DOES THE SOCIAL RESPONSIVENESS SCALE-2 OVER IDENTIFY SOCIAL IMPAIRMENT IN CHILDREN WHO ARE DEAF AND HARD OF HEARING?

by

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Abstract

Studies indicate that children who are deaf and hard of hearing (DHH) have poorer language skills than their peers with normal hearing (Blamey et al., 2001). This study considers deficits in social acuity measured by the Social Responsiveness Scale-2nd version (SRS-2), a parent questionnaire, and how children who are DHH may perform. Therefore, the research questions are: Does the SRS-2 identify pragmatic deficits in children who are DHH more often than children with typical hearing matched for age? Does the SRS-2 score correlate with omnibus language scores as measured by the CELF-5 for children who are DHH and children with typical hearing? If language-heavy items from the SRS-2 are removed (e.g., Redmond 2015), does the SRS-2 score of children with and without hearing loss differ? This study compared T-scores of the SRS-2 for group differences, correlation to CELF-5 scores, and changes after language-based items were removed. Results indicate that children who are DHH exhibit significantly more signs of social impairment than their typical hearing (TH) peers, SRS-2 scores are negatively correlated with language scores for both TH children and children who are DHH, and removing language-heavy items. Implications for professionals working with children who are DHH are discussed.

Introduction

Children with hearing loss are known to have, on average, poorer language outcomes than their peers with normal hearing (e.g., Blamey, et al., 2001). One documented area of deficit is in pragmatics, or the social use of language to navigate communicative interactions. Children who do not have hearing loss and have notable pragmatic difficulties are often diagnosed with Autism Spectrum Disorder (ASD) or Social Communication Disorder (SCD), according to The Diagnostic and Statistical Manual of Mental Disorders (5th ed.; DSM-5; American Psychiatric Association, 2013). It is also possible for those conditions to exist comorbidly with hearing loss: the estimated prevalence of ASD is higher in children with hearing loss than in children with typical hearing (CTH). To date, however, research literature has not given extensive consideration to the overlap between hearing-loss-related pragmatic deficits and ASD/SCD-related pragmatic deficits. This could create a problem for those children with hearing loss who develop higher-level language skills: there is a risk that educators will interpret hearing-loss-related pragmatic deficits as general pragmatic deficits. Screeners, such as parent and/or teacher questionnaires, are used in schools to determine if students should be evaluated for an ASD diagnosis. Because of the similar pragmatic abilities in children with hearing loss and children with ASD, children with hearing loss may mistakenly fail these screeners when that failure was predictable. The purpose of this study is to evaluate the performance of children with hearing loss on a screener commonly used to capture ASD behaviors in comparison to CTH.

Language Outcomes in Children with Hearing Loss

Children with hearing loss have lower language outcomes than CTH. These delays in language development likely include delays in complex syntax acquisition, vocabulary knowledge, articulation, and morphosyntax. Ann Geers and colleagues (2003) found that outcomes for individual children with hearing loss vary widely: some children persist with low language skills and others appear to enter the "range of normal" with language skills. Performance within the "range of normal," however, doesn't mean that some children who develop typical conversational skills don't continue to struggle with more nuanced issues in language (Werfel et. al., 2021). One nuanced skill that children with hearing loss may struggle with includes pragmatics. Research has documented that children who are DHH do often have lower pragmatic skills than CTH (Paul et. al., 2020). Specifically, conversational skills may be impaired for children who are DHH. Toe and Paatsch found that children with cochlear implants tended to dominate conversations with hearing peers, initiated more topics, took longer turns, asked more questions, and tended to make more personal comments (2013). They also have impairments in nonverbal communication, like reading facial expressions and body language. These skills, along with sequencing instructions and expository interactions, are important for school age children to succeed academically and socially in school (Paatsch and Toe 2020). To complicate matters, the prevalence of ASD as a co-morbid condition is higher in children with hearing loss compared to children with normal hearing. Estimates from YEAR indicate that ASD was diagnosed in 1 in 59 children with hearing loss, compared to the estimate of 1 in 68 for children with normal hearing at the time (Szarkowski and Johnston). Diagnosis of ASD in children with hearing loss should be evaluated with a large scope of different information to prevent misattribution of symptoms. Szarkowski, et. Al. found that red flags for each domain of ASD diagnosis may present differently in children with hearing loss, such as abnormal prosody

of speech. However, at a standard care level, practitioners are likely to be unfamiliar with the red flags for ASD in children with hearing loss, putting children with hearing loss at risk for over-referral.

