How to Use Developmentally Informed Strategies During a Hearing Evaluation

VANDERBILT UNIVERSITY MEDICAL CENTER

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Developmental Pediatrics
UNIVERSITY OF COLORADO ANSCHUTZ MEDICAL CAMPUS

JFK Partners
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Disclosures

AYB : Employed by Vanderbilt University Medical Center

AYB: Have received honorariums to present here. Have received honorariums to present on this topic from Washington EHDI, LEN Hearing First, and Phonak

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DM: Have received honorariums to present at EHDI and Phonak:
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Disclaimers

- Strategies that we'll share are supported by evidence in autism and other developmental disabilities
    - https://doi.org/10.1007/s10803-020-04844-2
- There is little published work that evaluate these strategies in audiology clinics
- The work from Dr. Bonino's lab is preliminary and has not undergone peer review

Agenda

1. Review research regarding disparities in hearing health care for children with developmental disabilities
2. What is developmentally informed practice?
3. Alignment of developmental demands of task with developmental abilities of the child
4. Specific strategies
    - Caregiver interview
    - Instructions and strategies for teaching task
    - Visual supports
    - Reinforcement alignment
    - Addressing sensory needs

Prevalence of Developmental Disabilities

- 1:6 (17%) of children in the U.S. have a developmental disability (Zablotsky et al, 2019)
- Approximately 40% of children who are D/HH have a secondary disability (GRI, 2011)
- High rates of unrecognized hearing and vision concerns among those with intellectual/developmental disabilities (Hey et al., 2014; Russ et al., 2013)
- Children with co-occurring conditions likely need tailored and interdisciplinary intervention approaches
- Determining a child's hearing status promptly is critical to ensure access to appropriate interventions for maximizing developmental outcomes (Cupples et al., 2018; Moeller, 2000).

Increased rates of reduced hearing and developmental disabilities

Developmental Disability	Rate of reduced hearing	
Down Syndrome	60-80% conductive hearing loss 15-20% sensorineural hearing loss 10-20% mixed hearing loss	Bull et al., 2022; Kreicher et al, 2018; DeSchrijver et al., 2019
Intellectual Disability	24-93% (depending on whether DS is included)	Hild et al, 2008; Erickson & Quick, 2017; Hey et al, 2014
Cerebral Palsy	12-30% (higher risk of ANSD or neural hearing loss)	Reid et al, 2011; Weir et al, 2018
Autism Spectrum Disorder	2-7%	Syzmanski et al, 2012; Kancherla et al., 2013
Blind/VI	5.8% (can range up to 40% depending on classification)	Kancherla et al., 2013

Overlapping Risk Factors for Deafness and Developmental Disabilities

- Genetic
- Prematurity
- Low birth weight
- Congenital infection (e.g., cCMV)
- Birth complications
- Hyperbilirubinemia requiring exchange transfusion
- Exposure to environmental toxins or drugs during pregnancy

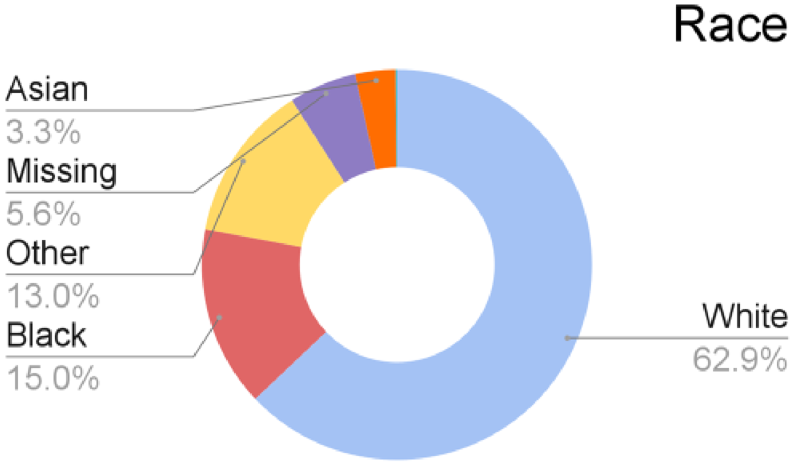
Overview of AudGenDB

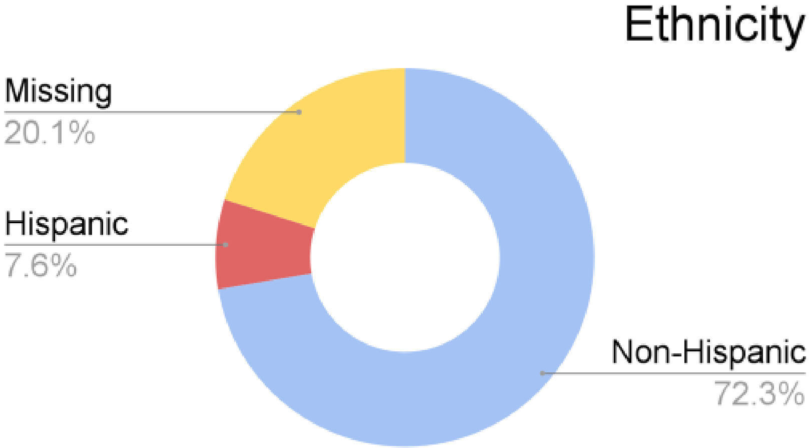
https://audgendb.chop.edu

NIH-NIDCD award number R24DC012207

Participants

- Restricted to patients (<19 yr) with:
    - Clinical hearing data
    - ICD-9/10 diagnosis codes
- After filtering:
    - 131,783 patients were identified
    - 383,237 encounters
- 74% are from CHOP
- 59% are boys





Prevalence of Developmental Disabilities in Audiology Clinics

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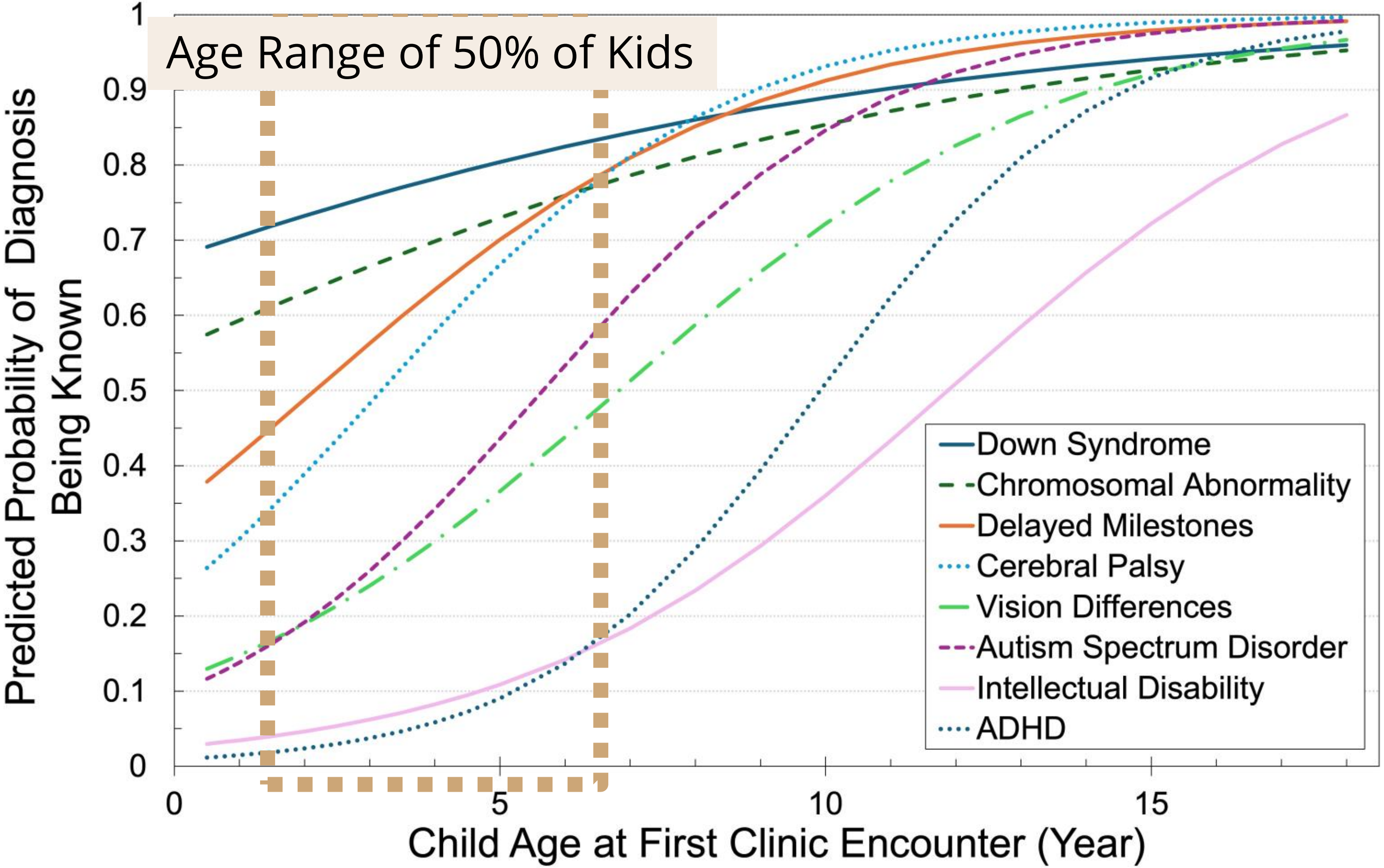
Bonino, Goodwich, & Mood (2025). Prevalence and characteristics of developmental disabilities among children who receive hearing health care. *American Journal of Audiology*.

