AUDIOLOGY & AUTISM

SUPPORTING SENSORY FEATURES

IN THE NEURODIVERGENT

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PRESENTER BACKGROUND

- Clinical Audiologist (ENT/PP- aural rehab)
- Parent- support group volunteer
- Certified Autism Specialist (IBCCES) & SEAT training (COPAA)
- Trained in APD dx/tx & Tinnitus Retraining Therapy
- Currently exploring efficacious delivery methods for ND children (& adults) who have auditory issues that interfere with communication, access to education, participation in society, overall functioning/agency

A NOTE ON LANGUAGE AND ACRONYMS

- Identity-first language/neurodiversity (ND) movement “autistic vs. person with autism”
- ”Autism Spectrum Condition” (ASC vs. ASD) – invaluable perspectives from #actuallyautistic self-advocates
- Disability Rights – Deaf culture
- Do abnormalities in auditory processing (in the presence of normal peripheral hearing) contribute to the speech and language delay seen in autistic children?


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AUDITORY FEATURES INHERENT IN AUTISM

- Clinically significant SiN difficulties
- Dichotic deficits/differences in brain lateralization
- Hyper- and hypo- neural connectivity across brain regions (synaptic/arborization dysfunction), delayed maturation
- Visual/auditory misalignment & temporal processing deficits
- Hyperacusis/misophonia (decreased sound tolerance- problem with down-regulation/suppression)
- Brainstem abnormalities/deficits in neural synchrony (timing) and phase locking (frequency encoding)

AUDITORY DYSFUNCTION IN ASC- EVIDENCE

- Atypical auditory processing in ASC- enhanced pitch perception, sensitivity to loud noises, lack of auditory orientation, impaired perception of prosody, diminished auditory stream segregation (Jones 2009, O'Conner 2012, Thye 2018)
- Auditory problems more common in younger ASC kids- suggests delayed maturation of neural transmission pathways between lower and higher brainstem levels. – includes atypical sound sensitivity, poor sound localization, and trouble with SiN. (Pillion, 2018)
- The representation of auditory attention to language has abnormal developmental path in ASC (Kujala 2013)

EVIDENCE (CONT.)

- Early adverse effects of auditory joint attention- ASC toddlers less likely than TD peers to alert to their own name or share new sounds with parents, but will alert to other (non-verbal) sounds (Adamson 2021)
- Receptive speech processing in ASC- meaningful speech elicits abnormal disengagement of the language system, while meaningless speech (normally filtered out by TDs) engages the language system through involuntary attention capture (Alho 2021)
- Children and adults with ASC exhibit AP difficulties as seen on behavioral AP measures- need for appropriate school/work accommodations (Schafer 2020)


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CORRELATIONS WITH BEHAVIOR

- Autistic children often insensitive to human voices- unresponsive to their names. The degree of under-connectivity between voice-selective cortex and reward pathways predicts symptom severity (Abrams 2019)
- Social deficits exacerbated by auditory deficits that interfere with the decoding of stimuli (Hitoglou 2010)
- Relationship between low-level auditory processing and restrictive/repetitive behaviors. The expression of these behaviors may be influenced by the degree to which sounds are detected or missed in the environment. (Kargas 2015)
- Relationship between functional connectivity between the ears correlated with lower verbal IQ. Atypical auditory processing are directly related to social, cognitive and communicative impairments in ASC (Linke 2018)

INTERHEMISPHERIC ABNORMALITIES

- Language impairments related to anatomical and functional abnormalities: abnormal lateralization of functional lang network - more right hemisphere activity in core language areas (Herringshaw 2016)
- Rightward asymmetry in ASC boys with language delay (opposite of Broca's area on left). Note: speech impairment before age 5- strong predictor of outcomes (Mody 2013)
- Abnormal right laterality and poor auditory discrimination suggested to be objective markers for language/communication skills in high and low verbal ASC kids (via MEG)- mismatch fields recorded by magnetoencephalography (Matsuzaki 2019)

