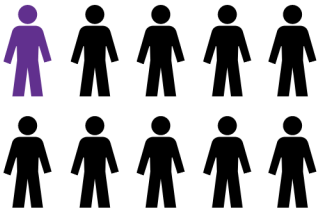
SPOG Lab
Speech & Cognitive Development Lab

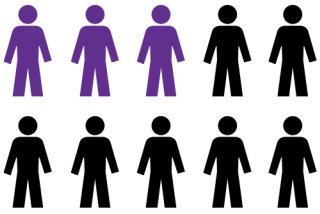
Q: Is there a correlation between hearing loss and ADHD?

Catherine Valentino*, Julianna Gross, & Meg Cychosz****
***Department of Hearing & Speech Sciences, University of Maryland, College Park**
****Department of Linguistics, University of California, Los Angeles**

An estimated 29% of children with hearing loss are also diagnosed with Attention Deficit Hyperactivity Disorder (ADHD) (Soleimani et al., 2020). However, only 9.8% of the general population of children have been diagnosed with ADHD (CDC, 2023). The overrepresentation of children with hearing loss among those diagnosed with ADHD presents a question: does hearing loss affect the development of ADHD in children, or are these children misdiagnosed?



Around 9.8% of typically hearing children are diagnosed with ADHD...
(CDC, 2023)



...while 29% of children with hearing loss are diagnosed with ADHD.
(Soleimani et al., 2020)

Misdiagnosis or Co-occurrence?

ADHD in children is diagnosed based on the existence of certain behavioral symptoms which are grouped into two categories: inattention and hyperactivity/impulsivity (Drechsler et al., 2020). While the direct cause(s) of ADHD is/are still unclear, researchers agree that the disorder could have multiple different causes even within a single individual, including genetics, structural brain differences, or developmental issues (such as prematurity or brain damage before or shortly after birth) (NHS, 2021). Most pharmacological treatments for ADHD focus on stimulating brain areas responsible for controlling attention and behavior, which can be smaller in size or less active at a baseline in children with ADHD (NHS, 2021).

In children, hearing loss and ADHD can be mistaken for one another because they can share similar symptoms, such as lack of attention, poorer performance in school, and lower scores on auditory processing tests (Dye & Hauser, 2013). It can be difficult to accurately diagnose ADHD when testing a child with hearing loss because many of the typical behaviors of children with hearing loss are misinterpreted as ADHD symptoms, such as scanning the room for visual cues (Morgan & Vernon, 1994).

Some behaviors can be mistaken for ADHD symptoms since children with hearing loss are likely to experience frustration and problems communicating or understanding speech and language. This frustration can manifest as impulsive behavior and disruptive actions (Dye & Hauser, 2013). However, children with hearing loss may express these symptoms without having the underlying genetic, structural, or developmental causes of ADHD. If these children are given ADHD medications without these underlying causes, there may be no effect or even negative consequences, such a reduced ability to focus or worse performance on cognitive tasks (Bowman et al., 2023). There are also possible long-term effects, such as increased risk of heart or mental health problems (Lakhan & Kirchgessner, 2012).

It is also difficult to accurately diagnose ADHD among children with hearing loss because many of the tests used to evaluate behavior and diagnose ADHD are based on hearing children, of a certain age at a certain level of language development. This is problematic considering the well-documented differences in language development between children with and without hearing loss. Children with hearing loss often have spoken language delays, due to delays in access to amplification or assistive hearing devices such as hearing aids and cochlear implants during early childhood (Nittrouer et al., 2020). It has been shown that language delay can contribute to "behavior problems" because of children's difficulty expressing emotions and comprehending the demands and needs of others (Barker et. al, 2009). Critically, these behaviors can mimic ADHD behaviors (caused by reduced brain activity in areas controlling attention), but the mechanism of their control could be different (i.e. stemming from language deficits), and it is unknown if the symptoms could be effectively treated in the same way.

How can we tell ADHD and hearing loss-related behaviors apart?