Prevalence in Audiology Clinics (N=131,709)

Developmental Disability	n (%)
None	99,500 (75.5)
Any Diagnosis	32,209 (24.5)
1	19,497 (14.8)
2	8,043 (6.1)
3	3,190 (2.4)
4 or More	1,479 (1.1)
Specific Disability	
ADHD	8,650 (6.6)
Autism	8,146 (6.2)
Cerebral Palsy	2,089 (1.6)
Chromosomal Abnormalities	3,144 (2.4)
Delayed Milestones	14,883 (11.3)
Down Syndrome	2,658 (2.0)
Intellectual Disability	2,212 (1.7)
Vision Differences	9,750 (7.4)

- **25% have at least 1 diagnosis**
- **10% have 2 or more diagnoses**

Is the Diagnosis Known?



Age Range of 50% of Kids

Earlier:

- DS
- Chromosomal

(sort of)

- Delayed Milestones
- CP

Later:

- Autism
- Vision
- ADHD
- ID

Accessing Gold-Standard Hearing Assessments

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Bonino, Mood, & Dietrich (2024). Rethinking the accessibility of hearing assessments for children with developmental disabilities. *Journal of Autism and Developmental Disorders*.

1-3-6 EHDI Framework

1 Receive a hearing screening no later than 1 month of age

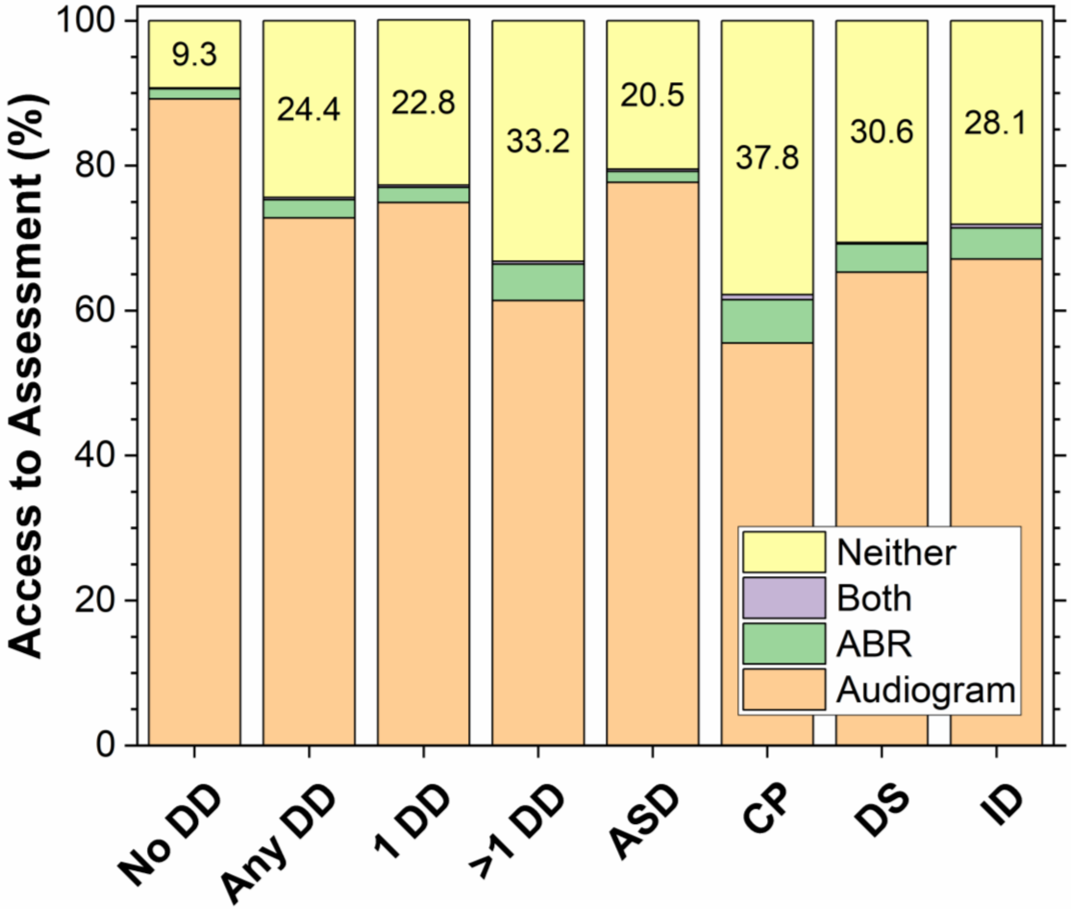
3 Receive a diagnostic evaluation no later than 3 months of age

6 Receive early intervention services no later than 6 months of age

Access to Gold-Standard Assessment?

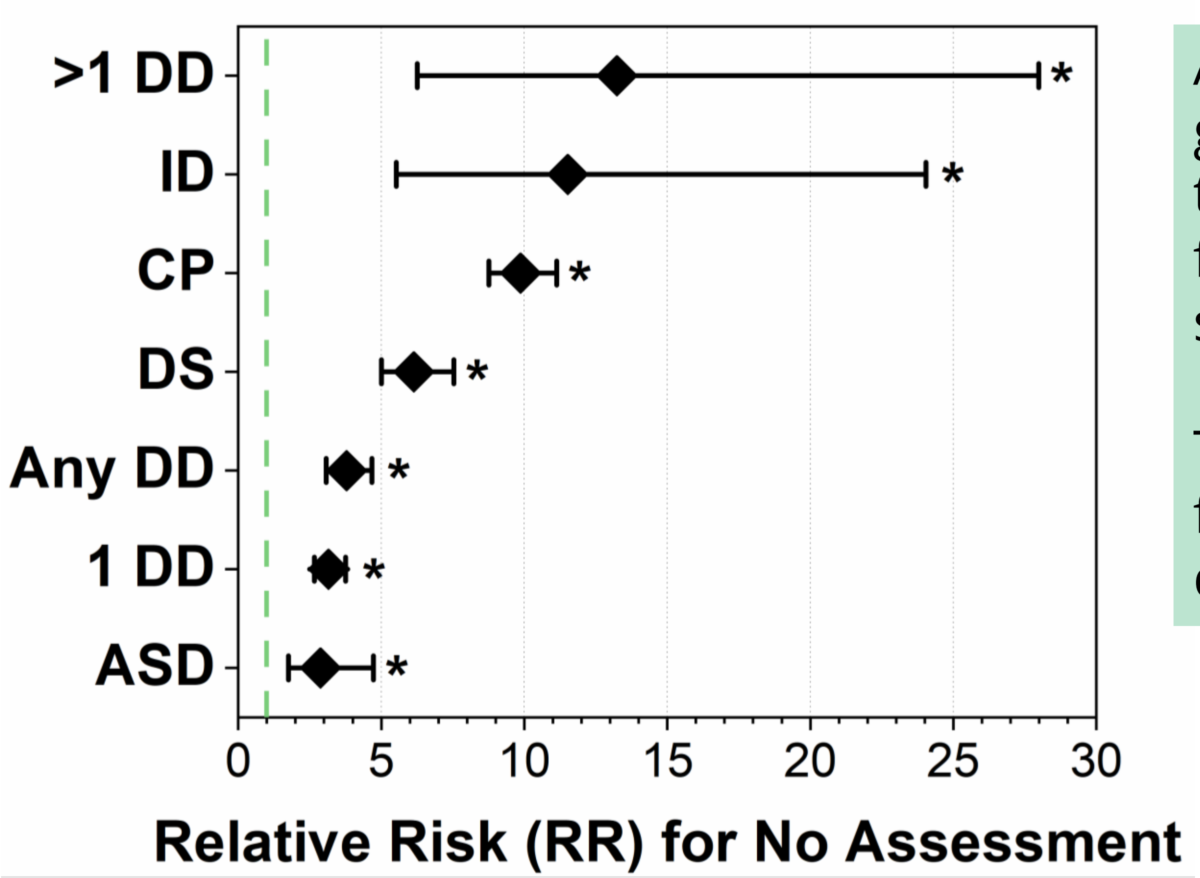
- In the first three months of hearing health care do children get access to:
    - Audiogram testing
    - ABR testing
- Access means that 1 or more thresholds had to be recorded
- Access to a gold-standard assessment is required to:
    - Fit hearing technology
    - Determine eligibility for hearing-related intervention services

Assessment Type By Group



During the initial 3 months of care **24.4%** of children with developmental disabilities did not receive a gold-standard assessment

