# Relationships among Intelligence, Speech Proficiency, and Hearing Sensitivity in Children with Cleft Palates

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The notion that children with cleft lip and/or palate also have some degree of intellectual impairment has been investigated by several researchers. In a recent article, Goodstein (*6*) reviewed seven studies dealing with the intelligence of cleft palate children (*2, 5, 8, 9, 13, 16, 19*). From the results of these studies he concluded that cleft palate children show a mild-to-moderate degree of intellectual impairment and that this impairment is greater in the verbal than in the performance area. In addition, studies by Morris (*12*) and Corrie and associates (*4*), using the Wechsler Intelligence Scale for Children, also support those general conclusions. Phipps (*14*) also reviewed studies concerned with the intelligence of children with cleft lip and palate (*3, 5, 8, 9, 18*). Phipps noted that the results of these studies showed that cleft palate children show an impairment of from 2 to 11 points on tests which stress verbal skills, but emphasized that their mean IQ is within the normal range of intellectual functioning.

There are several possible explanations for the impairment. The deficit could be developmental. The deficit could result from a lack of stimulation in the home because of parental attitudes of rejection or overprotection. Another possible explanation is that the communication problems of cleft palate individuals, in the areas of both speech and hearing, interfere with the development of intellectual skills which are assessed by intelligence tests.

For example, there is ample evidence that cleft palate children show a speech impairment when compared to noncleft palate children (*10*). There is, however, not very much evidence relating speech skills and intelligence for cleft palate children. Morris (*12*) reports significant correlations between articulation scores and verbal, performance, and full scale WISC scores and also between defectiveness ratings and verbal

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Research for this report was supported by PHS Research Grant DE-00853, the National Institute of Dental Research.

scale WISC scores for children with cleft lip and palate. Corrie and associates (*4*) showed significant differences on both the verbal and performance scale WISC scores for cleft palate subjects differing in connected speech ratings.

In the same way, Hayes (*7*) and Prather and Kos (*15*) report that most investigators agree that there is a greater frequency of hearing loss in the cleft palate than in the noncleft palate population. Irwin and Means (*8*) have shown that a significantly greater per cent of cleft palate children without a hearing loss have IQs above 100 than do those with a hearing loss. Corrie and associates (*4*) found significant differences in verbal IQs between children with a 30 dB+ loss in the better ear and children with a less extensive loss. No information is available about the relationship between hearing acuity and IQ scores for cleft palate subjects.

There are some indications that there may be differences in intellectual function between subject groups classified according to cleft type (*5*), with the cleft palate only subjects having significantly lower IQs. Other investigators have failed to find that difference and so further research seems indicated.

The purpose of this study is to provide additional information about the level of intellectual functioning of children with cleft lip and palate and to investigate the strength of the relationship between intelligence and the variables of speech proficiency and level of hearing sensitivity for that population.

## Procedure

SUBJECTS. Subjects were 466 children with congenital cleft lip only, lip and palate, or palate only. A total of 191 of the 466 subjects were children who are participating in longitudinal clinical investigation in The University of Iowa Cleft Palate Research Program. Those subjects, referred to hereafter as the research Ss, are followed closely from birth to age 15, then have psychometric, speech, and hearing evaluations routinely from the earliest age of cooperation to age 15. The remainder of the cleft palate subjects (275), referred to hereafter as the nonresearch Ss, were patients of the Department of Otolaryngology and Maxillofacial Surgery who were receiving treatment and who had been administered psychological evaluations as part of their general clinical examination. For example, they may have had speech problems, hearing problems, or cosmetic problems which required treatment. Only the research Ss were used in that portion of the study which involved speech and hearing assessments.

The number of subjects varies from comparison to comparison because not all tests were obtained for all subjects. In the same way, the age ranges for specific groups differ, according to the comparison to be made.

