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EC PHARMACOLOGY AND TOXICOLOGY
Review Article

Language Delay and Autism Spectrum Disorder-Like Behaviors: Differentiation and Diagnostic Hypotheses - Review Article

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Received: January 28, 2025; **Published:** February 05, 2025

Abstract

This study investigates the relationship between language delay and behaviors that resemble Autism Spectrum Disorder (ASD), highlighting difficulties in communication and social interaction. The main objective is to identify the distinctive characteristics between children with isolated language delay and those with ASD, providing support for an accurate differential diagnosis. The study explores how phonological errors, such as consistent phoneme substitutions, can indicate the presence of Speech Sound Disorder (SSD) or apraxia of speech, and how these patterns differ in children with ASD. In addition, the impact of neonatal complications, such as hypoxia, on language development and the manifestation of these behaviors is considered.

Keywords: *Language Delay; Autism Spectrum Disorder; Speech Sound Disorder; Apraxia of Speech; Differential Diagnosis; Neonatal Hypoxia*

Introduction

Language delay in children is a condition that can present complex diagnostic challenges, especially when the behaviors manifested resemble those observed in Autism Spectrum Disorder (ASD). Children with language delay often exhibit difficulties in verbal communication and social interaction, which can be confused with the characteristic symptoms of ASD. However, the distinction between these conditions is crucial for the development of appropriate interventions. This study seeks to explore the differences between children with language delay and those with ASD, focusing on phonological errors and possible neonatal complications that may influence language development.

The study "How language affects social cognition and emotional competence in typical and atypical development: A systematic review" investigates how different linguistic components interact with specific brain subregions, influencing social cognition (SC) and emotional competence (EC) in children with typical and atypical development, such as those with autism, developmental language disorder (DLD) and social communication disorder (SCD). The hierarchical model used in the study, based on Schurz., *et al*. (2021), divides SC into three main brain components: social cognitive cognition (CSC), affective social cognition (ASC) and intermediate social cognition (ISC).

CSC is associated with mentalization and Theory of Mind (ToM), processed mainly in the medial prefrontal cortex, which is crucial for attributing mental states to oneself and others. ASC involves empathetic processes, mainly regulated by the amygdala and the anterior cingulate cortex, responsible for perceiving and sharing other people's emotions. ISC, which integrates cognitive and affective aspects of SC, is particularly dependent on language and involves neural networks that connect the superior temporal cortex, associated with prose and the understanding of emotions in the linguistic context.

These brain interactions are essential to understanding how children with developmental disorders present different patterns of difficulties in language and SC. For example, the study observes that children with autism tend to have alterations in the activation of areas related to ASC and CSC, resulting in difficulties in both linguistic comprehension and production, especially in tasks that require the integration of emotional and cognitive processes [1].

Methodology

Phonological errors in speech sound disorders: Differences in children with typical and atypical development

The most recent studies on speech disorders, both in typical and atypical individuals, highlight the differences in difficulties in producing speech sounds, particularly in children who have problems articulating certain phonemes, such as the substitution of sounds (/r/ for /l/ and /c/ for /t/), resulting in childish speech.

Speech sound disorders (SSD) in typical and atypical development

A study investigated the patterns of phonological errors in Mandarin-speaking children, comparing those with Developmental Language Disorder (DLD) and Speech Sound Disorders (SSD) with neurotypical children. Children with DLD and SSD showed a higher frequency of phoneme substitutions and omissions, such as sound swapping, which is less common in typically developing children. These error patterns may be attributed to underlying deficits in brain regions involved in speech production and processing, particularly in the inferior frontal gyrus (IFG), Broca 's area, which is essential for phonological articulation and organization.

most affected subregions include the premotor cortex and primary motor cortex, which are involved in planning and executing the movements required for speech. In children with DLD and SSD, there is evidence that these areas exhibit altered neural activity, leading to difficulties in the fine motor coordination required for accurate speech sound production. In addition, the arcuate fasciculus, which connects Broca's and Wernicke's areas, may exhibit connectivity anomalies, resulting in difficulties in the integration of auditory comprehension and verbal production [2].