Pragmatic Skills in ASD

Children with ASD struggle with Theory of Mind, which affects their pragmatic skills, especially in conversation. Theory of mind is the capacity to understand other people's mental states and differentiate them from one's own. Specific pragmatic characteristics of children with ASD include noncontingent language, perseveration, fewer initiations of conversational turns, and non-responsiveness. Szarkowski, et. Al. found that overlapping symptoms of hearing loss and ASD most prominently include overall language delay, delayed theory of mind, failure to respond to one's name, and pragmatic language difficulties. These overlapping symptoms may masquerade hearing loss as ASD, or vice versa. For example, children with ASD may not respond to their name because of difficulties with social engagement, whereas children who are DHH may not respond to their name simply because they did not hear it called.

Screeners for ASD

As of 2014, there were no screening tools for ASD that were validated with D/HH children. However, there are screeners, such as the Social Communication Questionnaire and Social Responsiveness Scale, that are frequently used in classrooms that include children with and without normal hearing. The Social Responsiveness Scale (SRS) measures social ability and can serve as a screening tool, identifying the presence and severity of ASD-related behaviors, while the Social Communication Questionnaire (SCQ) is a screening tool derived from the Autism Diagnostic Interview (Mood, et. al., 2017). These items are found to have issues with children who have developmental or behavioral differences, but little research is done on non-ASD

conditions that involve overlapping difficulties. Universal screener use with children with hearing loss may be problematic and produce risk for over diagnosis or under diagnosis.

Thus, the purpose of this study is to begin exploring how common screeners may over-or under-identify pragmatic difficulties in children with hearing loss. It is important to understand how ASD and HL may overlap because this information could alert practitioners of test-bias for children with hearing loss. The following research questions guided this study:

1. Does the SRS-2 identify pragmatic deficits in children who are DHH more often than children with typical hearing matched for age?
2. Does the SRS-2 score correlate with omnibus language scores as measured by the CELF-5 for children who are DHH and children with typical hearing?
3. If language-heavy items from the SRS-2 are removed (e.g., Redmond 2015), does the SRS-2 score of children with and without hearing loss differ?

Method

Participants

Participants in this study were part of a larger longitudinal study of children with hearing loss (the Emergent Literacy and Language Acquisition project). All procedures in this study were approved by the University of South Carolina Institutional Review Board (as Institutional Review Board of Record), with Texas Christian University in agreement. Participants were recruited through flyers posted on social media and with clinical connections from the project principal investigators (Lund and Werfel). All participant parents consented to their participation and their child's participation, and all children assented to testing. For participation in the overall study, participants received a $50 gift card.

The subset of children included in this article are those children for whom data had been collected (98) at the time of this analysis and included children in a group with hearing loss (n= 60; 11 boys) and a group of children with typical hearing (n= 38; 13 boys). Children with hearing loss were average age of 117 months old, and children with normal hearing were average age of 113 months old. Mothers of children in the hearing loss group reported an average of 16.5 years of maternal education, and mothers of children in the normal hearing group reported an average of 18 years of maternal education. Of the children in the group with hearing loss, 28 children wore bilateral hearing aids, 30 children wore bilateral cochlear implants, and 2 used a unilateral cochlear implant with a hearing aid in the unimplanted ear. Average age of hearing loss identification was 8.13 months months, and the average age at the first hearing aid fitting was 16.26 months. For those children with cochlear implants, the average age at (first) cochlear implantation was 17.61 months. All children used spoken language. Study group characteristics are listed below in Table 1.

