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The Relation Between Language and Social Skills In Children with Down Syndrome: Examination of Pressure Equalization Tube Placement During the Critical Developmental Period

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The Relation Between Language and Social Skills In Children with Down Syndrome: Examination of Pressure Equalization Tube Placement During the Critical Developmental Period

by

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Abstract

The current study examined the relation among status regarding placement of pressure equalization tubes (PET), expressive language, receptive language, and social skills in children with Down syndrome. Previous research has documented the importance of PET placement for children with Down syndrome who suffer from chronic otitis media during the critical developmental period for language —not only to treat ear infections but also to prevent permanent damage leading to hearing loss. For the current study, the critical developmental period was defined as birth to 36 months. Parents and teachers of three children with Down syndrome (ages 12 to 15 years) completed social skills questionnaires concerning each child's general and compensatory social skills. A parent demographic and diagnostic form was used to collect data on history of intervention and assessment, hearing impairment, cognitive level, and key demographics of each child. Direct assessment of each child's expressive language, receptive language, and IQ was conducted by the researcher. No results were significant (likely due to limited power), but effect sizes were large. As predicted (based on effect size), expressive language and receptive language were positively related to social skills. Likewise, if a child did not require PET placement or required PET placement and received it within the critical developmental period, expressive language, receptive language, and general social skills were higher when compared to a child who was determined to need PET placement but did not receive it during the critical developmental period. Potential moderator and mediator models, including the possible role of compensatory social skills, were explored. The results from this pilot study are promising and underscore the importance of continued research that may inform early intervention efforts for children with Down syndrome, particularly regarding the placement of PET for these children.

Table of Contents

The Relation Between Language and Social Skills In Children with Down Syndrome: Examination of Pressure Equalization Tube Placement During the Critical Developmental Period

The relation between hearing loss and developmental language delay has been well documented in previous research (e.g., Shriberg, Friel-Patti, Flipsen, & Brown, 2000). The impact of hearing loss in early childhood development can be even greater for children with mental impairments such as Down syndrome (Mazzoni, Ackley, & Nash, 1994), and the increased incidence of ear infections and hearing loss in children with Down syndrome has become increasingly apparent due to more proactive care (Shott, 2000). The current study examined the relation between expressive language, receptive language, and social skills in children with Down syndrome within the context of receiving a placement of pressure equalization tubes (PET). Secondly, because language is thought to develop during a critical period (Leybaert & D'Hondt, 2003) possible differences in language skills and social skills were examined according to when PET placement was completed, if deemed necessary, in relation to this critical developmental period. In the current study, the critical developmental period was defined as birth to 36 months. Thirdly, preliminary analyses were conducted to consider expressive language as a possible mediator in the relation between PET placement (i.e., during critical developmental period or not) and social skills. Finally, as an exploratory research question, the relation among PET placement, receptive and expressive language skills, and certain compensatory social skills were examined. The results of the current study serve as a promising pilot for continued research in this area.

Hearing Loss and Down Syndrome: Implication for Language Learning

In a review of literature on children with cochlear implants, Pettinato (2009) examined the relation between early auditory deprivation and the development of speech processing skills without the potentially confounding variable of oral-motor complications often found in children with Down syndrome. According to Pettinato (2009), similarities appear to exist between children with cochlear implants and children with Down syndrome in delayed language acquisition, difficulty with articulation and intelligibility, difficulty retaining speech in short term memory, and greater variability in sound productions compared to typical children. These similarities strongly suggest that many of the language deficits in children with Down syndrome may be explained, at least in part, by auditory deprivation and not solely by cognitive and oral-motor complications (Pettinato, 2009).

Furthermore, Laybaert and D'Hondt (2003) found, using a sample of deaf children, that exposure to grammatical and phonological aspects of language within the critical developmental period early in life is crucial for typical neurological development. According to Laybaert and D'Hondt, a lack of exposure to these basic aspects of language may lead to the absence of premature halting of left hemisphere language specialization seen in the brains of typically hearing individuals (2003). Van Gorp and Baker (1984) studied individuals with Down syndrome from five years to twenty years of age, and they found that 82.2% of these individuals suffered hearing loss. Additionally, they determined that 82.1% of those with hearing loss were unable to detect flat or low frequencies—types of hearing loss often experienced by individuals with conductive hearing loss (Van Gorp & Baker 1984).

Van Gorp and Baker's findings appear consistent with Balkany, Mischke, Downs, and Jafek (1979) who found that 83% of the hearing losses detected in their sample were conductive

in nature, and 60% of the conductive losses were a result of ear disease such as middle ear effusion. Given that such a high percentage of children with Down syndrome exhibit hearing loss, it is important to note that

> both acute and chronic otitis media can contribute to both conductive and sensorineural hearing loss. . . . damage can occur if chronic middle ear effusions and infections are left untreated. [Therefore,] the need for repeated ventilation tube or pressure equalization tube (PET) placement is common and should be expected in the majority of children with Down syndrome. (Shott, 2000, p. 2)

Interestingly, a study of individuals with Down syndrome in northern Finland determined that only 33% of the participants experienced hearing loss or recurrent middle ear infections (Määtä, Kaski, Taanila, Keinänen-Kiukaanniemi & Livanainen, 2006). Määtä et al. suggested that the low percentage of incidence of hearing impairment in this study may be partly due to the proactive treatment of middle ear infections and glue ear in Finland.

Thus, it follows from the work of Määtä et al. (2006) that hands-on monitoring of the quality of hearing and timely completion of preventative treatments may aid in lessening the severity of hearing loss in children with Down syndrome. Because PET placement is a frequently used treatment for otitis media that is meant to prevent further, possibly permanent, damage to the ear in children with Down syndrome, PET placement is likely a highly effective treatment that betters the quality of life for individuals who undergo the surgery. The purpose of the current study is to examine whether the early detection of a need for PET placement in children with Down syndrome and the timely completion of this procedure within the critical developmental period (i.e., by 36 months of age) is related to the quality of their language skills and ultimately their social skills.

