, and crossing all geographic boundaries and cultures.[3] In developed countries the estimated prevalence is approximately 1.5%, with recent increases among those without comorbid intellectual disabilities.[4]

In individual cases, ASD- Autism Spectrum Disorder is rated by symptom severity and by the degree to which normal functioning is impaired in different settings such as home, school, and social venues.[5]

Intervention seems to be the key in ameliorating the scope of early disabilities.[6-10]

Multidisciplinary staffs at child development centers work together to improve early and eventually long terms functioning.[11] Professional staff members treating early symptoms seek to understand the neurocognitive and neurolinguistic mechanisms behind the pathologies to advance better treatment methods.[12]

Impairments in social communication are included in the primary diagnostic criteria for ASD. These impairments eventually lead to difficulty in language acquisition for use in communicating correctly in normal social situations. Individuals with ASD who are fluently verbal and typically functioning within the normal cognitive range, often use language inappropriately, thus belying their core disorder. The mix of language and social

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communication language problems among children with ASD are highly persistent and pervasive.[12]

In an exhaustive analysis of autistic language, Vicker noted that the language characteristics most typical of young children with ASD, especially those who are high-functioning, include the appearance of good vocabulary and sophisticated command of the language system based on their verbal utterances, yet contain repetition of bits of dialogue heard on television or in the conversations of others.[12] This attenuated echolalia may or may not be used in appropriate contexts. In some children, the depth of meaning of specific words used may be restricted, or the breadth of vocabulary may not be as expansive as utterances may suggest, and thus be misleading to the ears of the average listener. Of course, some individuals may have an excellent verbal repertoire, but appear to have difficulty with figurative language such as idioms, metaphors, similes and irony. Others appear to have difficulty in recognizing contextual (conversational) or text (print) situations that include certain vocabulary (words) that may have alternative meanings. Additional impairments include: a tendency to respond to suggestions, directions, or information in a very literal manner; difficulty in grasping the intended idea, drawing conclusions and making other inferences from conversation, text, TV programs and movies; and difficulty in understanding humor in TV programs, movies, cartoons (animated and static) and everyday interactions. Some children appear to understand basic sentence structure but may have more difficulty with more complex sentences that contain embedded and subordinate clauses. Some may attend primarily to key words rather than to the message conveyed by the grammar, and may also have difficulty understanding the grammar, and thus resort to the "key word" strategy. Some children will experience difficulties in both reading comprehension, as well as oral language, and may not be able to connect one idea to the next in a conversation or text, eg, they may not connect the content of one sentence to the following one.[12]

Children in different societies tend to make linguistic choices; one of these is usage of foreign words in their verbal communication, but when ASD children make these choices, they tend to be based on their desire to communicate. Their communication errors often reflect, not a problem in wanting to communicate, but rather their maladaptive choices of speech due to abnormal patterns of brain functioning, characteristic of autism. These reflect the impairments not only in the left prefrontal cortex and the left cingulate cortex, but also in the other potential areas of involvement in ASD, including the fronto-temporal lobe, the fronto-parietal cortex, the amygdala, the hippocampus, and the basal ganglia.[13-16] Many of these additions and modifications to regular speech and language constitute the hallmark pragmatic errors often associated with autism.

Several researchers have suggested that varying the mode of language – melody, intonation, and cadence – may enhance language attractiveness, perception and understanding among ASD children, similar to what foreign words or phrases may engender among young ASD children.[17-20]

In societies outside of the traditional Western social milieu, diagnostic approaches, assessment tools (albeit translated into the local language) and the traditional team approach have become standard practice in developmental centers, and are commonly implemented. It often becomes necessary for parents, teachers and professionals to become attuned to more local and culture-specific perturbations in what is considered normal developmental functioning in young children in order to identify and correctly diagnose ASD as early as possible.[21-24]Models of aberrant language function in ASD on the Vicker model do not always hold in other cultural language settings, such as Arabic, and therefore need revision to suit local clinical needs.[25-35]

Autism spectrum disorder has also been examined, both epidemiologically and in its clinical expression, in the context of societies in transition, whether as a result of refugee status, or of transcultural dislocation due to economic or other socioeconomic disruption,[36-38] including Arabic-speaking societies.[39-43]

Screening and evaluation of young Arabic-speaking children by speech and language therapists, to identify those presenting with language-based signs of potential social communication disorders require tools that specifically characterize pathological patterns of speech and language in that vernacular.[44]

The Arabic language and its many forms of usage by both ASD and non-ASD native speakers during their formative stage of language development provides a unique opportunity to study the potential characteristic patterns of language development in both normally developing youngsters and those with impairments. Arabic is a rich and multifaceted language, combining formal and literary (Koranic classic and Fossha classic) elements with an equally rich and varied spoken form that often varies according to locale and is influenced by social norms, cultural variations and style.

