

The Listening Brain

Why smart people can't read

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Two truths & a lie

Two tiny ear muscles in the middle ear contract and stiffen the middle ear bones to protect us from our own voice.

Ear wax is beneficial in that it is noxious to insects and helps keep bugs stay out of our ears.

The outer, middle and inner ear interpret the meaning of sound.



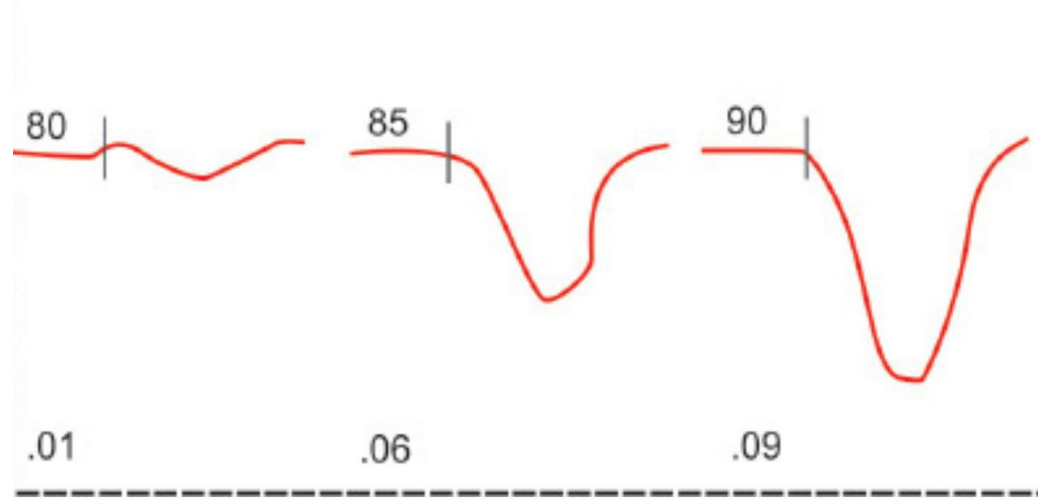
2 Truths

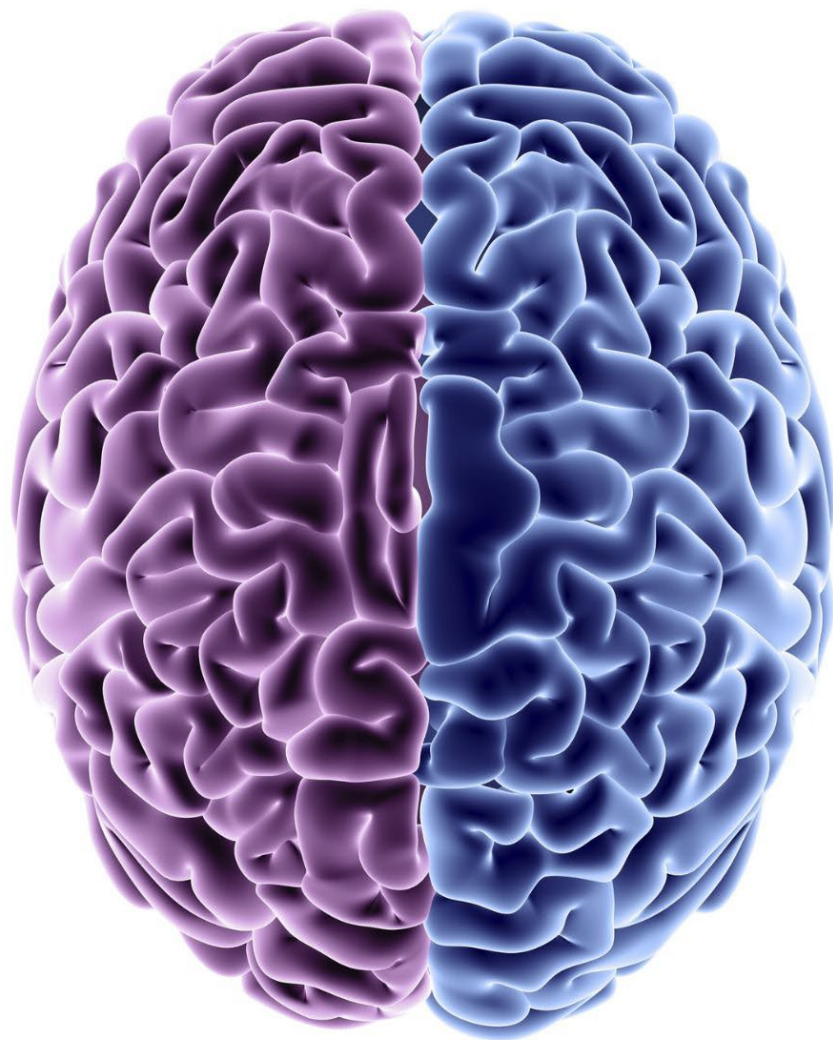
Two tiny muscles in the middle ear contract and stiffen the middle ear bones to protect us from our own voice.

TRUE! The stapedius and tensor tympani attenuate sound levels in the middle ear by dampening the vibration of the ossicular chain.

Ear wax is beneficial in that it is noxious to insects and helps keep bugs stay out of our ears.

TRUE! Earwax is a natural bug repellent. It has an odor that bugs don't like and acts like fly-paper so the bug gets stuck





The outer, middle and inner ear work together to transfer sound to the auditory cortex where it is interpreted for meaning

FALSE!

The brain is the neural crux for hearing.

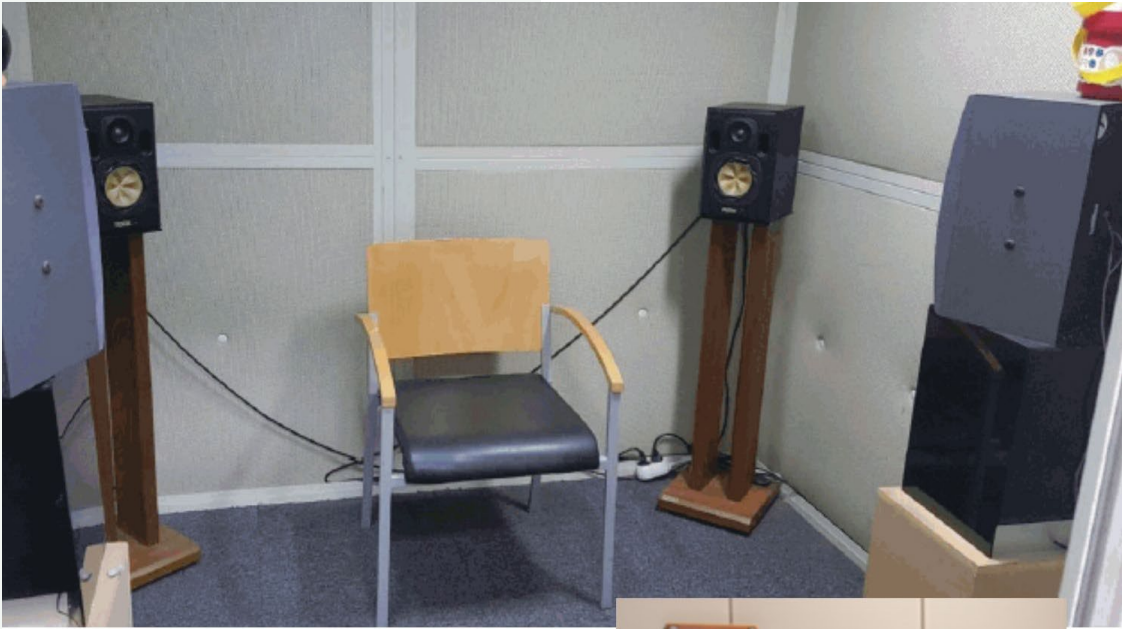
How do we know what the brain is hearing?