PSYCHOLOGICAL TESTING. The 191 research Ss and 275 nonresearch Ss

TABLE 1. The number and age range of research Ss (R) and nonresearch Ss (NR) for each of the three tests.

| | *N* | | *age range* | |
|---|---|---|---|---|
| | *R* | *NR* | *R* | *NR* |
| Vineland | 157 | 93 | 0–11 to 9–10 | 1–6 to 7–7 |
| Binet | 61 | 71 | 2–6 to 15–3 | 2–9 to 13–4 |
| WISC | 67 | 154 | 5–3 to 15–11 | 5–3 to 15–11 |

were used in this study. If more than one test was available for any subject, the first test administered was selected for use in this study. The 191 research Ss were tested between May, 1953, and April, 1967. At the time of testing, their ages ranged from 9 years, 11 months to 15 years, 11 months. The tests were administered by any one of 8 staff clinical psychologists. The 275 nonresearch Ss were tested between December, 1948, and April, 1967, with age of testing ranging from 1 year, 6 months to 13 years, 4 months. The tests were administered by any one of 16 staff clinical psychologists. For both the research and the nonresearch Ss, selection of the psychological test instrument was made by the examining psychologist, based on his evaluation of the problem and on the age of the child. The same three tests (Vineland, Binet[1], and WISC) were used for both groups. A summary of the psychological tests is shown in Table 1.

SPEECH PROFICIENCY. Verbal communication effectiveness was estimated for 167 of the 191 research Ss by obtaining ratings of defectiveness of connected speech, in a clinical setting. The ratings were made by one of two speech pathologists on the basis of a clinical speech evaluation. (The ratings were not made from tape-recorded samples of speech.) A seven-point rating scale was used with the value *one* representing least defective and the value *seven* representing most defective. When speech proficiency and intellectual function are compared, both estimates were made on the same day. The following number of research Ss had both speech ratings and psychological tests: Vineland, 56; Binet, 51; and WISC, 66. (The total number of subjects used was 167 rather than 191, because a few subjects had two psychological tests on the same day.) Speech ratings were not available for the nonresearch Ss.

Reliability of the ratings of verbal communication effectiveness was assessed by a procedure in which the two judges assigned ratings independently but simultaneously for 11 cleft palate children taken at random from cleft palate patients receiving treatment, but not in the study reported here. Ratings were done by use of the same seven point scale employed in this study. Identical ratings were assigned by both

[1] Prior to 1960, the 1937 Stanford-Binet Intelligence Test was administered, with form L being used predominantly.

judges for seven of the 11 children; ratings for the other four differed no more than one scale value. Based on these results, reliability of the rating procedure was considered satisfactory for the purposes of this study.

HEARING SENSITIVITY. A measure of hearing sensitivity, a pure-tone average, was computed from the audiograms of the research Ss taken within a six month period of their psychological tests. Pure tone audiograms had been obtained by standard techniques except in cases where the child's inability to respond made it necessary to use conditioned play audiometry. The pure tone average was taken to be the mean of the hearing threshold levels in decibels for pure-tones of 500, 1000, and 2000 Hz. All pure tone averages are reported in reference to 1964 ISO zero reference threshold. Those pure tone averages obtained with 1951 ASA zero reference threshold were converted to 1964 ISO by adding 10 dB (*1*). Measures of hearing sensitivity were not available for the nonresearch Ss.

## Results

DESCRIPTION OF PSYCHOLOGICAL TEST SCORES. Mean scores on the three tests are presented in Table 2 along with SDs and the number of subjects used in each analysis. (The three groups are neither mutually exclusive nor the same; some subjects had only one test, some had two, and some had all three.) Means, SDs, and a number of subjects are also reported from three other investigations. Morris (*11*), Corrie and others (*4*), and Goodstein (*5*) studied cleft palate subjects. In addition, Goodstein used a control group of normal children.

Since in the present study the research Ss and the nonresearch Ss were selected by different criteria, there is the question of whether they represent the same population. To test this assumption, analyses of variance were performed on the VSMS, the Binet, and the three WISC scores for the two groups. Differences between the scores of the research and nonresearch groups were not significant for any of the three WISC scores or for the Binet score and so the statistics reported in Table 2 are for the two groups (research and nonresearch) combined. The difference between the research and nonresearch groups was significant for the VSMS scores and so data are reported separately for the two groups. The mean VSMS score for the research group was higher than for the nonresearch group (106.7 versus 94.5).