All children first acquire the language of their mother tongue, often adopting style, intonation, morphology and pragmatics based on their innate abilities, home environment and cultural heritage. This is especially so in the case of Arabic, which offers the native speaker a variety of styles and forms resulting from the multilayered simultaneous exposure to the different forms of the language through daily speech, children's books, and the diverse types of mass media. Arabic is unique in the exposure to multiple forms of the language at an early age.

The present study attempted to identify those characteristics and elements of the Arabic language and its aberrant use by young children who signal possible at-risk status for autism and other developmental disabilities. By adding observations unique to the milieu of the Arabic speaking home and comparing them to what is considered normative speech in that society, speech and language therapists in child development would be adding to the diagnostic tool box of professionals in those societies, and in Western countries where Arabic speaking young children congregate due to immigration.

The study's hypothesis is that unique language patterns excessively employing non-vernacular forms of speech among young children whose mother tongue is Arabic could be a tip-off to the presence of ASD. Also, language choices in Arabic provide an insight into how the young ASD child's brain functions as to how much they really want to communicate effectively.

Methods

We reviewed evaluations performed over a 5-year period, of all the Arabic-speaking children aged 3 to 9 years with significant speech delays or impairments who had been referred to a community-based multidisciplinary child development center in the public health care system. These appraisals were performed to identify the presence of characteristic maladaptive speech pathologies, according to age-related norms. The information culled reflected a population trend for that particular area of the country.

All the children had been evaluated by a licensed speech and language pathologist affiliated with a child development center within the public health care system. She had utilized standardized evaluation tools and questionnaires, selecting her choice based on the child's age, cognitive level and behavioral and emotional status. The child in this age range were deemed eligible for effective speech analysis by the speech pathologist. These tools included informal and non-normed vernacular Arabic versions of the Guralnik Language Screening Test for Hebrew-speaking Preschool Children,[45] the Katzenberger Hebrew Language Assessment Measure for Preschool Children,[46] and the Preschool Language Scale PLS-4 (Hebrew).[47] At the time the survey was conducted, formal and standardized language screening tools for young children in the Arabic language were not locally available. The use of ad-hoc translations of tools in another language was a practiced norm in the area of child development in the country. All the children had also been examined by a developmental neurologist, a social worker and a developmental psychologist. In some cases the child was also seen by an occupational therapist, as needed.

The children had been referred to the center by practicing primary care pediatricians in their community. Although the center was not the exclusive child developmental service available to that community, it was by far the most readily available one in terms of waiting time and availability of testing in the Arab language. As an affiliate of the public health care system, there were no economic barriers regarding referral to the service and children were accepted on a first come-first served basis, with priority given to cases of social risk in the family. This child developmental center provides services to 85% of the Arab community in the area; the large majority of the community were registered with the health care provider that operated that center.

The patients were referred from several small to medium-sized suburban towns in the greater metropolitan area, where most of the residents (approximately 100,000 in number) were Arab, and almost exclusively Muslim. The families were universally educated; 48% of them had at least one parent with more than a secondary school education.

The full developmental evaluation of the child was reviewed by another team member who collected the data from the chart with no revealing information on the child's identity. Data was collected retrospectively and charted by arbitrary cut-off parameters, including age and medical diagnoses. Excluded were children with identified genetic syndromes, hearing and visual impairments and significant cognitive impairments with less than a IQ = 60.