Pure tone thresholds

Most commonly used by audiologists

- Tests hearing sensitivity
- Is valuable when programming hearing aids or explaining a hearing loss.
- Does not tell you anything about what the brain hears.



Sound field Testing

A bit more functional

- Can test with different types of signals and speech
- Gives more information about how the brain hears and understand speech especially in background noise.
- Functional information about technology.

iPad Apps

- Inexpensive
- Portable
- Accurate
- Can be used remotely
- *ANSI standards = calibrated headphones



Evoked Potentials

Objective

No cooperation from patient is necessary

Easy to obtain

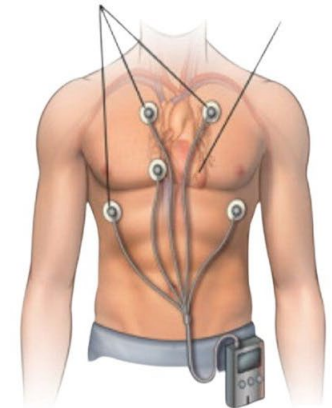
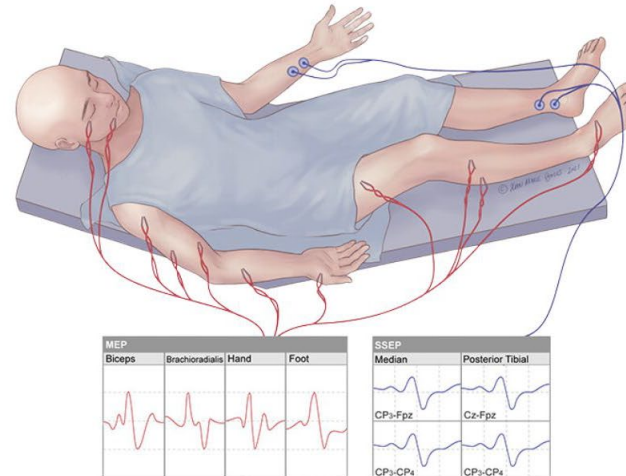
Trained clinician can elicit and record wave forms in the brain.

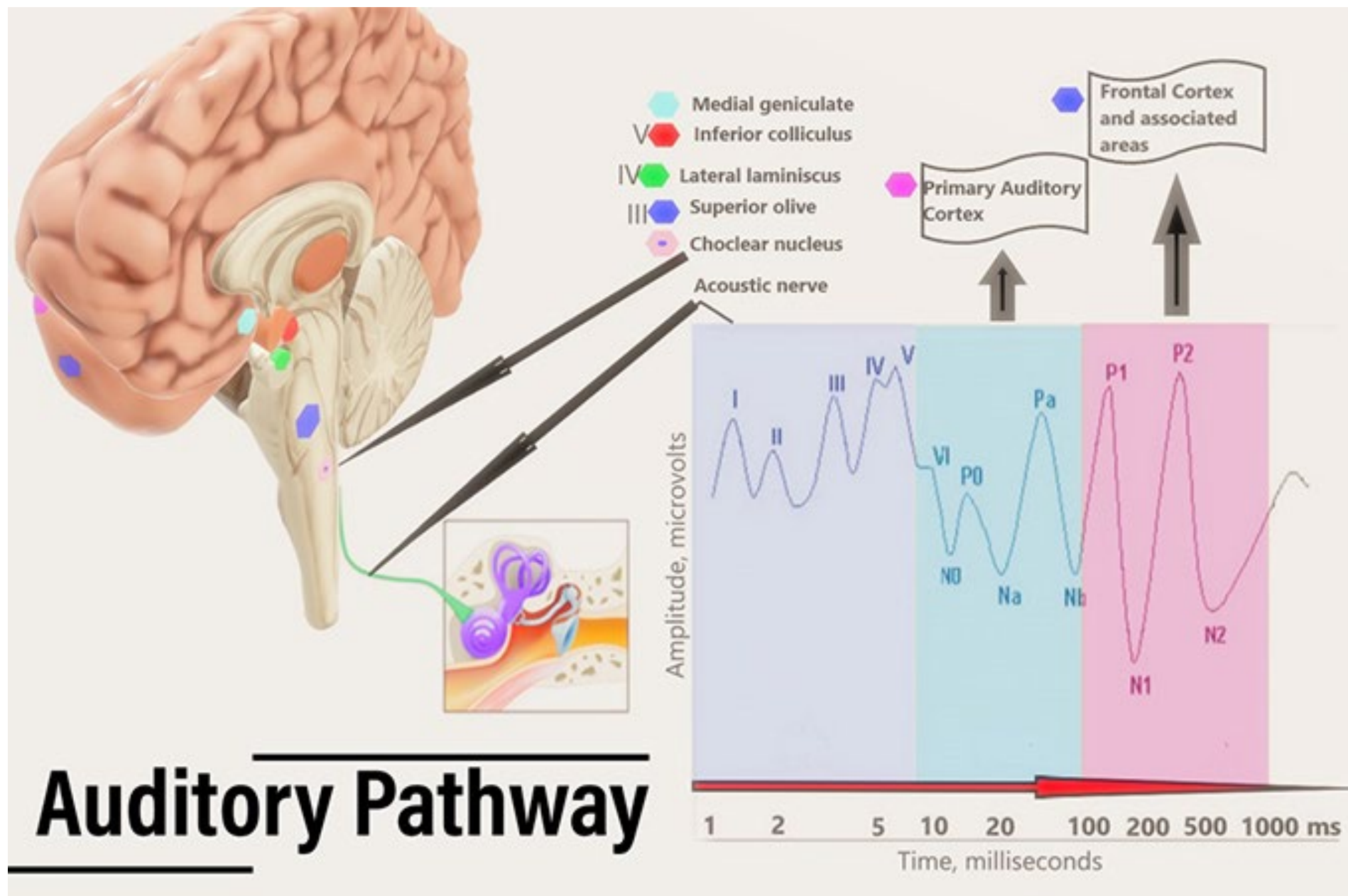
Modalities

The brain receives input from all over the body and can be recorded as waves.

Eureka Moments

What is puzzling on the surface is many times crystal clear in the waves.