A few recent studies have investigated the possible connection between ADHD and hearing loss in children and how we may be able to reduce misdiagnosis. A 2021 study focused on whether 9 to 10-year-olds with hearing loss expressed higher rates of ADHD behaviors, including inattention, hyperactivity, and impulsivity (González et al., 2021). They measured these behaviors in 34 children, split between a group of children with typical hearing and a group of children with hearing loss, using the Connors scale. The Connors scale is commonly used as a standard measurement of behavioral problems associated with ADHD. There were seventeen children in the group with hearing loss, nine of which had at least one cochlear implant. The degree of hearing loss varied: four children had moderate hearing loss, three had severe, and ten had profound. The children with hearing loss showed significantly higher rates of ADHD-linked behaviors than the children with typical hearing, as shown in Figure 1.

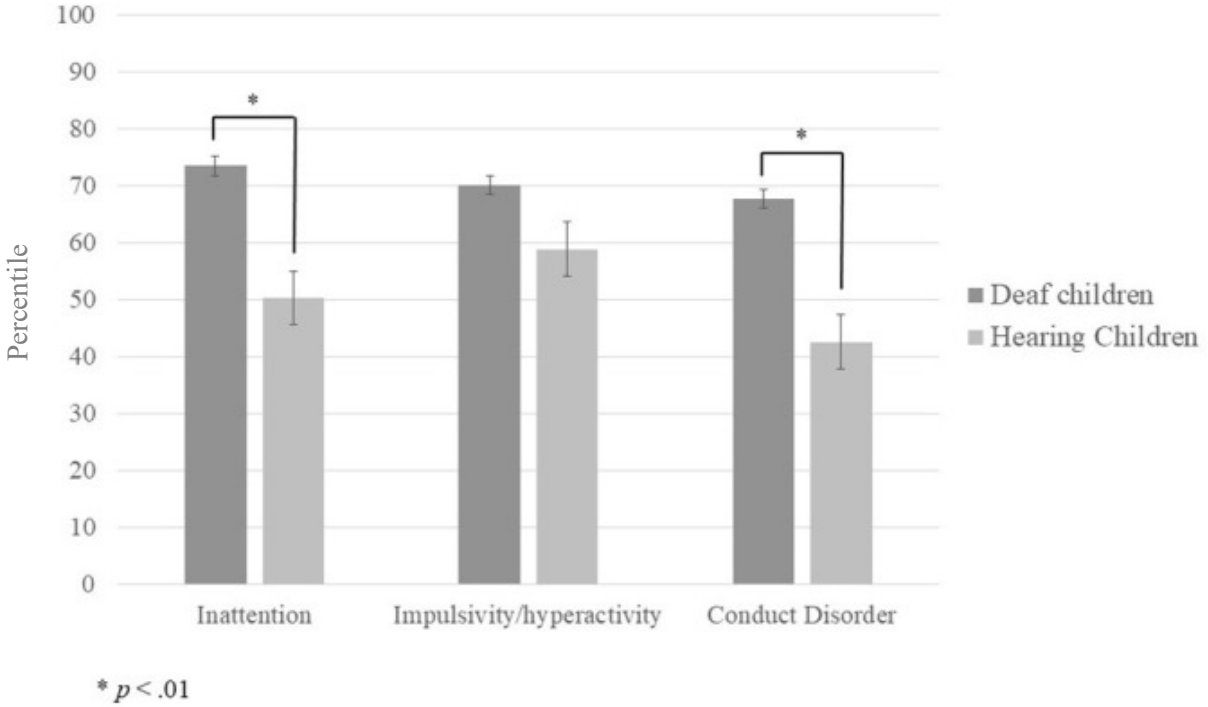


Figure 1: The mean percentile scores from the children with hearing loss and typical hearing on the Connors scale, a standard measure of behavioral problems associated with ADHD. The children with hearing loss and typical hearing differed significantly in inattention scores and Conduct Disorder scores (a separate disorder from ADHD characterized by aggressive and/or antisocial behavior). There were marginally significant differences between groups in impulsivity/hyperactivity (González et al., 2021).

