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ABSTRACT

The hypotheses that deaf students would be more field dependent than hearing students and that their competence in communication skills would be related to field dependence were supported for a group of 77 male and 67 female deaf students at the National Technical Institute for the Deaf. Stepwise multiple regression analyses of the data showed that for females, spatial skills followed by communication skills were signficant predictors of field dependence; for males, spatial skills followed by the extent of hearing loss were significant predictors of field dependence. Sex differences found on tests of field dependence and spatial relations were consistent with those obtained from the hearing population. Results supported the notion that socialization experiences and competence in communication skills may influence development of field dependence in deaf students. (Author)

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RELATIONSHIPS AMONG SPATIAL SKILLS, COMMUNICATION SKILLS AND FIELD DEPENDENCE IN DEAF STUDENTS

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NTID's principal goal in doing research is to influence the education, training and career placement of deaf citizens through systematic examination of issues related to deafness. As one part of NTID's total research effort, the Department of Research and Development conducts descriptive and experimental research. Research findings are used in the development of programs and materials in the areas of learning and instruction, personal and social growth, and career development of deaf students. This document was developed in the course of an agreement with the U. S. Department of Health, Education and Welfare.

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Abstract

The hypotheses that deaf students would be more field dependent than hearing students and that their competence in communication skills would be related to field dependence were supported for a group of 77 male and 67 female deaf students. Step-wise multiple regression analyses of the data showed that for females spatial skills followed by communication skills were significant predictors of field dependence; for males spatial skills followed by the extent of hearing loss were significant predictors of field dependence. Sex differences found on tests of field dependence and spatial relations were consistent with those obtained from the hearing population. The results support the notion that socialization experiences and competence in communication skills may influence development of field independence in deaf students.

Introduction

The purpose of this study was twofold: to compare deaf and hearing students on field dependence and to examine the relationship between communication skills and field dependence in a deaf student population.[1]

Field dependence in perception first identified by Witkin (Witkin, 1950; Witkin, Lewis, Hertzman, Machover, Meissner, & Wapner, 1954) refers to an ability to isolate and manipulate an item within a surrounding context. Field-independent people differ from field-dependent people in that they tend to perceive an item analytically rather than globally and can see an item as discrete from its background. Field-independent people are also more efficient than field-dependent people in imposing structure on a field and perceiving it as organized when the field has little inherent organization. The field dependence dimension is now considered as an indicator of psychological differentiation, a broad, organismic construct proposed by Witkin and his co-workers (Witkin, Dyk, Faterson, Goodenough, & Karp, 1962). Briefly, the differentiation theory states that with development, psychological systems become more differentiated as reflected in the greater articulation of experience. Individuals differ in the rate and extent to which they develop differentiation. However, the differentiation hypothesis postulates that within an individual, behaviors which involve articulation of experience are likely to be interrelated thus making for self-consistency in individual functioning across diverse psychological domains. In general, studies have supported this hypothesis (for extensive bibliographies, see Witkin, Oltman, Cox, Ehrlichman, Hamm, & Ringler, Note 1; Witkin, Cox, Friedman, Hrishikesan, & Siegel, Notes 2 and 3).

In his recent evaluation of the model of psychological differentiation (Witkin, Goodenough, & Oltman, Note 4), Witkin has suggested three major indicators of differentiation: 1) neurophysiological differentiation as manifested in cerebral lateralization, 2) psychological differentiation as manifested in specialized controls and defenses, and 3) field-dependence-independence as manifested in perceptual tasks, social situations and articulation of body concept. Each of these indicators may exert a causal influence on the other and, thus, partly determine the individual differences in these three domains. Thus it is postulated that field dependence in perception may result from socialization practices that affect psychological development as well as the degree of cerebral lateralization.

The following research seems to support such an hypothesis. Cross-cultural and developmental studies suggest that mother-child interaction and socio-cultural experiences are important factors in developing field independence. When conformity is stressed and roles are well defined, individuals in such social environments tend to be more field-dependent (Berry, 1966; Dawson, 1967; Witkin, & Berry, 1975; Witkin, Price-Williams, Bertini, Christiansen, Oltman, Ramirez, & Van Meel, 1974). When mothers are over-protective, demanding and discourage autonomous functioning; children tend to be more field-dependent (Dershowitz, 1971; Witkin et al., 1962; Goodenough, & Witkin, Note 5). Recent neurophysiological studies suggest that the degree of lateralization is related to the degree of field-dependence-independence with field-independent people being more strongly lateralized than field-dependent people (Oltman, Ehrlichman, & Cox, 1977; Pizzamiglio, 1974).