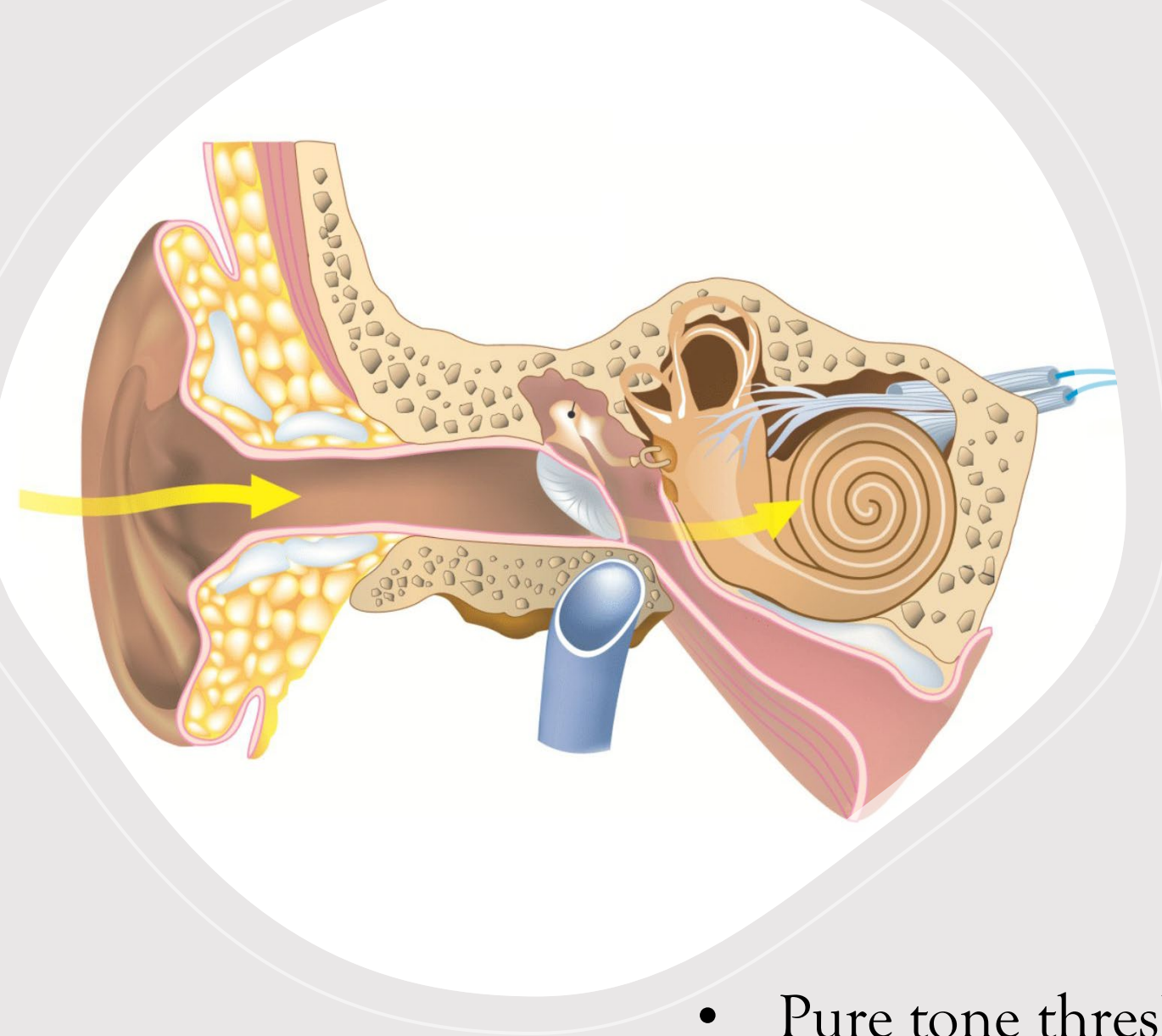
Which type of
testing is best?



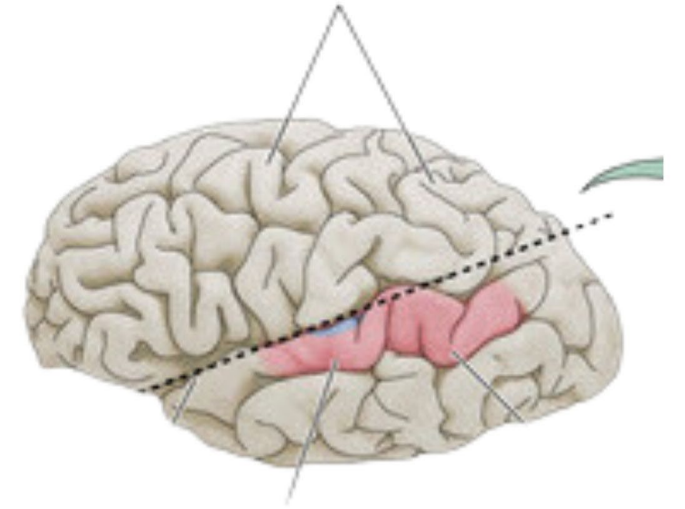


Mechanical Problem

The mechanism that transfers information to the brain is broken.



- Pure tone thresholds
- AEPs

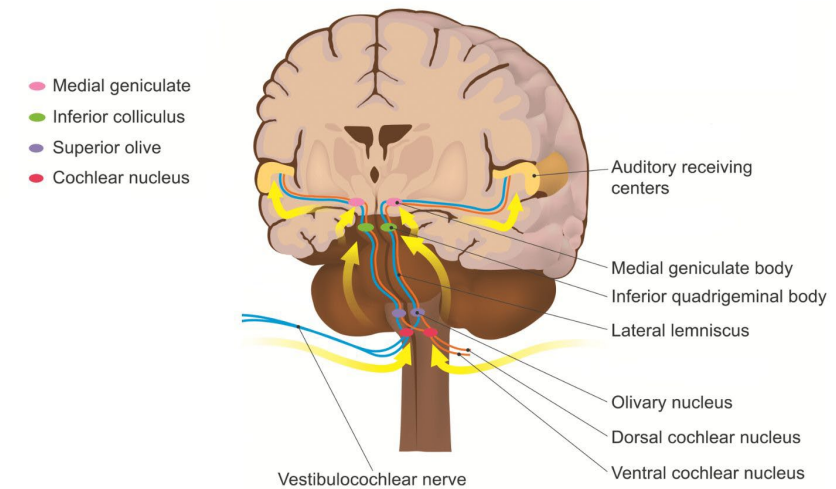


Cognition and/or
intellectual problems

*Outside scope of an audiologist
Rule out auditory problems with Pure Tone testing and/or AEPs



Speech in noise testing



Auditory Pathway Problem

What we do with what we hear.

Universal Newborn Hearing Screenings



- Hearing loss is one of the leading birth defects.
- 1-3 per 1000 born will have moderate to profound hearing loss
- Will miss a mild hearing loss
- Does not mean the child will never have a hearing loss.



Center for Disease Control (CDC)

By the time a child starts school, approximately 15% of kids will have some form of hearing loss.