These deficits are likely multifactorial, involving both genetic and environmental factors. For example, genetic variations in genes related to speech development, such as FOXP2, may predispose to alterations in the development of these neural networks. Additionally, exposure to a less rich linguistic environment during the first years of life may exacerbate these difficulties, leading to persistent patterns of phonological error.

The genetic condition that results in speech sound disorders, such as those seen in children with Developmental Language Disorder (DLD) and speech sound disorders (SSD), can be attributed to several underlying factors and mechanisms. Here are some of the main reasons and conditions associated with these genetic changes:

1. **Mutations in genes related to speech and language:** One of the most studied genes in this context is FOXP2. Mutations in this gene can lead to difficulties in the acquisition and development of speech. FOXP2 plays a crucial role in the regulation of neural networks involved in speech motor processing and synaptic plasticity, which is essential for learning speech patterns. Mutants of this gene have been associated with specific speech motor difficulties, which manifest as apraxia of speech and other articulation disorders.

2. **Genetic inheritance and polymorphisms:** Some conditions can result from genetic polymorphisms, which are variations in DNA sequences that do not cause disease by themselves but may predispose individuals to speech and language difficulties. These polymorphisms can influence the expression of genes such as FOXP2, CNTNAP2 (associated with neural connectivity and language development), and other genes involved in the development of the cerebral cortex and the maturation of the neural pathways that mediate speech.
3. **Epigenetic factors:** In addition to direct mutations, epigenetic alterations that affect gene expression without altering the DNA sequence may also play a role. Factors such as the intrauterine environment, maternal nutrition, and stress may influence DNA methylation and other epigenetic modifications that regulate the expression of genes related to speech and language development.
4. **Genetic susceptibility and gene interaction:** Some children may have an underlying genetic susceptibility that, when combined with unfavorable environmental factors (such as poor language stimulation, prematurity, or prenatal infections), can result in speech sound disorders. Interaction between multiple genes (epistasis) can also amplify or moderate the effects of mutations or variations in specific genes, leading to more severe or milder manifestations of the disorder [3].
5. **Related neurological conditions:** In some cases, genetic disorders such as Rett syndrome, fragile X syndrome, and other neurogenetic conditions can result in abnormalities in gene expression that affect global neurodevelopment, including the neural networks involved in speech and language. These conditions are often associated with autism spectrum disorders, where speech sound disorders are common.

Possible neonatal complications related to language delay

Language delay in children can be caused by a number of neonatal complications that affect neurological development. One such complication is neonatal hypoxia, which occurs when the oxygen supply to the newborn ‘s brain is inadequate, often due to problems such as knots in the umbilical cord. Hypoxia can lead to hypoxic-ischemic brain injuries, which result in damage to the areas of the brain responsible for language processing and production, such as the prefrontal cortex and Broca ‘s and Wernicke’s areas. These injuries can have lasting effects on speech and language development [16].

In addition to hypoxia, other neonatal complications can also contribute to language delays. For example, fetal acidosis, which occurs when the fetus experiences high levels of acidity in the blood due to oxygen deprivation, can cause neurological damage that affects language development. Complicated births, including those resulting in head trauma or intracranial hemorrhages, are also important risk factors for language delay. Children who are born prematurely are at greater risk because prematurity is associated with immature brain development, which can compromise language skills [19].

Infections, such as meningitis or encephalitis, are also significant causes of delays in language development. These infections can lead to inflammation of brain tissue, damaging areas crucial for cognitive and linguistic development. Another risk factor is low birth weight, often related to placental insufficiency, which can result in compromised neurological development and, subsequently, difficulties in language acquisition [17].

Language delay and autism spectrum disorder-like behaviors: Differentiation and diagnostic hypotheses

Language delay in children may, in some cases, manifest behaviors that resemble those observed in Autism Spectrum Disorder (ASD), challenging the differential diagnosis between these conditions. Children with language delay often exhibit significant difficulties in verbal communication, social interaction, and emotional expression, elements that are also characteristic of autism. However, the nature and origin of these difficulties may differ substantially between the two conditions.