In general, the mean scores obtained in the present studies are relatively similar to those reported by the other investigators for cleft palate subjects, and are lower than the means reported by Goodstein for normal subjects. The single exception is the mean VSMS for the research group in the present study, which is slightly higher than the mean VSMS reported by Goodstein for normal subjects. Without exception, the SDs reported in the present study are higher than those reported

TABLE 2. Means and standard deviations of psychological test measures from the present study and from three other studies. Dashes indicate that data are not available. Tests are the Wechlser Intelligence Scale for Children (WISC), the Stanford-Binet (Binet), and the Vineland Social Maturity Scale (VSMS). Subheadings for the WISC are Verbal Scale (VS), Performance Scale (PS), and Full Scale (FS). Data for the VSMS from the present study are reported separately for research (R) and nonresearch (NR) subjects.

| *test and statistic* | *studies* | | | *Goodstein (5)* | |
|---|---|---|---|---|---|
| | *Estes and Morris* | *Morris (11)* | *Corrie (4)* | *CP* | *Normal* |
| WISC | | | | | |
| N | 221 | 86 | 143 | 105 | 95 |
| VS | | | | | |
| Mean | 93.0 | 91.9 | 98.0 | 91.5 | 103.0 |
| SD | 17.0 | 14.4 | — | 14.4 | 12.7 |
| PS | | | | | |
| Mean | 99.7 | 101.7 | 99.5 | 97.9 | 104.6 |
| SD | 16.4 | 14.8 | — | 14.8 | 12.1 |
| FS | | | | | |
| Mean | 95.2 | 93.9 | — | 04.0 | 104.2 |
| SD | 17.8 | 14.1 | — | 14.5 | 11.9 |
| Binet | | | | | |
| N | 132 | — | 35 | — | — |
| Mean | 93.2 | — | 94.5 | — | — |
| SD | 18.6 | — | — | — | — |
| VSMS | | | | | |
| N | 157R<br>93N-R | 105 | — | 139 | 174 |
| Mean | 106.7R<br>94.5N-R | 98.7 | — | 99.0 | 105.8 |
| SD | 19.7R<br>25.1N-R | 13.0 | — | 13.1 | 12.7 |

by the other investigators, although the differences in the main are not great.

Although the means of all tests from the present study are within the normal range, the distributions of the Binet and Full Scale WISC IQs were compared to their respective standardization distributions[2] by means of two 2 × 7 chi-square tests. The results of both tests indicate that the obtained distributions were reliably different at the 1% level from their respective standardization distributions. Table 3 shows the distributions expected from the Binet and WISC standardization groups together with the percentages obtained at the various levels of intelligence. In general, a larger proportion of cleft palate subjects were in the classifications at the lower end of the IQ distribution than were the standardization groups.

[2] As no distinction was made between the 1937 and 1960 Stanford-Binet scores, their combined distributions were compared to the 1937 standardization distribution.

TABLE 3. Distributions of the obtained and expected percentages of IQ scores for the Full Scale WISC and Stanford-Binet Intelligence Tests. Bright Normal and Dull Normal classifications for the WISC correspond generally to High average and Low average, respectively, for the Binet.

| *WISC* | | | | *Binet* | | |
|---|---|---|---|---|---|---|
| *IQ* | *expected per cent* | *obtained per cent* | *intellectual classification* | *IQ* | *expected per cent* | *obtained per cent* |
| 130 and Above | 2.2 | 0.5 | Very Superior | 140 and Above | 1.33 | 0.8 |
| 120 to 129 | 6.7 | 7.2 | Superior | 120 to 139 | 11.3 | 4.6 |
| 110 to 119 | 16.1 | 11.3 | Bright Normal | 110 to 119 | 18.1 | 9.8 |
| 90 to 109 | 50.0 | 47.1 | Average | 90 to 109 | 46.5 | 46.2 |
| 80 to 89 | 16.1 | 17.2 | Dull Normal | 80 to 89 | 14.5 | 17.4 |
| 70 to 79 | 6.7 | 9.9 | Borderline | 70 to 79 | 5.6 | 12.9 |
| 69 and Below | 2.2 | 6.8 | Mental Defective | 69 and Below | 2.63 | 8.3 |