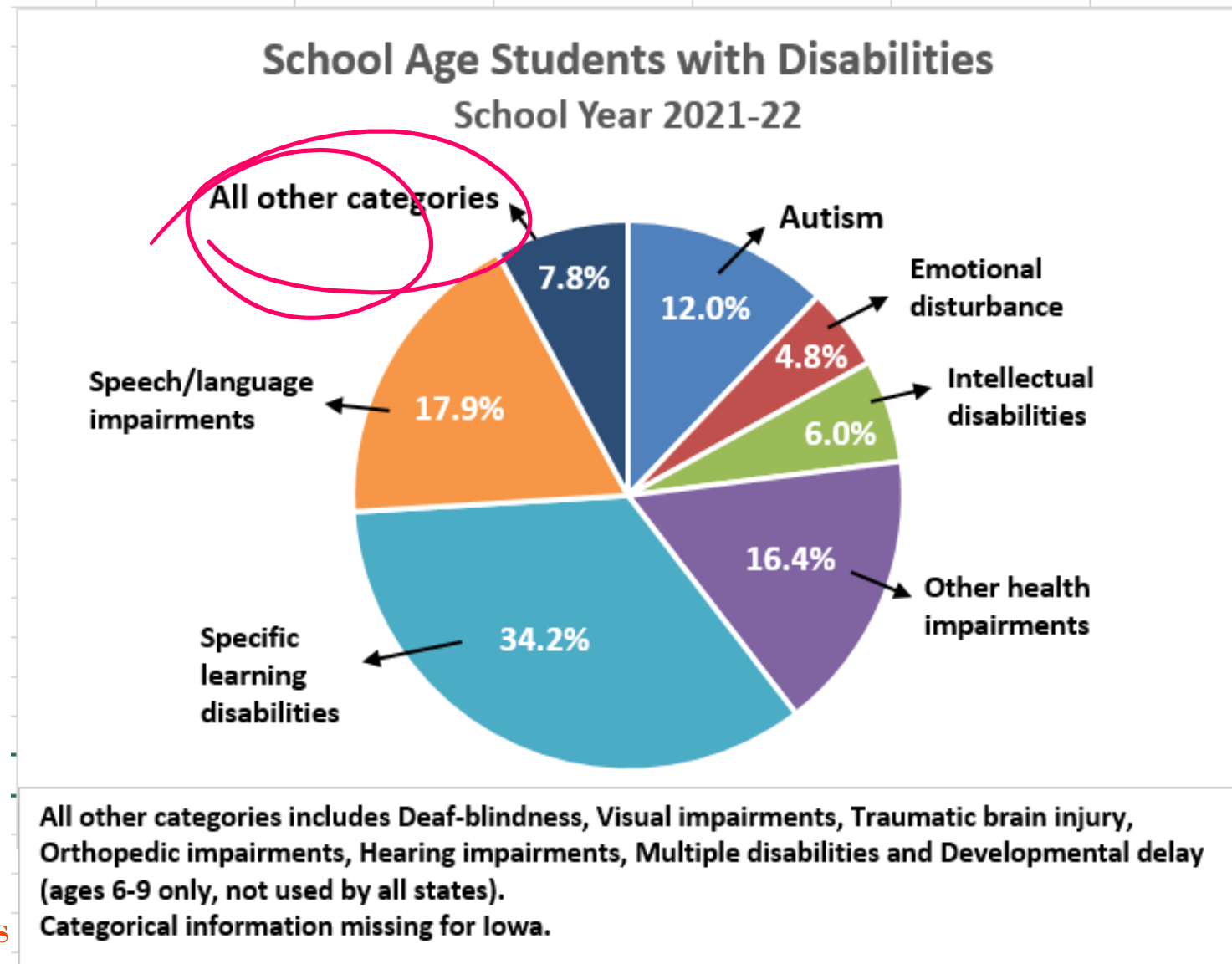
Child Find

- The Individuals with Disabilities Education Act (IDEA) includes the Child Find mandate.
- Child Find requires all school districts to identify, locate, and evaluate all children with disabilities, regardless of the severity of their disabilities.
- The IDEA requires all States to develop and implement a practical method of determining which children with disabilities are receiving special education and related services and which children are not.



Categories

1. Autism
2. Deaf-Blindness
3. Deafness
4. Emotional disturbances
5. Hearing Impairment
6. Intellectual disability
7. Multiple disabilities
8. Orthopedic impairment
9. Other health impairment
10. Specific learning disability
11. Traumatic brain injury
12. Visual impairment (including blindness)





Where are the children with
hearing loss?

Oklahoma 2019-2020

NBHS (2015-2019)