Table 1. Study Group Characteristics

	Grade	**Gender**	**Race**	**Ethnicity**	**HL Severity**
TH	13 1st grade	25 female	White 36	Hispanic/Latino 5	
(n=38)	9 2nd grade	13 male	Prefer not to	Non-Hispanic/Latino 31	
	12 3rd grade		respond 2	Prefer not to respond 2	
	4 4th grade+				
HA	18 1st grade	13 female	White 23	Hispanic/Latino 4	Severe to Profound 1
(n=28)	5 2nd grade	15 male	Black/African	Non-Hispanic/Latino 21	Severe 2
	3 3rd grade		American 3	Prefer not to respond 3	Moderately Severe
	2 4th grade+		Native		11
			Hawaiian/Pacifi		Moderate 5
			c Islander 1		Mild to Moderate 5

			Prefer not to respond 1		Mild 1 Unknown 3
CI (n=32)	13 1st grade 6 2nd grade 5 3rd grade 8 4th grade+	20 female 11 male	White 28 Prefer not to respond 4	Hispanic/Latino 5 Non-Hispanic/Latino 23 Prefer not to respond 4	Profound 23 Severe to Profound 8 Severe 1

Table 2. Descriptive assessment measures by group

Characteristic	**Typical Hearing (TH)**	**Hearing Aid (HA)**	**Cochlear Implant (CI)**
Test of Nonverbal Intelligence Standard Score	103.42 (7.93)	99.90 (9.08)	97.25 (12.80)
Arizona Articulation Phonology Scale (AAPS-3) Standard Score	104.14 (18.57)	96.43 (20.82)	91.52 (18.48)
Clinical Evaluation of Language Fundamentals (CELF-5) Core Language Score	111.26 (16.31)	98.23 (13.57)	92.52 (18.47)

The ELLA Study

The present study is part of a larger longitudinal study of children with hearing loss called the Emergent Literacy and Language Acquisition project (ELLA), a longitudinal study funded by NIH/NIDCD. This study focuses on tracking literacy development in children with hearing loss in the US from preschool through 5th grade. Through annual testing, ELLA

researchers identify early predictors of literacy success and difficulty in order to inform early interventions for this population (ellastudy.org). ELLA participants attend testing once a year to evaluate various areas such as speech, language, listening skills, and writing. These assessments are done by SLPs and audiologists employed by the study, and scores are calculated and checked by SLPs and speech-language pathology students.

SRS

The purpose of the Social Responsiveness Scale, Second Edition (SRS-2) is to identify the presence and severity of social impairment within the autism spectrum and differentiate it from that which occurs in other disorders. It is a standardized questionnaire that can be filled out by parents or teachers for children ages 4 through 18 years old and takes 15-20 minutes (Constantino, J.N. and Gruber, C.P. 2012). This questionnaire offers a form with 65 items for school-age children (ages 4 to 18 years). Parents and/or teachers rate each behavior item on a scale of 1 to 4, 1 meaning “not true,” 2 meaning “sometimes true,” 3 meaning “often true,” and 4 meaning “always true” over the past 6 months. These ratings are then converted by scorers on a scoring worksheet to numbers 0-3 that are added together for a raw score. The questionnaire provides a total score and five subscale scores: Social Awareness, Social Cognition, Social Communication, Social Motivation, and Restricted Interests and Repetitive Behavior. Raw scores from each domain are combined and converted for a total T-score, and T-scores from each domain are organized by gender and respondent age. T-scores below 59 are considered low to no ASD symptomology, while scores between 66 and 75 are considered more moderate deficit in social interaction, and a score above 76 is considered severe and strongly associated with a clinical diagnosis of ASD. The total reliability coefficient for the school-age form used in this study is calculated as 0.95, and the validity was calculated as a sensitivity value of 0.92 and

specificity value of 0.92. The SRS-2 uses these scores as a screening tool to identify if further evaluation is needed for an ASD diagnosis.

CELF-5

The purpose of the Clinical Evaluations of Language Fundamentals, Fifth Edition (CELF-5) is to assess language in the domains of morphology, semantics, syntax, and pragmatics for people ages 5-21 years (Wiig, E.H., et. Al. 2013). The norm-referenced assessment can provide information on language strengths and weaknesses with a strong relationship to educational objectives and curriculum. The assessment utilizes verbal responses to visual stimuli for test items. According to age, there are differential start points for each subtest, and most of the test items are scored as either 0 (incorrect) or 1 (correct) to calculate raw scores. Scaled scores are used for 14 subtests. The subscales include: Sentence Completion, Linguistic concepts, Word Structure, Word Classes, Following Directions, Formulating Sentences, Recalling Sentences, Understanding Spoken Paragraphs, Word Definitions, Sentence Assembly, Semantic Relationships, Reading Comprehension, Structured Writing, Pragmatics Profile, and a Pragmatics Activity Checklist. Raw scores can be converted into scaled scores to determine how far from the mean the client falls, and index scores can be converted to standard scores. The total reliability coefficient is calculated as ranging from 0.92 to 0.97, and the validity intercorrelations ranged from 0.72 to 0.97 for index scores. This test can give information on how a client's language appears in comparison to other people their age.