Goodstein (*6*) and Morris (*12*) have referred to a possible discrepancy between the WISC Verbal Scale IQ and the WISC Performance Scale IQ for the cleft palate population, with the Performance Scale being higher. As shown in Table 2, similar results were obtained in the present study. Seashore (*17*) evaluated such discrepancy scores, in which the Verbal IQ is subtracted from the Performance IQ, for the WISC standardization group. He observed that the frequency of positive and negative scores are nearly equal with about one-third of all scores being greater than 12 to 13 IQ points. Figure 1 presents the distribution of these discrepancy scores from the present study together with those obtained by Goodstein for his cleft palate Ss. A 2 × 12 chi-square test of the two distributions indicates that they are not significantly different. Approximately 33% of the Ss in the present study have negative discrepancy scores of 12 or greater (PS larger than VS) while 10% have positive scores of this magnitude (VS larger than PS), indicating a relative greater verbal than performance impairment for the cleft palate children.

Differences Between Cleft Types. The relationship between type of cleft and psychological test scores were evaluated for the Vineland, Binet, and WISC scales (Table 4). The Ss were divided into lip and palate, palate only, and lip only groups and analyses of variance performed on their test scores. Since only one Binet and two WISC scores were available for the lip only group, no analyses were performed on these test scores for this group.

With three exceptions, the trend for all four studies is that the scores for the lip and palate group are higher than for the palate only group. The exceptions (WISC PS, present study; Binet, Corrie data; and VSMS, nonresearch subjects in the present study) show differences in the op-

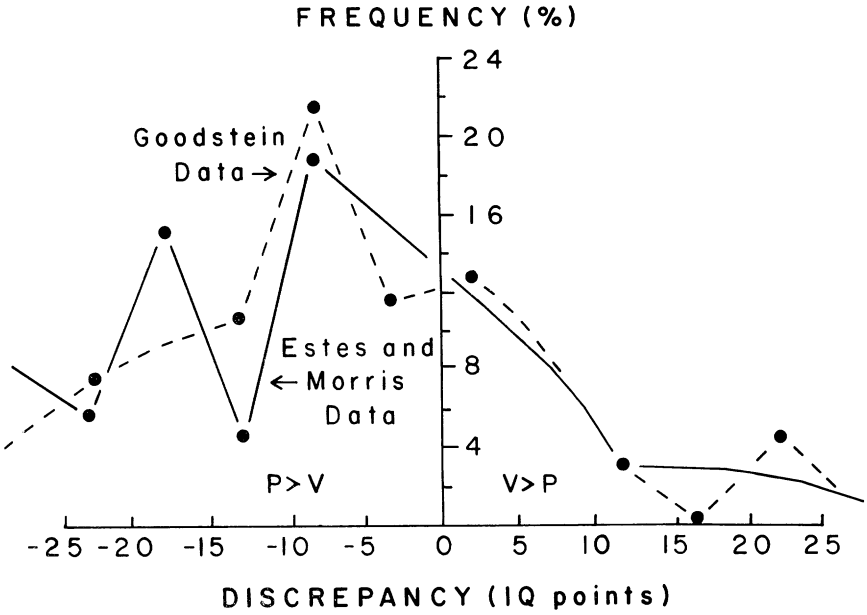


FIGURE 1

posite direction. In general, means for the cleft lip only group were also higher than for the palate only group and were similar to the means for the lip and palate group. In the present study, none of the differences between cleft types was significant. In subsequent analyses, the three cleft type groups were combined to form a single subject group.

