Chapter 10
A Follow-up Study of the Linguistic and Intellectual Abilities of Children Who Were Phonologically Disordered

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Introduction

Disorders affecting speech sound production are among the most common of handicapping conditions during the preschool years; however, many questions remain regarding the long-term prognosis for children with this type of communication disorder. Moreover, it has been suggested that much diversity exists among children with speech sound production disorders (Dodd, 1995; Shriberg, 1997). For some of these children, problems affecting the phonological system are resolved during the preschool years and they may be indistinguishable during follow-up from children with no history of speech disorder. Other children, however, are likely to present with residual disorders of communication or certain types of specific learning disabilities (Shriberg and Kwiatkowski, 1988; Felsenfeld et al., 1992).

Despite inherent design limitations, follow-up studies can provide important information regarding the nature and course of communication disorders (Weiner, 1985). The present follow-up study was undertaken to extend our understanding of the linguistic and intellectual sequelae of phonological disorders in young children. Specifically, the project sought to describe group trends and to identify patterns of linguistic and intellectual abilities that distinguish subgroups of these children.

Method

Participants

The 21 children (7 females, 14 males) who participated in this study represented a subset of the 40 phonologically disordered children

described by Dinnsen, Chin, Elbert and Powell (1990). On average, the interval between the original assessment and follow-up was 4;9 (SD = 12 months). The average age of the participants at follow-up was 9;2 (SD = 17 months). The numbering conventions used by Dinnsen et al. (1990) to identify participants have been retained to facilitate comparison with previously published results.

Instrumentation

During the follow-up, a series of cognitive-communicative tests was administered to each child using standardized procedures. Included in this test battery were norm-referenced measures of language and intellectual abilities.

Linguistic skills were assessed using the *Clinical Evaluation of Language Fundamentals – Revised* (CELF-R; Semel et al., 1987). This individually administered test was designed to assess a variety of vocabulary, (morpho)syntactic, and memory skills. For each child, a total language score was computed as a global measure of linguistic ability. In addition, two scores were computed to compare tasks emphasizing language comprehension (the receptive language score) against those emphasizing linguistic formulation (the expressive language score).

Intellectual measurement was achieved by administering the 14-subtest extended scale of the *Woodcock-Johnson Tests of Cognitive Ability - Revised* (WJTCA-R; Woodcock and Johnson, 1989). The WJTCA-R provided a global measure of intelligence (*Broad Cognitive Ability: Extended Scale* or BCA:ES) and seven cluster scores assessing discrete cognitive abilities associated with Horn and Cattell's Gf-Gc theory (Woodcock, 1990; Horn, 1991). The seven cognitive clusters were (1) long-term retrieval – Glr, (2) short-term memory – Gsm, (3) processing speed – Gs, (4) auditory processing – Ga, (5) visual processing – Gv, (6) comprehension – knowledge – Gc, and (7) fluid reasoning - Gf.

All CELF-R and WJTCA-R test scores were transformed into age-referenced standard scores, with a mean of 100 and a standard deviation of 15 prior to statistical analysis. Finally, a parent of each participant completed a questionnaire relating to the children's speech and language proficiency, academic placement in school, and scholastic achievement.

Results

Group results

Language skills

During follow-up, this group of children performed in the average range of language functioning, with a mean CELF-R total language score of

93.3 (SD = 15.7). The mean receptive language (mean = 97.0, SD = 17.4) and expressive language (mean = 90.8, SD = 14.6) scores were also in the average range. The 6.2-point discrepancy between the group's receptive and expressive language scores approached, but did not meet, statistical significance ($t = 2.074$, $df = 20$, $p = 0.051$).

Intellectual skills

As a group, the children's scores were in the average range on the global measure of intelligence (BCA:ES mean = 104.6, SD = 16.4) as well as on all seven cognitive ability clusters. The lowest cluster score was obtained on the auditory processing cluster (Ga: mean = 92.5, SD = 10.4) and the highest score was obtained on the fluid reasoning cluster (Gf: mean = 111.4, SD = 14.1) There was considerable overlap among the cluster score distributions (see Figure 10.1).

