HHS Public Access

Author manuscript

Semin Speech Lang. Author manuscript; available in PMC 2017 November 30.

Published in final edited form as:

Semin Speech Lang. 2015 November ; 36(4): 283–294. doi:10.1055/s-0035-1562911.

Social, emotional, and academic impact of residual speech errors in school-age children: A survey study

Elaine R. Hitchcock,
Montclair State University

Daphna Harel, and
New York University

Tara McAllister Byun
New York University

Abstract

Children with residual speech errors face an increased risk of social, emotional and/or academic challenges relative to their peers with typical speech. Previous research has shown that the effects of speech sound disorder may persist into adulthood and span multiple domains of Activity Limitations and/or Participation Restrictions, as defined by the World Health Organization's International Classification of Functioning, Disability and Health (ICF) model.[1] However, the nature and extent of these influences varies widely across children. This study aimed to expand the evidence base on the social, emotional, and academic impact of residual speech errors by collecting survey data from parents of children receiving treatment for /r/ misarticulation. By examining both an overall measure of impact (weighted summed score) and responses to individual questions, the present study offers preliminary suggestions for factors that could be taken into consideration when making decisions pertaining to treatment allocation in this population.

Keywords

residual speech errors; rhotic sounds; survey; socioemotional challenges

In childhood speech sound disorder (SSD), deficits in spoken communication pose a barrier to academic and social participation whose impact may be lifelong.[2] SSD affects an estimated 10% of preschool and school-aged children[3] and makes up a substantial proportion of the typical caseload for speech-language pathologists (SLPs). Most children who present with speech errors early in life do go on to develop perceptually typical speech by 8 to 9 years of age. When speech sound errors extend past this age, they can be termed residual speech errors, or RSE.[4] These errors may continue even in children who have received months or years of intervention.[5] The focus in this study is on residual errors

Contact Information: Elaine R. Hitchcock, Department of Communication Sciences & Disorders, 1515 Broad Street, 2nd Floor, Bloomfield, NJ 07003, Ph: 973.229.3797, hitchcocke@mail.montclair.edu.

affecting the North American English rhotic /r/, which was the type of RSE most frequently reported by school-based SLPs in a 1995 survey.[5]

The /r/ sound poses a notable challenge for many children acquiring English as their first language. In normative studies of typically-developing children,[6] /r/ has one of the latest ages of mastery, and it is almost invariably found among the error sounds of children with SSD. Speakers' difficulties acquiring /r/ are thought to be explained at least in part by the articulatory complexity of the sound.[7] While most speech sounds are produced with only one major lingual constriction or narrowing of the vocal tract, articulatory descriptions of North American English /r/ identify both an anterior and posterior lingual constriction. Further, the critical lingual constrictions for /r/ are not externally visible, and they provide little in the way of tactile-kinesthetic feedback to the speaker. As a consequence, clinicians report that they find /r/ to be one of the most challenging sounds to treat in articulatory intervention.[8]

Research to date has not yet converged on a best-practice intervention approach for RSE, although there is growing evidence that biofeedback methods can be effective in this population.[9–11] Lacking effective treatment options, SLPs often discharge these clients with their errors uncorrected.[5] The stated rationale for this decision may be that these errors have a relatively minor impact on intelligibility and often do not have a discernable impact on academic performance.[12] However, multiple studies have found that atypical speech can pose a barrier to participation in both academic and social settings, with effects lasting well into adulthood.[2,13] Furthermore, there is evidence that these impacts are not limited to children with a high level of severity or unintelligibility; studies have found that older children with as few as one or two speech sound errors are judged more negatively than their peers.[12,14,15] The existing literature on this subject is reviewed in more detail below.

Children as young as preschool age have been found to use communicative competence as a measure of peer popularity. Gertner, Rice, and Hadley[16] found that preschoolers were more likely to express positive judgments of children with typically developing speech and language compared to those with a speech and language impairment or English as a second language. In older children, a number of studies have reported evidence that even a mild speech disorder, consisting of as little as one error, can have negative consequences for the speaker in the domain of social interactions and peer perceptions. Using a semantic differential scale, Crowe Hall[14] evaluated the attitudes of fourth and sixth graders elicited by videos of peers with and without speech errors. Children with speech errors received more negative attitude judgments on their skills as "talkers," their likability as peers, and their likelihood of success in the upcoming teenage years. Relevant sex differences were also observed. Male speakers with speech errors were judged more negatively in comparison to their typical peers than females with speech errors; male listeners also tended to be more negative in their survey responses than female listeners. In a similar study by Freeby and Madison,[17] the speech of children with /r/ errors was judged more negatively than that of their peers on scales reflecting intelligence and personality measures. Again, male speakers were judged more negatively than female speakers. Finally, Silverman and Paulus[12] evaluated the reactions of 26 high school sophomores in response to a scenario depicting a typical speaker and a speaker demonstrating a /w/ for /r/ substitution. Using a series of

semantic differential scales, these authors reported that high school students who demonstrate this substitution were frequently judged as “speaking poorly” and their speech was described as “disfluent, unpleasant, soft, boring, and dull”.[12](p220) A number of additional undesirable descriptors were assigned to these speakers, including “nervous,” “less confident,” and “isolated.”[12](p220)