Data pertaining to the following variables were culled from the children's charts, and included age, gender, intelligence quotient (IQ), parent educational background, consanguinity in the family, presence of siblings in the home, screen time exposure at home, medical problems, parents with foreign backgrounds, other developmental problems (motoric, for example), attention-deficit/hyperactivity disorder (ADHD), age of entry into pre-school, diagnosis of ASD and joint attention difficulties. The presence and degree of classical Arabic in the child's speech, the use of English words and expressions, and the use of other languages in daily discourse was noted, and designated arbitrarily as present, moderate, or widespread. Other language problems recorded were word retrieval ability, echolalia, jargoning, associative speech, stereotypic speech, expressive and comprehension language problems and articulation disorders.

The standard diagnostic battery for each child included one of several social adaptive scales, such as the ABAS[48] or the Vineland Scales;[49] a social communication diagnostic tool, such as the CARS,[50] SCQ[51] or the ADOS;[52] and a cognitive assessment tool, such as the Mullen Scales,[53] the Bayley 3,[54] the Stanford Binet[55] or WISC.[56] In addition, some of the children had been previously screened using the M-CHAT,[57] and all were rated for severity and identified for showing at least minimal diagnostic criteria for ASD according to the DSM5.[58] Furthermore, diagnosis of ADHD was performed using the diagnostic criteria according to the DSM5, as well as the DC: 0–5.[59] There was use of DQ and IQ according to the tool employed by the clinician. The sub-scale verbal or performance quotients were presented separately in the data only where relevant. All of the tools, where use was made of English or Hebrew translated versions, were translated into the vernacular Arabic. In all homes and schools in the study, the vernacular was used on a daily basis, as was the case during therapy sessions by the speech and language therapist.

All research procedures were performed in accordance with the ethical standards of the Institute Research Committee and the 1964 Helsinki declaration and its later amendments.

Results

A total of 58 children between the ages of 3 and 9.0 years were included in the survey: 37 (64%) were diagnosed with ASD during their evaluation process and 21 (36%) were diagnosed with other complicated speech and language disorders. The group consisted of 45 males (78%) and 13 females (22%). Median age at diagnosis was 52 months (SD = 18.59). The average number of siblings in the home was 2.1 (SD = 1.4). The average age at the entrance to pre-school (1.08 years, SD = 0.53).

24% were from families who were consanguineous (second or third degree), often considered to be important in medical epidemiological surveys within Arab societies.

12% of the children had mild to moderate medical problems (asthma, renal problems such as hydronephrosis, or cardiac

findings not related to compromised circulatory or respiratory function)

41% had motor problems in their history, primarily delayed milestones that had required physical or occupational therapy

16% of the children had parents of foreign background, primarily from Jordan, Palestinian Authority areas and Morocco, where though Arabic is the native language, there the pronunciations and dialects tend to differ.

Children with an IQ or DQ below 60 were not included in the survey. Although the IQ and DQ at a very early age do not always reflect the child's eventual cognitive potential, it was deemed appropriate to eliminate from the analysis children whose language aberrations could be attributed to significant cognitive handicap. The psychologist used the DQ value terminology instead of an IQ value below the age of 4 years, as is common practice in local developmental centers. The average DQ (IQ for older children) was 79.1 (SD = 14.5). There were no significant differences between the DQ or IQ of the children with or without ASD.

60% of all children had speech articulation problems (SD = 0.67) (see Table 1).

The use of classical Arabic is often associated with an older age, since usage requires basic language maturational abilities, as well as a reasonable cognitive level. A subgroup of the cohort was therefore chosen for analysis based on minimal age and developmental quotient / intelligence quotient (DQ/IQ) score values. Our analysis was thus limited to a total of 24 children (20 M [80%] and 4 F [20%]). In this subgroup 13 (51%) were diagnosed with ASD, and 12 (49%) had other speech and language impairments. Use of non-vernacular Arabic was based on both parental report, as well as had to be witnessed by the speech and language therapist during the evaluation. Use of an inordinate degree of words and expressions in classical Fossha Arabic found typically in the media, children's literature and formalized venues, was highly associated with ASD, especially among those with higher IQ score (IQ >70) and older than age 4, where the differences were significant (Pearson 7.29, Fisher 2-tailed test, p = 0.015). There were 10 children over the age of 4 with high functional ASD defined as having a DQ/IQ = 70 or above, being that in this age range scores tend to rise in the future with the advent of early intervention therapies. Use of English or even Hebrew, the dominant vernacular in the country, did not approach significance between the ASD and the non-ASD groups, neither for the entire group, nor for the older, higher-functioning children. Of the children over 3 years of age (the age at which English and other foreign words from the media usually come to the fore in the general population, as observed by our speech pathologist) with a DQ of at least 60, two (11%) of the non-ASD children and eight (32%) ASD children used English words or expressions in their vernacular speech. Of the entire group of 58 subjects from all ages and cognitive levels, only two had used expressions in the Hebrew language. The one child in the study without ASD and using occasional Fossha expressions, was deemed "unusual" by the testing staff. (That child later on after the close of the study was eventually diagnosed with ASD). No record was made during the study of the use of Koranic Classical Arabic, a form of Arabic relegated to the use in Mosque prayers and other Islamic rituals.