Avg 1.7% per 1,000

CDC 15%

104,089

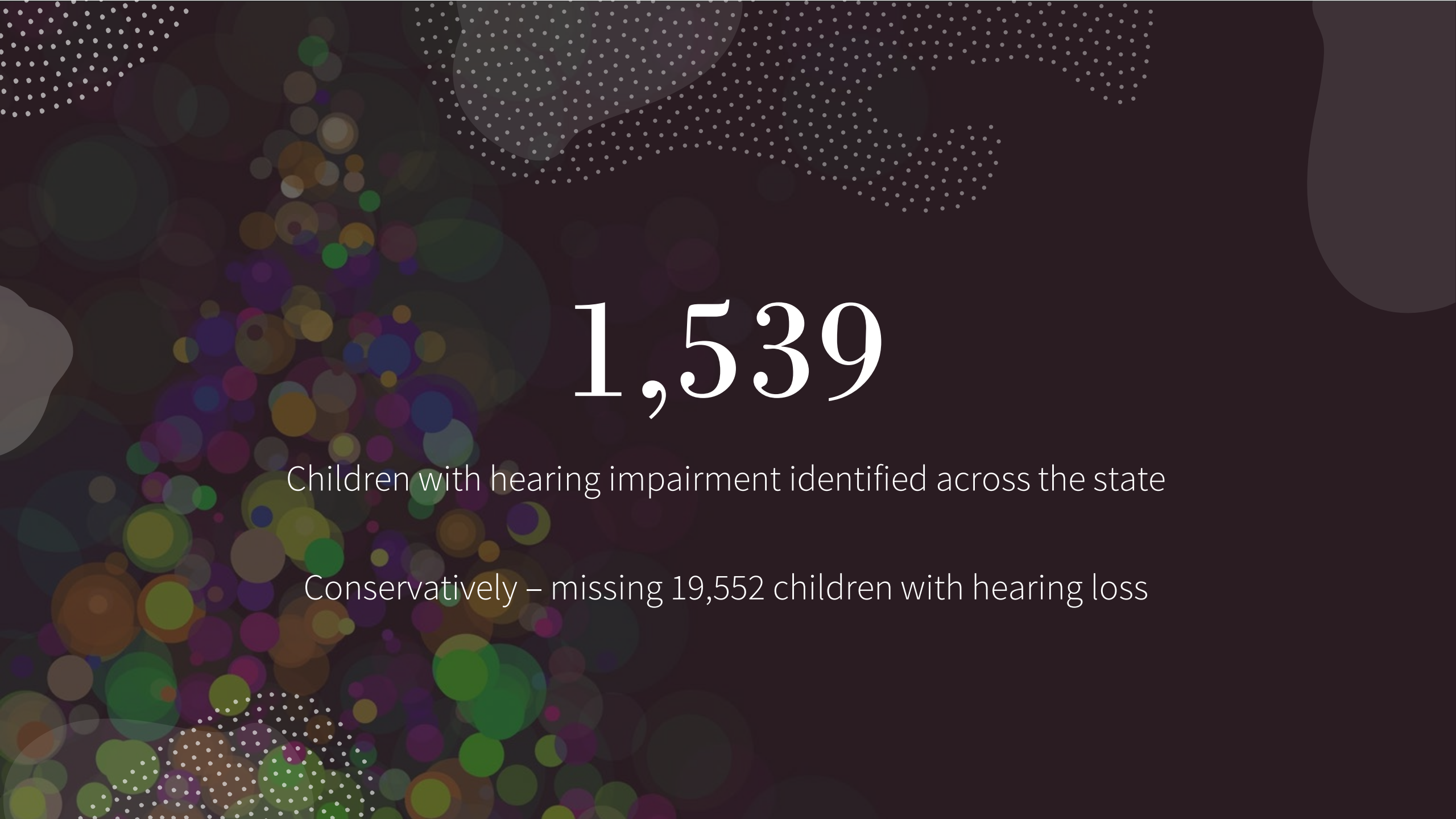
School Enrollment

693,924

3%

20,089





1,539

Children with hearing impairment identified across the state

Conservatively – missing 19,552 children with hearing loss

3 Oklahoma Truths



+50%

1st & 2nd Grade Reading Risk



71.5%

4th Graders not proficient in reading



74.5%

8th Graders not proficient in math

Data Sources

Reading Sufficiency Act Study, Oklahoma State Department of Education, 2020-21 School Year