Children with language delay have difficulty initiating and maintaining conversations, understanding, and using language appropriately in a social context, which can be confused with the atypical communication seen in autism, which includes repetitive use of words or phrases and difficulty using language for social purposes. However, while autism often involves repetitive behaviors and restricted interests, such as obsessive alignment of objects or insistence on rigid routines, these characteristics are not common in children with isolated language delay [5]. Furthermore, autistic children tend to have more profound deficits in interpreting social and emotional cues, such as facial expressions and gestures, while children with language delays often demonstrate interest in social interactions, although they are hampered by verbal limitations [3].

To differentiate between these two conditions, it is crucial to consider the presence of core autism behaviors that are not directly linked to language use, such as sensory hypersensitivity and repetitive behavior patterns. Detailed neuropsychological assessments, which include both observation of verbal communication and the child's response to social and environmental stimuli, are essential to establish an accurate diagnosis [12]. The hypothesis that autism-like behaviors in children with language delay may result from frustration caused by difficulty communicating is plausible, but it is important to distinguish this from the challenges inherent in autism, which involve a broader range of neuropsychological deficits [18].

Comparison of behaviors between children with language delay and high IQ versus autistic children with language delay

Language delays can manifest in different ways in children, depending on underlying factors such as intelligence (IQ) and the presence or absence of autism spectrum disorders (ASD). Children with language delay but high IQ often exhibit a distinct behavioral profile compared to those with language delay associated with autism. Differentiating between these profiles is crucial for implementing appropriate and specific intervention strategies.

Children with language delay but high IQs often demonstrate superior cognitive abilities that allow them to develop compensatory strategies to overcome their verbal limitations. These children may exhibit exceptional problem-solving abilities, robust working memory, and advanced analytical skills, all evidence of a compensatory brain system that utilizes alternative neural networks to mitigate language deficits. This profile may be associated with greater activation in brain regions not traditionally involved in language, such as the dorsolateral prefrontal cortex, which supports executive functions and cognitive planning [14]. Such children tend to show a strong interest in complex and abstract topics, using their intellectual capacities to interact with the environment in innovative ways, despite their linguistic difficulties [9].

On the other hand, children with language delay in the context of ASD often exhibit broader social deficits that go beyond simple verbal impairment. These deficits include difficulties interpreting and responding to social cues, a tendency toward isolation, and repetitive or stereotyped behaviors. Unlike children with high IQs and language delays, who can compensate for their communication difficulties with other cognitive skills, children with autism have difficulty developing effective compensatory strategies due to deficits in areas such as social cognition and sensory perception. Neuroimaging studies reveal atypical patterns of connectivity between regions such as the superior temporal cortex and limbic areas, suggesting that the integration between language and emotional-social response is compromised in children with ASD [8].

Differentiation between profiles

Differentiating between children with language delay and high IQ and those with autism requires a detailed assessment of behaviors beyond language. Children with high IQs often demonstrate a natural interest in learning and exploring complex concepts, even if they have initial difficulty expressing them verbally. They may use their intelligence to develop technical vocabulary in areas of specific interest or to solve problems in innovative ways, which is not common in children with autism, who often have restricted interests and difficulty adapting to new situations.

Furthermore, children with high IQs and language delays can compensate for their communication challenges through nonverbal strategies, such as the use of gestures or visual aids, and tend to exhibit more adaptive and responsive social interactions. In contrast, children with autism, even those with high IQs, continue to exhibit persistent deficits in social communication, reciprocal social interaction, and repetitive behaviors, regardless of their cognitive abilities.

Overview of phoneme substitutions in children: Speech sound disorders (SSD), neurological conditions and associated syndromes

Phoneme substitution in children is a common phenomenon that can be associated with a variety of conditions, including speech sound disorders (SSD), neurological conditions, and genetic syndromes. This overview explores the various potential causes, providing practical examples and explaining how these phonological errors may manifest in different clinical contexts.