Procedure

During the annual testing of ELLA participants, parents were given the SRS-2 parent questionnaire to complete. SRS-2 forms were then collected and scored for raw total and sub scores, as well as corresponding t-scores. Incomplete and/or unclear parent responses were

discarded and not included in this research. Scoring was done by speech-language pathology students and reviewed by speech-language pathologists.

Results

The overall purpose of this study was to investigate how social impairment is measured in children who are DHH in comparison to their TH peers. We analyzed the data for three different research questions meant to evaluate the effect of pragmatic skills on a social impairment questionnaire.

The first research question addressed if the SRS-2 identifies pragmatic deficits in children who are DHH more often than children who are TH, matched for age. See Figure 1. For each group, an analysis of variance (ANOVA) was calculated with SRS-2 score as the dependent variable and group membership as the independent variable. We also controlled for multiple comparisons using a Bonferroni correction. There was no significant main effect of group on total score ($F(2, 97) = 4.75$, $p = 0.11$). Subtests of the SRS-2 include social cognition (COG), social communication (COM), restrictive interests and repetitive behaviors (RRB), social awareness (AWR), and social motivation (MOT). For the COG subtest, there was a significant difference between the groups with hearing loss and the group with typical hearing (HA, CI > TH, $p = .001$). For the COM and RRB subtests, there was a significant difference between the HA and TH groups (COM: HA > TH, $p = .015$; RRB: HA > TH, $p = .002$). There was no significant main effect of group on AWR ($F(2, 97) = 2.59$, $p = .081$) or MOT ($F(2, 97) = .425$, $p = .655$). Table 4 also indicates the number of children identified in the "concern" range of T-scores on SRS-2 for each group by total score and subscale. This finding indicates that children who are DHH are identified as having possible deficiencies more often than children with TH.

Figure 1. SRS-2 scores by Group

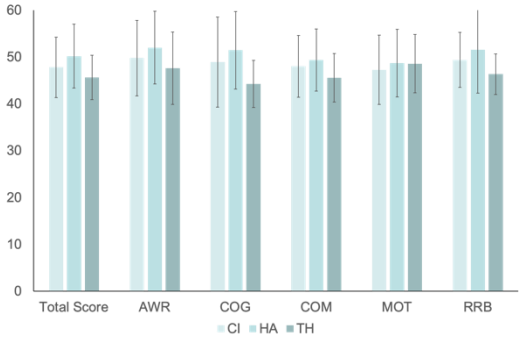

Table 4. Number of children identified in "concern" range on SRS-2

	Total	AWR	COG	COM	MOT	RRB
CI	3	3	6	1	2	2
HA	2	5	5	2	1	5
TH	0	3	0	1	2	0

The second research question addressed if the SRS-2 score correlates with omnibus language scores as measured by the CELF-5 for children who are DHH and children with TH. For each group, a correlation was calculated between overall SRS-2 T score and CELF-5 core language score. For the CI group, there was a moderate negative correlation ($r(25) = -.45$, p = .025). For the HA group, there was a moderately strong negative correlation ($r(26) = -.68$, $p < .001$). For the TH group, there was a mild negative correlation ($r\ (26) = -.35$, $p = 0.038$). This finding indicates that the SRS-2 total T-score negatively correlates with omnibus language scores as measured by the CELF-5 for children who are DHH and children with TH. See Figure 2.