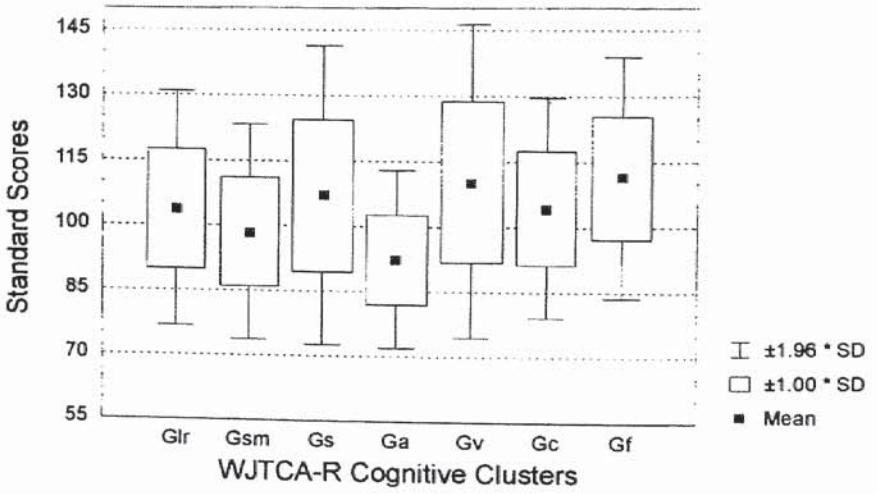

Figure 10.1. Box and whisker plot of group score distributions for the seven WJTCA-R cognitive clusters.

Individual results

Although group summaries allow identification of trends, they may obscure potentially important individual differences. Therefore, the diversity of performance among individual participants was examined.

Language skills

Each participant's total language score was classified using procedure described by Wiig (1989), and the frequency of cases corresponding to each diagnostic category is presented in Table 10.1. Although most

children earned scores that were well within normal limits, eight of the 21 children (38%) earned total language scores that were consistent with some degree of language disorder.

Table 10.1. CELF-R total language score distribution (broken down by severity level)

TLS* Range	Description	Frequency
>85	Within normal limits	13
78–85	Mild-to-moderate language disorder	3
70–77	Moderate language disorder	5
<70	Severe language disorder	0

*CELF-R total language score

The statistical significance of receptive and expressive language score discrepancies was also evaluated (Powell, 1993). For most children (71%), the difference between the two language scores was not significant. In five cases (24%), the receptive language score was significantly greater than the expressive language score (cases 4, 6, 8, 14, 22). In only one case (5%) did the expressive language score significantly exceed the receptive language score (case 33). Significant discrepancies do not imply pathology; of the six children with significant receptive and expressive language score discrepancies, only three (cases 8, 22, and 33) met generally accepted criteria for linguistic disability (e.g. Wiig, 1989).

Intellectual skills

The WJTCA-R classification scheme was used to assess each individual's global performance. Most children were in the 'average' or 'high average' range, but four individuals performed in the 'low average' and 'low' ranges (see Table 10.2).

Profile analysis procedures were used to evaluate and describe patterns of performance among the seven WJTCA-R cognitive clusters. Specifically, the intra-cognitive discrepancy score procedure described by Hessler (1993: 83–5) was used. This procedure entails statistical comparison of each cluster score with a predicted standard score, which is then compared against discrepancy norms. Following the rationale presented by McGrew (1994: 144), discrepancy scores were considered significant if they deviated from the mean by ≥ 1.5 SD. The most commonly occurring profiles involved a solitary relative strength in fluid reasoning (i.e. Gf), a relative strength in one area and a relative weakness in one other area, or a flat profile. These three patterns accounted for 71% of the children (see Table 10.3).