Phoneme substitutions in children with speech sound disorders (SSD)

- **Description:** Children with SSD often have difficulties in correctly producing speech sounds, leading to the replacement of phonemes. For example, a child may change the sound /c/ to the sound /t/ ("tasa" instead of "casa") or omit sounds such as /r/ ("pota" instead of "porta"). These substitutions indicate specific difficulties in speech motor planning and articulation.
- **Cause:** SSDs are generally the result of immaturity in the development of oral motor skills or difficulties in coordinating the movements necessary for the production of speech sounds.
- **Example:** A child who consistently says "pota" instead of "porta" may be demonstrating a typical SSD pattern, where difficulty in articulating /r/ leads to its omission or substitution.

Neurological disorders such as apraxia of Speech

- **Description:** Childhood apraxia of speech is a neurological disorder that affects a child's ability to plan and coordinate the movements required for speech. Children with apraxia often make inconsistent phonemic substitutions, where the same word may be pronounced differently on subsequent attempts.
- **Cause:** This disorder results from dysfunctions in the neural pathways that control articulatory movements, preventing the child from executing the motor patterns necessary for clear and consistent speech.
- **Example:** A child with apraxia may say "paw" instead of "duck" on one trial and "chat" on another, reflecting the inconsistency characteristic of apraxia of speech [1].

Genetic syndromes, such as Williams syndrome

- **Description:** Williams syndrome is a genetic condition characterized by a deletion on chromosome 7, which affects cognitive and motor development. Although these children may have relatively strong social skills, they often have difficulties with visuospatial and fine motor coordination, which can influence speech production.
- **Cause:** Genetic deletion impacts multiple areas of development, including speech, resulting in difficulties in both articulating sounds and organizing words [13].
- **Example:** A child with Williams Syndrome may present phoneme substitutions due to difficulty in articulating more complex sounds, in addition to having difficulties in visual-spatial tasks, such as assembling puzzles or cutting with scissors.

Autism spectrum disorder (ASD)

- **Description:** Children with ASD often have significant challenges in social communication, in addition to restricted and repetitive behavioral patterns. However, some individuals with ASD may also have phonemic substitutions and other articulation difficulties.

- **Cause:** In ASD, these difficulties can be attributed to differences in neurological development that affect both verbal communication and the understanding and use of language in a flexible way [9].
- **Example:** An autistic child may use echolalia or present phoneme substitutions, such as saying "tasa" instead of "casa", particularly in situations of sensory overload or stress.

Other neurological and genetic conditions, such as Fragile X syndrome

- **Description:** Fragile X syndrome is a genetic condition that causes intellectual disability and may be associated with speech delays and articulation difficulties. Children with this syndrome often present with repetitive speech, echolalia, and phonological errors [19].
- **Cause:** The condition results from a mutation in the FMR1 gene, which affects neurological development and synaptic function, leading to significant difficulties in several areas of development, including speech [7].
- **Example:** A child with Fragile X Syndrome may omit the /r/ in words such as "porta", saying "pota", in addition to demonstrating repetitive behaviors and difficulty following normal conversations.

Attention deficit/hyperactivity disorder (ADHD)

- **Description:** Children with ADHD may have difficulty sustaining attention on tasks that require precision, such as speech articulation. This can lead to phonemic substitutions or sound omissions, resulting in disorganized or hurried speech.
- **Cause:** ADHD affects the ability to concentrate and impulse control, which can impact speech accuracy and the ability to follow consistent phonological rules [2].
- **Example:** A child with ADHD may frequently omit or substitute sounds during speech, especially when distracted or rushed.

Environmental factors and linguistic exposure

- **Description:** The lack of a rich and varied linguistic environment may contribute to the persistent use of infantilized speech patterns or phonological errors. Children who are not exposed to accurate speech models may develop phoneme substitutions as a result of imitating incorrect speech.
- **Cause:** Limited interaction with appropriate linguistic models and the predominance of childish speech in the home environment can impede the adequate development of articulation and phonology skills [20].
- **Example:** A child who grows up in an environment where adults use simplified or infantilized forms of speech may continue to use sound substitutions or immature forms of speech, such as saying "embellished" instead of "embarrassed".