Table 1. Background Data Chart for Communication and Language-Impaired Young Arabic Speaking Children Aged 3-9 Years.

Background Data	Mean	Standard deviation	Significant difference by ANOVA ASD versus Non-ASD
Age	52.5	18.6	NS
Number and gender	77 M 23 F		NS
Developmental quotient	79.1	14.5	NS
Time in preschool after age 1 (years)	1.08	0.5	NS
Siblings	2.1	1.4	NS
Parent education above 12th grade	48%	0.5	NS
Consanguinity	24%	0.43	NS
Foreign-born parent (at least 1)	16%	0.37	NS
Medical problems	12%	0.33	NS
Motor problems	41%	0.59	NS
Attention-deficit/ hyperactivity disorder	**60%**	**0.67**	**NS**

ASD = Autism spectrum disorder; ANOVA = Analysis of variance.
NS = not significant.

There was no significant correlation between the use of classical Fossha Arabic in everyday speech and daily screen viewing time (ie, exposure to the media where there is extensive use of classical Arabic). Furthermore, use of classical Arabic was not related to jargoning in speech, associative speech, comprehension or expressive language impairments. Other factors which could potentially influence choice of language forms, such as time spent in preschool, number of siblings, parents of foreign background (primarily from other Arab countries, which in our cohort included Jordan, Palestine, and Morocco) did not approach significance. Parents from other Arab countries used the local Palestinian dialect in the home of the children in the study.

Children with severe language problems unrelated to autism were more likely to have speech retrieval difficulties (p = 0.003), compared to the ASD group, which had relatively few retrieval problems, especially among the subgroup with a higher cognitive level (IQ>70). The higher functioning children with ASD, had relatively fewer language problems, as reflected by the example of language retrieval problems, even though there were significant rates of expressive (86%) and comprehension (65%), jargoning (68%) and echolalia (38%) among the ASD group in general. Language-impaired children without ASD had more language retrieval problems than ASD children, perhaps indicating selection bias among the non-ASD children in our control group. Other speech and

language problems among non-ASD children, besides retrieval difficulties, included jargoning (81%), expressive delays (100%), comprehension problems (81%), and associative speech (48%) (see Table 2).

One of the pragmatic language difficulties observed is the out of context speech embedded in ordinary Arabic vernacular that is associated with a higher degree of speech stereotypy ($p < 0.001$) among ASD children, and is statistically unrelated to jargoning, echolalia or associative speech. The absence of a significant direct correlation between the use of classical Arabic and speech stereotypy ($p = 0.025$) in our findings was most likely due to our exceedingly small sample size, as 8 out of a total of 9 classical Fossha Arabic users showed significant stereotypy in their speech (Table 2).

Although children with ASD tended to have more ADHD than non-autistic children (28/37 vs 15/21), the differences did not approach significance in our cohort. There were no significant differences between ASD and non-ASD children in measures of associated motor delays, age at the start of preschool, or presence of older or younger siblings in the home, which may ordinarily influence the development of a young child's discourse abilities.

Discussion

Although use of classical Fossha Arabic on a daily basis, instead of spoken Arabic, is not the exclusive province of ASD (there was one non-ASD child who used classical Arabic during the study), in our findings this appears to be a sign indicative of a possible social communication disorder and should be further investigated. Furthermore, the frequent use of classical Arabic by ASD children indicates their preference of specific language mechanisms, and sheds light upon their emotional, social and neurolinguistic make-up and the pathology underlying their communication disorder.