The psychological ramifications of a speech sound disorder in childhood may persist well beyond the actual presentation of the speech errors. In a 28-year follow-up of adults with histories of moderate phonological disorders, Felsenfeld et al[13] found that individuals with phonological errors had less favorable academic outcomes, as measured by lower high school grades, than a comparison group with no history of SSD. The individuals with histories of SSD were disproportionately more likely to work in jobs that required minimal academic rigor when compared to controls. These disparities were observed even though individuals with a history of SSD generally presented with intelligence in the normal range. The study by Felsenfeld et al[13] did not specifically address individuals who initially presented with only one or two sounds in error. However, it is known that many children with RSE originally presented with moderate to severe speech sound errors, with those errors resolving over time until only one or two speech sound distortions remain.[18,19]

Using the ICF framework to evaluate the impact of speech disorders

Although numerous studies suggest that RSE can have a negative impact on children’s social and emotional well-being, the magnitude of this impact varies widely across individuals. It would be useful to document how the severity of socioemotional impact is influenced by different characteristics of the child or the child’s environment. However, it is difficult to measure socioemotional impact in a precise, quantifiable way. One relatively structured alternative is to draw on an accepted framework for evaluating an individual’s ability to execute and participate in life activities. McCormack et al[2] conducted a systematic review of relevant literature over a 10-year period to evaluate the impacts of speech impairment using the International Classification of Functioning, Disability and Health (ICF)[1] model released by the World Health Organization (WHO). This framework moves away from a narrow definition of health as the absence of disease; instead, it conceptualizes health in terms of the individual’s ability to function at his/her fullest potential in his/her living environment. Impacts on health are classified in terms of Activity Limitations and/or Participation Restrictions, with further subdivision into nine chapters. The chapters that were most commonly associated with SSD in the systematic review were *Learning and applying knowledge, Interpersonal interactions and relationships, Communication*, and *Major life areas*.

McCormack et al[2] reviewed numerous articles reporting evidence of an association between speech sound disorder and difficulty in the domain of *Learning and applying knowledge*. Of particular relevance to the present study, they noted that the risk of experiencing academic deficits in connection with speech impairment was greater in children whose speech errors persisted through school age.[20–22] In the *Communication* domain, there is an abundance of research documenting deficits in intelligibility and spoken communication associated with childhood speech sound disorder. McCormack et al[2] additionally reported evidence of a

meaningful impact of speech impairment on several subdomains of *Interpersonal interactions and relationships*. Overall, studies have shown that speech impairments are associated with: a) lowered academic expectations and limitations on teacher-child relationships[23,24]; b) difficulty with initiation and maintenance of peer relationships (see literature reviewed in previous section); c) increased parental anxiety and more difficulty forming a nurturing parent-child relationship[2]; and d) negative impact on sibling relationships. Finally, in the *Major life areas* of school education and acquiring, keeping, and terminating a job, children with speech impairments were found to be at increased risk for reading difficulties[23] and workplace difficulties, including job termination, harassment, and discriminatory hiring practices.[24]

Overall, the systematic review by McCormack et al[2] provides important evidence that speech impairment is associated with limitations on activities and participation across multiple domains. Because their review involved drawing comparisons across different studies with widely varying methodologies, McCormack et al[2] were not able to comment on the relative magnitude of the impact of speech impairment in different domains (e.g., academic versus social). However, some current policies for making decisions about treatment allocation include an implicit assumption about the relative importance of these domains. Specifically, some school districts allocate services preferentially to children whose speech disorder can be shown to affect academic performance (e.g., by appearing in spelling errors).[12] It is possible that children whose speech errors interact with academic performance are more severely impacted overall by their speech impairment than children who do not show corresponding academic effects. On the other hand, it is also plausible that a different factor might be more predictive of the overall degree of impact that RSE can be expected to have on life participation and satisfaction. Systematic evidence should be collected to address this question, which has potential implications for decisions about treatment allocation.