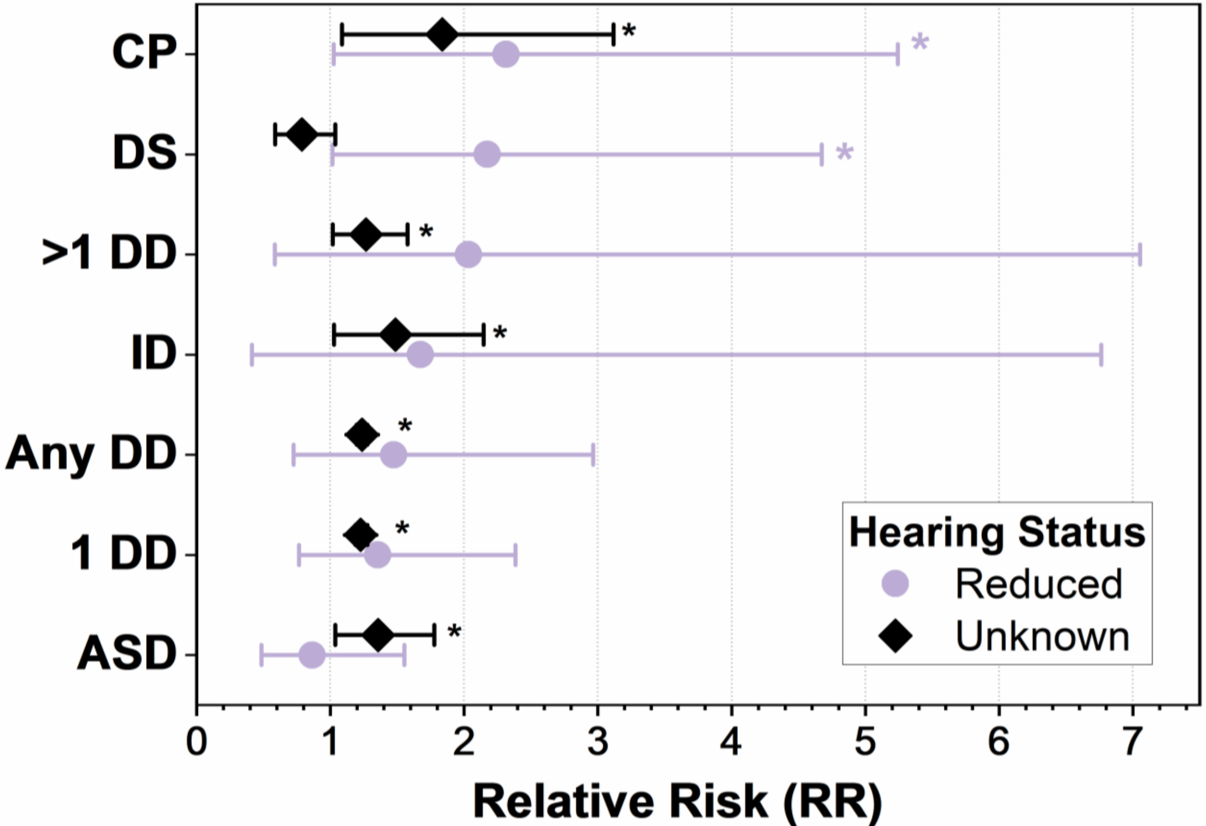
Risk for Not Accessing Assessment



All developmental disability groups were at higher risk than the comparison group for not receiving a gold-standard assessment.

The highest risk was seen for children with 2 or more diagnoses, ID, or CP.

Hearing Status



Children with developmental disabilities (except for DS) were more likely to have unknown hearing status.

Children with CP or DS had a higher risk of reduced hearing.

How are we doing?

The most common reason for a delayed diagnosis following newborn hearing screening was a developmental or medical concern (Fitzpatrick et al., 2017)

Children with developmental disabilities not identified with reduced hearing during newborn hearing screening, later dx with HL by age 7, encounter greater delays from referral to intervention (Mackey et al., 2024)

Children with DD, not able to complete behavioral audiogram, encounter long delays in accessing ABR (Trudeau et al., 2021)

Many studies regarding outcomes of children who are DHH exclude or fail to define children with developmental disabilities.

Children with developmental differences have a right to equitable access to:

- High-quality hearing healthcare
- Interventions to support language acquisition

TIMELY diagnosis of hearing and developmental concerns is critical

Developmentally Informed Practice

Flipping the Script

“Child is unable to complete testing”

- Perceived failure on part of the child
- Places onus on the child

Tasks are misaligned with developmental abilities/needs of the child

- Failure is on our methods and hearing health care practices
- Onus is on professionals to modify practices
- Encourages professionals to develop tasks that are accessible and inclusive for ALL children

Child and Clinic Related Factors

Traditional practice
Test selected based on child's chronological age
Reinforcement based on social praise, aspects of the task itself
Implicit task demands are assumed to be within the child's repertoire
Follow up schedule recommended several weeks later
Multiple follow up behavioral measures

Developmentally informed practice
*Pre-screen to understand child's developmental stage, modify tasks based on child's developmental needs
Reinforcement is accessible, meaningful, and aligned with interests
Reduce transitions, address sensory sensitivities, attend to language used to explain tasks
*Serial appointments scheduled to allow for gradual desensitization and benefit of repeated learning trials
Developmentally informed protocols specifying when to move to another procedure or sedated ABR, clear guidelines for establishing timely dx of hearing status

From Breheney, Bonino, Mood, Nightengale, and Wiley (2025). EHDI Presentation.

Alignment of Task

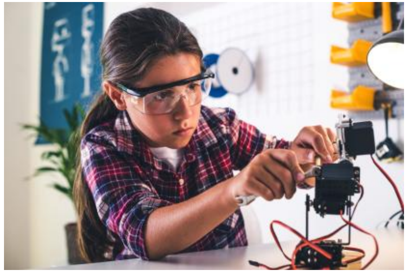
Selection of Method in Traditional Practice

- Available information in EHR
- Observations during interaction (language, motor, social)
- Case history

VRA
Small

CPA
Medium

Conventional
Large



What are the developmental demands for CPA?

Executive Functioning-shift and divide attention between stimuli and people and to transition between task demands
-sustained attention
-inhibition/impulse control
Play skills to participate in play schemes

Listen and follow abstract directions

- Ability to tolerate social press of test situation
- understand social expectations
- Assumes child is socially reinforced by clinician praise and play
- Ability to engage in adult directed behavior

- Trunk control for head turn response
- Fine motor skills for CPA games

- Tolerance for different sensory experiences (ear probes; headphone placement)
- Visual access

Our methods largely assume uniform development across AND within domains.

Fundamentals of Behavioral Testing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Signal → Target Response

Shape/strengthen the behavior

Reinforcement (Reward)

Motivation

To be under stimulus control:

- Child must consistently perform the response
- Response is time locked to the signal
- Audiologist can reliably judge the child’s response

Modifications

Use reinforcers that are meaningful and motivating to child

Be mindful that social interaction may be aversive


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(VRA) Use a reliable yes/no response instead of head turn

(CPA) Select "game" to be low developmental demand

Signal → Target Response

Shape/strengthen the behavior

Reinforcement (Reward)

Motivation

Slow down and make sure under stimulus at suprathreshold levels; use stimulus with best response; determine response time and adjust for motor or shifts in attention challenges

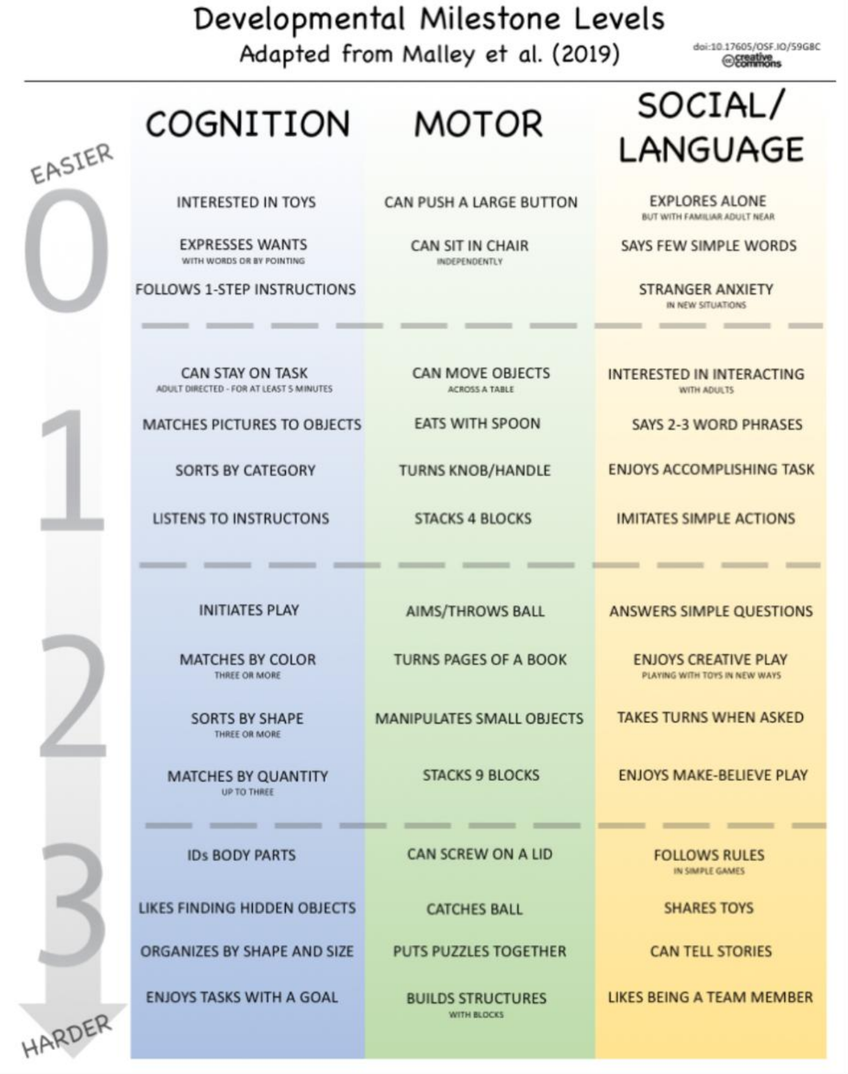
To be under stimulus control:

- ○ Child must consistently perform the resp
- ○ Response is time locked to the signal
- ○ Audiologist can judge the child's response