Then, researchers also assessed **inhibitory control**, or the child's ability to control their attention and behavior by withholding or stopping a response (Fosco et al., 2018). A deficit in inhibitory control is one of the defining characteristics of an ADHD diagnosis. In this study, the inhibitory control tests revealed **no difference** between the children with hearing loss and children with typical hearing, while children diagnosed with ADHD performed worse than children without an ADHD diagnosis on the same tasks. This indicates that it is likely the ADHD-related behaviors of children with hearing loss identified in the Connors scale were not actually associated with ADHD, but with mechanisms children with hearing loss may use to interact with and collect information from the environment around them that they otherwise struggle to obtain through auditory information. For example, children with hearing loss rely on both their central vision and peripheral vision to receive information, while children with typical hearing tend to rely more on central vision (González et al., 2021). Individuals with hearing loss also tend to shift their attention more often (González et al., 2021). Others might view behavior like this, such as a child looking around in a classroom setting, as inattentive or restless when in fact these are typical behaviors that a child with hearing loss might employ to obtain visual information from their environment.

Furthermore, a 2015 study analyzed which factors predicted ADHD diagnosis in children with hearing loss (Sibley, 2015). There was no correlation between severity of hearing loss and the probability of ADHD diagnosis, meaning if a child has higher levels of hearing loss, that does *not* mean they are more likely to also have an ADHD diagnosis.

If there is no real correlation between ADHD and hearing loss, why would there be disproportionately high levels of ADHD diagnosis among children with hearing loss? Perhaps this occurs due to the conditions having similar causes in some individuals. For example, both ADHD and hearing loss can be attributed to premature births, as children born premature have a 42% higher risk of dual diagnosis (Sibley, 2015). A low birth weight also increases the risk of dual diagnosis by 27% (Sibley, 2015). If a child has hearing loss and one or both risk factors (prematurity or low birth weight), it is more likely they will also be diagnosed with ADHD. This could possibly explain the correlation, as hearing loss is not causing ADHD, the diagnosis just commonly coexists because of associated risk factors.

Conclusions and Future Directions

While hearing loss and ADHD have different causes and defining characteristics, they can have similar behavioral outcomes, and some interventions that work for one population may be able to help the other. For those children who have both hearing loss and ADHD, these shared interventions may be especially effective.

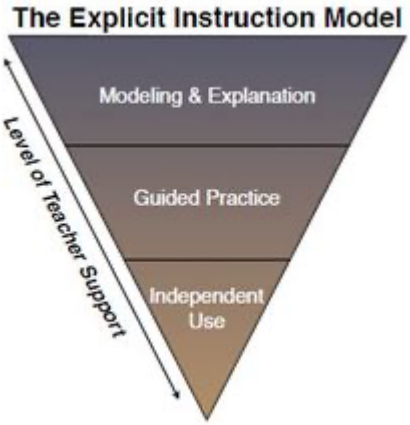


Figure 2: The Explicit Instruction Model (Williams, n.d.).

To assist a child with hearing loss and/or ADHD in the classroom, the learning environment can be altered. Different strategies that can be implemented include adjusting lighting to decrease eye strain, using strategically placed convex mirrors to increase visual access, and using materials that minimize intrusive noises (González et al., 2021). In particular, convex mirrors can assist children with hearing loss and ADHD by giving them more angles to pick up on visual cues that can assist them in interpreting their environment. By adapting environments to the child, the child will not have to adapt behaviors themselves.

At home, parents can support their children through **explicit instruction** (Greene, n.d.). Explicit instruction refers to giving the child step-by-step instructions and allowing breaks while learning and completing activities, as well as having the "big idea" of an assignment explained before it begins.

This style of teaching differs from allowing the child to "discover" the content through guided activity before formal instruction.

Explicit instruction allows the child to understand without having to adapt their behavior by possibly looking around for cues, asking for clarification repeatedly, and possibly misinterpreting the concept. To ensure that the child is completing the material with a full understanding, self-evaluations and quarterly check-in meetings, that include the teacher and child, should be implemented.

While ADHD and hearing loss are commonly mistaken for one another, there is still a chance a child is experiencing both. When a child may have both hearing loss and ADHD, they should be tested in ways that are tailored to the two diagnoses. Creating hearing-loss specific ADHD assessments should be prioritized to provide the best care for these two, sometimes intermixing, populations. With more research and better assessments, researchers will be able to discern whether hearing loss and ADHD affect one another, they just coexist in higher numbers due to similar risk factors, or if misdiagnosis is the true culprit.