Survey study

The survey research described in this paper was carried out to collect new data addressing the question framed above. Because this survey collected information about three ICF domains within the same sample of participants, it is possible to compare the relative impact of deficits in these domains on children's overall well-being. To analyze the survey data, we derived an overall measure of impact (a transformation of the weighted summed score) from the questionnaire. It was hypothesized that certain question(s) or domain(s) would be more sensitive predictors of overall impact. In addition, based on previous research, it was hypothesized that the overall impact would be greater for older versus younger and for male versus female children with /r/ misarticulation.

An 11-question survey was constructed that asked parents of children with speech sound errors affecting /r/ to estimate the impact of their child's speech impairment on various areas of life participation and satisfaction. In keeping with the structured ICF framework used by McCormack et al,[2] each survey question was categorized according to the most relevant chapter of the Activities and Participation framework. The questions fell primarily into two domains: *Interpersonal interactions and relationships* and *Major life areas*, with two other

questions that were most closely aligned with the *Communication* chapter. The questions and their associated ICF domains are represented in Table 1. Each question was presented in connection with a 5-point Likert scale, where a response of 5 represented “strongly agree” and a response of 1 represented “strongly disagree.”

Survey data for children with /r/ misarticulation

The majority of survey responses reported in this study were collected as part of the intake procedure when children were evaluated for inclusion in one of several research studies investigating the efficacy of biofeedback treatment for /r/ misarticulation.[9,10,25] Additional responses were solicited through a letter that described the survey and invited clinicians to share this information with the families of any children on their caseload who were receiving treatment for /r/ misarticulation; the letter was posted to mailing lists and social media channels targeted at SLPs. To complete the survey, respondents were required to self-report that they were over the age of 18, were the parent or guardian of a child who currently has difficulty producing the North American English /r/ sound, and were fully proficient speakers of English. (One parent who completed the survey as part of an initial evaluation for treatment was primarily Spanish-speaking; a bilingual SLP read through the survey with her, translating the questions and recording her responses.)

A total of 101 surveys were collected between the years 2010 and 2015. Ten surveys were discarded due to missing data. Of the remaining 91 surveys, 60 were collected in studies conducted at Montclair State University, 22 were collected in studies conducted at New York University, and 9 were collected online. Because the three groups did not differ significantly in their overall impact scores (described below), all results were pooled for the purpose of analysis and discussion.

Participant characteristics

The children described by these parent surveys were reported to range in age from a minimum of 5;6 to a maximum of 15;9 (see Figure 1), with a median age of roughly 9;6. (One online survey was excluded from calculations involving age due to an error in which the parent reported the current year instead of the child’s year of birth.) A total of 21 children were below the age of 8;0, meaning that their /r/ misarticulation could potentially be classified as developmental rather than residual; 69 children were 8;0 or older. A total of 66 participants were reported to be male, versus 24 female participants. This is in keeping with previous literature indicating a greater prevalence of RSE among male than female speakers.[26]

A total of 84 parents reported that English was the primary or only language in the home, and three parents indicated that English and another language were spoken; three parents did not answer this question. Parents reported that 43 participants were currently receiving treatment targeting /r/ in the school setting exclusively; 9 were receiving exclusively private therapy, and 6 were receiving both school and private therapy. For 31 participants, parent report indicated that no treatment targeting /r/ was currently being received, and one parent did not respond to this question. The duration of previous treatment targeting /r/ (based on

parent report) ranged from 0 to 11 years, with a median of two years. Eleven participants were reported to have received no previous treatment.

Analysis of responses

Our first goal was to derive a measure that would estimate the overall degree of impact of /r/ misarticulation on a given child's activities and participation. The simplest way to estimate overall impact would be to use a summed score, i.e., add together the values of all parent responses on one survey; a higher score would indicate a greater degree of overall impact. (For all questions but one, a higher-numbered score indicated a more negative impact on the child's well-being. The one exception, "My child is happy with his speech," was reverse-coded prior to analysis so that across all questions, a higher score was indicative of a more negative degree of impact.) For a more nuanced measure of impact, though, we opted to put more weight on questions that were most specific to the condition under investigation. For example, the question "My child is reluctant to participate in activities that call for public speaking" might not be a highly specific indicator of how /r/ misarticulation affects participation, because people can be reluctant to engage in public speaking for a variety of reasons that are not necessarily related to speech production difficulties. On the other hand, a parent's response to a question like "My child feels that his/her speech sounds different from other children's" provides information that is more specifically linked to the child's misarticulation. It is not appropriate to assign these weights by hand, because individuals might have different opinions of how specifically a given question is related to /r/ misarticulation. Instead, these weights can be derived automatically using a statistical method called a Generalized Partial Credit Model (GPCM).[27] A GPCM weights scores observed on individual survey questions to form a total score, while characterizing questions as more versus less associated with the total score.