Developmental milestone levels

Can be used for children with a developmental age of approximately 18 months to 5 years

DOI:10.17605/OSF.IO/59G8C



Developmental Milestone Levels

Adapted from Malley et al. (2019)

doi:10.17605/OSF.IO/59G8C

EASIER

	COGNITION	MOTOR	SOCIAL/ LANGUAGE
0	INTERESTED IN TOYS	CAN PUSH A LARGE BUTTON	EXPLORES ALONE BUT WITH FAMILIAR ADULT NEAR
	EXPRESSES WANTS WITH WORDS OR BY POINTING	CAN SIT IN CHAIR INDEPENDENTLY	SAYS FEW SIMPLE WORDS
	FOLLOWS 1-STEP INSTRUCTIONS		STRANGER ANXIETY IN NEW SITUATIONS
1	CAN STAY ON TASK ADULT DIRECTED - FOR AT LEAST 5 MINUTES	CAN MOVE OBJECTS ACROSS A TABLE	INTERESTED IN INTERACTING WITH ADULTS
	MATCHES PICTURES TO OBJECTS	EATS WITH SPOON	SAYS 2-3 WORD PHRASES
	SORTS BY CATEGORY	TURNS KNOB/HANDLE	ENJOYS ACCOMPLISHING TASK
	LISTENS TO INSTRUCTONS	STACKS 4 BLOCKS	IMITATES SIMPLE ACTIONS
2	INITIATES PLAY	AIMS/THROWS BALL	ANSWERS SIMPLE QUESTIONS
	MATCHES BY COLOR THREE OR MORE	TURNS PAGES OF A BOOK	ENJOYS CREATIVE PLAY PLAYING WITH TOYS IN NEW WAYS
	SORTS BY SHAPE THREE OR MORE	MANIPULATES SMALL OBJECTS	TAKES TURNS WHEN ASKED
	MATCHES BY QUANTITY UP TO THREE	STACKS 9 BLOCKS	ENJOYS MAKE-BELIEVE PLAY
3	IDs BODY PARTS	CAN SCREW ON A LID	FOLLOWS RULES IN SIMPLE GAMES
	LIKES FINDING HIDDEN OBJECTS	CATCHES BALL	SHARES TOYS
	ORGANIZES BY SHAPE AND SIZE	PUTS PUZZLES TOGETHER	CAN TELL STORIES
	ENJOYS TASKS WITH A GOAL	BUILDS STRUCTURES WITH BLOCKS	LIKES BEING A TEAM MEMBER

HARDER

Game explanations and modifications

Game Explanations and Modifications

C = Cognition M = Motor S = Social

Adapted from Malley et al. (2019)
doi:10.17605/OSF.IO/59G8C

BUZZER

Push the buzzer button when the beep is heard.

TIP: The "ready state" can be placing a hand on the belly or on a hand-shaped cut out on the table.

CHANGE IT UP by using buzzers with different light and sound options.

0C 0M 0S

CAUSE AND EFFECT TOYS

Push a button on the toy when the signal is heard. The toy light up, spin, or make a noise.

CHANGE IT UP by waiting to turn on sounds or lights.

TIP: Use toys with a similar response technique (e.g., button push) to reduce the need to re-training.

0C 0M 0S

BLOCKS IN A BUCKET

Drop a block in a bucket each time a beep is heard.

CHANGE IT UP by using different toys such as rubber ducks or dinosaurs!

UPSCALE IT by getting rid of the bucket and letting the child build a tower.

1C 1M 1S

RAINBOW DOMES

Add a dome each time a beep is heard.

UPSCALE IT by creating spheres with similar dome sizes.

TIP: This is a new twist on the old "ring on a stand" game. This allows for more trials and more colors!

1C 1M 1S

BAKING CUPCAKES

Place a cupcake in the pan each time a beep is heard.

TIP: Don't forget to "put them in the oven" once the pan is full!

UPSCALE IT by separating the cupcakes to reveal a simple shape puzzle.

1C 1M 1S

PEG BOARD

Add a peg each trial.

CHANGE IT UP by using different variations of the same concept!

UPSCALE IT by allowing the child to build peg towers!

1C 2M 1S

BUILD A CHAIN

Add a link to the chain each trial.

TIP: In the end, allow the child to try on the "necklace" and let them model it for their parents!

DOWNSCALE IT by having the child hand the clinician the link rather then adding it to the chain themselves.

1C 2M 2S

STICKERS

Place a sticker on a piece of construction paper each trial.

UPSCALE or DOWNSCALE IT by using larger or smaller stickers!

1C 2M 2S

SHAPE SORTING

Add a shape to a dowel each time a beep is heard.

TIP: This is a versatile game as any shape can fit over any dowel. The child does not need to know how to match colors or shapes.

2C 1M 1S

RACE CAR RAMP

Race a car down the ramp each trial.

TIP: Have the clinician or test assist catch the car as it rolls of the ramp!

2C 1M 2S

MR. POTATO HEAD

Add a new body part or accessory each time a beep is heard.

TIP: Allow the child to have some fun by instructing them to make a "silly" version.

CHANGE IT UP by purchasing different accessories for Mr. or Mrs. Potato Head.

3C 3M 3S

PRETEND PLAY

Add a new component each trial. Start by building animal houses, then place each animal in their home.

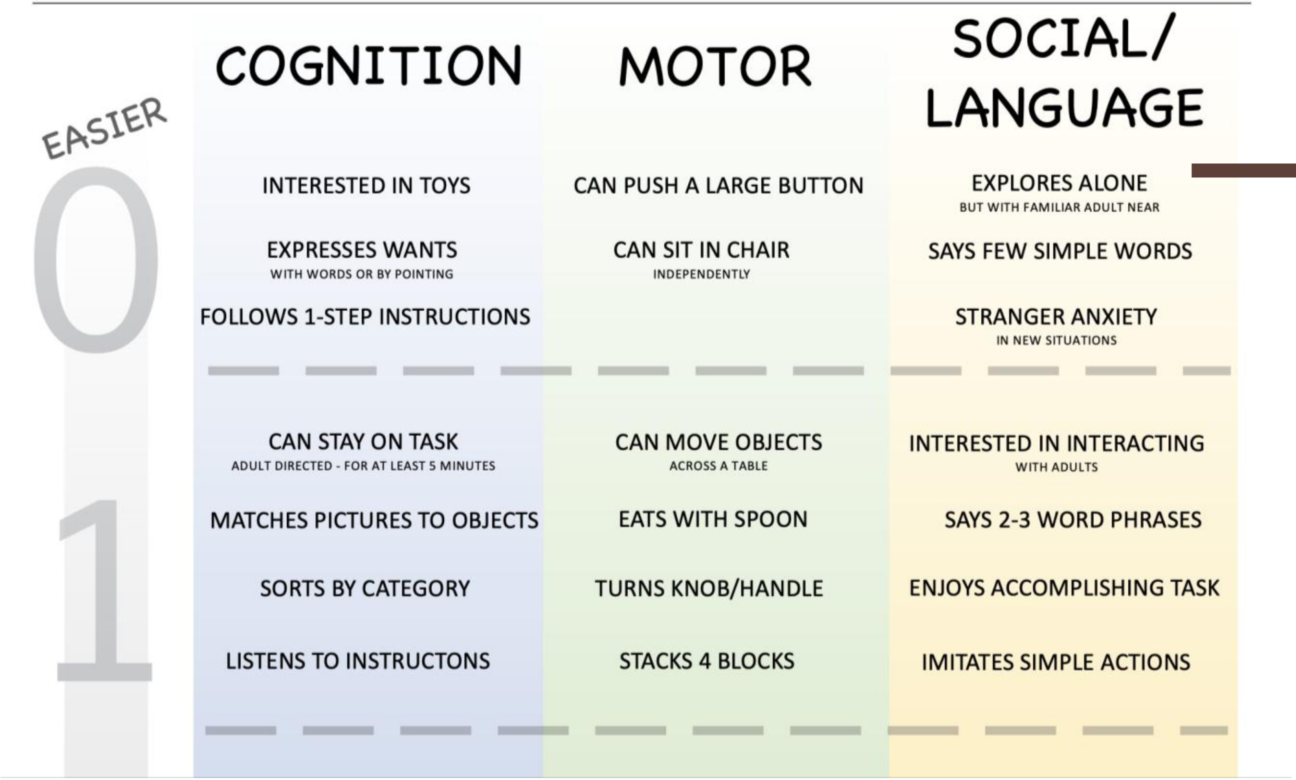
UPSCALE IT by building the storyline. Use blue chips to give each animal some "water" or add more animals and create a "slumber party."