AUDITORY/VISUAL MISALIGNMENT & TEMPORAL PROCESSING

- Reduced influence of visual speech with ASC (Irwin, 2021)
- Temporal binding deficit hypothesis of autism- weak central coherence (bias toward piecemeal rather than Gestalt) caused by poor neural synchronization and brainstem abnormalities
- McGurk effect- the poorer the temporal acuity between vision and audition (the larger their temporal binding window (TBW) – the weaker their ability to bind and visual speech to create a robust McGurk effect.
- TBW- the narrower the window, the more acute the perception- this process is ***malleable***. Autistics exhibit enlarged TBW specifically for ***speech***. Sensory plasticity can be engaged to improve functional outcomes for autistics individuals (Stevenson, 2014)


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HYPERACUSIS & MISOPHONIA IN AUTISM

- 50-70% of autistic population exhibit DST- source of significant distress and impairment. Related to central gain (Williams 2021)
- Central Gain- excessive production of information in the brain, in the absence of commensurate sensory stimuli. This non-linear processing may underlie the cognitive differences seen in ASC. Information gain evident in the brain's resting state may contribute to the withdrawal of autistics into their own inner world (Perez Velazquez 2013)
- Hypersensitivity to sound does not appear to predict performance on SiN tasks- suggesting it is an attentional versus perceptual deficit (Dunlop, 2016)
- TRT effective in treating DST- protocols include avoiding silence, breaking negative, automatic (subcortical) association/feedback loop.

HOW ARE THESE CURRENTLY ADDRESSED?

- They're not (directly). SLP, OT, ABA go-to disciplines
- RCT and other high-level evidence difficult in rehabilitative fields- difficult to control for maturation/complex individual variables. This is even more difficult for highly-impacted/non-speaking autistics- focus is more on adaptive functioning
- Therapeutic supports are lack-luster in education and health care. Need to address the research-to-practice gap (Wetherby 2018)
- Can we meet this need in a thoughtful, evidence-informed way? Evidence of CANS malleability- core dysfunction that we can treat!

APD CONFUSION MUDDLES THIS PROCESS

- APD dx appropriate for ASC? Poor performance in the absence of symptoms on an auditory measure- subclinical (Vermiglio, 2014). BUT AP issues in ASC likely meet the criteria for being a clinical entity
- Self Report- better indicator of SiN difficulties than audiogram (Vermiglio, 2018). Compare/contrast with DST- reliable/valid measures? Parent/patient reports on auditory issues that effect quality of life and access to education/vocation should be enough to begin intervention/support. Do SLP's/OT's perform a 3-hour diagnostic battery before providing care?
- Functional testing versus diagnostic- to bolster Educational accommodations in IEPs