The GPCM analysis provides information about each child in the form of an overall impact score that is weighted to account for the specificity of each question. These impact scores are scaled to have a mean of zero and standard deviation equal to one, so that a child with a score of two shows an impact that is two standard deviations above the mean degree of impact in the sample. This information might be useful for treatment allocation, with the rationale that children who are most strongly impacted by /r/ misarticulation should have top priority for immediate intervention. It can also be used to address our two secondary questions pertaining to the relative impacts of /r/ misarticulation on different demographic groups. T-tests were used to assess whether the degree of overall impact differed between male and female children and between older and younger children. To evaluate the effect of age, we asked whether there was a difference between children less than eight years of age, where non-adult-like production of /r/ might still be considered within normal limits, and children eight years of age and older, who might be classified as presenting with RSE.

In addition to providing a composite measure of impact for each child, the GPCM provides a measure of specificity, called the "discrimination parameter," for each individual question on the survey. This measure represents how strongly scores on a particular question are associated with the overall degree of affectedness. A question with a high level of discrimination is effective in classifying children into groups representing a high or low

degree of overall impact. Questions with a low level of discrimination are less successful in classifying children as more versus less affected. This analysis can be used to address our question about which questions or domains, such as academic versus social, can be regarded as the most sensitive predictors of overall impact. Because some school systems currently use degree of academic impact as a criterion for deciding whether or not a child can receive intervention for speech errors, we specifically examined how strongly the survey question asking about the influence of misarticulation on the child's academic performance was associated with the composite measure of overall impact.

Impact range using the GPCM

We began by ranking the 11 questions according to their discrimination parameters from the GPCM. Questions with the highest discrimination parameters were most strongly associated with overall degree of impact. The most discriminative question, by a substantial margin, asked whether the child's speech difficulty had an impact on his/her social interactions. The next most discriminative question was "My child's speech has an impact on his/her general life satisfaction," followed by "My child has been teased or bullied because of the way his/her speech sounds." Questions representing the *Interpersonal interactions and relationships* chapter of the ICF framework tended to be more strongly associated with overall impact than questions representing the *Communication* and *Major life activities* chapters. Specifically, four out of the five questions with the highest discrimination parameters belonged to the *Interpersonal interactions and relationships* chapter, whereas only one out of the five questions with the lowest discrimination parameters came from this category.

As noted above, the extent to which a child's speech errors affect his/her academic performance is sometimes used as a criterion to determine whether or not the child should receive intervention. Thus, we were particularly interested in the discrimination parameter of the survey question specifically addressing this issue ("My child's speech has an impact on his/her academic performance"). This question was ranked sixth out of the 11 survey questions, with a moderate discrimination parameter of 0.52. Compared to questions assessing the child's participation in social activities and evaluating the child's emotional well-being, the question about academics was a less useful indicator of overall degree of impact.

Figure 2 provides two histograms representing the impact scores for the 91 children included in the GPCM analysis. Children with impact scores greater than zero have higher than average socioemotional impact compared to the rest of the sample; children with negative impact scores are less impacted than average for this sample. In Figure 2A, the 91 children have been subdivided by gender. The t-test for gender was not statistically significant, indicating that on average, males and females in this sample did not differ in their socioemotional impact scores. Figure 2B again presents the histogram of impact scores for all 91 children, but in this case they are subdivided by age. The impact scores for children less than eight years of age tend to be lower than the impact scores for older children. Confirming this visual impression, the t-test comparing younger versus older children was statistically significant ($t = -2.8$, df = 47, $p < .01$). This is consistent with the fact that

misarticulation of /r/ can be considered within normal limits for children up to eight years, but in older children, it can be classified as atypical.

Discussion

It is a reality that many school SLPs face overwhelming caseloads, and that many children with communication needs are in competition for limited resources. Under these circumstances, it is understandable that some school districts adopt policies to prioritize the provision of speech-language services to children with the most pressing needs. However, decisions about which children receive top priority should be based on the best available evidence. In the course of our intervention research, we have heard numerous parents express frustration that their child's speech deficits were deemed ineligible for treatment in the school setting due to a lack of impact on academic performance. In the subjective view of these parents, it seemed, a child could exhibit strong academic performance yet still be meaningfully impacted by speech errors.

The present study collected parent survey data with the goal of achieving a deeper understanding of how social, emotional, and academic factors relate to Activity Limitations and Participation Restrictions in children with RSE. The results of our analysis indicated that the question most strongly associated with overall impact asked whether a child's speech errors affected his or her social interactions. Furthermore, four out of the five most strongly associated questions fell in the *Interpersonal interactions and relationships* chapter of the ICF framework. The question asking whether the child's speech errors affected academic performance was moderately associated with overall impact, ranking sixth out of the 11 survey questions. Thus, the results of the present study suggest that academic impact is a worthwhile factor to take into consideration when making decisions about treatment allocation for children with speech sound errors, but they do not support the practice of using academic impact as the sole criterion to determine eligibility for intervention.