3C 2M 3S

DOI:10.17605/OSF.IO/59G8C

Experiment 1: Cause-and-effect Versus Drop-and-release Response Task

Cause-and-Effect



EASIER	COGNITION	MOTOR	SOCIAL/ LANGUAGE
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	SORTS BY CATEGORY	TURNS KNOB/HANDLE	ENJOYS ACCOMPLISHING TASK
	LISTENS TO INSTRUCTONS	STACKS 4 BLOCKS	IMITATES SIMPLE ACTIONS

Cause-and-effect is a developmental skill commonly observed at 15 to 18 months

Example Cause-and-Effect Toys

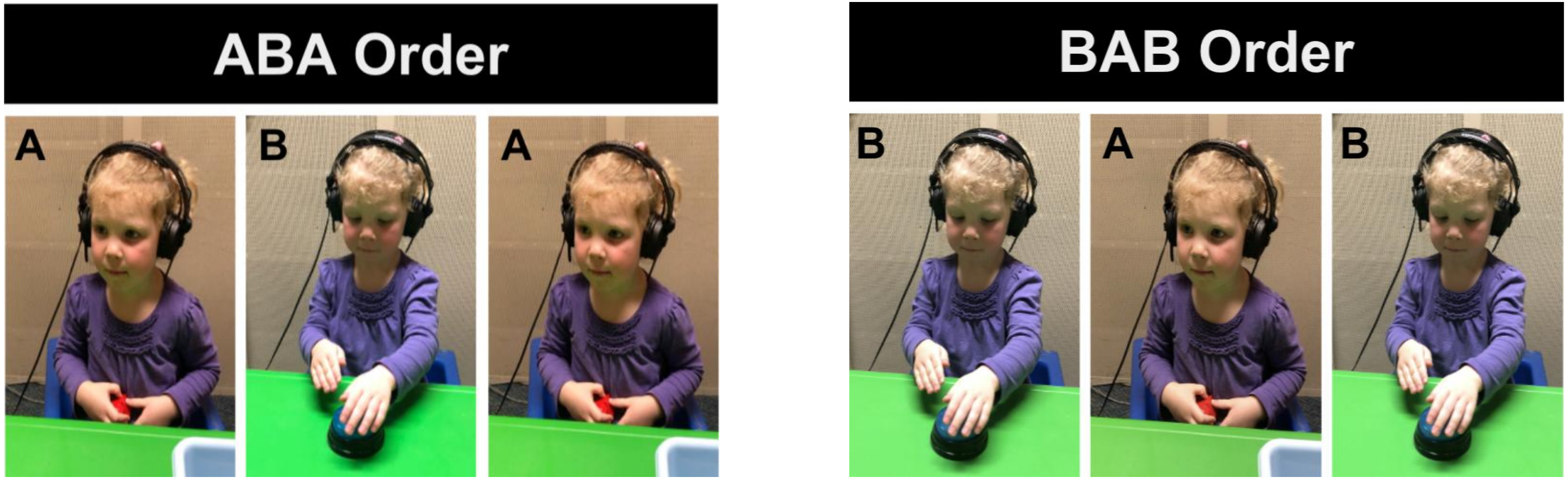
- Buzzers (e.g., Learning Resources Answer or Animal Buzzers)

- Enabled switch toys

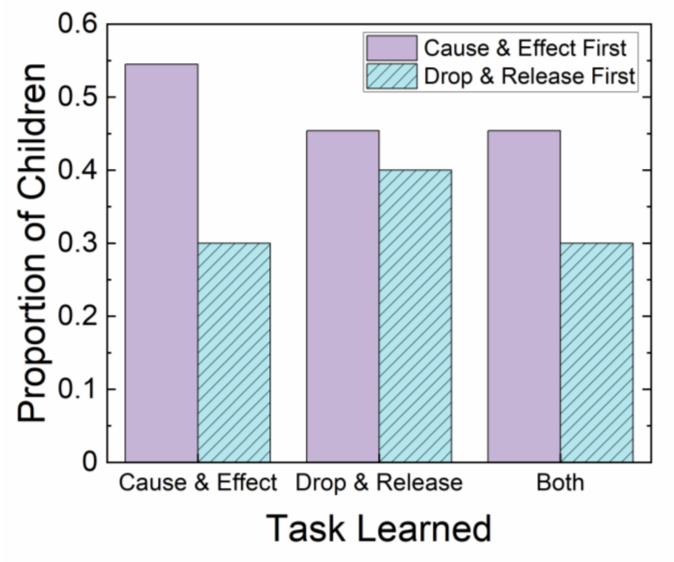
https://enablingdevices.com

Experiment 1: Methods

- 21 children who were 18 – 63 months (TD = 9; DD = 12)
- Detect a 1000-Hz warble tone at 50 dB SPL under headphones
- Use the PlayO2I Method



Experiment 1: Results



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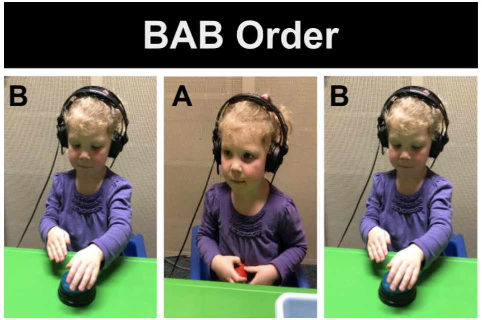
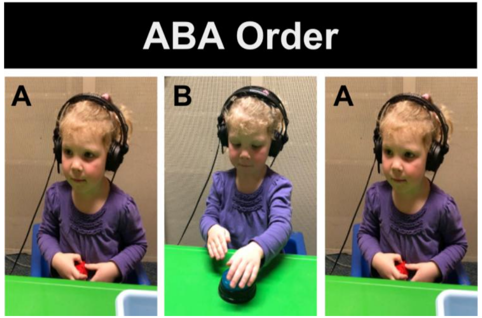




- A higher proportion of children tested in the BAB order learned both tasks compared to children in the ABA order.
- “Scaffolding” effects
- “Interference” effects

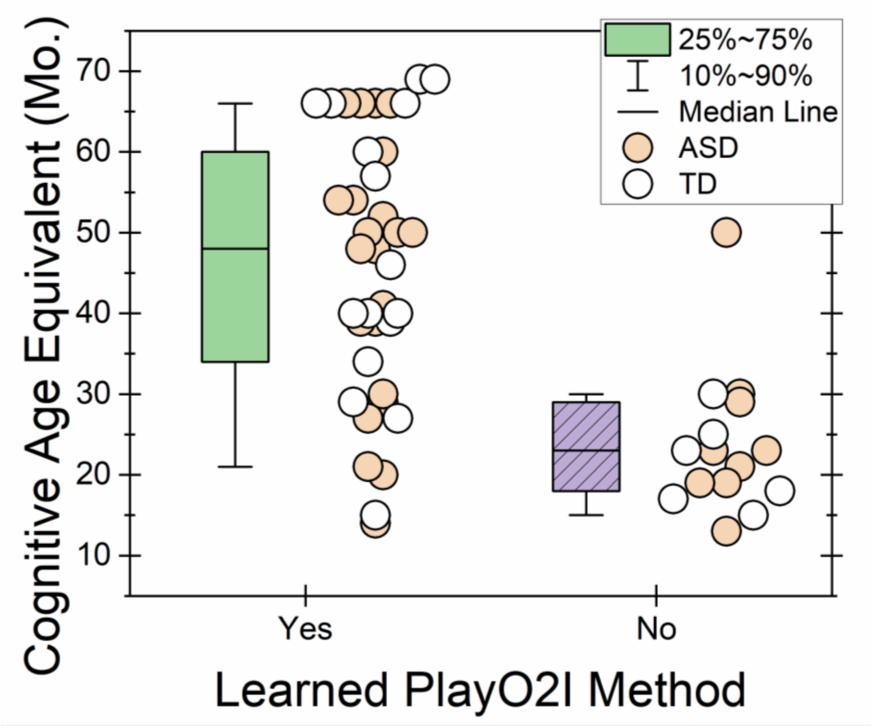
Experiment 2: Methods

- 49 children (DD = 36)
- Detect a 1000-Hz warble tone at 50 dB SPL
- Use the PlayO2I Method
- Start with Cause & Effect, then move to Drop and Release
- Option to start in soundfield first

Experiment 2: Results

- 30 out of 36 children with DD learned the method (83%)
- 9/13 children with DD who started in speaker and learned the task, successfully transitioned to headphones

Role of Cognition



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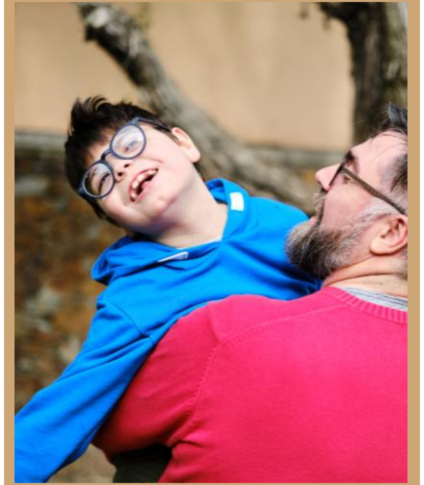
Word of Caution

- There appears to be a “cost” when you get the starting task ”wrong”
- Based on pilot data we have seen:
    - If the child learned a head-turn response first, they often either did not learn cause-and-effect or continued to show earlier response
    - If we were not successful in training the cause-and-effect response task, we were not successful in training them to make a head-turn response in the same visit. (We were successfully at the 2nd visit)

Specific Strategies

Caregiver Interview



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Interview Approach

- Parents of children with developmental disabilities endorse asking them about their child prior to the appointment
- We conduct a phone interview (30-45 min) with every family prior to the first visit
- Information helps us with our test session and creates a partnership with the family

Interview Questions

- Do you or your child use any communication systems or technology to communicate with each other? (e.g., sign language, picture exchange system, augmentative communication devices).
    - If Yes, what kind of communication strategies do you or your child use?
- Does your child have a reliable way to indicate a ‘Yes’ or ‘No’ response?
    - If Yes, what does this response look like?
- Tell me about what types of games or toys your child likes to play with and how they play with others.
- What are your child’s particular interests?
- Some children have items they’re so interested in that they’ll stop working if they’re introduced to these items. Does your child experience this with any particular items?
    - If Yes, can you explain this further?
- Does your child have any fears or anything that makes them upset?
- Is your child fearful of enclosed spaces?
- How do you anticipate your child would respond to a toy animal that lights up and moves?