Annie E. Casey Foundation, Aug. 2022. Kids Count Data

LEVEL 1: A LOOK AT THE LEAST LITERATE



25%

were born in
another
country



2/3

terminated their
education before
completing high
school



1/3

were 65 or
older



26%

had mental,
physical, or
health



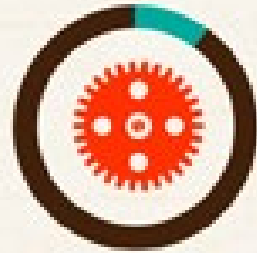
19%

had visual
difficulties



13%

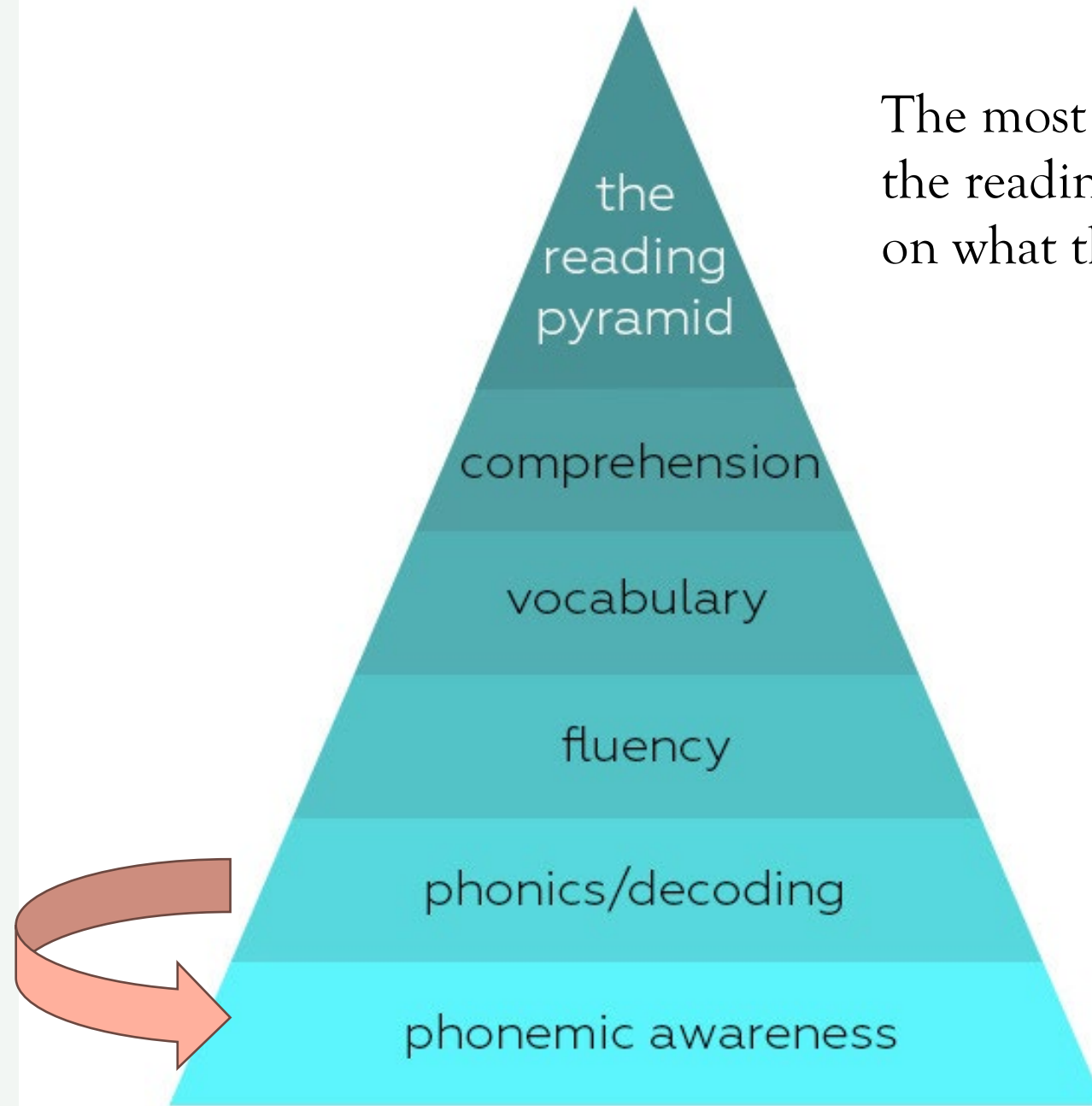
had hearing
difficulties



9%

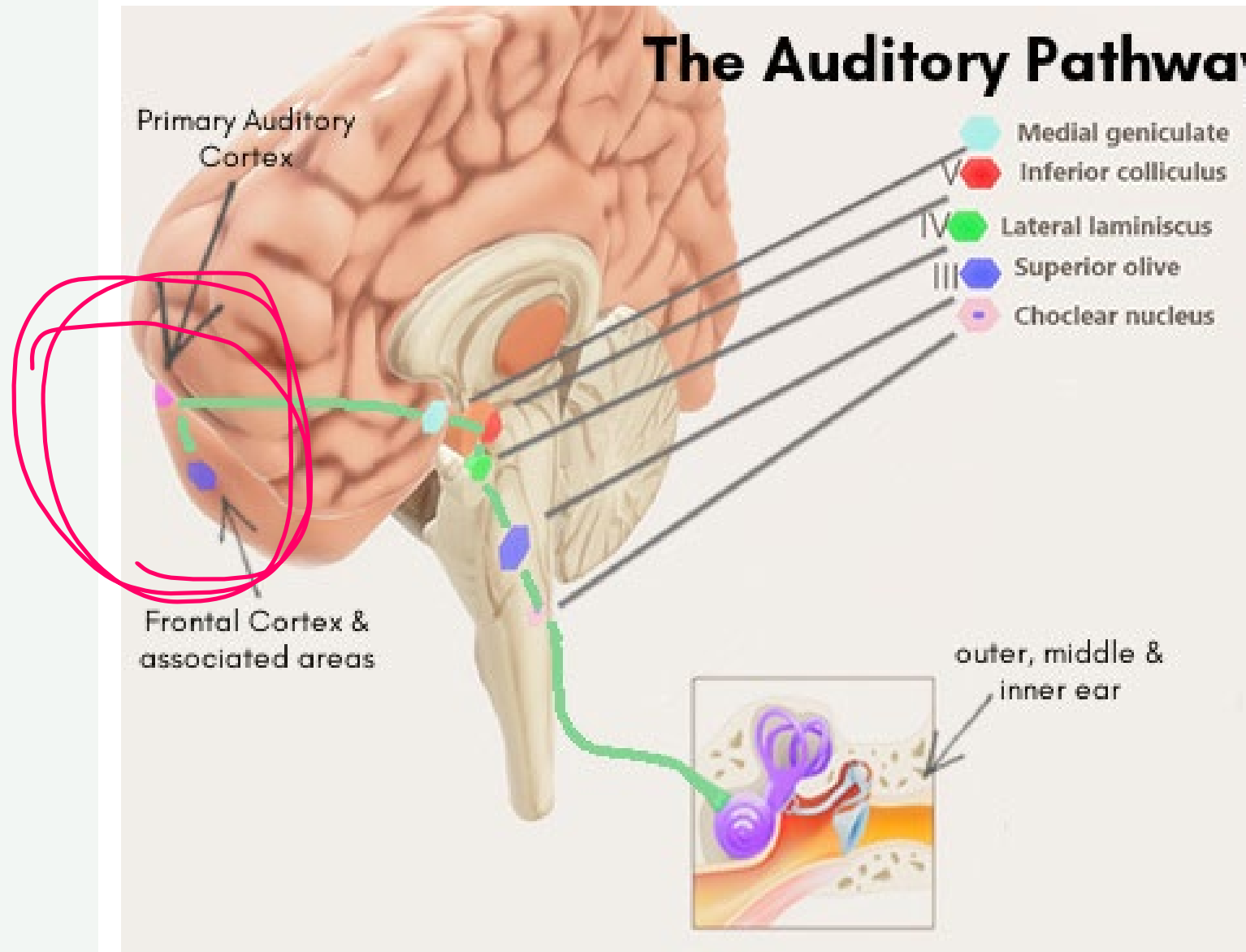
had a
learning
disability

More Truths



The most fundamental part of the reading pyramid depends on what the brain hears.

The Auditory Pathway



Auditory Pathway Disorder

- Normal to high intelligence
- Difficulty understanding speech in background noise
- Problems with multi-step directions without visual cues
- Easily distracted by sounds
- Asks often for people to repeat
- “huh” “what”
- Trouble remembering details of things that are read or spoken
- Take longer to respond
- Difficulty with localization of sounds
- Disorganized

Signs and Symptoms

APD

Shared

ADHD

- Easily distracted by background noise, often sounds most people do not notice
- Need more time to process information heard, long delays before responding
- May mishear spoken questions or struggle to respond when asked a question verbally
- May fatigue easily when listening
- Struggles with activities that involve listening comprehension
- May confuse similar sounds and have trouble with phonemic awareness.
- Often responds with "huh?" or "what?" Frequently asks people to repeat what they said, even when paying attention.
- May have been speech delayed and have persistent pronunciation issues
- Sensitive to loud noises, may get upset and cover their ears in noisy environments
- May misinterpret tone of voice and have difficulty recognizing sarcasm

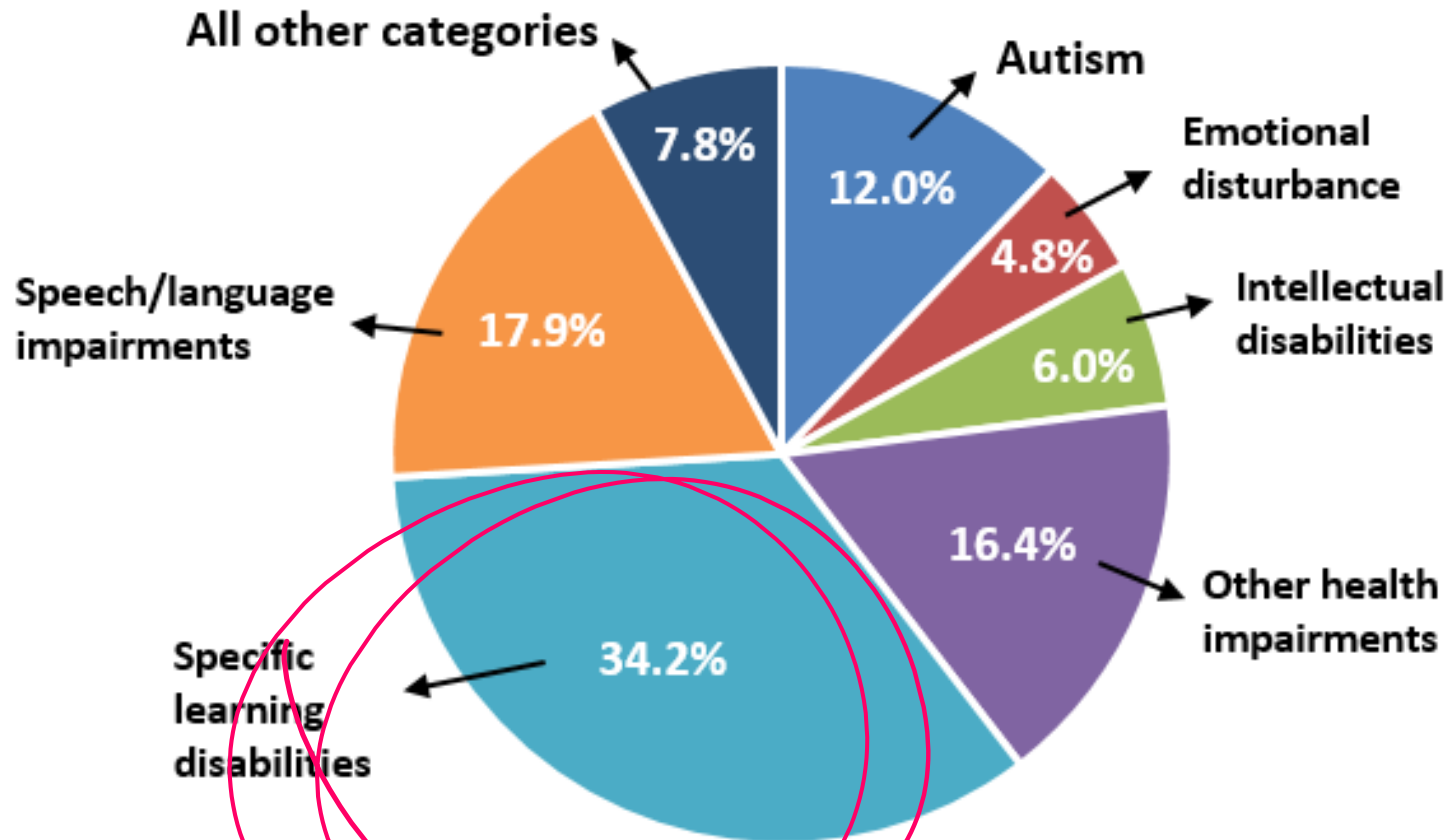
- Seems to not listen (be tuned out)
- Is forgetful
- Trouble following instructions



