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Speech Sound Production Deficits in Children with Visual Impairment: A Preliminary Investigation of the Nature and Prevalence of Co-Occurring Conditions

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Abstract

This study explores the co-occurrence of speech sound production deficits in school age children with vision impairment (VI). A survey of VI professionals provides estimates of the percentage of their students with VI who have coexisting speech sound production deficits. Survey questions probed the characteristics of the students, including the severity of VI, age of onset of VI, cognitive abilities, and the severity of speech deficits. Statistical analyses of the responses show that the percentage of students with VI who receive speech sound production interventions was higher than expected when compared to the percentage of students in the general population who receive interventions. There is a need for future study of the coexistence of VI and speech sound production deficits.

IRB approval was obtained for this study.

Purpose

Speech sound production is dependent upon a myriad of cognitive-linguistic and perceptual processes (Bernthal, Bankson, & Flipsen, 2009; McLeod, 2007). From a psycholinguistic perspective, speech sound production begins with speech perception (Perkell et al., 2004; Vance, Stackhouse, & Wells, 2005). Ineffective speech perception or auditory discrimination can negatively influence speech sound production.

In contrast to the well-researched effects of hearing loss on speech sound production, there is considerably less information available on speech sound production in children with a different type of perceptual impairment – that being vision impairment (VI). The present study considers the speech sound production of children with VI.

Theoretical Framework

It is widely accepted that auditory and visual information are integrated during speech perception (Jiang & Bernstein, 2011; McGurk & MacDonald, 1976). A number of studies have demonstrated that receiving visual cues enhances the intelligibility of speech (Jesse, Vrignaud, Cohen, & Massaro, 2000; Massaro & Bosseler, 2003) as well as the precision of speech and the variety of speech contrasts that can be produced (Menard, Dupont, Baum, & Aubin, 2009). Visual cues provide visible information that complements the auditory signal. Listeners can more effectively identify speech sounds when receiving redundant visual and auditory cues. Several studies of speakers with VI revealed that their speech discrimination abilities differed from speakers who are sighted (Gougoux, Lapore, Lassonde, Voss, Zatorre, & Belin, 2004; Hugdahl, Ek, Rintee, Tuomainen, Haaral, & Hamalainen, 2004; Lucas, 1984). Menard et al. (2009, pp. 1406-1407) suggest that "apart from differences in discrimination abilities between congenitally blind speakers and sighted speakers, the lack of access to visual information might also induce differences in the use and/or control of the speech articulators."

It seems reasonable, then, to hypothesize that children who lack visual cues may be at risk for speech sound production difficulties. Methodologies to explore the co-occurrence of these deficits vary. James and Stojanovik (2007) utilized a parent checklist to investigate co-existing communication disorders in children with VI. The children's mean percentile rank was 34.4, placing them in the lower third of performance abilities. LeZak and Starbuck (1964) analyzed speech samples of 173 children who attended a residential school for students with VI and found that 37% exhibited speech disorders.

One significant difficulty that researcher face is, as Elstner (1983) observed, that there really is no homogeneous population of persons with VI to research. Differences in speech sound production can vary considerably within a population that is diverse in etiology of disorder, presentation of impairment, and severity of impairment, as well as in occurrence of co-morbid conditions. In the United States, 0.6% of persons under the age of 18 have a visual impairment characterized by blindness in one or both eyes or by vision that cannot be corrected by glasses. This represents 448,000 children and youth. One in every 20 preschool children has a visual impairment that can affect learning (Lighthouse International, n.d.).

Methods

Given the limited information on the prevalence and nature of speech sound production deficits in children with VI, the purpose of this preliminary study is to survey VI professionals to explore the presence of speech sound production deficits in children with VI, and to identify some of the variables that may coexist with speech sound production deficits. This study addressed the following research questions:

- Per the report of VI professionals, what percentage of a sample of students with VI exhibits co-occurring speech sound production deficits? Are there any age-related trends? What are the cognitive abilities of the students identified with speech sound production deficits?
- What is the relationship of two vision variables, (a) severity of VI and (b) onset of VI, to the VI professionals' reports of co-occurring speech sound production deficits?

The rationale for using a survey methodology is that VI professionals have a unique vantage point for identifying what is known about the development of children with VI. This survey is an indirect measure that can yield some initial evidence and begin the groundwork for more detailed direct investigations of speech sound production in children with VI.

Data sources

Participants

The authors emailed state-level administrators of VI educational programs from 16 states representing all U.S. regions to request that they invite VI professionals within their states to participate in the survey. Five administrators (31% of those solicited) from Colorado, Iowa, Nebraska, Michigan, and South Dakota, responded. Forty VI professionals received invitations. Eighteen VI professionals responded to the survey invitation. The participants had diverse work assignments, representing rural, suburban, and urban settings. Their job titles were (a) Teacher Consultant for the Blind/Visually Impaired, (b) Vision Consultant, or (c) Teacher of the Blind/Visually Impaired. All of these educators were involved in the development and implementation of the students' Individualized Educational Plans (IEP). Despite their various job titles, their roles were similar, that being to provide direct services to the students.