Hearing is considered to be extremely important for language development in early childhood (Shriberg et al., 2000), and this finding is especially true for children with mental disabilities. Mazzoni et al. (1994) concluded from the existing literature that mild hearing loss in individuals with mental impairment can have an impact, beyond the difficulties related to the nature of their impairment on the development of their language skills and IQ levels. Because later aspects of language learning are thought to build upon experiences with language during infancy, Pettinato (2009) conjectured that exposure to and analysis of speech sounds during infancy is critical for a child's language acquisition. As with any skill, children must have a reliable foundation upon which to build more fine-tuned language skills for successful communication (Pettinato, 2009).

Some research suggests that the communication delays typically found in children with Down syndrome are likely associated with persistent otitis media, a condition commonly treated with PET placement (Hugo, Louw & Kritzinger, 1998). Whereas the communication deficits often found in children with Down syndrome may be attributed to a number of factors, of which otitis media is only one, it could be the case that more aggressive prevention and treatment of any hearing difficulties in these children caused by otitis media may help to improve their development of sufficient language skills. For the current study, language was defined as a child's ability to understand a message from others (i.e., receptive language) as well as a child's ability to communicate his/her thoughts to another person in a manner that conveys the intended message (i.e., expressive communication), rather than focusing on correct use of grammar and other technicalities of language. A need to focus on language skills is further underscored by research showing that individuals with Down syndrome often have poorly developed expressive language skills when compared to their nonverbal cognitive skills (Chapman & Hesketh, 2001).

Given the apparent relation between hearing loss during or around the theorized critical period for language development and later expressive language skills (Laybaert & D'Hondt, 2003; Marcotte & Morere, 1990), the timing, efficiency, and overall effectiveness of the treatment of hearing loss using PET placement may have important implications for later language development, particularly for children with Down syndrome. Thus, proper PET placement (i.e., within the critical period of development), when determined as needed, may serve as a valuable point of intervention that may allow for better expressive language development in children with Down syndrome. Identification of a relation between expressive language and the timing of PET placement relative to the critical period of development may not only indicate a need for greater use of PET placement, but may also suggest a need for better monitoring of hearing loss so that PET placement in children with Down syndrome can occur at a time that will increase the likelihood of its effectiveness and other positive outcomes related to better hearing. Thus, the current study has important clinical implications for children with Down syndrome.

Compensatory Social Skills in Down Syndrome

Despite the many deficits in the various aspects of language often exhibited by children with Down syndrome, these children often seem to have better developed social skills, in comparison, than might be expected, and these social skills may help them compensate for their communication weaknesses (Guralnick, Connor, & Johnson, 2011). Children with Down syndrome tend to possess "pronounced social orientation" (p. 59) and "well developed representational skills" (p. 59) that competent partners can use to overcome language difficulties (Guralnick et al., 2011). Guralnick et al. found that playmates often employed scaffolding in order to make this compensation, but, according to Guralnick et al. (2011), these compensatory

social strategies seem to work optimally in structured play situations that have very clear expectations for each child. When the play grows beyond a dyad into more unstructured social interactions, children with Down syndrome often lose much of their ability to mask their communication deficits and cannot compensate adequately (Guralnick et al., 2011) because communication skills are necessary to keep up with the group. In everyday situations, social interactions are not likely to be concretely structured, and perhaps improvement upon communication skills could increase more practical social functioning.

As such, it seems that, even with these compensatory social skills, many children with Down syndrome cannot function well in many socially common situations. Furthermore, children with Down syndrome develop these compensatory social skills as a result of deficits in language, so it would follow to reason that an increase in communication skills would boost children with Down syndrome toward their full potential, making compensatory social skills less unnecessary (although perhaps still useful). Given their continued struggles in social situations despite compensatory strategies, examination of possible factors related to social functioning, such as overall language abilities, remains important. If PET placement during the critical developmental period relates to better language skills in children with Down syndrome, examination of those language skills as a possible mediator in the relation between PET placement is very important.

Current Study and Hypotheses

Given the research showing the importance of exposure to the complexities of language during a critical developmental period as an important part of the foundation of language learning (Laybaert & D'Hondt, 2003; Marcotte & Morere, 1990), it is imperative that preemptive measures be taken as needed to ensure that children with Down syndrome have the opportunity

to develop to their full potential in this area. Secondly, because language skills appear to be positively related to social skills, the benefits of careful monitoring of hearing deficiency due to otitis media and the subsequent treatment of the condition increase greatly for children with Down syndrome. Research shows that hearing loss at a critical period during a child's development may be related to later deficits in language and social skills (Marcotte & Morere, 1990). However, hearing loss due to otitis media in children with Down syndrome may be avoidable through treatment with PET placement, which would suggest that later language and social deficits may be preventable with optimal treatment of hearing problems. Therefore, PET placement occurring either during or outside of the critical developmental window will be examined as a possible moderator of the relation between language skills and social skills.

First, it is hypothesized that receptive language, expressive language, and social skills will be positively correlated among children with Down syndrome (Hypothesis 1). Second, it is hypothesized that children with Down syndrome who have had PET placement during the critical developmental period (or who do not otherwise require PET placement) will have better developed receptive language, expressive language, and social skills than children who did not have PET placement during the critical developmental period but who, nevertheless, were determined to need such placement (Hypothesis 2). Third, it is expected that the relation between PET placement (i.e., during critical developmental period or not) and social skills will be at least partially mediated by expressive language (Hypothesis 3). In addition to these specific predictions, the current study begins to address one exploratory research question for which there was no *a priori* hypothesis. Specifically, the relation between expressive language and *compensatory* social skills and whether that relation may be moderated by PET placement during the critical developmental period was examined. Finally, the current study aimed to determine

how the variables of interest (PET placement, language, and social skills) interrelate with problem behaviors among children with Down syndrome.

The current study served as a pilot project to obtain an initial understanding of the relations among the variables of interest in preparation for a larger planned study. Hypotheses 1 and 2 were fully tested. However, due to the small sample size, the focus was on effect sizes rather than on significance testing. Hypotheses 3 and 4, which involved more complex moderational and mediational models, could not be fully tested due to the small sample size and limited degrees of freedom. Nevertheless, relations among the variables within these models were examined, and some conclusions are drawn about the likelihood of these models being supported within a larger sample.