- Easily distracted by sights, sounds, and activity around them.
- May blurt out answers before someone finishes asking them a question.
- Interrupts people
- May become restless when listening
- Struggles with organization, prioritizing, and planning
- Tendency to make careless mistakes
- May hyperfocus on an activity they really enjoy and not respond when spoken to.
- May talk excessively
- Impulsive and acts without thinking of the consequences
- Struggles to sit still, fidgets and squirms when seated

School Age Students with Disabilities

School Year 2021-22



All other categories includes Deaf-blindness, Visual impairments, Traumatic brain injury, Orthopedic impairments, Hearing impairments, Multiple disabilities and Developmental delay (ages 6-9 only, not used by all states).
Categorical information missing for Iowa.

Eight Academic Domains of SLD:

- Oral Expression
- Listening Comprehension
- Written Expression
- Basic Reading Skills
- Reading Fluency Skills
- Reading Comprehension
- Mathematics Calculation
- Mathematics Problem Solving



Nick

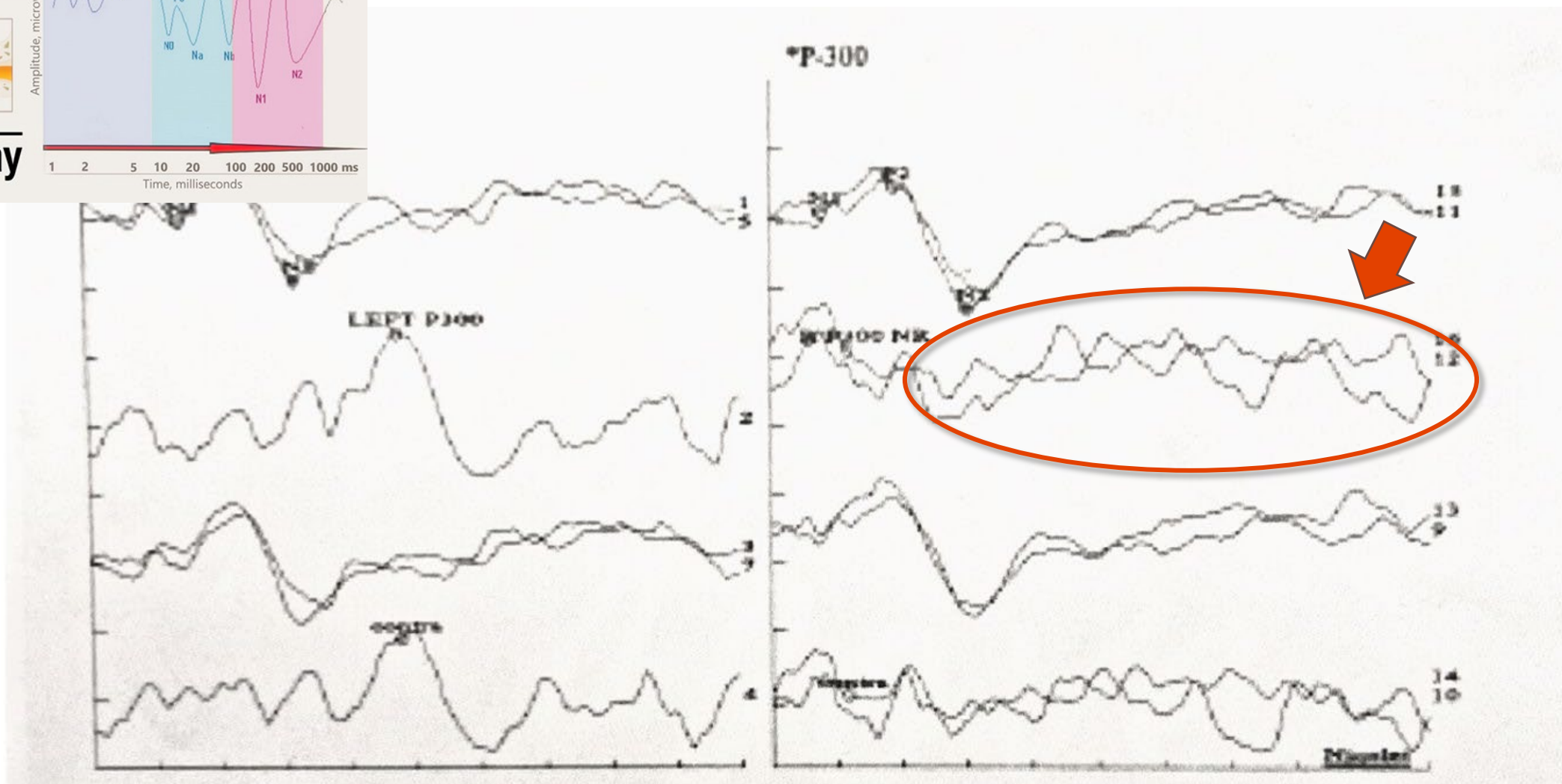
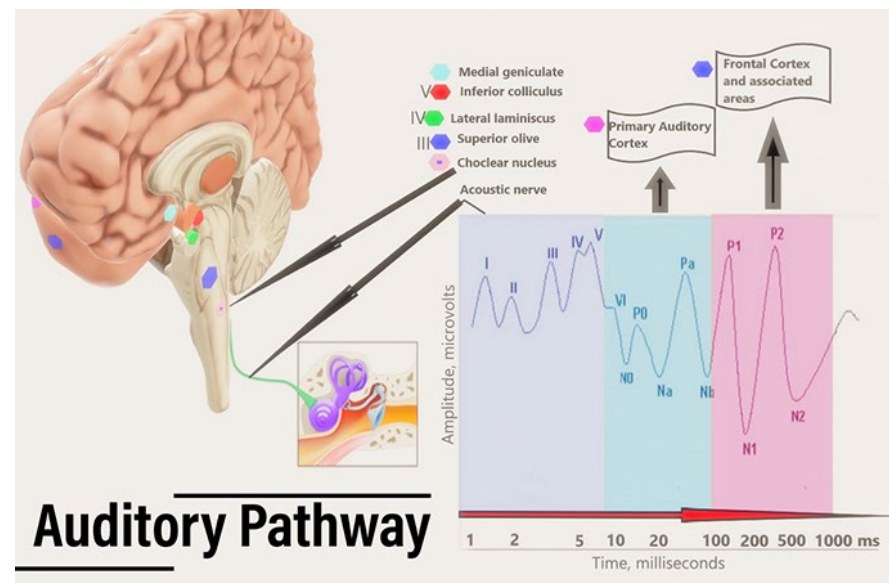
- High intelligence
- Legos – 12-13 years older
- Ambassador of Kindergarten
- Couldn't read at the beginning of 2nd grade
- Poor handwriting
- Sensory issues
- Disorganized
- Could not follow verbal multistep directions
- Hated school