References

Barker, D. H., Quittner, A. L., Fink, N. E., Eisenberg, L. S., Tobey, E. A., & Niparko, J. K. (2009). Predicting behavior problems in deaf and hearing children: The influences of language, attention, and parent–child communication. *Development and Psychopathology*, *21*(2), 373–392. https://doi.org/10.1017/s0954579409000212

Boston Children's Hospital. (n.d.). *Hearing Loss*. Boston Children's Hospital. https://www.childrenshospital.org/conditions/hearing-loss

Bowman, E., Coghill, D., Murawski, C., & Bossaerts, P. (2023). Not so smart? "smart" drugs increase the level but decrease the quality of cognitive effort. *Science Advances*, *9*(24). https://doi.org/10.1126/sciadv.add4165

Centers for Disease Control and Prevention (CDC). (2023, October 16). *Data and statistics about ADHD*. Centers for Disease Control and Prevention. https://www.cdc.gov/ncbddd/adhd/data.html

Drechsler, R., Brem, S., Brandeis, D., Grünblatt, E., Berger, G., & Walitza, S. (2020). ADHD: Current concepts and treatments in children and adolescents. *Neuropediatrics*, *51*(05), 315–335. https://doi.org/10.1055/s-0040-1701658

Dye, M. W.G., & Hauser, P. C. (2014). Sustained attention, selective attention and cognitive control in deaf and hearing children. *Hearing Research*, *309*, 94-102. https://doi.org/10.1016/j.heares.2013.12.001

Fosco, W. D., Kofler, M. J., Alderson, R. M., Tarle, S. J., Raiker, J. S., & Sarver, D. E. (2018). Inhibitory control and information processing in ADHD: Comparing the dual task and performance adjustment hypotheses. *Journal of Abnormal Child Psychology*, *47*(6), 961–974. https://doi.org/10.1007/s10802-018-0504-9

González, M. T. D., Phillips-Silver, J., Liria, R. L., Maurno, N. G., Garcia, L. F., & Ruiz Castaneda, P. (2021). Inattention, impulsivity, and hyperactivity in dead children are not due to deficits in inhibitory control, but may reflect an adaptive strategy. *Frontiers in Psychology*, *12*. https://doi.org/10.3389/fpsyg.2021.629032

Greene, K. (n.d.). *What Is Explicit Instruction?* Understood.org. Retrieved February 6, 2023, from www.understood.org/en/articles/what-is-explicit-instruction

Lakhan, S. E., & Kirchgessner, A. (2012). Prescription stimulants in individuals with and without attention deficit hyperactivity disorder: Misuse, cognitive impact, and adverse effects. *Brain and Behavior*, *2*(5), 661–677. https://doi.org/10.1002/brb3.78

Morgan, A., & Vernon, M. (1994). A guide to the diagnosis of learning disabilities in deaf and hard-of-hearing children and adults. *American Annals of the Deaf*, *139*(3), 358-370. doi: 10.1353/aad.2012.0276

National Health Service (NHS). (2021, December 24). *Attention deficit hyperactivity disorder (ADHD)*. NHS. www.nhs.uk/conditions/attention-deficit-hyperactivity-disorder-adhd/

Nittrouer, S., Lowenstein, J. H., & Antonelli, J. (2020). Parental language input to children with hearing loss: Does it matter in the end? *Journal of Speech, Language, and Hearing Research*, *63*(1), 234–258. https://doi.org/10.1044/2019_jslhr-19-00123

Sibley, J. A. (2015). *ADHD and hearing loss: A study examining the co-occurrence of the two disorders* (thesis). Retrieved February 19, 2024, from www.semanticscholar.org/paper/ADHD-and-hearing-loss%3A-A-study-examining-the-of-the-Sibley/fe73e4fe4dbbc98dce7c5dc3226937169013d1b8.

Soleimani, R., Jalali, M., & Faghih, H. (2020). Comparing the prevalence of attention deficit hyperactivity disorder in hearing-impaired children with normal hearing peers. *Archives de pediatrie: organe officiel de la Societe francaise de pediatrie*, *27*(8), 432-435. https://doi.org/10.1016/j.arcped.2020.08.014

Williams, M. (n.d.). *The Explicit Instruction Model*. IgnitED. IgnitED. Retrieved February 19, 2024, from https://fuelgreatminds.com/explicit-instruction-lost-in-translation/.