The above studies exploring the origins of field dependence are especially important in speculating about the degree of field-dependence-independence in deaf individuals. It seems that socialization experiences may foster field dependence in deaf people. It is estimated that about 90% of deaf children are born of hearing parents (Sisco, & Anderson, 1978). Several researchers (Meadow, 1976; Mindel, & Vernon, 1971) have noted that in most cases there is a communication difficulty between parents and the child, and the family and the child have to go through a few psychological adjustments once the deafness is detected. In a developmental study of deaf children, Schlesinger and Meadow (1972) have shown that hearing mothers of deaf children are more likely to be controlling, inflexible and over-protective than those of hearing children and have noted that these mothers felt frustrated about the quality and extent of mother-child communication. Whatever the underlying cause may be, the behavior of these mothers seems to be strikingly similar to the behavior of mothers of more field dependent children. Another related factor to consider is the deaf person's interaction with the world, which has a predominantly oral culture. Perhaps to socialize and interact in the hearing world where most people rely on spoken communication, deaf individuals may tend to seek information from others in structuring the social situation. They may pay more attention to other people and to social cues. Furth (1973) reports that deaf adolescent students were more sociable and less inclined to remain aloof than a peer group of hearing students. All of the above characteristics are considered to be those of field-dependent people (McFall, & Schenkein, 1970; Rubel, & Nakamura, 1972; Witkin, & Goodenough, 1977; Witkin, Moore, Goodenough, & Cox, 1977).

The above reasoning suggests that deaf students may differ from hearing subjects in field dependence. Furthermore, competence in communication skills may, therefore, be related to field dependence in deaf students since better communication skills may tend to foster effective social and mother-child interactions, articulation and communication of experience, and greater autonomy, all of which would lead to greater field independence. Thus it may be hypothesized that deaf students would be more field-dependent than hearing students and that there would be a significant relationship between communication skills and field-independence for deaf students.

There are only two published studies on the topic of field dependence in deaf students (Blanton, & Nunnaly, 1964; Fiebert, 1967) and a few unpublished doctoral dissertations (Bennett, 1971; Best, 1975; Naiman, 1970). Only the published studies will be considered here. Blanton, and Nunnally (1964) found that deaf male children were more field-independent than hearing male children while deaf and hearing female children did not differ in performance on the Gottschaldt's figures test (a measure related to field-dependence). Sex differences in performance of deaf subjects on the Embedded Figures Test (EFT) were found by Fiebert (1967) and Blanton and Nunnally (1964). Using an English language test Fiebert (1967) reported a positive but non-significant correlation (.28) between field independence and communication skills for girls in his sample. There was no evidence of such a relationship for boys.

There are a few methodological considerations that should be taken into account in intepreting the results of Fiebert's study. First, an English language test is used as the only indicator of communication skills. It is well known that English language tests do not adequately measure the communication skills of many deaf individuals. Many deaf individuals in America rely on manual communication using signed English and/or ASL which has a grammar different from English (Bellugi, & Klima, 1975). It is well-known that proficiency in English language is difficult to achieve for deaf students when the input is primarily auditory. Thus the choice of only a written English test to measure communication skills is not proper. Moreover Fiebert's study is a simple correlational study. It is quite possible that a combination of spatial and communication variables would be better predictors of field dependence.

This research was, therefore, undertaken to study the relationship between field dependence and communication skills in deaf students by using several variables that may affect field dependence. Performance on the Embedded Figures Test was used as an indicator of field dependence since earlier researchers (Fiebert, 1967; Naiman, 1970) have already used this test with deaf students. A second reason for the choice of this test over the Rod and Frame Test was that the Rod and Frame Test involves reliance on vestibular mechanism and thus may not be suitable for deaf students owing to a larger incidence of vestibular dysfunctions in deaf population. Two tests of perceptual-spatial skills were included for the purpose of examining the relationship between field dependence and spatial skills in deaf students and to see if the field dependence test differs from other spatial skills tests.

Two tests of English language skills and two tests of sign skills[2] were used to measure communication skills. The inclusion of sign skills tests provided a more complete picture of the communication skills of deaf subjects. Also, it made possible a search for a special relationship between the Embedded Figures Test (EFT) and a visual-manual mode of communication both of which seem to rely on a cognitive structuring of space. Lastly, the extent of hearing loss (pure tone average loss in the better ear, PTA) was used as an indicator to see how the magnitude of hearing loss was related to field dependence. By using a multiple regression design, it was seen how these variables separately and together influenced the performance of deaf students on a field dependence test.

Method

Subjects In total, 77 male and 67 females (n=144) first year students at the National Technical Institute for the Deaf, Rochester, NY were tested. Their mean age was 20 years (s.d. = 1.80) and the average hearing loss as measured by the pure tone average in the better ear at 500-1000-2000 Hz level, HL (ANSI, 1969) was 90.36 dB (s.d. = 16.81). There was no significant sex difference in age or hearing loss. The onset of deafness information available on 108 subjects showed that 96 were deaf from birth, and 12 before age 6. For the remaining 36 subjects either the information was missing or coded as 'Don't know'. Out of 144 students, 138 students had hearing parents, 5 had deaf parents and one student had 1 deaf and 1 hearing parent.