Phonemic substitution errors in children with atypical development: Persistence in language disorders and autism

Phonemic substitution errors, such as replacing /r/ with /l/ or /c/ with /t/, are frequently observed in children with speech sound disorders (SSD). These errors represent specific difficulties in articulation and phonological processing and are especially common in children with Developmental Language Disorder (DLD) or Autism Spectrum Disorder (ASD). In these groups, phoneme substitution may persist for longer periods of time, reflecting ongoing challenges in phonological representation and the motor coordination required for accurate sound production.

Phonemic substitution in language disorders

In children with DLD, changing phonemes such as /r/ to /l/ (saying "lato" instead of "rato") or /c/ to /t/ (saying "tasa" instead of "casa") is an indicator of persistent difficulties in language acquisition. These errors reflect a failure to form robust phonological representations, which impacts both speech comprehension and speech production. The inability to internalize and use speech sounds consistently can

be attributed to deficits in auditory perception or phonological memory, areas frequently compromised in children with DLD [10]. As a result, these children continue to make phoneme substitutions beyond the age at which these errors are expected to be overcome.

Persistence of errors in children with ASD

In children with ASD, phonemic substitution errors may be linked not only to difficulties in articulation, but also to challenges in sensory integration and fine motor coordination. Sound substitutions, such as replacing /c/ with /t/, may be exacerbated by cognitive rigidity and difficulty adapting speech production to new contexts. In addition, atypical sensory processing and difficulty generalizing specific motor learning contribute to the persistence of these errors [4]. The lack of cognitive flexibility common in ASD may make it difficult to correct these phonemic errors, leading to speech patterns that remain immature for longer.

The persistence of these errors in children with DLD or ASD highlights the importance of early and focused interventions that address both the phonological and motor aspects of speech production. Therapies that combine auditory training, articulation practices, and motor coordination exercises may be effective in reducing these phonemic substitution patterns, promoting more typical language development [15].

Result and Discussion

The consistency of phonological errors observed in a child who consistently substitutes the sound /c/ for the sound /t/, as in "tasa" instead of "casa", suggests the presence of a Speech Sound Disorder (SSD) or a Phonological Disorder, rather than apraxia of speech. This conclusion is based on the fact that, in cases of apraxia of speech, children typically present inconsistencies in word production, that is, they may pronounce the same word in different ways at different times. Apraxia of speech is a motor speech disorder that affects the ability to plan and program the movements necessary for articulation, resulting in a significant variation in speech production error [1].

On the other hand, when a child consistently makes the same error, such as saying "tasa" for "house" in a predictable and unvarying way, this indicates a problem in phonological representation or perception, which is typical in cases of SSD or Phonological Disorder. In these conditions, the problem lies in the way the child internalizes and stores the sounds of language. He or she may have learned an incorrect rule for the production of certain sounds, leading to consistent substitutions of phonemes. This pattern of errors reflects a stable difficulty in articulation or phonology, rather than a difficulty in coordinating the motor movements of speech, as would be the case in apraxia [10].

The diagnostic implication for a child who consistently substitutes one sound for another is that he or she would likely benefit from an intervention that focuses on correcting these phonological representations and practicing correct articulation of sounds. Unlike an approach for apraxia, which would emphasize motor speech planning, intervention for SSD or Phonological Disorder would include exercises to restructure phonological perception and correct internalized error patterns.

Conclusion

Differential diagnosis between language delay and ASD is essential for developing effective treatment strategies. Children with language delay may exhibit behaviors that resemble ASD, but careful analysis of phonological error patterns, such as consistent phoneme substitutions, and neonatal history, such as the presence of hypoxia, can help differentiate these conditions. Understanding the origins and manifestations of these behaviors is critical to ensuring that interventions are targeted in ways that promote the linguistic and social development of these children. Future studies should continue to investigate the interactions between genetic, neurological, and environmental factors in language development and associated behaviors.

Conflicts of Interest

Nil.

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Volume 13 Issue 2 February 2025