Figure 2. SRS-2 T-Scores and CELF-5 Core Language Scores by Group

The third research question addressed if the SRS-2 score of children with and without hearing loss differs if language-heavy items from the SRS-2 are removed (e.g., Redmond 2015). For each group, an ANOVA was calculated with SRS-2 score as the dependent variable and group membership as the independent variable. The ANOVA indicated the main effect of group on Total Raw Rescore Score ($F(2,97) = 5.82$, $p = .004$). After the language-heavy items were removed, the calculation indicated a significant difference between the HA and TH groups ($p = .002$), and no significant difference between HA and CIgroups ($p = .008$) and CI and TH groups ($p = .688$). This finding indicates that if language-heavy items from the SRS-2 are removed, the SRS-2 does score children who are DHH and children with TH differently, but most specifically, the HA group.

Across tasks and across groups, reliability remained above 99%. Given the high degree of reliability, the authors' original scoring was used for all analyses.

Discussion

The purpose of this study was to investigate how common screeners may over- or under-identify pragmatic difficulties in children who are deaf and hard of hearing based on language profile. The foundational understanding of how ASD and HL may overlap is important so practitioners can be alerted of test-bias for children who are deaf and hard of hearing.

Screeners such as the SCQ and SRS-2 (the screener used in this study) are frequently used in classrooms that include children with and without typical hearing, but no screening tools for ASD are validated with D/HH children, as of this writing. Little research has been done on non-ASD conditions that involve overlapping difficulties pertaining to these screeners. Universal screener use with children who are deaf and hard of hearing may be problematic and produce risk for over-diagnosis or under-diagnosis.

The first research question addressed if children who are deaf and hard of hearing were identified as having pragmatic deficits on the SRS-2 more often than children with typical hearing matched for age. Because there are overlapping symptoms of hearing loss and ASD, such as overall language delay, delayed theory of mind, failure to respond to one's name, and pragmatic language difficulties, it is important that professionals are aware of possible bias. The results show us that the SRS-2 does identify pragmatic deficits in children who are DHH more often than their typical hearing peers. Children who are DHH, especially children who use hearing aids, also scored more in the "concern" range in areas of social responsiveness, particularly social cognition, social communication, and restrictive/repetitive behaviors. This is important for professionals administering this screener so that they can be aware of any possible bias. Possibly taking a closer look at screener sub scores and/or giving another assessment may allow for less over-identification of social impairment in children who are DHH.

The second research question addressed if the SRS-2 score correlates with omnibus language scores, as measured by the CELF-5, for children who are deaf and hard of hearing and children with typical hearing. The correlations concluded that all groups have SRS-2 scores that negatively correlate with CELF-5 scores. Children with hearing aids have the strongest negative correlation.

We know that children who are DHH have lower language outcomes than children with typical hearing, specifically in the areas of pragmatics and conversational skills. The negative correlation between SRS-2 scores and CELF-5 scores indicates that children who are DHH and struggle with language will most likely appear more socially impaired. Additionally, this has implications for children who struggle with language because of other impairments or general delays because professionals should note the correlation between language abilities and social impairment.

The third research question addressed if children with and without hearing loss would have differing scores on the SRS-2 if language-heavy items were removed. This question was designed to determine if the presence of language-heavy items significantly affects scores on the SRS-2. Children who use hearing aids still scored significantly different from CTH, whereas children who use cochlear implants began to appear similarly to CTH. Thus, it appears language-heavy items particularly affected children with cochlear implants; when language-bias was accounted for in questions, the difference between children with CI and CTH disappeared.

Limitations

This study included limitations that give us further research directions. First, findings for the hearing aid group in this sample may be affected by audiological management. Because many of the participants in this group live in rural areas, hearing aids may have less-than-optimal

fitting, and services for audiology and aural rehabilitation may have been less common. A further study should explore the differences between pragmatic skills of rural and urban children with hearing loss.

Additionally, it is possible that some of the children in this study have undiagnosed Autism Spectrum Disorder (and so, were a "true positive" on the screener). Although we do not believe this is the case, the only way to verify this would be to complete a full Autism Spectrum Disorder diagnostic battery. Future work should recruit a population-based sample and use a multidisciplinary team to verify/ discount diagnoses.

Conclusion

Overall, this study represents an important first step towards identifying how some screeners may over-identify impairment in children who are DHH because of their low language level. If these screeners are used as universal screeners, this is problematic because resources are disproportionately directed towards children who are DHH when they perhaps do not need to be. Professionals should account for a child's language knowledge when assessing for co-morbid diagnoses in children who are DHH.

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