The Tests Seven standardized tests were used in this study. A short description of each is given below.

1. The Group Embedded Figures Test GEFT (Witkin, Oltman, Raskin, & Karp, 1971). This is a group version of the Embedded Figures Test and was the dependent variable in this study. The subjects' task is to find a simple form which is embedded in a complex display. The score is the total number of simple forms correctly traced. Maximum score is 18.

2. Spatial Relations Test SRE (Bennett, Seashore, & Wesman, 1966). This is a subtest of the Differential Aptitude Tests which measures the ability to deal with concrete material through visualization and mental manipulation of objects in three-dimensional space. Maximum score is 60.

3. Abstract Reasoning Test ABT (Bennett, et al., 1966). This is a subtest of the Differential Aptitude Tests which is intended as a non-verbal measure of the students' reasoning ability. It measures the ability to perceive relationships in abstract figure patterns and to discover the operating principle in the changing diagram. Maximum score is 50.

4. The California Reading Comprehension Test READ (Tiegs, & Clark, 1963). This is a subtest of the California Reading Tests, Junior high school battery. It is divided into three areas: following directions, reference skills and interpretation of material. The score is in terms of grade equivalents. Maximum score is 12.

5. The NTID Written Language Test WRITE (Crandall, Note 6). This is a test developed at the National Technical Institute for the Deaf (NTID) to measure the intelligibility of the spontaneous written language samples. The performance of the subject is rated

on a 5-point scale using grammatical correctness as a predictor of the intelligibility. The overall reliability of the test (including rater, test-retest, and form reliability) is .72 and the construct validity is .59. Maximum score is 5.

6. The Simultaneous Reception Test SRT (Johnson, 1976). This is a subtest of the test battery of CID Everyday Sentence List developed at NTID. In this test, a person is presented with multiple cues (listening, speechreading, signs and/or fingerspelling) for receiving information. The score is percent correct out of 50 key words identified from ten sentences. The internal consistency reliability coefficients range from .73 to .90 and the test-retest reliability is .91 (Blasdell, & Caccamise, Note 7). Validity data are not yet available.

7. The Manual Reception Test MRT (Johnson, 1976). This is also a subtest of the Test battery of CID Everyday Sentence List. It differs from the Simultaneous Reception Test only in that the presentor uses no lip movements or voice, but only signs and fingerspelling in giving the message. The internal-consistency reliability coefficients range from .89 to .97 and the test-retest reliability is .95 (Blasdell, & Caccamise, Note 7).

Procedure Data on all tests except for the GEFT were obtained from the student files. Every entering NTID student is routinely given these tests. The Group Embedded Figures Test was given specifically for this research project. The instructions were signed and spoken simultaneously and were also presented in written form. The test was scored according to the instructions in the manual (Witkin, et al., 1971).

While examining the practice section scores it was found that some subjects were having difficulty in completing the section correctly within the given time. Since the hearing students typically finish all the items correctly regardless of their level of field-independence, it was decided to look closer at this apparent discrepancy. One might argue that the people who could not finish the practice section were people who did not understand the task. This explanation was considered improbable for two reasons. First, the instructions were such that getting any items correct was difficult without following them. Secondly, to test the hypothesis more directly the students were divided into two categories: those who scored less than 6 correct (n=31) and those who scored 6 or 7 correct (n=113) on the practice section and compared them on tests of English language skills, sign skills, spatial skills, and average hearing loss. One-way analysis of variance showed that the groups did not differ on tests of communication skills or average hearing loss. But they did differ on tests of spatial skills (see Appendix 1 for detailed analysis). Thus what seemed to be likely was that these students as a group were lower in spatial abilities and therefore were finding the GEFT practice section relatively difficult even when they understood the task. They were, therefore, included in the total group for the subsequent analyses.

Results

Reliability of the GEFT

The inter-form reliability of the Group Embedded Figures Test (GEFT) corrected by the Spearman-Brown formula was .86 for deaf students (.89 for males and .82 for females) which compares favorably with the reliability estimates of .82 for hearing males and females reported in the Embedded Figures Test manual (Witkin, et al., 1971).

Sex Differences in Performance

Since many researchers have noted sex differences in field dependence tests and spatial ability tests (Sherman, 1967; Witkin, & Berry, 1975), the males and females were compared on various tests and the data were analyzed separately for them.

