



# The Neuroscience of Stuttering



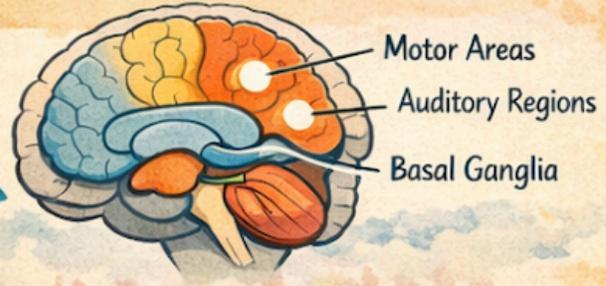
## Genetic Factors



Mutations in genes GNPTAB, GNPTG, NAGPA and AP4E1 can disrupt lysosomal function, affecting brain cells involved in speech.

- These mutations impair how cellular waste is cleared and processed, potentially harming astrocytes that support neural connectivity.

## Brain Networks



The brain's 'speech network' includes motor areas, auditory processing regions, and basal ganglia.

- Reduced white matter connectivity linking these regions
- Inefficient coordination between motor and auditory circuits
- An imbalanced speech network may lead to struggling with timing, sequencing and smooth motor control.

## Timing & Coordination



Fluent speech requires precise muscle movements controlled by brain circuits involving basal ganglia.

- Stuttering may reflect difficulty timing and sequencing rapid, complex muscle.
- Basal ganglia dysfunction can disrupt internal speech timing and motor planning.

## Overactive Monitoring



- Overly aware of their speech errors.
- Excessive self-monitoring can disrupt natural speech flow.
- Increased activity may create a cycle of frustration and avoidant behaviors.

## White Matter Differences



Neurofluency  
INITIATIVE

## Neuroplasticity



Children and adults who stutter often show reduced connectivity in this region.



### EEG Studies

Irregular brain activity patterns during speech reflect challenges with motor function and speech timing.

- Unstable motor phonemic representations
- Reduced suppression of auditory cortex during speech.



With practice, the brain can form new, more efficient connections for fluent speech.