Next, the authors provided participants with training on how to complete the survey in one of two ways: (a) participants and researchers engaged in personal phone calls (n=12) or (b) participants viewed an electronically accessed training video (n=6) produced by the researchers. Training taught how to rate speech sound production as "clear and age-appropriate," "mildly impaired," or "moderately to severely impaired." The researchers trained participants on how to review students' records in order to establish that children receive (or have received) speech sound production interventions.

Instrumentation

The survey identified students' age, gender, ethnicity, vision status (onset and severity of VI), hearing status (unimpaired or impaired), cognitive status (typical cognition, or mild, moderate, or severe intellectual disability) and speech sound production deficits, and the presence of other conditions (e.g., autism). The VI professionals categorized each student's speech sound production as a) clear and age-appropriate, b) demonstrating mild speech sound errors (errors that do not impair general intelligibility, are few in quantity,

infrequently produced, less prominent, subtle, or in the context of words that are more difficult to say), or c) demonstrating moderate or severe speech sound errors (that impair general intelligibility, are many in quantity, frequently produced, prominent, and in most or all speaking contexts).

Results

Due to word count, this proposal describes only part of the findings. Fuller results will be provided during the presentation. Findings described here represent only the bolded numbers in tables.

VI professionals reported data for 271 students on their caseloads. All respondents attested that they had reported on the entirety of their caseloads, which controls for possible selection bias within caseloads. The first consideration in data analysis was to rule out students with moderate or severe intellectual disability and autism. Only children with typical cognition or a mild intellectual disability (n = 120) were included in the current analyses. All 120 students were reported to have hearing within normal limits. No student was on the caseload of more than one VI professional who participated in the study; there is no possibility of double counting any student.

To provide context for the significance of 120 responses, it is important to establish that VI is a low prevalence condition. A total of 1,648 children with VI are reported in Colorado, Iowa, Nebraska, Michigan, and South Dakota combined (National Center for Education Statistics, 2011). The overall sample of 271 students accounts for approximately 16% of the states' students with VI. The delimited sample of 120 students represents a little over 7% of all of the students with VI in these states.

Table 1 shows participants' severity of VI according to their age groups. The majority of students (n = 71, 59%) are classified as low vision, 36 (30%) are legally blind, and 12 (10%) are blind. Students' ages are relevant because speech production expectations differ markedly according to children's ages. Sixty-nine of the students are males and 51 are females. A large proportion of the children (90%) were diagnosed with VI at

birth, which is an occurrence rate similar to an epidemiological study by Mervis, Yeargin-Allsopp, Winter, and Boyle (2000).

Statistical Results

Percentages of co-existing VI and speech sound production deficits. Table 2 presents that an average of 29% of the sample receives speech sound production intervention. An average of 42% of the sample had previously received speech sound production intervention.

To compare these percentages of occurrence in these five states, the authors requested state-level data. All five states reported that it is not possible to determine the percentage of students in these five states who receive speech-language services specifically for speech sound production deficits. However, the percentages of students who receive special education services of any kind are as follows: Colorado: 10%; Iowa: 14%; Michigan 14% (Data Accountability Center, 2012). The percentages of students receiving speech sound production interventions would be a smaller proportion of these rates.

The averages of 29% of students with VI currently receiving interventions and 42% previously receiving interventions are far greater numbers than are seen in the general population who receive speech-language services to address any type of speech or language disorder or who receive special education services for any reason. On average, 71% of their students with VI have received interventions for speech sound production at some time.

Speech sound production deficit severity ratings. Severity ratings are presented in Tables 2 and 3. Overall, 56% of the children with mild intellectual disability were receiving speech sound production intervention, compared to 18% of the children with typical cognition.

Correlation between vision variables and speech variables. Spearman rank correlational analyses were computed for the two vision variables – severity of VI and onset of VI – as related to the two speech

sound production variables – receiving speech sound production intervention and speech sound production severity judgments. Correlations for students with typical cognition appear in Table 4, and correlations for students with mild intellectual disability appear in Table 5.

Severity of VI. Severity of VI is related to severity of speech sound production deficit in students with typical cognition, $r = .24$ ($df = 77$, $p = .017$). Severity of VI is not correlated with severity of speech sound production deficit in students with mild intellectual disability.

Onset of VI. Onset of VI is not correlated with either of the speech variables for any of the students.

Significance of the Study

It seems reasonable to suspect that insufficient visual input contributes to children's risk for speech sound production deficits. The elevated occurrence rate is consistent with previous studies that describe the occurrence of speech sound production deficits in children with VI (House, 2000; James & Stojanovik, 2007; LeZak & Starbuck, 1964; Mills, 1988).