A one-way analysis of variance of the data showed that males (n=77) and females (n=67) did not differ from each other on the Abstract Reasoning Test (ABT), the Reading Comprehension Test and the NTID Writing Test, the Simultaneous Reception Test and the Manual Reception Test, or on the extent of hearing loss as measured by pure tone average in the better ear (PTA). However, there were significant sex differences in their scores on the Spatial Relations Test (SRE) and the Group Embedded Figures Test (GEFT) with males scoring higher than females (see Table 1). The sex differences in the Spatial Relations Test and the GEFT are consistent with the results generally found in the hearing population (Sherman, 1967; Witkin and Berry, 1975). The absence of a sex difference on the Abstract Reasoning Test (ABT) for deaf students is not consistent with the result found in hearing students. Typically males outperform females on the Abstract Reasoning Test (Bennett, et al., 1966).

Insert Table 1 about here

Comparison of Performance of Deaf and Hearing Students

To compare the subjects' scores on the Spatial Relations Test and the Abstract Reasoning Test with the norms for 12th grade hearing students reported in the Differential Aptitudes Tests manual (Bennett, et al., 1966), Welch's t-test was used (Welch, 1938, 1947). Since the difference between Ns was very large (see Hays, 1973: p. 410). The results reported in Table 2 show that deaf females did not differ from hearing females on either of the two tests, and deaf males did not differ from hearing males on the Spatial Relations Test but performed less well on the Abstract Reasoning Test.

Insert Table 2 about here

The average scores of deaf students on the GEFT were then compared with the norms for hearing students reported in the Embedded Figures Tests manual (Witkin et al., 1971) using Welch's t-test. Deaf males scored significantly lower than hearing males and deaf females scored significantly lower than hearing females (see Table 3). These results are consistent with those found by Siple, Hatfield, and Caccamise (in press) on NTID students, but different from those found by Blanton, and Nunnally (1964) on deaf children.

Insert Table 3 about here

Multiple Regression Analysis

As a step toward understanding why these differences occurred, it was decided to explore the relationship between the GEFT and the various tests that were selected and to study which variables were important in determining the performance on the GEFT of deaf students. The procedure of step-wise multiple regression analysis was used since it indicates the contribution of the independent variables which provide the best prediction of the dependent variable. A multiple correlation coefficient is also derived which indicates the degree of relationship between predicted and observed scores for a designated dependent variable. In addition, the variance associated with the multiple correlation coefficient indicates the amount of variance accounted for in the dependent variable by the independent variables. The Statistical Package for the Social Sciences computer program SPSS, Xerox version 6.03 was used for the analysis of the data (Nie, Hull, Jenkins, Steinbrenner, & Bent, 1970).

Intercorrelations Among Variables

The correlation matrices for males and females reported in Table 4 show that many of the tests were well correlated with each other.

Insert Table 4 about here

The spatial skills tests were moderately correlated with each other (r for males = .46, and r for females = .56) and the English skills tests were also well correlated (r for males = .64, r for females = .62) as expected. However, it is interesting to note that the Simultaneous Reception Test which was included in the study as a measure of sign skills correlated substantially with the English skills tests (r's for males and females range from .42 to .67), negatively with the extent of hearing loss (r for males = -.57, for females r = -.41), but did not have much relationship with the Manual Reception Test, the other test of sign skills (r for males = .03, r for females = .22). In the Simultaneous Reception Test, the message is presented using multiple cues while in the Manual Reception Test it is presented only through signs and fingerspelling. It is possible that lip movements and voice are distracting to manual people while at the same time giving advantage to the students with residual hearing or speech reading skills. The evidence that the Simultaneous Reception Test correlated positively with the English skills suggests it is more a test of English language skills than of sign skills. The Manual Reception Test, on the other hand, did not correlate much with any test (highest r = -.23). Other researchers at NTID have found a similar pattern of relationship between the Manual Reception Test and other tests (Walter, Note 8; White, Note 9). It is possible that sign skills do not have to be correlated with English skills or with spatial skills. However, more tests of sign skills with known reliability and validity are needed to test the hypothesis that sign skills tests and field dependence tests rely on a common cognitive structuring ability.

The Group Embedded Figures Test was highly correlated with the Spatial Relations Test for both males and females and for the Reading Comprehension Test for females (see Table 4). This finding further confirms Fiebert's (1967) results on deaf children which showed low-level but non-significant relationship between reading skills and field independence for female children and no relationship for male children.

<u>Step-wise Multiple Regression Analyses</u>

Step-wise multiple regression analyses of data on males showed that the Spatial Relations Test was the best predictor of the Group Embedded Figures Test (GEFT) scores, accounting for 45% of the variance in the

GEFT (See Table 5). The next best predictor was the extent of hearing loss which accounted for 4% of the variance beyond that explained by the Spatial Relations Test. Thus together these variables accounted for 49% of the variance in the GEFT and were significant predictors of it. The remaining variables did not add significantly to the equation. They collectively accounted for only 2% of the variance.