Readers who are interested in the legal issues pertaining to decisions about treatment allocation are referred to a 1980 correspondence between Stan Dublinske (Director of the School Services Program at ASHA) and Edwin Martin (Acting Assistant Secretary for Special Education & Rehabilitative Services, Department of Health, Education and Welfare)[28]. Mr. Dublinske asked for clarification of how the term "adversely affects educational performance," used in the Education for All Handicapped Children's Act of 1975 (PL 94-142), should be interpreted for children with speech impairment. Mr. Martin's response includes the following statement:

> In the event that the speech-language pathologist establishes through appropriate appraisal procedures the existence of a speech/language impairment, the determination of the child's status as a "handicapped child" cannot be conditioned on a requirement that there must be a concurrent deficiency in academic performance (3).

Additional findings of interest from the present study pertained to differences in overall impact between groups of children. It is noteworthy that the overall negative impact of /r/ misarticulation was reported to be more severe for children eight years of age and older than

for younger children. Considering this finding in connection with evidence that spontaneous resolution of speech sound errors is unlikely after around eight years of age,[4,29] it seems particularly vital to provide speech intervention services to older children affected by RSE. Finally, because previous studies have reported that males with RSE may be judged more negatively than females,[14,17] it was hypothesized that male speakers would show a more negative overall impact of RSE than female speakers. However, the present study revealed no significant effect of gender on overall impact scores.

Limitations and future directions

Although the present results make a novel contribution to the literature on the social, emotional, and academic impact of speech errors with possible implications for treatment planning, it is important to recognize the limitations of this study. First, the parents who responded to this survey were actively exploring treatment or supplemental services for their child's rhotic misarticulation. Thus, the sample in question cannot be treated as a neutral representation of the broader population of children with RSE; it is possible that they represent the extreme end of a continuum of severity of impairment or magnitude of impact. Alternatively, the parents who sought this treatment for their children may have been more concerned about the impact of /r/ misarticulation on their child's well-being than the average parent of a child with RSE. However, this paper does not aim to quantify the absolute magnitude of the impact of /r/ misarticulation on well-being; rather, it aims to identify relationships within the survey (e.g., which questions are most successful in differentiating children who are highly impacted versus children who are less impacted overall).

Second, the small size of the sample (91 usable responses) limits the degree of confidence we can have in the conclusions of the statistical analysis reported here. Another limitation is that the three ICF chapters considered here were represented by different numbers of questions (five representing *Interpersonal interactions and relationships*, four representing *Major life areas*, and two representing the *Communication* chapter). Because the category of *Interpersonal interactions and relationships* contributed the largest number of questions to the survey, it is to be expected that these questions will be strongly associated with the overall impact scores. However, a separate statistical model (exploratory factor analysis) was used to evaluate the possibility that there might be multiple factors or domains contributing to the overall impact score. For the present data, this model did not indicate that the questions measuring the categories of *Major life areas* and *Communication* were behaving as separate factors that could not be analyzed alongside the questions assessing *Interpersonal interactions and relationships*. Still, we do anticipate that a larger sample size of survey responses could reveal independent influences of each of the three ICF domains on a child's overall impact score.

Overall, there is a clear need to follow up on the present research using a refined questionnaire and a larger sample size. Nevertheless, the survey and results reported here can provide a useful starting point for an ongoing conversation about how children are affected by residual speech errors and how clinicians and schools might act to optimize their social, emotional, and academic outcomes.

Conclusions

The current study is in agreement with previous research in finding that children may experience social, emotional, and/or academic challenges in connection with speech sound disorder. The present results underline that these difficulties are not limited to severely unintelligible speakers; although the great majority of children represented in this study were highly intelligible and exhibited only 1–2 sounds in error, parents endorsed a high degree of impact on their children in various domains. The overall impact of speech errors was found to be greater in older than younger children. Furthermore, the survey questions representing the *Interpersonal interactions and relationships* chapter of the ICF framework were found to be most strongly associated with overall severity in the present sample. These results suggest that, to find the children who are experiencing the greatest Activity Limitations and Participation Restrictions in connection with speech sound disorder, clinicians and schools should consider the social and emotional dimensions of impact. This contrasts with the practice, not uncommon in US schools, of making decisions about treatment allocation on the basis of whether the child's speech errors affect his or her academic performance. The survey used in this study could give clinicians a concrete way to assess and document the social and emotional difficulties faced by many children with RSE, and to advocate for services to reduce the impact of these challenges.