Method

Participants

Data were collected from a group of children with Down syndrome ranging in age from 12 to 15 years (M = 14.0, SD = 1.7). The total sample size included 3 children and consisted of 2 males and 1 female, with 100% of the total sample being Caucasian. One of the children was diagnosed by a pediatrician, one diagnosed by his mother's obstetrician/gynecologist, and one was diagnosed by a neonatologist. No participants were reported to have another type of developmental or mental disorder.. Regarding birth order rank, one participant was the first child, one participant was the second child, and one participant was the eighth child in the family.

The parent of one participant reported that he had a hearing deficiency, which was identified at 36 months of age. All three participants were identified to have a language delay (one at 3 months of age, one at 18 months of age, and one at 36 months of age). All three

participants were currently receiving some form of special services (one attended a community-based program and two attended a special education program). Parents of all three participants reported that they had received speech therapy, physical therapy, and occupational therapy. In addition, two participants had received early intervention services. Participants' cognitive functioning was rated by their parents on a scale from *0-Well Below Average* to *4-Well Above Average*. Participants' mean on the cognitive functioning scale was 1.33 (*SD* = .58), which is an average score generally consistent with *Below Average*. Regarding school placement, one participant attended a special school, one participant attended an elementary school, and one participant (i.e., the child placed in a community based program) attended a high school.

Participants were coded based on their PET placement status. Participants were coded 0 if they needed PET placement and either did not receive it or received after the critical developmental period. One participant was coded as such (i.e., he required PET placement but did not receive it until 48 months). Participants were coded 1 if they either needed PET placement and received it during the critical developmental period or if they were deemed not to need PET placement at any point. One participant received PET placement during the critical developmental period (i.e., received at 36 months) after being diagnosed with hearing impairment by an ear-nose-and-throat doctor (ENT), and one participant did not require PET placement. The two participants who required PET placement were both diagnosed with otitis media. Thus, all participants who were deemed to need PET placement received it. However, one of the two received placement outside of the critical developmental period. The two participants who received PET placement received follow-up visits to a hearing specialist at six month intervals. For both, there was no need for repeated placement.

Parent respondents were all mothers of the child with Down syndrome, ranging in age from 41 to 54 years (M = 48.0, SD = 6.6). The marital status of participants' parents was evenly divided among the sample; one was married, one was separated, and one was divorced. Family income was coded on a scale from *0*, which is $0-$4,999 to *8*, which is $100,000 and above. Participants' mean family income was 7.0 (SD = 1.0), which represents an average family income of $75,000-$99,999. All three parents had at least a 4-year college degree, with one earning a graduate degree.

Measures

Woodcock Johnson-III Normative Update Tests of Cognitive Abilities (WJ-III) Brief Intellectual Ability (BIA) subtests. Children's cognitive functioning was assessed directly using the WJ-III BIA subtests, which yields age-adjusted standard scores (WJ-III COG; Woodcock, McGrew, Mather, & Shrank, 2003). The BIA consists of the Verbal Comprehension subtest which measures language development and word knowledge, the Concept Formation subtest which measures fluid reasoning, and the Visual Matching subtest which measures processing speed. The child was asked to identify pictures and respond correctly to synonyms, antonyms, and verbal analogies for the Verbal Comprehension component. Then, during the Concept Formation subtest, the child was presented with stimulus sets and was asked to correctly determine the rule for each set. Finally, the child was asked to rapidly identify two identical shapes or numbers for the Visual Matching subtest. Internal consistency alpha coefficients range from .80s to .90s for individual tests. Test-retest reliabilities range from .70s to .90s. The WJ-III COG has shown concurrent validity with other measures of cognition/intelligence (Woodcock et al., 2003).

Expressive Vocabulary Test-2 (EVT-2). Children's expressive language functioning was directly assessed using Form A of the EVT-2, which yields age-adjusted standard scores (EVT-2; Williams, 2007). The EVT-2 uses labeling and synonym items to measure expressive vocabulary knowledge. The test consists of pictures which are presented to the examinee, who is asked to provide an acceptable label for the picture using one word, a correct synonym for the context of the picture, or an answer to a question about the picture. The internal consistency reliability (α =.96), split-half reliability (r = .96), test–retest reliability (r = .95), and alternate form reliability (r = .87) in previous psychometric studies are consistently high suggesting excellent reliability. The EVT-2 has established content and concurrent validity [e.g., correlations ranging from .50 to .84 with the *Comprehensive Assessment of Spoken Language* (CASL)]. This assessment has been validated for speech impaired, language delayed, hearing impaired, and mentally impaired populations. Each of these groups would be expected to score lower than the general population, with the mentally impaired group scoring, on average, two standard deviations below the general population average (Williams, 2007).

Peabody Picture Vocabulary Test-2 (PPVT-4).Children's receptive language functioning was directly assessed using Form A of the PPVT-4, that yields age-adjusted standard scores (PPVT-4; Dunn & Dunn, 2007). The PPVT-4 is an untimed power test of vocabulary that consists of nineteen sets of twelve items which become increasingly difficult as the test progresses. The PPVT-4 has been shown to have an internal consistency alpha coefficient of .97 and split-half reliability of .94. Alternate form reliability (mean of .89) and test-retest reliability (average of .93) have been found to be high as well. The PPVT-4 has established content and concurrent validity (e.g., correlations ranging from .62 to .77 with the CASL). This assessment has been successfully used with speech impaired, language delayed, hearing impaired, and

mentally impaired populations. Each of these groups would be expected to score lower than the general population mean, with mentally impaired individuals and those with cochlear implants scoring, on average, two standard deviations below the general population mean (Dunn & Dunn, 2007).

Social Skills Rating System-Parent Rating Form and Teacher Rating Form (SSRS). The Social Skills scale from the SSRS was used as a broad measure of social functioning (Gresham & Elliott, 1990). The Social Skills scale includes subscales measuring prosocial skills including cooperation, empathy, assertion, self-control, and responsibility. The Problem Behaviors scale from the SRRS was also calculated to be used in additional exploratory analyses that were not specific to the hypotheses of the current study. The Problem Behavior scale of the SRRS includes externalizing problems (e.g., aggression, poor temper control), internalizing problems (e.g., anxiety, depression), and hyperactivity (e.g., fidgeting, impulsive acts). The teacher version of the SSRS also includes an Academic Competence scale. Internal consistency for the teacher report scales could not be calculated due to some missing items and only two respondents. Within the current sample, the parent report of the SSRS showed excellent internal consistency (α = .97) for the Social Skills scale but poor internal consistency (α = .13) for the Problem Behaviors scale. It is difficult to interpret the meaning of this low internal consistency, however, given the small sample size in the current study. The SSRS has been shown to demonstrate good reliability and validity (Gresham & Elliott, 1990).