Table 2. Frequency of Language Measures by Autism spectrum Disorder (ASD) Diagnostic Designation.

Language Measures	ASD	Non-ASD
Classical Arabic	22% (8/37)	4% (1/21)
Classical Arabic High-Functioning	46% (6/13) *	0% (0/12)
Stereotype	70% (26/37) *	14% (3/21)
Echolalia	38% (14/37)	29% (6/21)
Jargon	68% (25/37)	81% (17/21)
Associative Speech	19% (7/37)	48% (10/21) *
Retrieval Problems	51% (19/37)	90% (19/21) *
Expressive Delays	86% (32/37)	100% (21/21) *
Comprehension Problems	65% (24/37)	81% (17/21)
Use of English	11% (2/18)	32% (8/25)
Use of Hebrew	0	9% (2/25)
Screen Use	65% (27/37)	76% (16/21)

If use of classical Arabic is statistically unrelated to screen time viewing (eg, non-classical Arabic users and non-ASD children spend as much time screen viewing) why do so many ASD children use classical Arabic acquired from screen viewing (as well as from listening to stories read to them by preschool teachers and from the media)?

The pathways of language acquisition in children with ASD have been vastly investigated throughout the last decade. The language ability in this population remains heterogeneous.[60-62] The existing literature has identified three common impairments in language development in ASD children – early language delays; atypical language production; and pragmatic difficulties.[60,63] Classical Fossha Arabic is a high formal language.Its use on a daily basis in speech among children and adolescents with ASDcan be considered to constitute part of a larger pragmatic disorder. Indeed, a recent survey of 15 Saudi adolescents with ASD and in the normal cognitive range, found them to be suffering from significant pragmatic speech and language deficits, as compared with normal matched controls, when evaluated using the Yale in vivo Pragmatic Protocol.[64] Why do ASD Arab children speak classical Arabic more often?

We assume that typically developing infants and children observe their natural environment and engage in taking statistics to produce sounds in their mother tongue at a later stage, as suggested by Kuhl in her pioneer study.[65] ASD children observe their environment as well, but in their own way, and under their own rules. Thus, ASD children have difficulty in simultaneously recognizing a word in an entire conversation, grasping its meaning, and knowing when to retrieve it (that is, it is a pragmatic matter).

Spoken Arabic is much more flexible than classical Fossha Arabic. Classical Arabic also has a strict grammar, making it more templated, organized and much more predictable. It is well known that ASD children tend toward sameness and find it difficult to adapt to change. This tendency toward sameness may be the key to explaining why classical Arabic is more frequently used by Arabic ASD children. Typically developing children may rarely use isolated words in fossha to compensate for words that are lacking in spoken Arabic. At four years of age and older children with ASD do use classical Arabic in the classroom when listening to formalized stories and poems. For some of them, their comprehension is within the normal range overall, but their language is poorly organized. Those using classical Arabic are not making a conscious effort to ignore vernacular speech; rather the subconscious choice to use a formalized language seems to result from an imprinting process derived from extensive exposure to alternative language forms, other than only from screen viewing.

We assume that the use of classical Arabic instead of the spoken form results from the need and desire to communicate. Much more often, when high-functioning ASD children fail to retrieve and process the spoken Arabic form due to all the vast theories behind the language perception they experience ("weak central coherence"),[66] they choose to rely on a neater and more organized context in order to compensate for their expressive

verbal gap. It is worth noting that use of Fossha is intended to be coherent and express exactly what a normally functioning child wishes to say, but in a more organized and formalized way, and not be merely a string of disconnected associative or stereotypic jingles or slogans taken out of context from bits of school stories or programs from the media. As such, the use of Fossah is a unique phenomenon in the world of autistic language and represents a higher level of associativeness than has previously been cited from other locales around the world. The mismatch occurs when the child chooses a classical Arabic sentence or phrase which does not conform to the social setting of the conversation

The difficulty in choosing the right phrase for the right context is the core of the pragmatic impairment and the essence of the autistic disorder. This phenomenon can be distinguished in the Arabic language when choosing the formal classical Arabic form instead of the spoken one. In a sense, it might be considered a form of a distant form of verbal stereotypy. High-functioning ASD children strive for order and coherence both out of a need for order and to satisfy social expectations. Many are not totally detached, but rather lack a true understanding of the full meaning of social communication. For instance, an example given by our speech pathologist was the child who simply wanted to forcefully and emphatically say to his therapist,"Please help me," used the phrase, "Be gracious and assist my efforts," instead.