Insert Table 5 about here

Step-wise regression analyses of the data on females reported in Table 6 shows that the best predictor of the GEFT scores was, again, the Spatial Relations Test (SRE) accounting for 39% of the variance. The second best predictor was the Reading Comprehension Test (READ) which accounted for 6% of the variance and the third predictor was the Manual Reception Test (MRT) which accounted for 4% of the variance. Taken together these variables accounted for 49% of the variance in the GEFT. The contribution of each of the three variables was significant.

Insert Table 6 about here

After these three variables entered the equation the contribution of other variables to the equation was not significant in predicting the GEFT scores. They accounted for only 2% of the variance.

DISCUSSION

The results of this study are consistent with the hypotheses that deaf students would be more field-dependent than hearing students and competence in communication skills would influence field independence of deaf students. There was a sex difference in performance on the GEFT and both deaf males and females scored significantly lower on the test of field independence compared with hearing students. The lower scores on the Group Embedded Figures Test (GEFT) cannot be explained as due to generally lower spatial skills of deaf students since on the two other tests of perceptual-spatial skills, namely the Spatial Relations Test and the Abstract Reasoning Test, deaf females did not differ from hearing females and on the Spatial Relations Test deaf males were not different from hearing males. The results thus suggest that there is something peculiar to the GEFT which makes deaf students perform differently from hearing students, and thus seem to support our hypothesis.

Step-wise multiple regression analysis of the data showed that for both males and females spatial skills as measured by the Spatial Relations Test were the best predictors of field independence. The second best predictor for males was the extent of hearing loss (PTA). For females the Reading Comprehension Test, followed by the Manual Recption Test were the next 2 significant predictors of the GEFT. Though the amount of variance in the GEFT predicted by the variables was the same for males and females (49%), in females 39% of that variance was predicted by the Spatial Relations Test and 10% by communication skills. However, in males 45% of the variance was accounted for by the SRE and only 4% by the extent of hearing loss. These sex differences may be taken as indirectly supporting factor analyses studies which show that the

Spatial factor is less well differentiated in females than in males (Anastasi, 1970; Hyde, Geisinger, & Yen, 1975).

It is not surprising that for both males and females, a spatial skills test was the best predictor of the GEFT scores. There is ample evidence to show that field independence tests correlate with tests of spatial skills (McGillian, & Barclay, 1974; Thurstone, 1944; Witkin, et al., 1962) and factor analyses studies show that field independence measures load on the Spatial factor (Bergman, & Engelbrektson, 1973; Gardner, Jackson, & Messick, 1960; Hyde et al., 1975; Vernon, 1972). Sherman (1967) has argued that the sex difference in fiedl dependence tests is due to a sex difference in spatial abilities. Whether the origins of the sex difference are due to socio-cultural factors as she argues, genetic differences (Hartlage, 1970; Stafford, 1961), endocrinological differences (Waber, 1977), or differences in the strength of cerebral lateralization (Kimura, 1969) is controversial. However, it is clear that spatial skills are closely associated with field independence across sexes and also within each sex in deaf students.

The second best predictor of the GEFT for males was the extent of hearing loss. This measure is negatively correlated with both the GEFT (-.14) and the Simultaneous Reception Test (-.57). Thus it may be that the magnitude of hearing loss influences field independence and communication skills to some extent: the greater the hearing loss the worse the performance on the GEFT and the Simultaneous Reception Test.

The next 2 variables which predicted the GEFT scores for female deaf students were the Reading Comprehension Test and the Manual Reception Test which were tests of communication skills. These results, together with high correlations of reading skills with the GEFT for females, are at variance with those found in the hearing population. There have been a few exceptions (e.g., De Fazio, 1973) but in general there is not a strong relationship between field dependence and verbal ability in hearing subjects (Witkin, et al., 1962; Witkin, et al., 1977; Witkin, Moore, Oltman, Goodenough, Friedman, Owen, & Raskin, 1977). It is proposed that competence in communication skills is necessary but not sufficient to develop field independence. Thus when there is a general interference in language development, its role would be apparent in developing field independence. However, once a required minimum level of communication competence is reached, development of field independence may not be related to further language development.

One way to test these hypotheses, namely, the effect of socialization and the degree of competence in communication skills on field dependence, is to study deaf individuals born of deaf parents who have learned ASL as their first language. These individuals, presumably would have reached the putative minimum competence in communication skills and since there will not be communication difficulties present between mother and child, will have mother-child interaction experiences similar to hearing children. Whether these deaf individuals would still be different than the hearing remains to be tested. Perhaps the experience of growing up in an oral culture with their auditory handicap may still make them more field-dependent than hearing individuals. In a study of congenitally blind children (Witkin, Birnbaum, Lomonaco, Lehr, & Herman, 1968), Witkin found that the blind children were more field-dependent compared to the sighted and suggested that the presence of a handicap may account for interference in development of field independence. Perhaps, as it was suggested, earlier, it is advantageous for deaf persons to develop a cluster of characteristics related to field-dependent individuals namely attentiveness to others and reliance on external referents while moving in the hearing world. Also, it is possible that the very nature of processing sign language encourages such characteristics. For example, it has been noted that the speakers of ASL tend to look primarily at the face (Meadow, 1972; Siple, in press). More research is clearly needed to look at the social influence of the deaf sub-culture on deaf individual's psychological development.