Table 10.2. Global cognitive score distribution (broken down by WJ-R classification)

BCA:ES* Range	Description	Frequency
131+	Very superior	1
121–130	Superior	2
111–120	High average	7
90–110	Average	7
80–89	Low average	2
70–79	Low	2
≤ 69	Very low	0

*WJTCA-R broad cognitive ability: extended scale

Table 10.3. Summary of WJTCA-R profile analysis based on intra-cognitive discrepancy scores

Relative strengths	Relative weaknesses	N of subjects (percentage)
1	0	6* (28.5)
1	1	5 (23.75)
0	0	4** (19)
1	2	3 (14.25)
0	1	1 (4.75)
2	1	1 (4.75)
0	2	1 (4.75)

*Gf was strength in all cases
**'Flat' profile

Residual communication disorders and reading disability

Many children with moderate-to-severe speech sound production disorders continue to evidence some degree of disability through later childhood and even into adulthood (Felsenfeld et al., 1992). Furthermore, children with a history of phonological disorder are at-risk for later reading problems (Dodd et al., 1995). Therefore, the data were analysed to determine the incidence of residual speech errors and reading disability among the children under study.

According to parental report, 10 of the 21 children (48%) exhibited some degree of communication disorder at the time of follow-up. Four children (cases 3, 4, 8, and 25) reportedly had difficulty producing [r]. Other children had general 'difficulty with pronunciation', or 'occasional difficulty producing more complex two-syllable words'. One child (case 33) was reported to stutter, while another (case 22) used 'inappropriate words to express herself'. Parents of seven children (33.3% of the sample) said their child had reading problems that were sufficiently severe as to warrant retention, special placement in school, or tutoring.

Subgroups of children

As noted previously, children with disorders of speech sound production are a diverse group. To differentiate subgroups of children with different ability patterns, a hierarchical cluster analysis of the linguistic and intellectual data was undertaken. This procedure sought to identify groupings of individuals that are relatively homogeneous in their patterning of scores. The complete linkage method was used, with distances between observations expressed in simple Euclidean distance.

A vertical dendrogram was plotted to illustrate the cluster structure that emerged from the data (see Figure 10.2). Individuals dominated by a common node are maximally similar, whereas individuals who are subordinate to different nodes are less similar in their pattern of scores. The subject pool is first subdivided into two major groups. The 11 individuals on the left side of the diagram (cases 32–3) earned scores at the high end of the range (mean ≥ 104.66). Individuals on the right (cases 40–2) earned lower scores (mean ≤ 98.33). The majority of children with residual speech problems were among those with lower scores. Indeed, nine of the 10 children with lower scores evidenced some communication disability according to parental report.

Each major branch is subdivided into three smaller clusters, and these six clusters are labelled on the figure. Although these clusters were determined solely by a computer program searching for statistical

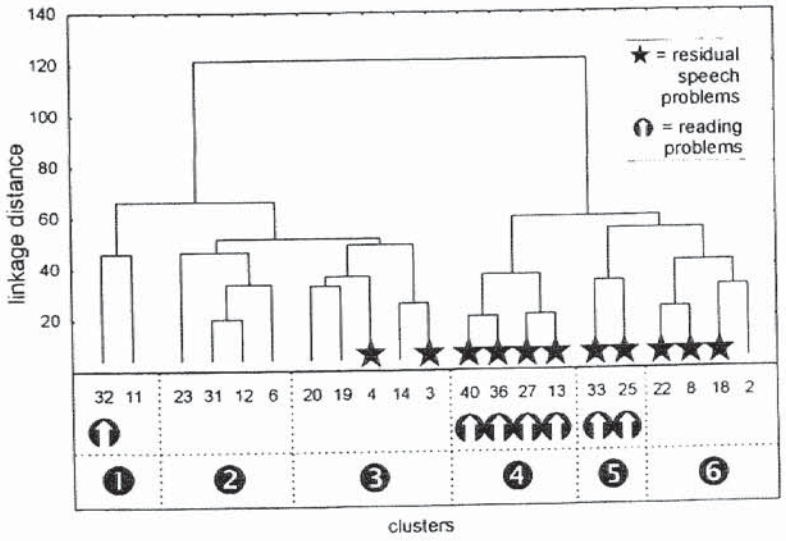

Figure 10.2. Vertical dendrogram summarizing cluster analysis results. Participants with residual speech errors are identified by stars; arrows denote children with reading problems.