More limited use of Fossha is also found anecdotally in approximately 10% of younger ASD children, age 3–4, to compensate for retrieval deficits, which are more of a technical nature (for example, the use by one child of the overly formal "absent hat on the head" as opposed to the customary "no hat on the head" to describe the state of what he was wearing on his head, and differ from what is observed in older children over the age of 4 years in an attempt at actual communication of desires, ideas or needs, and the use of more sophisticated and grammatical constructs. Usage of limited Fossha is rarely seen in younger non-ASD children.

Children using classical Arabic have problems primarily in narrative ability, eg seeking instructional scaffolding to gain better understanding of the language, and consequently being understood. It is not a blind antisocial behavior, but it does express a social communication disorder in not being able to understand its inappropriateness, especially over time. Typically developing children attempt archaic language forms they are exposed to in the media or from listening to stories read to them. It is analogous to trying on a costume and then looking in the mirror, quickly realizing the inappropriateness for a daily setting, and the routine of regular social interaction. Remaining in the costume would make them look ludicrous, thereby endangering their social acceptance. ASD high-functioning children do not have the social referencing ability to ultimately discard the Fossha in time, and therefore continue to be conspicuous by persisting in its use (as if they were still wearing the costume). Our data suggested that a reasonable IQ (borderline to normal range) and comprehension abilities must be present for this use of Fossha.

The use of English words, expressions or slogans taken from watching screens is different. The lingo is melodious to the ear and the reaction it engenders in the listener is altogether different, ie, more socially acceptable, less strange and invokes a highly positive social response and reinforcement from the listener, being that Western culture is held in high regard. In addition, English is easily acquired, especially when presented with an attractive cartoon, or other visual stimuli on the screen. A similar analogy would be one of primary school children in English-speaking countries attending Shakespearean theater and coming away with archaic expressions acquired during the performance. Use of words such as "thou, thee and thine"is quickly abandoned in everyday discourse due to inappropriateness and social derision.

Interestingly enough, the general social use of Hebrew among Arab children does not enter into the equation, mainly because this language is outside the context of readily sought-after media programs watched by Arab children.

Conclusions

In conclusion, our small study should be considered an initial attempt at characterizing features in language development in young autistic children who are native-born Arabic speakers, by observing the development of both their social and language skills in a unique environment where not only is there exposure to other languages through the media, as in other countries (especially those where Arab speakers are in the minority), but also to a parallel home-grown additional form of their native language used in very specific contexts and governed by strict rules and practice. Of particular interest, is that in other Arab societies, such as Egypt, more English is found in the vernacular Arabic of young ASD children, as compared to classical Arabic, possibly reflecting patterns of teaching and media viewing with different forms of dubbing (anecdotal report from Dr Dina El Alafy, Al Shams University Department of Speech Pathology, Cairo).

The preference for a formalized backing or reinforcement of everyday speech reflects the ways that young, intelligent native Arabic speakers form and adapt their linguistic skills, inevitably influencing language and social functioning at a later stage. A topic that warrants further research is whether stereotypy is a mainstay of language development in larger studies of high functioning, young children with ASD. The absence of a correlation with echolalia and jargoning in our study indicates that the use of classical Arabic can be viewed as a higher-level linguistic aberration, influenced by ASD-associated pathology in different brain areas influencing language production and, social functioning, and language choice.

Our small sample size as well as the long-term implications for early diagnosis and intervention in normalizing later speech pattern acquisition by young Arabic speaking children, mandate further study.

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Author Contributions

All authors participated equally in the process of conception, planning, and carrying out the study. The first author was most instrumental in the writing of the text, due to his fluency in the English language. Shelly Almog performed supervisory functions for the language testing and Prof. Jaber was instrumental in formulating the discussion in tying the current study with previous works published by the staff.

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Informed Consent

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Trial Registration

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