Compensatory Social Skills Measure-Parent Report and Teacher Report (CSSM-P and CSSM-T; Appendix A and Appendix B). A measure was developed for the current study to assess compensatory social skills (e.g., cute digressions, excessive physical interaction) among children with Down syndrome. The items for this measure were developed by examining studies

(e.g., Guralnick et al., 2011) that discussed compensatory social skills among children with Down syndrome, which focused on behaviors that had a pronounced social orientation often meant to digress from the topic at hand. The measure was developed in consultation with a child clinical psychologist. It was determined to have good face validity (although this was assessed by the developers and was not further reviewed by an expert panel). Parents and teachers rated each item on a Likert-type scale from *1-almost never* to *5-almost always*. Scores on the items were summed for a total compensatory social skills scale. For the current sample, internal consistency for the CSSM-P was good ($\alpha = 0.83$), and the internal consistency for the CSSM-T was excellent ($\alpha = 0.93$).

Demographic and Diagnostic Form. Parents completed a Demographic and Diagnostic Form (Appendix C), which included basic demographic information, data about the family structure, academic and medical history, and information about the child's Down syndrome diagnosis and any other comorbid diagnoses. Information regarding whether PET placement was deemed necessary for each child and the timing of their PET placement (if deemed necessary) was gathered using this form.

Procedure

Participants were recruited via announcements, flyers, and emails to parents of children with Down syndrome. Contacts were obtained from the Association for the Rights of Citizens with Developmental Disabilities (The ARC) in Hattiesburg, Mississippi, and the Down Syndrome Society in Mobile, Alabama.

Upon agreeing to participate, parents completed a consent form (Appendix D) on behalf of themselves and their child. Following parental consent, children provided written assent (Appendix E) and then were tested on the WJ-III COG, PPVT-4, and EVT-2, in that order.

Testing with the child was completed in either one or two sessions depending on the needs of the child in an effort to minimize fatigue. Testing was completed on-site at The ARC in Hattiesburg, Mississippi, or at the Goodwill Easter Seal's Center in Mobile, Alabama. Stickers and other small rewards were given to motivate the child during testing. Parents completed the parent packet, which included the Demographic and Diagnostic Form, SSRS, and CSSM-P. Finally, teachers received a packet with the SSRS and CSSM-T to complete on any child in their classroom who had consent from the parent to participate in the study. Teachers also completed a consent form prior to providing data (Appendix F).

Design

The current study used a correlational and a quasi-experimental design. No direct manipulation of variables was conducted. Rather, relations among variables were examined through correlation and regression analyses. Differences based on PET placement status were examined through independent samples *t*-tests.

Results

Due to the small sample size, the current study focuses on effect sizes and shared variance among variables of interest (i.e., rather than significance testing, which would be underpowered) when reviewing the results of the analyses that were conducted. Nevertheless, the tests of significance are reported. Descriptive statistics for variables of interest are presented in Table 1. Other variables from the SSRS and testing results are also included for descriptive purposes. None of the variables were significantly skewed.

Hypothesis 1 (that receptive language, expressive language, and social skills were positively correlated) was tested with correlation analyses (Table 2). For all of the correlations,

Table 1

Descriptive Statistics of Main Variables of Interest

Variable of Interest	Min	Max	Mean	SD	Skewness
General Social Skills Standard Score (Teacher Report)[a]	96.00	98.00	97.00	1.41	--
Problem Behaviors Standard Score (Teacher Report) [a]	87.00	100.00	93.50	9.19	--
Academic Competence Standard Score (Teacher Report) [a]	88.00	91.00	89.50	2.12	--
General Social Skills Standard Score (Parent Report) [a]	78.00	129.00	95.00	29.45	1.73
Problem Behaviors Standard Score (Parent Report) [a]	96.00	112.00	102.67	8.33	1.29
Compensatory Social Skills Raw Score (Parent Report) [b]	.83	2.17	1.44	.67	.72
Compensatory Social Skills Raw Score (Teacher Report) [b]	.67	2.50	1.58	1.30	--
Verbal Ability Standard Score [c]	24.00	40.00	33.00	8.19	-1.03
Verbal Comprehension Standard Score [c]	24.00	40.00	33.00	8.19	-1.03
Concept Formation Standard Score [c]	15.00	55.00	29.33	22.28	1.70
Visual Matching Raw Score [c, d]	8.00	21.00	16.00	7.00	-1.57
Expressive Language Standard Score [e]	20.00	52.00	40.00	17.44	-1.63
Receptive Language Standard Score [f]	20.00	36.00	28.33	8.02	-.37

Note. $N = 3$, unless teacher report, where $n = 2$. Standard scores were used where indicated and all were on a scale where the mean = 100 and the standard deviation is 15 within a normative sample. Min = minimum. Max = maximum. SD = standard deviation.

[a] From the Social Skills Rating System (SSRS; Gresham & Elliott, 1990). [b] From the Compensatory Social Skills Measure. [c] From the Woodcock Johnson-III Normative Update Tests of Cognitive Abilities (WJ-III) Brief Intellectual Ability (BIA) subtests (WJ-III COG; Woodcock, McGrew, Mather, & Shrank, 2003). [d] The raw score for Visual Matching was used (i.e., rather than a standard score) due to a floor effect and lack of variability on the standard score. [e] From the Expressive Vocabulary Test-2 (EVT-2; Williams, 2007). [f] From the Peabody Picture Vocabulary Test-2 (PPVT-4; Dunn & Dunn, 2007).

the relations are positive and the effect sizes are large (Cohen, 1992) based on the magnitude of the correlations; however, the results are non-significant due to limited power.

Table 2

Correlations Among Language and General Social Skills (Test of Hypothesis 1)

	Expressive Language	Receptive Language	General Social Skills (Parent Report)
Expressive Language	---	.94	.60
Receptive Language		---	.83
General Social Skills (Parent Report)			---

Note. Correlations are non-significant ($p > .10$), but effect sizes are large (Cohen, 1992).