A second possibility is that the effect of auditory deprivation and/or knowledge of sign language on cerebral lateralization in congenitally deaf individuals may be such that they would be weakly lateralized compared to hearing people and, thus, according to Witkin's model (Witkin, et al., Note 4) may be more field-dependent. Cerebral lateralization studies in the deaf population have just begun (McKeever, Hoemann, Florian, & Van Deventer, 1975; Neville, & Bellugi, in press) and though it is too early to determine their generality, the results, at least, do not rule out the above possibility.

In conclusion, the results of this study show that deaf students are more field-dependent compared to hearing students and spatial skills and communication skills are significantly related to the performance on the field dependence test. Furthermore there is a sex-difference in performance on the GEFT. These results are consistent with the hypothesis about the role of communication skills in the development of field independence. However, more research is needed to separate and elucidate the contribution of these variables and in general to study the influence of psychological and neurophysiological factors in development of field independence.

FOOTNOTES

[1]The term deaf as used in this paper refers to all hearing impaired people whose hearing loss is so severe as to interfere with the normal acquisition of spoken language.

[2]The term sign skills is used here as a general term referring to the use of fingerspelling, signed English and American Sign Language in any combination.

Reference Notes

1. Witkin, H. A., Oltman, P. K., Cox, P. W., Eholichman, E., Hamm, R. M., Ringler, R. W. Field-dependence-independence and psychological differentiation: A bibliography through 1972 with index. (ETS RB-73-62) Princeton: Educational Testing Service, 1973.

2. Witkin, H. A., Cox, P. W., Friedman, F., Haishikesan, A. G., & Siegel, K. N. Supplement No. 1, Field-dependence-independence and psychological differentiation: Bibliography with index. (ETS RB-74-42). Princeton: Educational Testing Service, 1974.

3. Witkin, H. A., Cox, P. W., Friedman, F. Supplement No. 2, Field-dependence-independence and psychological differentiation: Bibliography with index. (ETS RB-76-28). Princeton: Educational Testing Service, 1976.

4. Witkin, H. A., Goodenough, D. R., & Oltman, P. K. Psychological differentiation: current status. (ETS RB 77-107). Princeton: Educational Testing Service, 1977.

5. Goodenough, D. R., & Witkin, H. A. Origins of field-dependent and field-independent cognitive styles. (ETS RB-77-9). Princeton: Educational Testing Service, 1977.

6. Crandall, K. E. The NTID written language test. Paper presented at the 1976 Annual Convention of the American Speech and Hearing Association, 1976.

7. Blasdell, R., & Caccamise, F. Validity and reliability of manual and simultaneous reception tests. Paper in preparation, 1978.

8. Walter, G. A factor analytic study of communication skills, aptitudes, and verbal abilities of young deaf adults. Unpublished manuscript, National Technical Institute for the Deaf, 1978.

9. White, K. Summary report of an evaluation of 1976 summer vestibule program students. Unpublished manuscript, National Technical Institute for the Deaf, 1978.

References

Anastasi, A. On the formation of psychological traits. American Psychologist, 1970, 25, 899-910.

Bellugi, U., & Klima, E. S. Aspects of sign language and its structure. In J. F. Kavanagh and J. E. Cuttings (Eds.) The Role of Speech in Language. Cambridge: MIT Press, 1975.

Bennett, B. Psychological differentiation and language development in deaf and hearing subjects. Dissertation Abstract International. 1971. 1833-B

Bennett, G. K., Seashore, H. G., Wesman, A. G. Differential Aptitude Tests, New York: The Psychological Corporation, 1966.

Bergman, H., & Engelbrektson, K. An examination of factor structure of rod-and-frame test and embedded figures test. Perceptual and Motor Skills. 1973, 37, 1934-147.

Berry, J. W. Temne and Eskimo perceptual skill. International Journal of Psychology, 1966, 1, 207-229.

Best, P, K. Psychological differentiation in the deaf. Dissertation Abstract International., 1975, 35, 4239A.

Blanton, R. L., & Nunnally, J. C. Semantic habits and cognitive style processes in the deaf. Journal of Abnormal and Social Psychology, 1964, 68, 4, 397-402.

Dawson, J. L. M. Cultural and physiological influences upon spatial-perceptual processes in West-Africa. Part I and II. International Journal of Psychology, 1967, 2, 115-128 and 171-185.

De Fazio, V. J. Field articulation differences in language abilities. Journal of Personality and Social Psychology, 1973, 25, 351-356.