INTERCORRELATIONS AMONG THE PSYCHOLOGICAL TEST SCORES. For a number of subjects, and the number varied with each comparison, scores on several tests were available which were obtained usually at different times. The correlation coefficients and the numbers of subjects upon which the coefficients are based are presented in Table 5. All the correlation coefficients are reliable with the exceptions of the VSMS and WISC PS IQ, research Ss; the VSMS and WISC VS IQ, research Ss, and VSMS and WISC PS IQ, nonresearch Ss. In general, the strength of the relationships among the tests is in the order of .60.

RELATIONSHIPS AMONG SPEECH PROFICIENY, HEARING SENSITIVITY, AND PSYCHOLOGICAL TEST SCORES. As reported previously, ratings of speech proficiency and assessments of hearing sensitivity were obtained for those research Ss who were old enough to cooperate for such tasks. Ratings of speech proficiency extended throughout the entire range of the scale. The majority of subjects demonstrated measurable hearing loss, although few had severe losses of hearing sensitivity.

The relationships among ratings of verbal communication defectiveness, measures of hearing sensitivity, and psychological test scores are presented in Table 6. All of the *r*s are low; only three are reliable:

TABLE 4. Means and standard deviations of the psychological test measures for the three cleft-type groups with comparable data from other studies presented for comparison purposes. Dashes indicate that the data are not available. R designates research Ss and N-R designates nonresearch Ss. None of the differences between cleft types for subjects in the present study was significant.

| *test and study* | *lip and palate* | | | *palate only* | | | *lip only* | | |
|---|---|---|---|---|---|---|---|---|---|
| | *mean* | *SD* | *N* | *mean* | *SD* | *N* | *mean* | *SD* | *N* |
| WISC VS IQ | | | | | | | | | |
| Estes and Morris | 93.4 | 17.2 | 161 | 92.7 | 16.0 | 58 | — | — | — |
| Morris (*11*) | 93.8 | 14.0 | 49 | 86.1 | 13.6 | 17 | — | — | — |
| Corrie (*4*) | 99 | — | 71 | 96 | — | 55 | 100 | — | 17 |
| Goodstein (*5*) | 93.2 | 14.5 | 74 | 85.6 | 13.8 | 23 | 92.8 | 11.0 | 8 |
| WISC PS IQ | | | | | | | | | |
| Estes and Morris | 99.7 | 16.4 | 161 | 100.5 | 15.5 | 58 | — | — | — |
| Morris (*11*) | 99.6 | 14.0 | 49 | 93.0 | 13.8 | 17 | — | — | — |
| Corrie (*4*) | 102 | — | 71 | 95 | — | 55 | 104 | — | 17 |
| Goodstein (*5*) | 99.3 | 14.5 | 74 | 92.5 | 14.2 | 23 | 100.9 | 15.4 | 8 |
| WISC FS IQ | | | | | | | | | |
| Estes and Morris | 95.7 | 17.3 | 161 | 92.9 | 22.2 | 58 | — | — | — |
| Morris (*11*) | 96.1 | 14.0 | 49 | 88.2 | 13.6 | 17 | — | — | — |
| Corrie (*4*) | — | — | — | — | — | — | — | — | — |
| Goodstein (*5*) | 95.7 | 14.5 | 74 | 87.7 | 12.5 | 23 | 96.3 | 13.8 | 8 |
| Binet IQ | | | | | | | | | |
| Estes and Morris | 93.8 | 18.8 | 85 | 91.8 | 18.1 | 46 | — | — | — |
| Corrie (*4*) | 87 | — | 12 | 97 | — | 20 | 108 | — | 3 |
| VSMS SQ | | | | | | | | | |
| Estes and Morris | 107.1R | 18.2 | 91 | 103.8R | 22.7 | 48 | 112.9R | 16.6 | 18 |
| | 90.7N-R | 23.9 | 48 | 99.2N-R | 25.6 | 44 | | | |
| Morris (*11*) | 99.5 | 13.9 | 49 | 98.6 | 13.5 | 17 | — | — | — |
| Goodstein (*5*) | 100.6 | 11.7 | 74 | 97.0 | 12.7 | 23 | 100.4 | 8.3 | 8 |