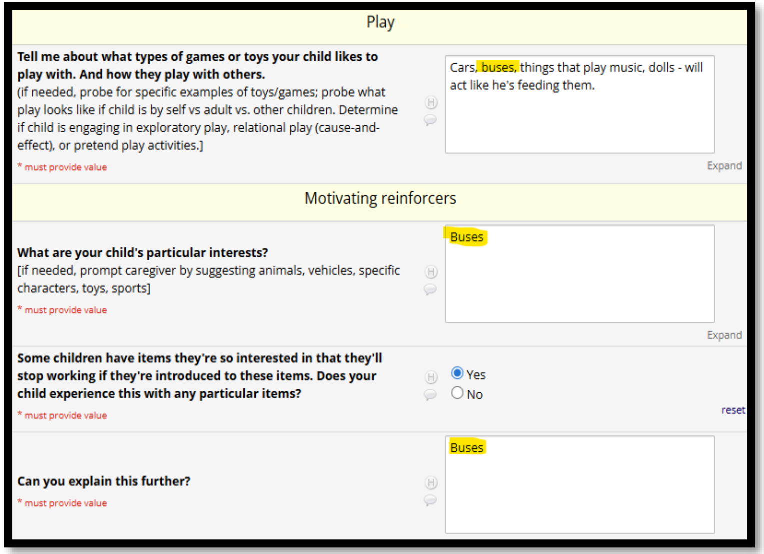
Interview Questions Continued

- Would flexible seating be helpful during testing (e.g., stool, beanbag chair, cushion, large chair, small chair)?
- Is your child sensitive to having things on their ears or head, such as headphones?
  - If Yes or Unsure:
    - Can you have your child wear a hat?
    - Is it difficult to shampoo or brush your child’s hair?
- Is your child sensitive to sounds, light, touch, or smells?
  - If Yes, share details about how your child responds.
- Is your child fearful of new spaces?
- Would your child benefit from coming to visit the testing space beforehand or seeing a video of what will happen during the visit?
- Does your child separate from parents or caregivers easily?
- What can we do to help gain your child’s trust and ease the transition into testing?
- Where can we position the parent, in the booth with child or in the control room to make the child comfortable?

Interview Questions Cont.

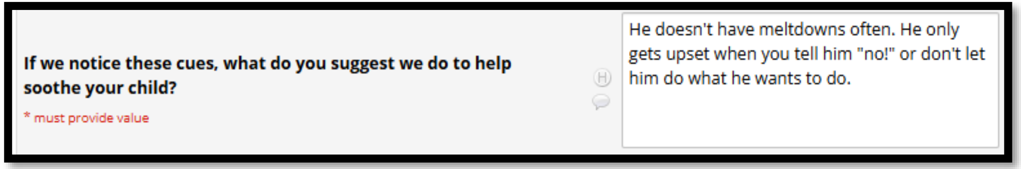
- Do we need to make arrangements to have lab personnel babysit accompanying siblings?
- How does your child do when interacting with strangers? Is your child very social, or would your child do better with fewer new people around during the testing session?
- The testing we are completing will involve some transitions between toys and/or activities. Please tell us a little bit about how your child handles transitions.
    - If transitions are difficult for your child during testing, do you have strategies that help with transitioning that you use at home or school?
- If your child becomes upset during testing, what can we do to best support them?
- Does your child provide any cues that they may be unhappy or upset?
- If we notice these cues, what do you suggest we do to help soothe your child?
- Is there anything else that you would like to let us know about your child that we have not yet addressed?

Interview Examples



Play	
Tell me about what types of games or toys your child likes to play with. And how they play with others. (if needed, probe for specific examples of toys/games; probe what play looks like if child is by self vs adult vs. other children. Determine if child is engaging in exploratory play, relational play (cause-and-effect), or pretend play activities.] * must provide value	Cars, buses, things that play music, dolls - will act like he's feeding them. Expand
Motivating reinforcers	
What are your child's particular interests? [if needed, prompt caregiver by suggesting animals, vehicles, specific characters, toys, sports] * must provide value	Buses Expand
Some children have items they're so interested in that they'll stop working if they're introduced to these items. Does your child experience this with any particular items? * must provide value	● Yes ○ No reset
Can you explain this further? * must provide value	Buses

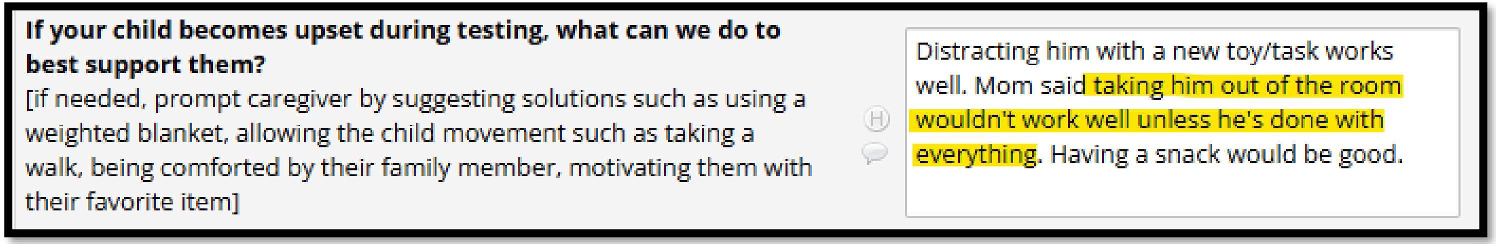
- ❖ A favorite toy/activity can be ***too*** engaging



If we notice these cues, what do you suggest we do to help soothe your child? * must provide value	He doesn't have meltdowns often. He only gets upset when you tell him "no!" or don't let him do what he wants to do.

- ❖ Child does not like adult-directed activities, so I could warn parent that he may get upset from some of our games

Interview Examples (continued)



If your child becomes upset during testing, what can we do to best support them?
[if needed, prompt caregiver by suggesting solutions such as using a weighted blanket, allowing the child movement such as taking a walk, being comforted by their family member, motivating them with their favorite item]

Distracting him with a new toy/task works well. Mom said taking him out of the room wouldn't work well unless he's done with everything. Having a snack would be good.

How does your child do when interacting with strangers?
Is your child very social, or would your child do better with fewer new people around during the testing session?

* must provide value

Does ok with new people as long as they are chill and not too loud and overwhelming.

Instructions

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Communication

- Providers need to ensure that children can understand and communicate their needs and questions during a medical appointment

Training Strategy: Language

- Use concrete and concise language
- Matched to the child's receptive language abilities
- Maintain appropriate social and body boundaries (i.e., no describing the probe tip as "kissing" or "tickling" the ear)
- Describe the tactile and sensory experience(s)
- Avoid saying "it won't hurt," instead use:
    - "Most children say it doesn't hurt"
    - "You can handle it"
- Use "first ____, then ____" language
- Use visual supports

See our scripts here: https://osf.io/3yhmf/

Example: Tympanometry

Common Directions

Time for your ear picture!
Squish, squish. [show squishing top of probe tip]
I'm going to give you kisses!
Let's kiss your hand.
Let's kiss your arm.
Let's kiss your belly.
Let's kiss your ear.

Simplified Directions

Look at this! [point to probe tip]
It's squishy/soft.
You can touch it.
It's going to go in your ear [puts probe in child's ear].
I am going to count to five and it will all be done.

Example: Otoscopy

Child Friendly

Look at my flashlight. I'm going to use it to look in your ears.

Revision 1

Look at this light.
I can see it on your hand.
I can see it on your arm.
I am going to use this light to look in your ear.

Revision 2

This is a light.
The light is on your hand.
Arm.
Shoulder.
Ear.

Visual Supports

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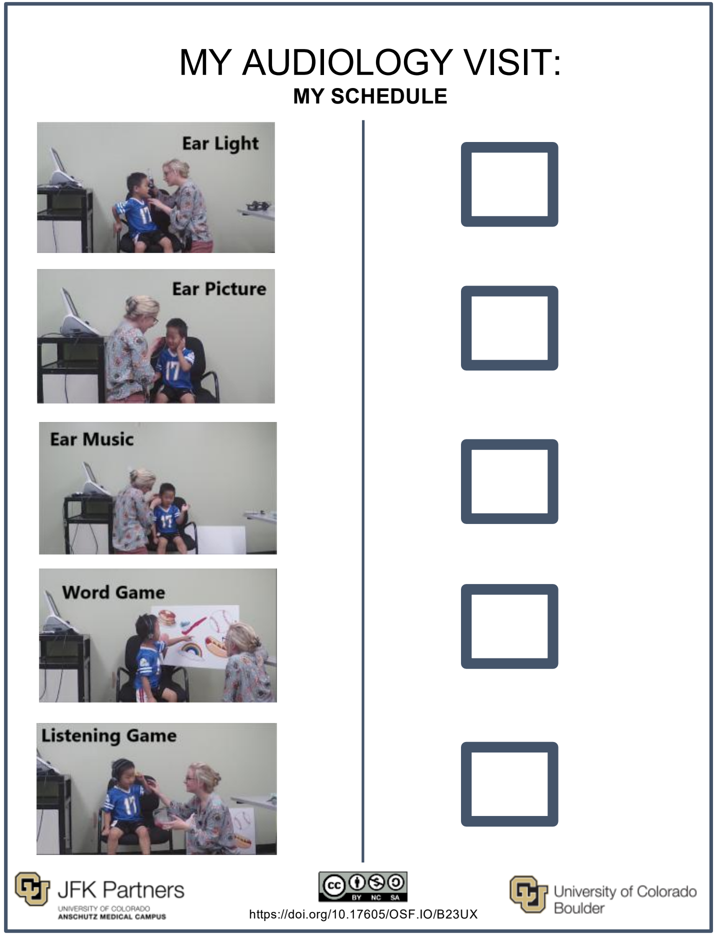
Visual Support Examples