Dershowitz, Z. Jewish subcultural patterns and psychological differentiation. International Journal of Psychology, 1971, v. 6, 223-231.

Fiebert, M. Cognitive styles in the deaf. Perceptual and Motor Skills, 1967, 24, 319-329.

Furth, H. G. Deafness and Learning. Belmont, Calif.: Wadsworth Publishing Co., 1973.

Gardner, R. W., Jackson, D. N., & Messick, S. J. Personality organization in cognitive controls and intellectual abilities. Psychological Issues, 1960, 2 (whole No. 8).

Hartlage, L. Sex-linked inhesitance of spatial ability. Perceptual and Motor Skills, 1970, 31, 610.

Hays, W. L. Statistics for the Social Sciences. New York: Holt, Rinehart and Winston, 1973.

Hyde, J., Geisinger, E. and Yen, W. On the empirical relation between spatial ability and sex differences in other aspects of cognitive performance. Multivariate Behavioral Research, 1975, 10, 3, 289-309.

Johnson, D. Communication characteristics of a young deaf adult population: techniques for evaluating their communication skills. American Annals of the Deaf, 1976, 121, 4, 409-423.

Kimura, D. Spatial localization in left and right visual fields. Canadian Journal of Psychology, 1969, 23, 445-458.

McFall, R. M., & Schenkein, D. Experimenter expectancy effects, need for achievement and field-dependence. Journal of Experimental Research in Personality, 1970, 4, 122-128.

McGilligan, R. P., & Barclay, A. G. Sex differences and spatial ability factors in Witkin's 'differentiation' construct. Journal of Clinical Psychology, 1974, 30, 528-532.

McKeever, W. F., Hoemann, N. W., Florian, V. A., & Van Deventer, A. D. Evidence of minimal cerebral asymmetries in the congenitally deaf. Neuropsychologia, 1976, 14, 413-423.

Meadow, K. P. Sociolinguistics, sign language and the deaf sub-culture. in T. O'Rourke (Ed.), Psycholinguistics and Total Communication: The state of the art. Silver Spring, Maryland: National Association for the Deaf, 1972, 68-84.

Meadow, K. P. Personality and Social Development of deaf persons. Journal of Rehabilitation of the Deaf, 1976, 9, 3 1-12.

Mindel, E. D., & Vernon, M. They Grow in Silence. Silver Spring, Maryland: National Association of the Deaf, 1971.

Naiman, D. W. The relationship of verbal language ability to psychological differentiation in the adult deaf. Dissertation Abstract International, 1970, 15, 1972.

Neville, H., & Bellugi, U. Patterns of cereleral specialization in congenitally deaf adults: A preliminary report. In P. Siple (Ed.), Understanding Language through Sign Language Research. New York: Academic Press, in press.

Nie, N. H., Hull, C. H., Jenkins, J. G., Steinbrenner, K., & Bent, D. H. SPSS Statistical Package for the Social Sciences. New York: McGraw Hill, 1970.

Oltman, P. K., Ehrlichman, H. & Cox, P. W. Field-independence and laterality in the perception of faces. Perceptual and Motor Skills, 1977, 45, 255-260.

Pizzamiglio, L. Handedness, ear preference, and field dependence. Perceptual and Motor Skills, 1974, 38, 700-702.

Ruble, D. N., & Nakamura, C. Y. Task orientation versus social orientation in young children and their attention to relevant social cues. Child Development, 1972, 43, 471-480.

Schlesinger, H. S., & Meadow, K. P. Sound and Sign. Berkley: University of California Press, 1972.

Sherman, J. Problem of sex differences in space perception and aspects of intellectual functioning. Psychological Review, 1967, 74, 290-299.

Siple, P. Visual constraints for sign language communication. Sign Language Studies, in press.

Siple, P., Hatfield, N., & Caccamise, F. The role of visual perceptual abilities in the acquisition and comprehension of Sign language. American Annals of the Deaf, in press.

Sisco, F. H., & Anderson, R. J. Current findings regarding the performance of deaf children on the WISC-R. American Annals of the Deaf, 1978, 123, 2, 115-121.

Stafford, R. Sex differences in spatial visualization as evidence of sex-linked inheritance. Perceptual and Motor Skills, 1961, 13, 428.

Thurstone, L. L. A factorial study of perception. Chicago: University of Chicago Press, 1944.

Tiegs, E. W., & Clark, W. W. California Reading Tests. California Testing Bureau, 1963.

Vernon, P. E. The distinctiveness of field independence. Journal of Personality, 1972, 40, 366-391.

Vernon M., & Mindel, E. Psychological and psychiatric aspects of profound hearing loss. In D. Rose (Ed.), Audiological Assessment. Englewood Cliffs, N.J.: Prentice Hall, 1971,87-132.

Waber, D. P. Biological substrates of field dependence: Implications of the sex difference. Psychological Bulletin, 1977, 84, 6, 1076-1087.