AUDITORY TRAINING – TARGETED SKILLS

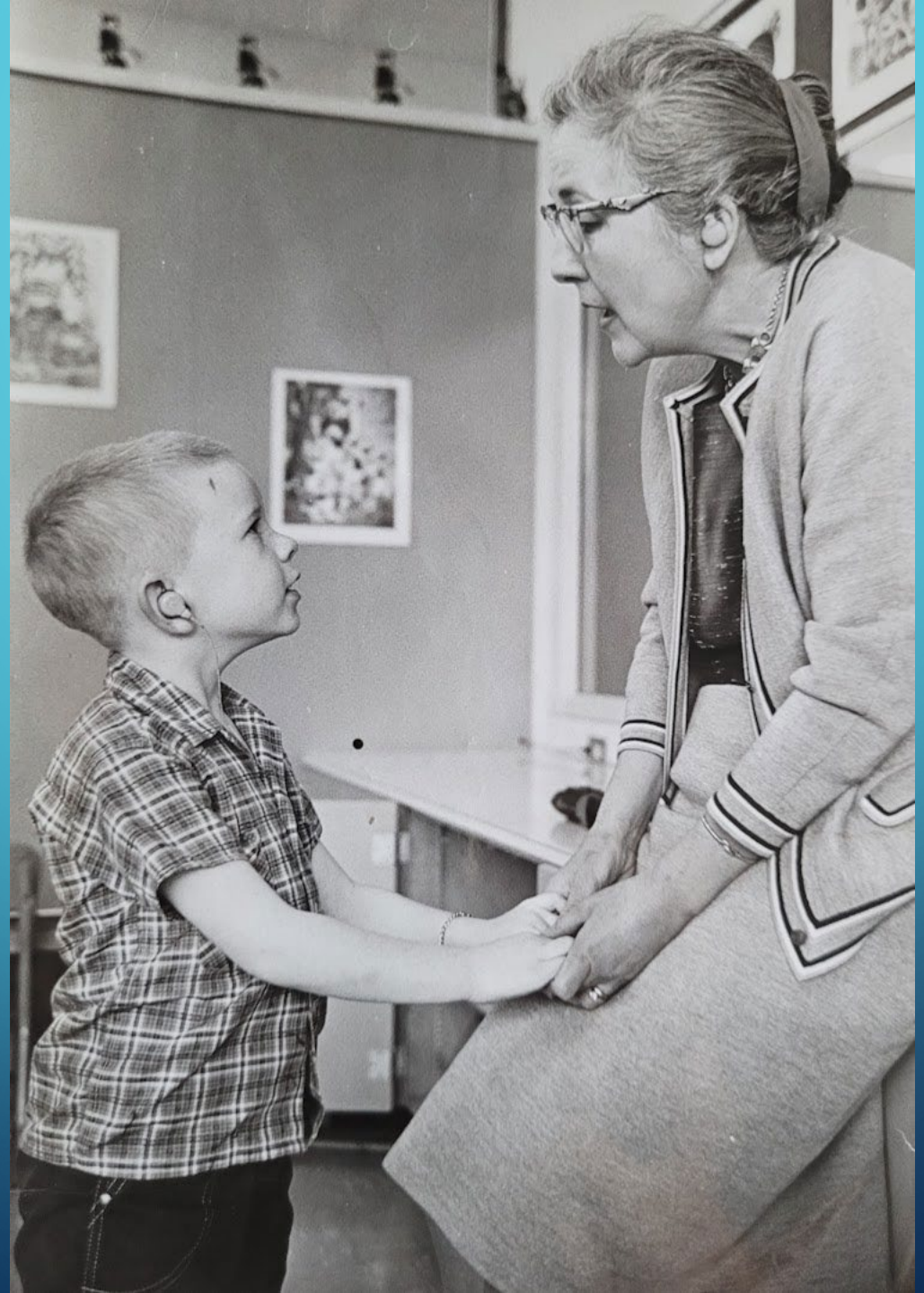
- Phonemic Training/Synthesis (Auditory skills hierarchy- AVT parallels)
- Dichotic Listening
- Temporal Processing/auditory-motor entrainment
- Spatial Listening/Localization training
- Auditory/Working Memory (N-Back)
- Note: SiN pre-requisite brainstem processes- spatial listening, dichotic listening.

DICHOTIC TRAINING EVIDENCE

- Dichotic auditory training is seen to remediate auditory and language deficits in autism (Denman, 2015)
- Dichotic training improved dichotic listening as well as general listening and language processing skills on autistic children, as seen on behavioral measures (Kozou 2018)
- 12 weeks of tx on autistic children- including computerized dichotic training, direct auditory training, and remote-mic tech. Objective (cABR) and behavioral testing (TAPS-3) revealed a reduction in interaural asymmetry and improved signal transmission along the CANS (Gopal 2020)
- Dichotic training demonstrated improvement within ASC population. Improvements also seen in auditory attention, other untrained auditory & language skills (Kozou 2018 & (Tallus 2015)