Acknowledgments

This research was supported by NIH R03DC 012883 and a Separately Budgeted Research Grant from Montclair State University.

References

1. World Health Organization. International classification of functioning, disability, and health: children & youth version. Geneva, Switzerland: World Health Organization; 2007.
2. McCormack J, McLeod S, McAllister L, Harrison LJ. A systematic review of the association between childhood speech impairment and participation across the lifespan. Int J Speech Lang Pathol. 2009; 11(2):155–170.
3. National Institute on Deafness and Other Communication Disorders. National strategic research plan. Bethesda, MD: Department of Health and Human Services; 1994.
4. Shriberg LD, Gruber FA, Kwiatkowski J. Developmental phonological disorders III: long-term speech-sound normalization. J Speech Lang Hear Res. 1994; 37(5):1151–1177.
5. Ruscello DM. Visual feedback in treatment of residual phonological disorders. J Commun Disord. 1995; 28(4):279–302. [PubMed: 8576411]
6. Smit AB, Hand L, Freilinger JJ, Bernthal JE, Bird A. The Iowa articulation norms project and its Nebraska replication. J Speech Hear Disord. 1990; 55(4):779–798. [PubMed: 2232757]
7. Gick B, Bernhardt B, Bacsfalvi P, Wilson I, Hansen Edwards J, Zampini M. Ultrasound imaging applications in second language acquisition. Phonology Second Lang Acquisition. 2008; 36:315–328.
8. Shuster LI, Ruscello DM, Toth AR. The use of visual feedback to elicit correct /r/. Am J Speech Lang Pathol. 1995; 4(2):37–44.
9. McAllister Byun T, Hitchcock ER. Investigating the use of traditional and spectral biofeedback approaches to intervention for /r/ misarticulation. Am J Speech Lang Pathol. 2012; 21(3):207–221. [PubMed: 22442281]

10. McAllister Byun T, Hitchcock ER, Swartz MT. Retroflex versus bunched in treatment for rhotic misarticulation: evidence from ultrasound biofeedback intervention. J Speech Lang Hear Res. 2014:1–15. [PubMed: 24687464]
11. Preston JL, McCabe P, Rivera-Campos A, Whittle JL, Landry E, Maas E. Ultrasound visual feedback treatment and practice variability for residual speech sound errors. J Speech Lang Hear Res. 2014; 57(6):2102–2115. [PubMed: 25087938]
12. Silverman FH, Paulus PG. Peer reactions to teenagers who substitute /w/ for /r/. Lang Speech Hear Serv Sch. 1989; 20(2):219–221.
13. Felsenfeld S, Broen PA, McGue M. A 28-year follow-up of adults with a history of moderate phonological disorder: educational and occupational results. J Speech Lang Hear Res. 1994; 37(6): 1341–1353.
14. Crowe Hall BJ. Attitudes of fourth and sixth graders toward peers with mild articulation disorders. Lang Speech Hear Serv Sch. 1991; 22(1):334–340.
15. Silverman FH, Falk SM. Attitudes of teenagers toward peers who have a single articulation error. Lang Speech Hear Serv Sch. 1992; 23(2):187–187.
16. Gertner BL, Rice ML, Hadley PA. Influence of communicative competence on peer preferences in a preschool classroom. J Speech Lang Hear Res. 1994; 37(4):913–923.
17. Freeby N, Madison CL. Children's perceptions of peers with articulation disorders. Child Study J. 1989; 19(2):133–144.
18. Shriberg LD, Fourakis M, Hall SD, et al. Extensions to the speech disorders classification system (SDCS). Clin Ling Phonet. 2010; 24(10):795–824.
19. Flipsen P. Etiology and prevalence of persistent and residual speech sound errors. Sem in Speech and Lang Dis. (in press).
20. Preston JL, Edwards ML. Phonological processing skills of adolescents with residual speech sound errors. Lang Speech Hear Serv Sch. 2007; 38(4):297–308. [PubMed: 17890510]
21. Nathan L, Stackhouse J, Goulandris N, Snowling MJ. The development of early literacy skills among children with speech difficulties: a test of the critical age hypothesis. J Speech Lang Hear Res. 2004; 47(2):377–391. [PubMed: 15157138]
22. Young AR, Beitchman JH, Johnson C, et al. Young adult academic outcomes in a longitudinal sample of early identified language impaired and control children. J Child Psychol Psychiatry. 2002; 43(5):635–645. [PubMed: 12120859]
23. Overby M, Carrell T, Bernthal J. Teachers' perceptions of students with speech sound disorders: A quantitative and qualitative analysis. Lang Speech Hear Serv Sch. 2007; 38(4):327–341. [PubMed: 17890513]
24. Marshall J, Ralph S, Palmer S. 'I wasn't trained to work with them': mainstream teachers' attitudes to children with speech and language difficulties. Int J Inclusive Educ. 2002; 6(3):199–215.
25. Hitchcock ER, McAllister Byun T. Enhancing generalisation in biofeedback intervention using the challenge point framework: A case study. Clin Ling Phonet. 2014; (0):1–17.
26. Shriberg, LD. Childhood speech sound disorders: From post-behaviorism to the postgenomic era. In: Paul, R., Flipsen, P., Jr, editors. Speech sound disorders in children: In honor of Lawrence D. Shriberg. San Diego, CA: Plural; 2009. p. 1-34.
27. Muraki, E. A generalized partial credit model. In: Linden, WJ., Hambleton, RK., editors. Handbook of modern item response theory. Springer; 1997. p. 153-164.
28. Edward, M. ASHA.org. Dept. of Health, Ed., and Welfare; 1980. ASHA Letter on Policy Interpretation of the term "Adversely Affect Performance" as it relates to speech impaired children. Web. 3 Feb. 2015. <http://www.asha.org/uploadedFiles/slp/schools/prof-consult/LetterPolicyInterpretation.pdf>
29. Gibbon FE, Paterson L. A survey of speech and language therapists' views on electropalatography therapy outcomes in Scotland. Child Lang Teach Ther. 2006; 22(3):275–292.