Hypothesis 2 (that children who have had PET placement during the critical developmental period had better developed receptive language, expressive language, and social skills than children who did not) was examined using independent samples *t*-tests, with PET placement status as the independent variable and each of the outcomes as the dependent variables. Results are presented in Table 3. Descriptively, for both expressive language and receptive language, the child who was deemed to not need PET placement had the highest standardized scores of the group. The child who received placement during the critical developmental period had the second highest standardized scores, and the child who did not receive PET placement during the critical developmental period had the lowest standardized scores of the group. However, it is interesting to note that, with the exception of the participant who did not receive PET placement during the critical developmental period, the participants

scored descriptively lower on the receptive language measure than on the expressive language measure. The participant who did not receive PET placement during the critical developmental period had equal scores on both measures. For social skills, the child who was deemed not to need PET placement again received the highest standardized score (again, descriptively). However, the participant who received PET placement during the critical developmental period for language had a standardized score equivalent to the standardized score of the participant who did not receive PET placement during the critical developmental period.

Table 3

Independent Samples t-tests Examining the Differences in Language and General Social Skills Based on PET Placement Status (Test of Hypothesis 2)

	Independent Variable: PET Placement Status				
	No		**Yes/NA**		
Dependent Variables	*M*	*SD* [a]	*M*	*SD*	*t*(1,1)
Expressive Language	20.00	--	50.00	2.83	-8.66[†]
Receptive Language	20.00	--	32.5	4.95	-2.06
General Social Skills (Parent Report)	78.00	--	103.50	36.06	-.58

Note. PET = pressure equalization tubes. PET Placement-No = not placed when needed or placed after the critical developmental period; PET Placement-Yes/NA = placed during the critical developmental period or PET not needed.

[a] Due to sample size for this status, there is no standard deviation.

Trend; [†] $p < .10$

Hypothesis 3 (that the relation between PET placement and social skills was at least partially mediated by expressive language) was partially examined using regression analyses. Specifically, two regression analyses were conducted: (1) PET placement predicting social skills, and (2) PET placement predicting expressive language. The third regression analysis that would be necessary for testing mediation (i.e., PET placement and expressive language simultaneously predicting social skills) could not be conducted due to limited degrees of freedom. Notably, these two regression analyses are redundant in terms of significance testing with the independent samples *t*-tests that examined group differences on social skills and expressive language based on PET status. Nevertheless, the findings are presented here as preliminary findings for the mediation analyses and to allow an examination of the *amount of variance* among these outcome variables that is attributable to PET placement.

For the first regression analysis (PET placement predicting social skills), the model was non-significant, $R^2 = 0.25$, $\beta = 0.50$, $p = .67$, $f^2 = .33$. For the second regression analysis (PET placement predicting expressive language), the model was marginally significant, $R^2 = 0.99$, $\beta = 0.99$, $p = .07$, $f^2 = 99$. Although not significant, these beta weights serve as encouragement for continued data collection and analysis. Whereas these statistics almost certainly would decrease in size with a larger sample and more stable data set, it is likely that a strong relation may be found if the trend found in the present data persists. Additionally, with a larger sample size, significance can be meaningfully evaluated and, if the larger sample data reflects the effect size findings from the current pilot sample, a significant relation may be found.

The third regression analysis required for testing mediation (i.e., PET placement and expressive language entered simultaneously when predicting social skills) could not be conducted due to limited degrees of freedom. However, an analysis including only expressive

language (the hypothesized mediator) as a predictor for social skills found, $R^2 = 0.36$, $\beta = 0.60$, $p = .59$, $f^2 = .56$, for the model. Thus, all effect sizes for the regression analyses were large and it is plausible, therefore, that mediation models could be supported within a larger sample.

Although moderation models could not be tested to examine the exploratory research question (i.e., due to limited degrees of freedom), exploratory correlation analyses were conducted to examine the relation among receptive language, expressive language, and *compensatory* social skills (Table 4). For all of the correlations, effect sizes are large (Cohen, 1992) based on the magnitude of the correlations but non-significant due to limited power. Furthermore, for the correlation between compensatory social skills and general social skills, $r = .93$, $p = .24$, showed that the effect size was large but non-significant due to limited power. The effect size for the correlation between PET placement and compensatory social skills, $r = .79$, $p = .43$, is also large. Thus, these effect sizes hint at the possibility of main effects (that may be

Table 4

Correlations Among Language and Compensatory Social Skills (Partial Test of Exploratory Moderation Analyses)

	Expressive Language	Receptive Language	Compensatory Social Skills (Parent Report)
Expressive Language	---	.94	.85
Receptive Language		---	.98
Compensatory Social Skills (Parent Report)			---

Note. Correlations are non-significant ($p > .10$), but effect sizes are large (Cohen, 1992).

significant in a larger sample). However, there is no way to directly test if there is a multiplicative interaction effect above and beyond the main effects until a large sample is collected.

Finally, data were collected on problem behaviors on the SSRS. Therefore, the problem behaviors scale was correlated with other variables of interest to explore their interrelations. Again, only parent report data were used in the correlation analyses given the missing data and too small of a sample for teacher report. The correlations are presented in Table 5.

Table 5

Exploration of Interrelation Among Variables of Interest and Problem Behaviors

	Problem Behaviors
PET Status	-.97
Expressive Language	-.99
Receptive Language	-.98
General Social Skills (Parent Report)	-.69
Compensatory Social Skills (Parent Report)	-.91

Note. PET = pressure equalization tubes. PET coded where 0 = not placed when needed or placed after the critical developmental period and 1 = placed during the critical developmental period or PET not needed.

Discussion

The current study examined the relation between expressive language, receptive language, and social skills in children with Down syndrome and how placements of pressure equalization tubes (PET) may mediate that relation. Due to the small *n* design of the study, there

was not enough power to fully test hypotheses or to find significance for the analyses conducted. However, the effect sizes for the hypotheses tested are large (Cohen, 1992). PET placement accounted for 25% of the variance in social skills and 98% of the variance in expressive language. Whereas no inferences can be made about correlations among the variables of interest at the present time, these effect sizes suggest that findings may be significant with a larger sample—even if the magnitude of the relations decrease somewhat due to a more reliable and stable data set. Therefore, the current study serves as an excellent pilot for continued data collection and analysis. Once a larger sample has been obtained, the hypotheses will be fully tested.