TABLE 5. Intercorrelations among the Vineland (VSMS), research and nonresearch, Binet, WISC Verbal Scale, WISC Performance Scale, and WISC full scale. The number of subjects used varies, as shown, for each of the correlations. Asterisks indicate correlations which are significant at the 5% level.

| | *N* | *Binet* | *N* | *VS* | *WISC* | |
|---|---|---|---|---|---|---|
| | | | | | *PS* | *FS* |
| Research VSMS | 48 | .38* | 39 | .30 | .31 | .33* |
| Nonresearch VSMS | 14 | .74* | 17 | .55* | .31 | .49* |
| Binet | | | 42 | .70* | .63* | .66* |
| WISC VS | | | 221 | | .65* | .81* |
| WISC PS | | | 221 | | | .77* |

TABLE 6. Intercorrelations between speech proficiency, hearing sensitivity, and scores on the psychological tests. An asterisk (*) indicates statistical significance at the .05 level and a dagger (†) indicates statistical significance at the .01 level.

| | *N* | *hearing* | *N* | *VSMS* | *N* | *Binet* | *WISC* | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | *N* | *VS* | *PS* | *FS* |
| Speech | 159 | .36† | 56 | −.16 | 51 | −.16 | 66 | −.22 | −.25* | −.26* |
| Hearing | | | 54 | .13 | 55 | −.22 | 67 | −.12 | −.14 | −.14 |

communication defectiveness and hearing loss, communication defectiveness and WISC PS, and communication defectiveness and WISC FS. Therefore, the hypothesis that a relationship exists among these variables cannot be supported.

## Discussion

The data reported here regarding level of intelligence of cleft palate children are, in general, consistent with those data reported by previous investigators. WISC Full Scale IQs and Binet IQs for cleft palate children are, on the average, about five points lower than for normal children. In addition, Vineland scores for cleft palate children are somewhat lower than for normal children, although the differences are apparently not very large.

In addition, the cleft palate children obtain higher WISC Performance Scale IQs than WISC Verbal Scale IQs, indicating an apparent deficit in skills related to verbal activities as compared to those skills related to performance activities.

Apparently, the depressed IQs, particularly in verbal areas, cannot be explained by the fact that these children frequently have communication problems. It may be that losses in hearing sensitivity which these children demonstrate are not sufficiently extensive temporally or sufficiently severe in nature to result in depressed IQ scores. In the same way, level of IQ is not related to severity of verbal communication defectiveness to the degree that one can identify problems in speech proficiency as a possible etiological factor in causing the depressed IQ scores. Perhaps the procedure used to assess verbal communication defectiveness in this study is not sufficiently reliable or even valid for the study of such a relationship, but that seems rather unlikely. A more plausible explanation is that the depressed IQs are related to some other factor or combination of factors.

The results of this study support the general trend established by other investigations that children with cleft palate only have, on the average, lower IQs than children with cleft lip and palate, although the difference may not be great enough to be clinically significant. The trend, how-

ever, supports the general notion that of the two cleft types, cleft palate only is the more severe defect.

Finally, the results of this study indicate that, for cleft palate children, no single IQ test can be used with confidence at an early age; for example, to predict an IQ obtained at a later age with another test. Apparently there is sufficient variance among tests and among age levels that repeated testing is warranted, at least for most purposes. Of the three tests, results obtained with the Vineland are in least agreement with the other two. Very probably, the role of the parent as interviewee contributes greatly to that variance.

**Summary**

Psychological tests were administered to 466 children with cleft lip and palate. Of that group, ratings of speech proficiency and measures of hearing sensitivity were also available for some of the children. Mean IQs for the cleft palate children were lower than for the standardization groups for the tests. In general, IQs were lower for cleft palate only children than for cleft lip and palate children, although the difference was not statistically significant. No evidence of a relationship between IQ score and level of communication problem, either speech or hearing, was obtained.

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