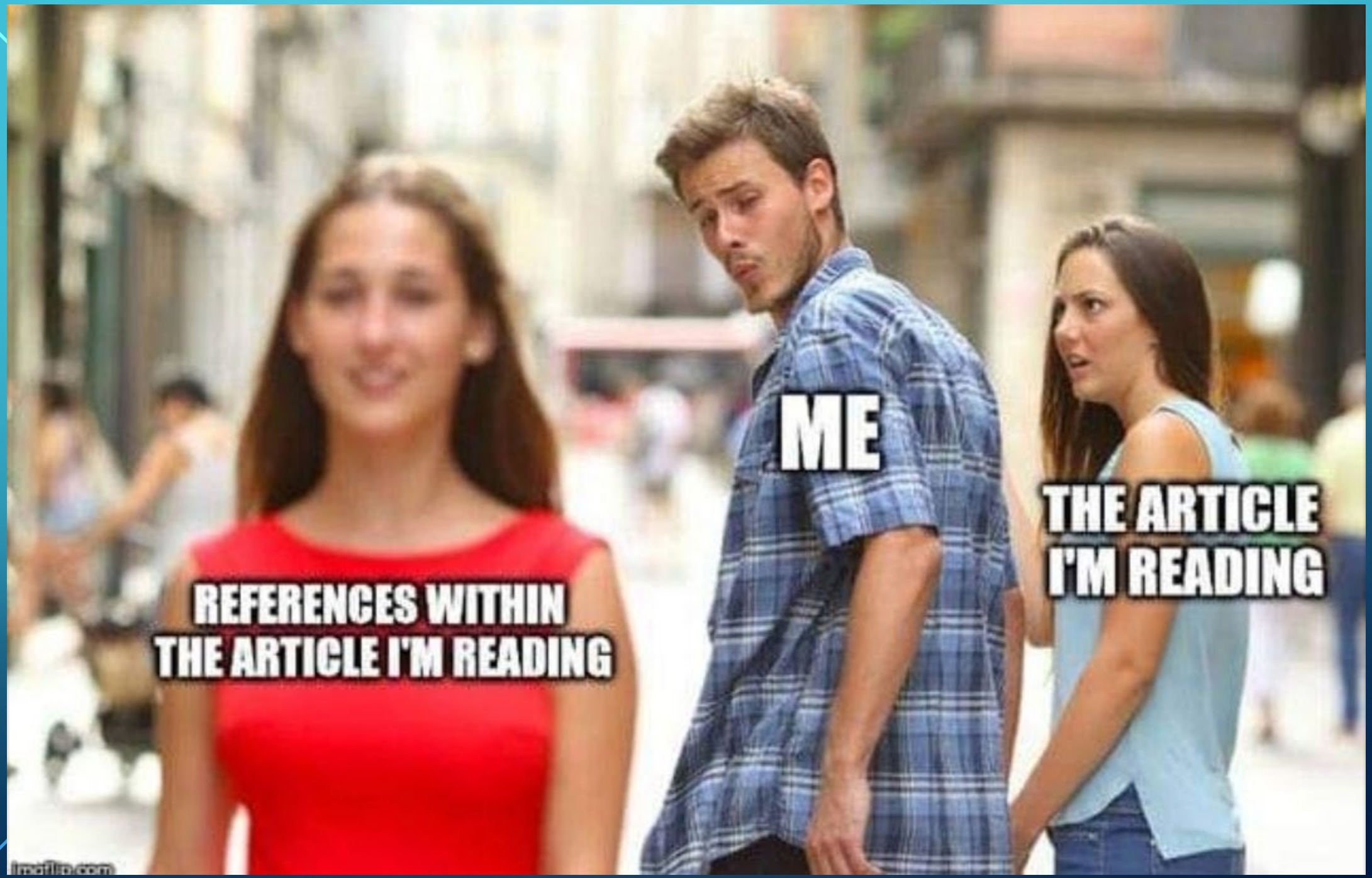
COMPUTER-BASED AUDITORY TRAINING EVIDENCE

- Examined SiN/temporal processing in ASC- Temporal-based auditory training program, electrophysiologic results (sABR)- SiN improved (seen after 1 month of tx)- highlights the role of temporal processing in brainstem bottom-up pathways involved in speech perception (Lotfi, 2021)
- Auditory Integration Tx (NOT dubious AIT)- increased scores on behavioral measures of AP as well as increased IQ scores (Li 2018)
- Auditory processing deficits relate to over-arching language impairments- FFW- improvement see on electrophysiologic measures including improvements in response timing, pitch tracking and cortical response timing (Russo, 2010) Similar results on ___ Heim 2016)
- To address prosody/social communication in ASC- Combined RM and computerized emotion perception training- improvements seen in cortical evoked potentials (MMN), post-training (Leung, 2021)



CONCLUSION

- “Sensory processing abnormalities create a maladaptive developmental trajectory of cascading delays and deficits.” The relationship between social and sensory features are interdependent- causes people to withdraw (Thye 2018) Another parallel with HL and how it leads to social withdrawl
- Autism involves functional hearing impairment! How is this different from newborns identified with peripheral HL in terms of need for swift and appropriate intervention?
- How can we provide support for these individuals? Address DST via AP remediation?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THANK YOU!

Feel free to reach out with any questions, or interest in collaborating

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