Anecdotally, the descriptive findings for the individual participants appeared to be consistent with the overall theory of this study. The participant who was deemed to need no PET placement spoke very clearly and was skilled at holding a conversation. The participant who received PET placement during the critical developmental period spoke a little less clearly than the participant who did not need PET placement at all. However, he was still easily understood. The participant who did not receive PET placement during the critical developmental period spoke much less clearly than the other participants. This participant made a lot of nonverbal noise and was not very conversational as compared to the rest of the sample. As previously noted, this participant scored lower than both the participant who was deemed to not need PET placement and the participant who received it within the critical developmental period on both expressive and receptive language measures.

Additionally, the participant who did not receive PET placement during the critical developmental period seemed to have a very short tolerance for anything considered irritating. The participant repeatedly fussed at the researcher for turning the pages in the test

booklets, and he would demand that the researcher "Go back!" while holding the pages down with his hands. Conversely, both the participant who had received PET placement during the critical developmental period and the participant who was deemed to not need PET placement were extremely cooperative and exhibited well developed compensatory social skills. The participant who was deemed to not need PET placement persisted in asking the researcher about her plans for the following weekend. This participant would take any open opportunity, such as a long pause or a shift in tasks, to attempt to divert the researcher's attention away from the examination by trying to initiate a conversation or delivering compliments. The participant who received PET placement during the critical developmental period also employed distractive tactics. When asked difficult questions, this participant would ensure he had the researcher's attention and proceed to make cute digressions (as predicted earlier in the study). This participant would show things that he could do well and would also smile at the researcher or mimic the researcher's facial expressions. Periodically, this participant would take the researcher's face into his hands and redirect it toward the participant's face as he flashed a huge smile.

Conversely, the participant who did not receive PET placement during the critical developmental period exhibited some compensatory behavior whenever the child's mother was in the same room; however, this participant never exhibited any compensatory behaviors with the researcher. Furthermore, even with the participant's mother, the degree of compensatory behavior shown was not observed to be as high during the testing session as the degree of compensatory behavior exhibited by both the participant who had PET placement during the critical developmental period and the participant who was deemed to not need placement. These experiences during testing seem to be consistent with the parent reported compensatory social

skills. So, it seems that the exploratory research question addressing a possible moderation of the relation between expressive language and compensatory social skills by PET status may be supported with further data collection and analyses.

All of the correlations between problem behaviors and other variables (PET status, receptive language, expressive language, compensatory social skills, and general social skills) had large effect sizes (Cohen, 1992). The negative correlations indicate that, as expressive language, receptive language, compensatory social skills, and general social skills go up, problem behaviors go down. The negative correlation between PET status and problem behaviors indicates that both the participant who had PET placement during the critical developmental period and the participant who was deemed to not need PET placement had lower problem behaviors than the participant who did not have PET placement during the critical developmental period. None of the correlations are clinically significant; however, the large effect sizes are good indicators of possible significant findings with further data collection and analysis.

Limitations and Directions for Future Research

Whereas there seems to be a great deal of potential for possibly obtaining significant results with continued data collection, certain limitations of the current study should be given careful consideration. First, the sample size is incredibly small (n = 3), and may not reliably estimate how the constructs of this study relate. Because the data from only three participants were analyzed, one outlier could have greatly altered the results. Due to the small sample size, the study cannot indicate whether these participants are representative of the population at large. In addition, any unique factors at the time of testing with any one of the individuals could have affected the results (e.g., being tired on the day of testing, desiring to be with the other children

instead of testing). Additionally, the participant who had PET placement during the critical developmental period attempted to use sign language during testing. This was unanticipated and could have negatively impacted the results, particularly on his verbal IQ and expressive language tests. These limitations will be addressed by obtaining more participants to ensure more accurate results.

Furthermore, recruiting participants within this very specific clinical population (i.e., children with Down syndrome) was difficult. First, this impediment may have been the case due to the timing of the study. Recruiting and assessment began during the second semester of the school year, and the target population consisted of school-age children. Parents and caregivers may have had difficulty in finding a convenient time outside of both work and school hours to bring their child to testing. Secondly, the difficulty in recruitment could very well be due to parental age. Many of the parents to children with Down syndrome are older adults and have advanced careers. Therefore, their time may be more limited due to career demands. This could possibly be a contributing factor to the limited access to this particular population. Difficulty in reaching this population, for whatever reason, could be a contributing factor to the limited amount of research as compared to the research on other clinical disorders.

Future research should expand this study with a larger sample size to enable a full analysis of the data. Future studies may wish to address these issues within other developmental disorders, as these findings may translate. Research into the compensatory social skills of children with Down syndrome appears to be fairly limited, and future studies may want to address these skills by expanding upon how they are used and developed within this clinical population. Furthermore, because the present trend of the findings appears to suggest that early intervention, when needed, may improve language, social skills, and problem behaviors in this

clinical population, future studies may also wish to address the impact of increasing awareness and education in new parents of children with Down syndrome.

Conclusion

The results of the current study are promising and suggest that further work in this area could have important implications for the quality of life in children and adults with Down syndrome. Further study could provide support for more aggressive monitoring of hearing loss in children with Down syndrome and for careful treatment and follow up of middle ear diseases such as otitis media in an effort to not only relieve infections and improve hearing but also to improve language and social skills.

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Appendix A

CSSM-P

Please complete the following items by circling the frequency (Never, Sometimes, Often, or Almost Always) that each item applies to your child.

When my child has difficulty communicating with me, he/she:

1. smiles.

   Never Sometimes Often Almost Always

2. laughs.

   Never Sometimes Often Almost Always

3. tries to give me a hug or provide other physical contact.

   Never Sometimes Often Almost Always

4. uses humor/tries to make me laugh.

   Never Sometimes Often Almost Always

5. changes the topic of conversation.

   Never Sometimes Often Almost Always

6. makes eye contact to initiate help from me.

   Never Sometimes Often Almost Always

Appendix B

CSSM-T

Please complete the following items by circling the frequency (Never, Sometimes, Often, or Almost Always) that each item applies to this child.