- Help children transition and generalize desirable behavior(s) to new activities

- Visual schedules
- Video models

Paper:

Open Access Materials:



MY AUDIOLOGY VISIT:

MY SCHEDULE

Ear Light ☐

Ear Picture ☐

Ear Music ☐

Word Game ☐

Listening Game ☐

JFK Partners
UNIVERSITY OF COLORADO
ANSCHUTZ MEDICAL CAMPUS

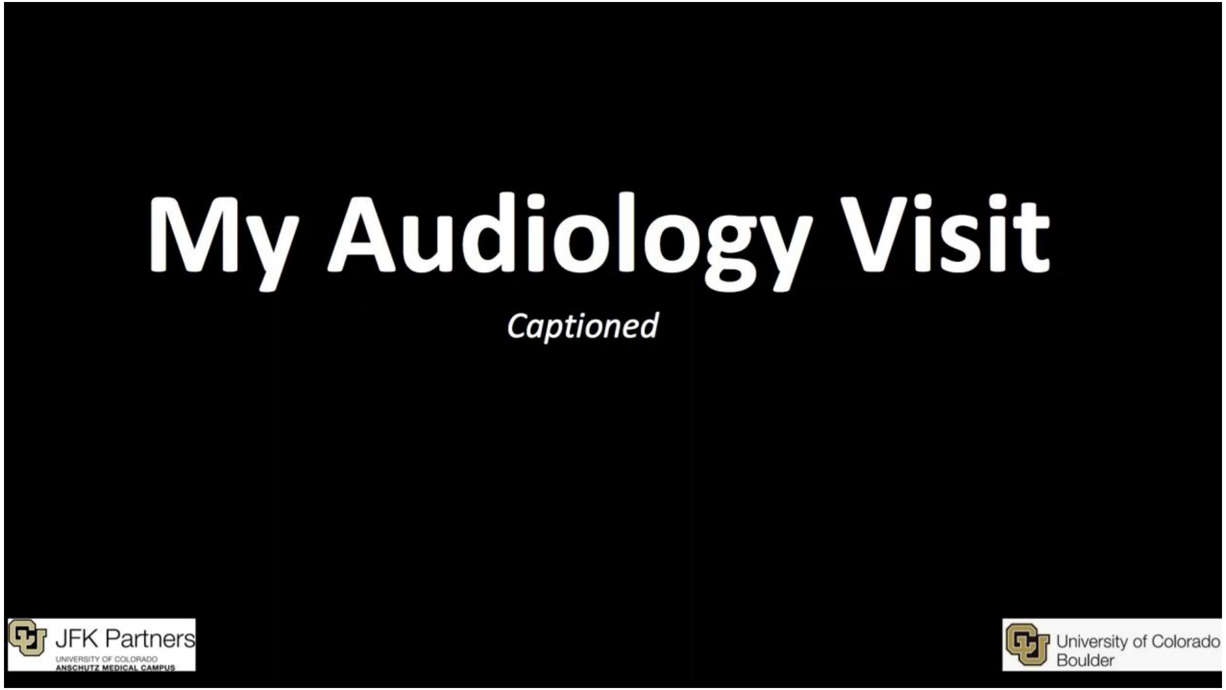
https://doi.org/10.17605/OSF.IO/B23UX

University of Colorado Boulder

How to Use Visual Schedules

- Can be introduced for the first time in the clinic
- Arrange components of the visit in order
- When each step is done:
  - Move with Velcro
  - Check off with marker

Video Models



My Audiology Visit

Captioned

JFK Partners
UNIVERSITY OF COLORADO
ANSCHUTZ MEDICAL CAMPUS

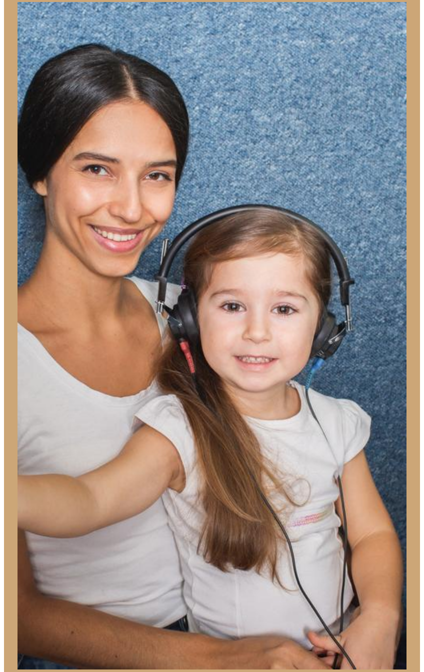
University of Colorado
Boulder

https://osf.io/b23ux/

How to Use Video Models

- Video models should be shown at home until the child appears to understand the concepts
- Caregiver should tell child that some things might be different than what is shown in the video
- Review at clinic, immediately before appointment
- Audiologist should tell child what will be different about the visit relative to the video
- Can be used in the clinic even if family did not watch at home

Placing Transducers and Probes



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Placing Transducers & Probes

- Concrete language
- Describe the tactile and sensory sensation
- Model on others before placing on child
- Use a mirror so the child can see what is happening on their body
- Use visual timers for quick placements (e.g., otoscopy, OAEs)
- Use affirmative language like “You can do this” rather than “it won’t hurt”
- Alternative sensory input

Examples of Sensory Supports

- Sensory mats
- Playdough
- Slime
- Fidget toys
- Weighted vest/blanket
- Toys that provide tactile input (vibration)

Clinic Challenge: Ear-specific Testing

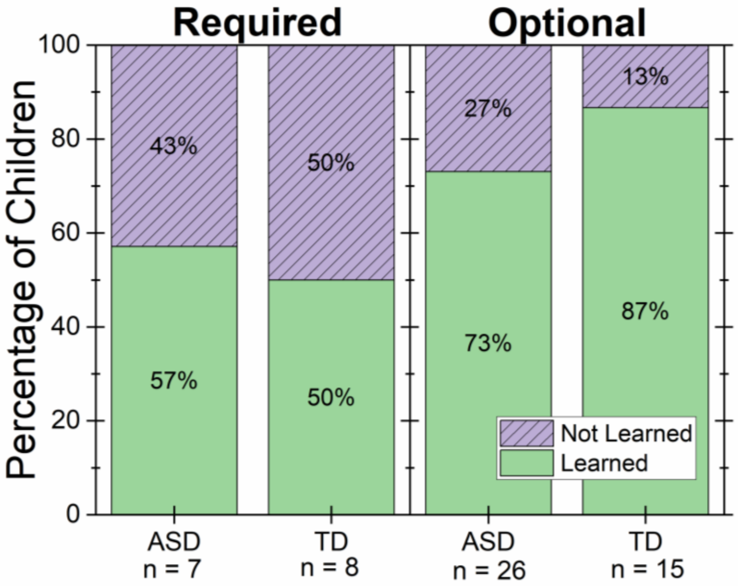
- Based on AudGenDB data
- The estimated proportion of 3-year-olds with ear-specific thresholds was:
    - ASD: 56% [95% CI: 37%, 74%]
    - TD: 92% [95% CI: 89%, 94%].

Lab Protocol for Systematic Desensitization

- Headphones are initially optional
- Train task first in soundfield

When placing headphones:

- Alternative sensory input
- Select high motivating game



Clinic Challenge: Obtaining OAEs

- 286 children at VUMC (18 mo – 8 yr olds)
- N = 72 ASD diagnosis; N = 214 no ASD diagnosis
- Similar rate of collecting bilateral DPOAEs for the two groups (60% vs. 57%, $p = 0.11$)

Protocol for OAEs and WBT in Lab

- First, 1000-10,000 Hz, **Descending**
  - Second, if only lower frequencies needed, 1000-6000 Hz **Ascending**
- "Present" if > 0 dB amplitude and > 6 dB S/N ratio for 2000-6000 Hz
- Also run wideband tympanometry for both ears
- Often performed at beginning of visit unless extreme ear sensitivity was described or observed
- Strategies used:
  - Discuss with parents about what is needed to perform OAEs and discuss how child should be positioned
  - Identify a video the child would like
  - Provide sensory supports (mats, slime, playdough)
  - Use of visual supports and mirror were helpful for more developmentally advanced children

Protocol for OAE: Success Rate

- We were able to successfully obtain bilateral OAEs and WBT for 80% of children with ASD in the lab (N = 19)

Alignment of Reinforcement with Child’s Interest(s)