patterns that underlie the test scores, they provide insight into the nature of the sample: clusters 4 and 5 included six of the seven children with reading problems.

A stepwise discriminant analysis was performed to identify the variables that distinguished among clusters. Poor performance on three variables differentiated the children in clusters 4 and 5 from all others: processing speed (Gs), CELF-R receptive language score, and long-term retrieval (Glr). The children in cluster 4 earned, on average, the lowest scores on all the norm-referenced tests. The children in cluster 5 earned low scores on most tests, but earned relatively high scores on three cognitive clusters: visual processing (Gv), comprehension knowledge (Gc) and fluid reasoning (Gf).

The remaining child with problems in the language arts (case 32) was assigned to cluster 1 by the computer. This assignment reflects the fact that his test performance differed markedly from the other children with reading problems. Indeed, he was the highest scoring child in this study (mean score of 122 across the variables under study). Clearly, consideration of additional variables would be necessary to identify a viable hypothesis regarding his reading disability.

Finally, severity of the initial phonological disorder emerged as a poor predictor of later reading problems. Case 4 evidenced the most limited range of phonological competence when his speech was assessed by Dinnsen et al. (1990). His phonetic inventory at age 3;7 was severely restricted (limited to vowels, glides, nasals, and voiced anterior stop consonants); his percentage of consonants correct score (PCC; Shriberg and Kwiatkowski, 1982) was 27% (i.e. severe). During follow-up, this child continued to have difficulty producing [r]; however, he reportedly excelled in reading and earned scores between the 90th and 95th percentile in all areas measured by a standardized statewide achievement testing programme.

Discussion

As a group, these 21 children performed in the average range on standardized tests of language and intellect, but diversity was apparent among individuals. Almost half of the children presented with some residual disorder of communication and one-third of the children were described as having difficulty in the language arts. These findings replicate and extend the findings of other researchers (e.g. Shriberg and Kwiatkowski, 1988; Dodd et al., 1995).

The use of cluster analysis in the present study provided a means of identifying certain subgroups of children, and attested to the validity of using psychoeducational assessment procedures with this population. It is true, however, that differentiating variables should not be interpreted as causal. For example, poor performance on the processing speed

variable differentiated the poor readers (clusters 4 and 5) from all other children. While poor skills in this area could contribute to a reading disability, it is also possible that a reading disability would negatively impact performance on these tasks. A child with reading problems may earn a low score due to slow execution of the tasks in an attempt to compensate for reading imprecision. Clearly, additional research is needed in this area.

Finally, it is important to note that despite reports of residual speech and reading problems, many of the parental reports were encouraging. In fact, 71% of the children were reported to excel in at least one academic area, most commonly mathematics (43%) and reading (28%). As additional research becomes available, it is hoped that we will one day be able to isolate the variables that will enable earlier identification and treatment of children with phonological disorders who are at greatest risk for long-term disability.

Summary

Twenty-one children were seen for follow-up approximately five years after they were diagnosed with phonological disorder. Nearly half of the sample presented with some residual communication impairment (typically of a mild nature), and one-third of the sample was reported to have difficulty with the language arts, especially reading. Group trends, as well as individual variability, in linguistic and intellectual abilities are described, and a hierarchical cluster analysis was completed to identify relatively homogeneous subgroupings of children on the basis of their linguistic and intellectual performance on norm-referenced tests.

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