When this child has difficulty communicating with me, he/she:

1. smiles.

   Never Sometimes Often Almost Always

2. laughs.

   Never Sometimes Often Almost Always

3. tries to give me a hug or provide other physical contact.

   Never Sometimes Often Almost Always

4. uses humor/tries to make me laugh.

   Never Sometimes Often Almost Always

5. changes the topic of conversation.

   Never Sometimes Often Almost Always

6. makes eye contact to initiate help from me.

   Never Sometimes Often Almost Always

Appendix C

Demographic and Diagnostic Form

These forms are for caregivers who provide most of the care for a child with a Down syndrome child between the ages of 8 and 18 years. Please fill out the following information **about your child**.

Child's Age: _____ **Child's Date of Birth: (**Month/Day/Year) ____/____/____

Child's Gender: Female ___ Male ___ **Child's First and Last Initials:** _____

Child's Race: White ___ Black ___ Hispanic ___ Asian ___ Other _____

Your child's birth order rank: First (Oldest)____ Second____ Third____ Fourth____
Other (Please Specify)_____

What diagnosis/diagnoses was/were given to your child? _____ Down syndrome _____ Autism
_____Other (Please specify) _____

Has your child received any other diagnoses? (Please select all diagnoses received)
___ADHD ___Anxiety Disorder ___Conduct Disorder ___Depression ___Learning Disability
___Oppositional Defiant Disorder ___ Hearing Impairment
___Other_____

What age was your child when you first noticed symptoms of hearing impairment? _____
What age was your child when you first noticed a language delay? _____
How old was your child when he/she was diagnosed (Please provide an age for each diagnosis your child received)?
_____

Did your child suffer from otitis media at any point up to the present? _____

Was your child ever determined to need pressure equalization tube placement (i.e. ear tubes)?
_____

Did your child receive this placement? _____ If your child did receive placement of pressure equalization tubes, at what age was placement completed? _____

How often, after pressure equalization tube placement, did your child receive follow up visits to a hearing specialist? _____

Was your child determined to need repeated placement of tubes after the initial pressure equalization tube placement? _____ If so, did your child receive this placement as needed _____ and how far apart, in months, did placement of pressure equalization tubes occur?_____

Who diagnosed your child with Down syndrome? Psychologist ____ Pediatrician_____
Neurologist____ Psychiatrist____ Other (Please specify) _____

Who diagnosed your child with hearing impairment? Pediatrician_____ Neurologist____
Other (Please specify) _____

Please rate your child's overall cognitive functioning level:

___Well Below Average ___Below Average ___Average ___Above Average

___Well Above Average

What is your child's current school placement? (Please specify at least the type of classroom, type of school and if your child has an individual aide.)

_____
_____

What services has your child received? (Please check all that apply)

___Applied Behavioral Analysis (ABA) ___Early Intervention Services ___Physical Therapy

___Occupational Therapy ___Psychological Treatment ___Speech Therapy

___Other (Please Specify)_____

Is your child currently on any medications? (If so, please list each medication and dosage received)

_____

Have there been any significant changes in your child's life, major life events, in the past two years? (Examples include a birth/death in the family, moving, parental loss of job, parental separation, medical illness in the family, etc.) Please list any/all major life events that have occurred in the past two years.

_____
_____

On a scale of 1 to 5 please rate how much your child appeared to be affected by these major life events, with 1 being not at all or very little and 5 being significantly affected._____

ABOUT YOU AND YOUR FAMILY

Your Gender: Female ___ Male ___ **Your Age: _____** years

Location: (City, State) _____, _____

Your Race: White____ Black ____ Hispanic ____ Asian ____ Other _____

Marital Status: Married ___ Separated ___ Divorced ___ Widowed ___
Never Married/Living Alone ___ Never Married/Living with Someone ___
Education: What is the highest level of education completed by:

Yourself	**Your Spouse/Significant Other (Only if he/she lives in the household)**
_____ 6th grade or less	_____ 6th grade or less
_____ Junior high school (7th, 8th, 9th grade)	_____ Junior high school (7th, 8th, 9th grade)
_____ Some high school (10th, 11th grade)	_____ Some high school (10th,11th grade)
_____ High school graduate	_____ High school graduate
_____ Some college (at least 1 year) or specialized training	_____ Some college (at least 1 year) or specialized training
_____ College/university graduate (4-year degree)	_____ College/university graduate (4-year degree)
_____ Graduate professional degree (Master's, Doctorate)	_____ Graduate professional degree (Master's, Doctorate)

Occupation: Please provide your job title or position, NOT the just name of your employer. For example, if you are a teacher at Lee High School, please state "high school teacher". If you are **retired**, please state your prior occupation. If you **do not work** outside the home, state "unemployed."

What is your occupation? _____
(Please be specific)

What is your spouse's occupation?_____
(Please be specific)

Income: What is the total annual income of your household? (Combine the income of **all** people living in your house.)

_____ $ 0 -- $ 4,999 _____ $15,000 -- $24,999 _____ $50,000 -- $74,999

_____ $ 5,000 -- $ 9,999 _____ $25,000 -- $34,999 _____ $75,000 -- $99,999

_____ $10,000 – $14,999 _____ $35,000 -- $49,999 _____ $100,000 and above

Please list who lives in the household:

Age	Gender	Relation to Child**	Any Diagnoses (If so, please specify)

** Please be specific in describing the relation to child; self, brother, mother, father, step-father, stepbrother, half-brother, adopted sister, grandmother, aunt, cousin, etc.

Appendix D

Parent Consent

THE UNIVERSITY OF SOUTHERN MISSISSIPPI
AUTHORIZATION TO PARTICIPATE IN RESEARCH PROJECT

Consent is hereby given to participate in the study titled: The Relation Between Language and Social Skills In Children with Down Syndrome

1. **Purpose:** This study will examine the relation between expressive language, receptive language, and social skills in children with Down syndrome age 8 to 18 years. Findings may be used to advocate for a more proactive stance on the monitoring and treatment of hearing deficits in children with Down syndrome in order to improve their quality of life.