The current results describe subsets of children with VI by cognitive levels, severity of VI, and onset of VI, which have been not described in the prior literature. Children with typical cognition and less severe VI are more likely to exhibit typical speech sound production.

Practitioners need to be aware that students with any degree of VI should be carefully assessed and monitored to ascertain a need for interventions. Severity of VI correlated with severity of speech sound production deficits in children with typical cognition; therefore, one cannot assume that a child with VI who has typical cognition will develop appropriate speech sound production. Among children with mild intellectual disability, the data obtained show that the need is even greater.

Moreover, the need for early intervention is crucial. Resolution of speech sound production deficits may take more time and this protraction may have a long-term impact on literacy development.

The findings of the current study substantiate the need for future research related to the influence of VI on speech sound production and on the effectiveness of speech sound production interventions. It may be that VI negatively influences speech sound production, or perhaps the children's decreased vision inhibits the effectiveness of speech sound production interventions provided to this population. More efficacy research on applying treatments that are successful with children without VI to children with VI is warranted. These investigations may provide a better understanding of the role vision plays in the speech sound production process and may contribute to the pursuit of improved speech sound production outcomes for children with VI.

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Table 1

Student characteristics by age group, VI status, and gender

		Vision Impairment Status			Gender	
Age Group	N	Low Vision	Legally Blind	Blind	Male	Female
Early Childhood Ages 0-5	25	4	10	17	12	13
Early Elementary Ages 6-9	32	4	10	17	16	16
Late Elementary/ Adolescence Ages 10 and older	63	39	19	5	41	22
Total	120	**71**	**36**	**12**	69	51

Table 2

Percentages of students who receive or have received speech sound production intervention; range of severity of children's speech sound production deficits

	Services			Severity		
	Currently Receiving Speech Sound Production Intervention	Previously Received Speech Sound Production Intervention	Combined Total: Currently and Previously Received Speech Sound Production Intervention	"Clear and Age Appropriate Speech" Production	Some Speech Sound Production Errors Present (Mild)	Many Speech Sound Production Errors Present (Moderate Or Severe)
Early Childhood Ages 0-5 (n = 25)[1]	52% (n = 13)	32% (n = 8)	84% (n = 21)	40% (n = 8)	35% (n = 7)	25% (n = 5)
Early Elementary Ages 6-9 (n = 32)	32% (n = 10)	45% (n = 14)	77% (n = 24)	56% (n = 18)	38% (n = 12)	6% (n = 2)
Late Elementary/ Adolescence Ages 10 and Older (n = 63) [2]	18% (n = 11)	45% (n = 28)	63% (n =39)	77% (n = 47)	20% (n = 12)	3% (n = 2)
Average Across All Ages (n = 120) [3]	**29%** (n = 34)	**42%** (n = 50)	**71%** (n = 84)	65% (n=73)	27% (n = 31)	8% (n = 9)

[1]Early Childhood: 5 cases are missing from the severity totals

[2]Late Elementary/Adolescence: 2 cases are missing from the severity totals

[3]Average Across All Ages: 7 cases are missing from the severity totals

Table 3

Percentage of students who receive speech sound production intervention vs. percentage of students with "clear and age-appropriate speech" disaggregated by cognitive levels

	Mild Intellectual Disability			Typical Cognition		
	N	% Receiving Speech Sound Production Intervention	% Exhibits "Clear and Age-Appropriate Speech"	n	% Receiving Speech Sound Production Intervention	% Exhibits "Clear and Age-Appropriate Speech"
Early Childhood Ages 0-5	8	75%	25%	17	41%	50%
Early Elementary Ages 6-9	8	75%	25%	24	17%	67%
Late Elementary/Adolescence Ages 10 and older	18	39%	58%	45	9%	84%
Total	34	**56%**	41%	86	**18%**	68%

Table 4

Correlations between VI and speech sound production (SSP) intervention in children with typical cognition

	1. VI Severity	2. VI Onset	3. Speech Severity	4. Receiving SSP Intervention
1. VI Severity	___	.13 (p=.118)	**.24* (p=.017)**	.027 (p=.807)
2. VI Onset		___	.12 (p=.143)	.07 (p=.532)
3. Speech Severity			___	.68** (p=.000)
4. Receiving SSP Intervention				___

Note: * = p < .05; ** = p <.01

Table 5

Correlations between VI and speech sound production (SSP) intervention in children with mild intellectual disability

	1. VI Severity	2. VI Onset	3. Speech Severity	4. Receiving SSP Intervention
1. VI Severity	___	.47** (p=.005)	.16 (p=.371)	.03 (p=.882)
2. VI Onset		___	.18 (p=.652)	.03 (p=.868)
3. Speech Severity			___	.85** (p=.000)
4. Receiving SSP Intervention				___

Note: ** = p <.01