Anxiety & ADHD

- Medicated with Abilify







We are misdiagnosing and missing
children/adults with auditory
pathway disorders



What can we do

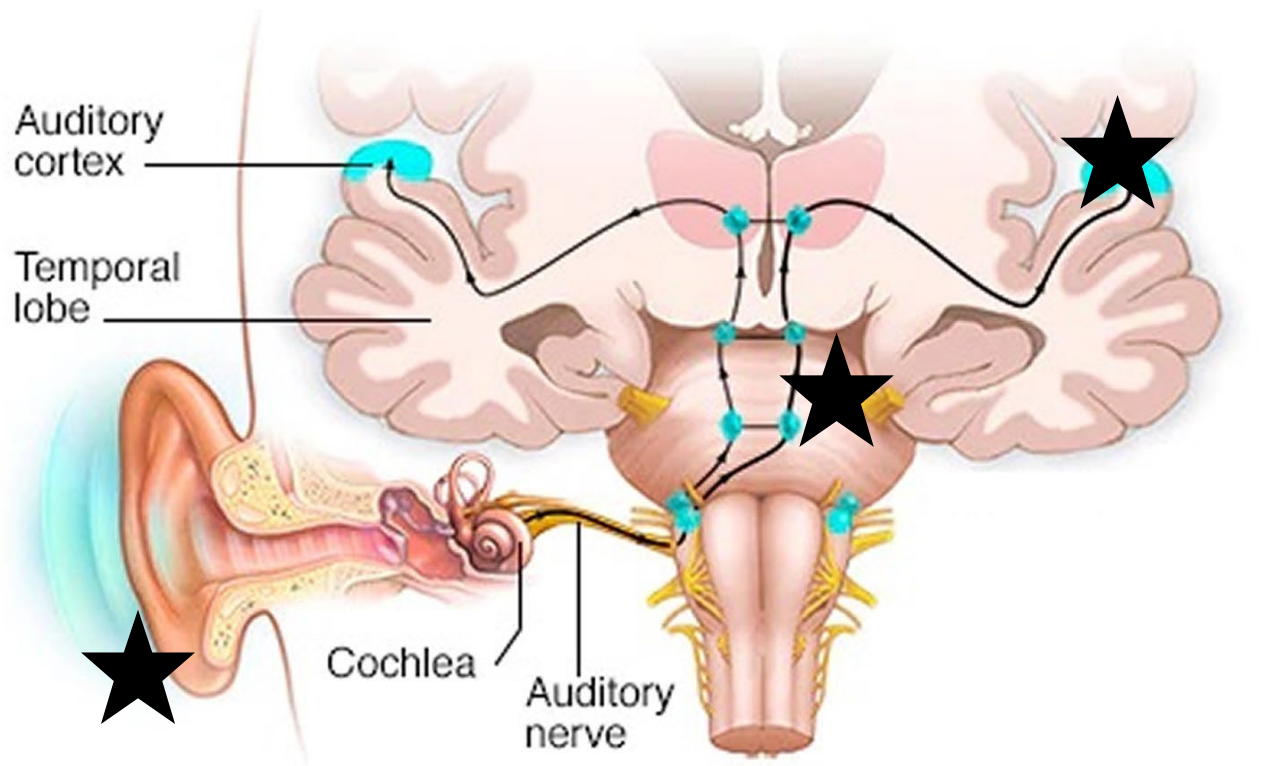
Screen using contemporary methods

Educate others about the auditory system

Demand our schools do better.

Identify those with auditory pathway disorders so
intervention can be appropriate

What can be done about an auditory pathway disorder?



Depends on which part of the auditory pathway is at fault.



Repair it

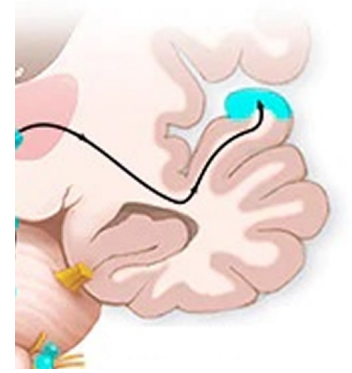


Sound isn't getting to the brain

If the way in is broken, it can be repaired with a hearing aid, implantable technology, or a FM system.



Intervene Early

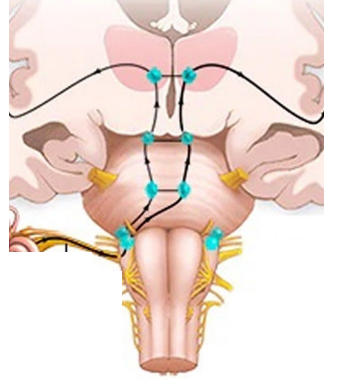


Other areas of the brain may be affecting cognition.

Cognitive deficits can affect the ability to learn and function. The auditory pathway should be thoroughly evaluated first.



Auditory Pathway Disorder (APD)



The only part of the auditory system that is plastic.

APD involves the auditory mechanisms responsible for:

- Auditory discrimination
- Sound localization and lateralization
- Temporal aspects of audition
- Auditory performance with degraded and/or competing signals.

The right dx = right intervention

Auditory Discrimination

FastForward
Earobics
Acoustic Pioneer

Binaural Processing

Dichotic listening
skills

Temporal Processing

Rhythm/music
Horseback riding
Interactive Metronome

Degraded Signal

Earbobsics
Acoustic Pioneer
FM System



“Therapy” at Home

Auditory Discrimination

Simple rhyming games
A Rhyme in Time
Telephone game
Splat
Alphabet Go Fish
Alphabet Island
Listening Lotto
Word Seeds
Word-A-Melon
*Orchard Toys
Slam Words

Binaural Processing

Marco Polo
Blind Man’s Bluff
Twister
Patty Cake
Ned’s Head
Name That Tune
Musical Cups – Wendy Stevens
<https://youtu.be/7ZogzAbSjdI>

Temporal Processing

Musical Instrument
Horseback riding
Mad Gab
Bop it
Bop it Extreme
Simon
Tongue twisters
Nursery Rhymes
Clapping Syllables
School House Rock

Degraded Signal

Simon Says in
background noise
Battleship
Musical Chairs
Duck Duck Goose

Thank you



Dr. Jacqueline R Scholl