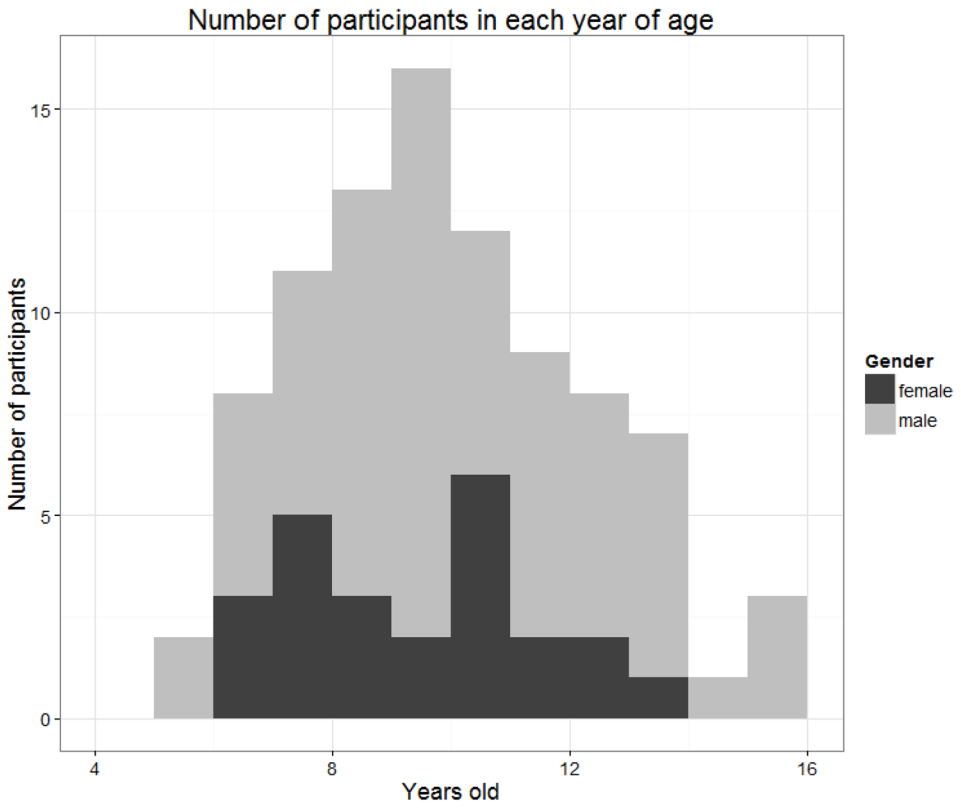

Figure 1.
Number of participants in each year of age, subdivided by gender

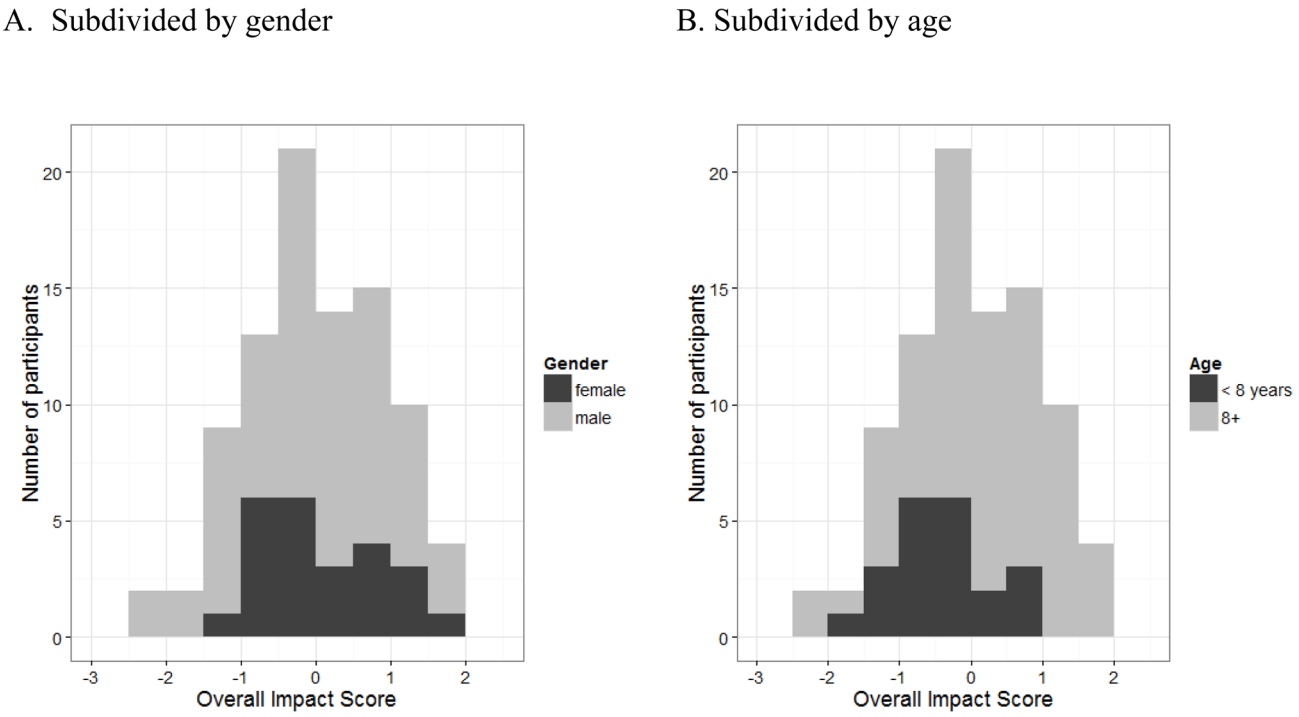

Figure 2.

Number of participants in each interval of overall impact. Impact scores have been scaled to a mean of 0 and a standard deviation of 1.

Table 1

Survey questions, subdivided by the most closely affiliated ICF Chapter

ICF Chapter/Component
Communication (d3)
My child's speech sounds different from the speech of other children his/her age.
My child feels that his/her speech sounds different from other children's.
Interpersonal interactions and relationships (d7)
My child is reluctant to speak to unfamiliar people.
My child's speech has an impact on his/her social interactions.
My child has been teased or bullied because of the way his/her speech sounds.
My child's speech is a source of conflict within our family.
I worry about my child's speech.
Major life areas (d8)
My child's speech has an impact on his/her academic performance.
My child is reluctant to participate in activities that call for public speaking (theater, debate, etc.).
My child is happy with the way his/her speech sounds.
My child's speech has an impact on his/her general life satisfaction.

Table 2

Survey questions, ranked by discrimination parameter. Discrimination parameters represent the strength of association between the score on each question and the level of overall impact. Higher discrimination parameters indicate that the question is a stronger indicator of overall impact.

Question	Category	Discrimination Parameter
My child's speech has an impact on his/her social interactions.	Interpersonal interactions and relationships	2.73
My child's speech has an impact on his/her general life satisfaction.	Major life areas	1.27
My child has been teased or bullied because of the way his/her speech sounds.	Interpersonal interactions and relationships	0.88
I worry about my child's speech.	Interpersonal interactions and relationships	0.72
My child's speech is a source of conflict within our family.	Interpersonal interactions and relationships	0.54
My child is happy with the way his/her speech sounds.	Interpersonal interactions and relationships	0.52
My child's speech has an impact on his/her academic performance.	Major life areas	0.51
My child is reluctant to speak to unfamiliar people.	Interpersonal interactions and relationships	0.49
My child is reluctant to participate in activities that call for public speaking (theater, debate, etc.).	Major life areas	0.40
My child feels that his/her speech sounds different from other children's.	Communication	0.38
My child's speech sounds different from the speech of other children his/her age.	Communication	0.37