2. **Description of Study:** Parents and teachers of each child will be asked to complete a demographic form, and two social skills questionnaires describing both general and compensatory social skills. Children's IQ, expressive language, and receptive language will be directly assessed by the researcher in a testing session lasting approximately one hour. Testing can be scheduled over two sessions if preferred.

3. **Benefits:** While there are no direct benefits that result from participation in this study, the participation of you and your child may help create a better understanding of hearing impairment in children with Down syndrome and how this impairment affects their language and social skills. This knowledge may enable those who provide relevant services to children with Down syndrome in providing more effective means of treatment and therapy.

4. **Risks:** Completion of the social skills measures may cause anxiety in parents. If this anxiety occurs we will immediately release the parent(s) from the study and provide an appropriate referral. Children may become fatigued while participating in the direct assessments. Children will be given frequent breaks and small motivators (e.g. stickers) to minimize fatigue and maintain engagement. However, if children become too fatigued or frustrated at any point during testing or otherwise wish to stop, testing will immediately cease and will be continued at a later time if desired by the participant.

5. **Confidentiality:** All data gathered in the study from parents, teachers, and children will remain completely confidential. Records will be kept in a filing cabinet in a locked laboratory at The University of Southern Mississippi. Records will only be viewed by qualified researchers and research assistants.

Otherwise, no one else will be able to see or use the information. Your name, your child's name, and any other identifying information will not be linked to any findings, results or reports. The results of the project will focus on the overall findings, and no specific information about you or the students will be released.

7. **Participant's Assurance:** Whereas no assurance can be made concerning results that may be obtained (since results from investigational studies cannot be predicted) the researcher will take

every precaution consistent with the best scientific practice. Participation in this project is completely voluntary, and participants may withdraw from this study at any time without penalty, prejudice, or loss of benefits. Questions concerning the research should be directed to Brandi Ellis at (228) 493-0572 (or Dr. Tammy Barry at 601-266-5514). This project and this consent form have been reviewed by the Institutional Review Board, which ensures that research projects involving human subjects follow federal regulations. Any questions or concerns about rights as a research participant should be directed to the Chair of the Institutional Review Board, The University of Southern Mississippi, 118 College Drive #5147, Hattiesburg, MS 39406-0001, (601) 266-6820. A copy of this form will be given to the participant.

8. **Signatures:**

Signature of Parent Participant _____ Date _____

Brandi Ellis (Researcher) _____ Date _____

9. **Other Information:**

Child's Name _____ Teacher's Name _____

Age _____ Grade_____

The lab would like to keep a record of contact information to inquire about participation in future studies. If you would like to be included in the database of research participants and to be contacted to receive information about future studies, please provide your contact information below. This information will NOT be stored with your responses to the questions for the current study.

I would like to be contacted about future studies in the lab for which I or my child may qualify.

Yes _____ No _____

If yes:

E-mail Address: _____

Telephone Number: _____

Mailing address: _____

Street address: _____

City, State, Zip code: _____

Appendix E

Child Assent

Thank you helping us with this project. I am going to do some activities with you today that will be a lot like things you do in school. I will say some words and ask you to pick the picture that goes with it. I will show some pictures and ask you to say what it shows. I will also ask you to solve some problems and answer some questions. All you have to do is try your best. You may get tired or bored during the study, but I will give you a break if you need it. You can always ask for more breaks if needed. If you need us to stop the activities at any time, you just have to let me know. All of the information will be kept confidential. That means no one will know how you did on any of the tests or know your answers. We will put that information in our computers by a number code, not your name. Do you have any questions? Do you want to do the activities with me?

_____ I agree to participate in this study.

_____ I choose not to participate in this study at this time.

_____
Participant's (Child's) Name (print)

_____ Date: _____
Child Signature (for assent)

_____ Date: _____
Researcher's Signature

Appendix F

The Relation Between Language and Social Skills In Children with Down Syndrome

Teacher Consent Form

This project is being conducted by faculty and students of The University of Southern Mississippi.

Purpose: This study will examine the relation between expressive language, receptive language, and social skills in children with Down syndrome age 8 to 18 years. Findings may be used to advocate for a more proactive stance on the monitoring and treatment of hearing deficits in children with Down syndrome in order to improve their quality of life.

Study Description: If you choose to participate in the project, you will be asked to answer questions about the students in your class whose parents have consented to participate in this study. We expect that you may have 1 to 3 students involved in the project. If you agree, you will answer questions about the students' on two social skills questionnaires describing both general and compensatory social skills. Children's IQ, expressive language, and receptive language will be directly assessed by the researcher in three one-hour sessions.

Benefits: While there are no direct benefits that result from participation in this study, your participation may help create a better understanding of social skills in children with Down syndrome and how those skills relate to hearing impairment and language skills. This knowledge may enable those who provide relevant services to children with Down syndrome in providing more effective means of treatment and therapy.

Risks: There are no anticipated risks associated with your participation in this study.

Confidentiality: All data gathered in the study will remain completely confidential. Records will be kept in a filing cabinet in a locked laboratory at The University of Southern Mississippi. Records will only be viewed by qualified researchers and research assistants.

Otherwise, no one else will be able to see or use the information. Your name, the students' names, and any other identifying information will not be linked to any findings, results or reports. The results of the project will focus on the overall findings, and no specific information about you or the students will be released.

Voluntary Participation: Participation in this project is completely voluntary, and you may withdraw from this project at any time without any negative consequences. Your employment will not be affected if you do not join or withdraw later. If you leave the project early, the information that has already been collected will stay with the research team if the information is needed for this project or any follow-up activities.

Questions concerning the research should be directed to Brandi Ellis at (228) 493-0572 (or Dr. Tammy Barry at 601-266-5514). This project and this consent form have been reviewed by the

Institutional Review Board, which ensures that research projects involving human subjects follow federal regulations. Any questions or concerns about rights as a research participant should be directed to the Chair of the Institutional Review Board, The University of Southern Mississippi, 118 College Drive #5147, Hattiesburg, MS 39406-0001, (601) 266-6820. A copy of this form will be given to the participant.

Signatures: Your signature below means that you understand the information given to you in this form and you agree to participate in the project. You will be given a copy of this consent form for your records. You may contact us with any further questions before or after consenting to participate.

Name of Teacher (Please Print)	Name of School	Grade Taught	Date

Signature of Research Team Staff	Date