

FOXP2-related Speech and Language Disorder

Subjects: **Genetics & Heredity**

Contributor: Nicole Yin

FOXP2-related speech and language disorder is a condition that affects the development of speech and language starting in early childhood. Affected individuals have a speech problem known as apraxia, which makes it difficult to produce sequences of sounds, syllables, and words.

genetic conditions

1. Introduction

This condition results from abnormalities involving parts of the brain that plan and coordinate movements of the lips, mouth, and tongue. Children with apraxia typically say their first words later than other children. Their speech is often difficult to understand, although the clarity of speech improves somewhat over time. Some affected individuals also cannot cough, sneeze, or clear their throats.

In addition to having problems with producing speech (expressive language), people with *FOXP2*-related speech and language disorder may have difficulty with understanding speech (receptive language). Some also have trouble with other language-related skills, such as reading, writing, spelling, and grammar. In some affected individuals, problems with speech and language are the only features of the condition. Others also have delayed development in other areas, including motor skills such as walking and tying shoelaces, and autism spectrum disorders, which are conditions characterized by impaired communication and social interaction.

2. Frequency

FOXP2-related speech and language disorder appears to be a relatively uncommon cause of problems with speech and language development. The total prevalence of apraxia is estimated to be 1 to 2 in 1,000 people, and it is likely that *FOXP2*-related speech and language disorder accounts for only a small portion of cases.

3. Causes

As its name suggests, *FOXP2*-related speech and language disorder is caused by changes involving the *FOXP2* gene. This gene provides instructions for making a protein called forkhead box P2, which appears to be essential for the normal development of speech and language. The forkhead box P2 protein is active in many different tissues, including the brain, both before and after birth. It acts as a transcription factor, which means that it helps

control the activity of other genes. Researchers suspect that many of the genes targeted by forkhead box P2 play important roles in brain development and the connections between nerve cells.

Several changes involving the *FOXP2* gene can result in *FOXP2*-related speech and language disorder. Some affected individuals have a deletion that removes a small segment of chromosome 7, including the *FOXP2* gene and several neighboring genes. Other people with this condition have a mutation within the *FOXP2* gene itself. Less commonly, *FOXP2*-related speech and language disorder results from a rearrangement of the structure of chromosome 7 (such as a translocation) or from inheriting two copies of chromosome 7 from the mother instead of one from each parent (a phenomenon called maternal uniparental disomy or maternal UPD). It remains unclear how having two maternal copies of chromosome 7 affects the activity of the *FOXP2* gene.

The genetic changes that underlie *FOXP2*-related speech and language disorder disrupt the activity of the *FOXP2* gene. Because forkhead box P2 is a transcription factor, these changes affect the activity of other genes in the developing brain. Researchers are working to determine which of these genes are involved and how changes in their activity lead to abnormal speech and language development.

Additional features that are sometimes associated with *FOXP2*-related speech and language disorder, including delayed motor development and autism spectrum disorders, likely result from changes to other genes on chromosome 7. For example, in affected individuals with a deletion involving chromosome 7, a loss of *FOXP2* is thought to disrupt speech and language development, while the loss of nearby genes accounts for other signs and symptoms. People with maternal UPD for chromosome 7 have *FOXP2*-related speech and language disorder as part of a larger condition called Russell-Silver syndrome. In addition to speech and language problems, these individuals have slow growth, distinctive facial features, delayed development, and learning disabilities.

3.1. The Gene and Chromosome Associated with FOXP2-Related Speech and Language Disorder

- *FOXP2*
- chromosome 7

I 4. Inheritance

The inheritance pattern of *FOXP2*-related speech and language disorder depends on its genetic cause. Mutations within the *FOXP2* gene and deletions of genetic material from chromosome 7 that include *FOXP2* have an autosomal dominant pattern of inheritance, which means one copy of the altered gene or chromosome in each cell is sufficient to cause the disorder. In most cases, the condition results from a new (de novo) mutation or deletion that occurs during the formation of reproductive cells (eggs or sperm) or in early embryonic development. These cases occur in people with no history of the disorder in their family. Less commonly, an affected individual inherits the genetic change from a parent with the condition; in at least one large family, a *FOXP2* gene mutation has been passed through several generations.

When *FOXP2*-related speech and language disorder results from maternal UPD of chromosome 7 as part of Russell-Silver syndrome, the condition is not inherited. UPD occurs as a random event during the formation of reproductive cells (eggs and sperm) or in early embryonic development. Affected people with maternal UPD of chromosome 7 typically have no history of the disorder in their family.

When the condition is caused by rearrangements of the structure of chromosome 7, its pattern of inheritance can be complex and depends on the specific genetic change.

5. Other Names for This Condition

- speech and language disorder with orofacial dyspraxia
- speech-language disorder 1

References

1. Feuk L, Kalervo A, Lipsanen-Nyman M, Skaug J, Nakabayashi K, Finucane B, Hartung D, Innes M, Kerem B, Nowaczyk MJ, Rivlin J, Roberts W, Senman L, Summers A, Szatmari P, Wong V, Vincent JB, Zeeman S, Osborne LR, Cardy JO, Kere J, Scherer SW, Hannula-Jouppi K. Absence of a paternally inherited *FOXP2* gene in developmental verbal dyspraxia. *Am J Hum Genet*. 2006 Nov;79(5):965-72.
2. Fisher SE, Vargha-Khadem F, Watkins KE, Monaco AP, Pembrey ME. Localisation of a gene implicated in a severe speech and language disorder. *Nat Genet*. 1998 Feb;18(2):168-70. Erratum in: *Nat Genet* 1998 Mar;18(3):298.
3. Lai CS, Fisher SE, Hurst JA, Vargha-Khadem F, Monaco AP. A forkhead-domain gene is mutated in a severe speech and language disorder. *Nature*. 2001 Oct 4;413(6855):519-23.
4. MacDermot KD, Bonora E, Sykes N, Coupe AM, Lai CS, Vernes SC, Vargha-Khadem F, McKenzie F, Smith RL, Monaco AP, Fisher SE. Identification of *FOXP2* truncation as a novel cause of developmental speech and language deficits. *Am J Hum Genet*. 2005 Jun;76(6):1074-80.
5. Morgan A, Fisher SE, Scheffer I, Hildebrand M. *FOXP2*-Related Speech and Language Disorders. 2016 Jun 23 [updated 2017 Feb 2]. In: Adam MP, Ardinger HH, Pagon RA, Wallace SE, Bean LJH, Stephens K, Amemiya A, editors. *GeneReviews*® [Internet]. Seattle (WA): University of Washington, Seattle; 1993-2020. Available from <http://www.ncbi.nlm.nih.gov/books/NBK368474/>
6. Tomblin JB, O'Brien M, Shriberg LD, Williams C, Murray J, Patil S, Bjork J, Anderson S, Ballard K. Language features in a mother and daughter of a chromosome 7;13 translocation involving *FOXP2*. *J Speech Lang Hear Res*. 2009 Oct;52(5):1157-74. doi: 10.1044/1092-4388(2009/07-0162).

7. Zeesman S, Nowaczyk MJ, Teshima I, Roberts W, Cardy JO, Brian J, Senman L, Feuk L, Osborne LR, Scherer SW. Speech and language impairment and oromotor dyspraxia due to deletion of 7q31 that involves FOXP2. *Am J Med Genet A*. 2006 Mar 1;140(5):509-14.
-

Retrieved from <https://www.encyclopedia.pub/entry/history/show/11396>