Library of Visual Reinforcement Materials

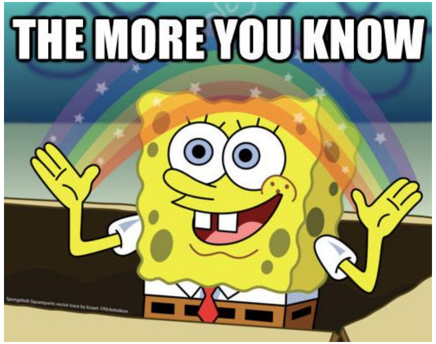
Activities	**Animals**	**Sensory**	**Transportation and Equipment**
- Cleaning - Cooking - Shopping - Sports **People** - Babies - Faces **Science and Letters** - Alphabet - Space - Waterfalls - Weather	- African Safari - Big Cats - Birds - Birds of Prey - Bugs - Butterflies and Moths - Cats - Dinosaurs - Dogs - Farm Animals - Forest Animals - Frog and Toads - Reptiles - Sea Creatures - Snakes - Zoo Animals	- Bubbles - Clocks, Timers and Counters - Fans and Windmills Spinning - Items Moving and Spinning - People in Motion - Rainbows and Colorful Images - Reflections - Rides at Amusement Parks - Water spinning	- Airplanes - Boats - Emergency Vehicles - Farm Equipment - General Transportation Vehicles - Race Cars - Semi-Trucks and Heavy Construction Equipment - Trains

Open Access Materials:

Paper:

Applying to the Clinic: Lessons Learned

Rachel's Lessons Learned



- Do not make assumptions about child's cognitive level based on verbal language ability.
    - Ask parent how child communicates their needs and ask about preferred activities.
- Have numerous toys/games (different motor responses) for each developmental level.
- Training/conditioning could take 20 trials!
- Prioritize quality and reliability of results over time and mess. Don't make them stack another tower. Offer another game every ~10 trials or sooner if you see fatigue. Make it fun and be creative.

Clinical Practices & Tailored Protocols

Slides from Breheney, Bonino, Mood, Nightengale, and Wiley (2025). EHDI Presentation.

Training, Collaboration, & Policy

- Trainees and audiologists need training on:
    - Developmentally-informed strategies to support testing session
    - Hearing profile and risk for specific developmental profiles
- Assessment protocols for specific developmental profiles
- Evidence-base needs to include children with developmental disabilities
- Establish collaborative partnerships to streamline referrals

JCIH Guidance: Limited Regarding DD

- Guidance has been broadly focused on identifying hearing thresholds based on **newborn** screening programs across all children.
- Risk factors for **late onset** hearing differences includes conditions that are associated with developmental disabilities, though does <u>not</u> address hearing evaluation among children with Intellectual and Developmental Disabilities (IDD).
- Guidance from the Early Intervention Supplement addresses therapeutic needs of children who are DHH with disabilities.

Medically Informed Strategies to Support Children with DD

- Follow condition specific guidance when available
- The AAP policy on otitis media with effusion that encourages watchful waiting for middle ear fluid is explicitly **not appropriate** for children with disabilities and high risk conditions for hearing differences (speech delay, cleft lip/palate, Trisomy 21 as examples).
- For MD's, definitively manage middle ear fluid (look, if can't see, send to ENT for microscope evaluation) Treat with antibiotics and re-evaluate middle ear status.
- For audiologists, even if there is fluid or abnormal tymps, **please still evaluate hearing thresholds**. If they are impacted, we manage this more robustly than when fluid without a hearing impact is occurring.
- In children who have difficulty participating in hearing evaluations and are not getting results to reassure you that hearing is sufficient to support spoken language development, it is medically appropriate/necessary to pursue a sedated ABR.
- It is helpful to coordinate with other sedated procedures, though consider the impact of scheduling benefits to the risk of delayed confirmation of hearing status.

Medically Informed Strategies to Support Children with DD (continued)

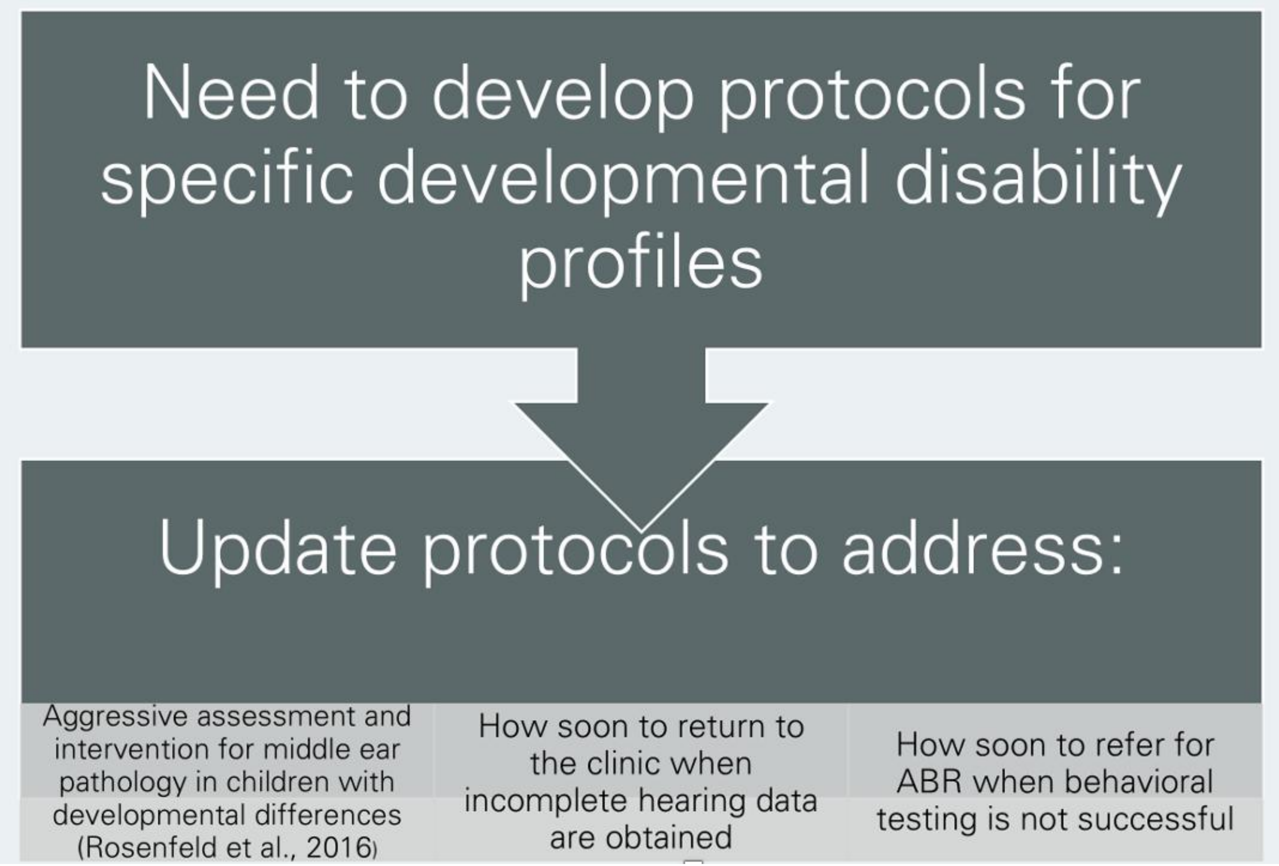
- Medical work-up related to hearing within children with disabilities who are DHH should follow the same guidance as for those without disabilities (imaging, genetic evaluations). Workup can further be informed by what we may know about a specific condition.
- On the flip side, children who are DHH and subsequently are identified with a disability should receive the appropriate work-up for individuals with IDD (genetic testing standards for IDD, additional medical work-up per condition and exam, i.e. CNS imaging in those with cerebral palsy).
- Coordination of care is very important among children with disabilities who are DHH.

Partnering with Medical Providers

INSTEAD OF....
(child has) "normal hearing in at least the better hearing ear"
CONSIDER.....
"We cannot rule out all types of hearing loss at this time, therefore, an appointment to complete hearing testing is scheduled on (date)"
While awaiting further hearing evaluation, appropriate to move on with developmental evaluation and intervention

- Primary care providers have varying levels of experience interpreting audiograms/audiology reports
- Helpful to have consistent and clear documentation of hearing status and need for follow-up

Tailored Assessment Protocols



Need to develop protocols for specific developmental disability profiles

Update protocols to address:

- Aggressive assessment and intervention for middle ear pathology in children with developmental differences (Rosenfeld et al., 2016)
- How soon to return to the clinic when incomplete hearing data are obtained
- How soon to refer for ABR when behavioral testing is not successful

Example: Down Syndrome

Current AAP guidelines	Research based suggestions
0-1 months: evaluate for congenital hearing loss with objective testing such as BAER or OAE. If don’t pass NBHS refer to ENT familiar with stenotic external canals Tympanometry if TM poorly visualized	0-1 months evaluate for HL with ABR
If pass NBHS, rescreen at 6 months of age; middle ear disease should be treated immediately when dx	Basonbul et al, 2020- N=131 Of those who pass NBHS, only 22% had ABR in first 12 months; 71% of those ABRs were abnormal Taking into consideration risks of anesthesia (not given in their cohort before 10 months) and greater unlikelihood of unreliable behavioral testing in this population at young ages in this population, rx natural sleep ABR by 3 months
Behavioral audiogram at age 1 but many unable to complete: BAER if not able to complete; consider vestibular	Porter et al, 2022 85% of participants (ages 5-17) had moderate or greater HL above 8KHx 50% had abnormal middle ear function when wideband acoustic immitence (WAI) or tympanometry were successfully measured
If pass early BAER, behavioral audiogram and tympanometry rx every 6 months until normal hearing levels are established bilaterally via ear specific testing (usually after 4 yo);	
Behavioral tests annually; if normal hearing not established via behavioral, additional screen via OAE **or** dx BAER with sedation of necessary	

Questions?

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