Welch, B. The significance of the difference between two means when the population variances are unequal. Biometrika, 1938, 29, 250-262.

Welch, B. The generalization of 'Student' problem when several different population variances are involved. Biometrika, 1947, 34, 28-35.

Witkin, H. A. Individual differences in ease of perception of embedded figures. Journal of Personality, 1950, 19, 1-15.

Witkin, H. A., & Berry, J. W. Psychological differentiation in cross-cultural perspective. Journal of Cross-cultural Psychology. 1975, 6, 4-87.

Witkin, H. A., Birnbaum, J., Lomonaco, S., Lehr, S., & Herman, J. L. Cognitive patterning in congenitally totally blind children. Child Development, 1968, 39, 3, 767-786.

Witkin, H. A., Dyk, R., Faterson, H. F., Goodenough, D. R. & Karp, S. A. Psychological Differentiation. New York: Wiley, 1962.

Witkin, H. A., & Goodenough, D. R. Field-dependence and interpersonal behavior. Psychological Bulletin, 1977, 84, 4, 661-689.

Witkin, H. A., Lewis, H. B., Hertzman, M., Machover, K., Meissner, P. B., & Wapner, S. Personality through Perception. New York: Harper, 1954.

Witkin, H. A., Moore, C. A., Goodenough, D. R., & Cox, P. W. Field-dependent and field-independent cognitive styles and their educational implications. Review of Educational Research, 1977, 47, 1, 1-64.

Witkin, H. A., Moore, C. A., Oltman, P. K., Goodenough, D. R., Friedman, F., Owen, D. R., & Raskin, E. Role of field-dependent and field-independent cognitive styles in academic evolution: A longitudinal study. Journal of Educational Psychology, 1977, 69, 3, 197-211.

Witkin, H. A., Oltman, P. K., Raskin, E., & Karp, S. A. A Manual for the Embedded Figures Tests. Palo Alto, Calif: Consulting Psychologists Press, 1971.

Witkin, H. A., Price-Williams, D, Bertina, M, Christiansen, B., Oltman, P. K., Raimirez, M., & Van Meel, J. Social conformity and psychological differentiation. International Journal of Psychology, 1974, 9, 11-29.

Table 1

Mean Scores for Males and Females on the Eight Tests Used in the Study

	Males			Females			
Tests	n	M	SD	n	M	SD	F
1. GEFT	77	10.12	(5.14)	67	7.45	(4.36)	11.10*
2. SRE	75	38.32	(11.94)	67	31.69	(11.51)	11.30*
3. ABT	74	31.54	(13.19)	64	33.33	(11.4)	.71
4. READ	76	9.31	(1.48)	67	9.31	(1.48)	0
5. WRITE	76	4.15	(.57)	67	4.15	(.50)	0
6. SRT	76	75.92	(21.40)	67	81.76	(17.53)	3.13
7. MRT	74	50.22	(29.09)	66	56.57	(30.11)	1.61
8. PTA	76	91.16	(15.72)	67	89.46	(18.05)	.36

Note: ns differ owing to the missing data on some variables.

*p .001

Table 2

Mean Scores for Deaf and Hearing Students on the SRE and the ABT
(Standard deviations in parentheses)

	Males			Females		
Tests	Deaf[a]	Hearing[b]	p[c]	Deaf	Hearing	p
SRE	38.22 (12.00)	35.8 (13.1)	n.s.	31.46 (11.49)	30.9 (12.0)	n.s.
ABT	31.22 (13.23)	34.8 (9.3)	.05	33.51 (1[illegible].45)	33.3 (10.2)	n.s.

Note. The data for hearing students is taken from norms reported by Bennett, et al., 1966.

[a] $\underline{n}$ = 72 for males and $\underline{n}$ = 63 for females

[b] $\underline{n}$ = 2000 + for both males and females

[c] Significance level of Welch's t-test of difference between means, two tailed.

Table 3

Mean Scores for Deaf and Hearing Students on the GEFT (Standard deviations in parentheses).

	Deaf		Hearing[a]		
	n	M	n	M	t
Males	72	9.99 (5.25)	242	12.0 (4.2)	3.00*
Females	63	7.57 (4.44)	155	10.8 (4.1)	4.99*

[a]The data for hearing students is taken from norms reported by Witkin, et al., 1971.

*$p < .001$, two tailed.

Table 4

Correlations of Eight Variables for Each Sex[a]
(correlations for females are shown above the diagonal, for males below)

Variable	1	2	3	4	5	6	7	8
1. GEFT		.62	.36	.51	.34	.29	.12	.00
2. SRE	.67		.56	.47	.30	.17	.00	.05
3. ABT	.45	.46		.54	.42	.32	.03	.03
4. READ	.25	.25	.43		.62	.48	-.23	-.05
5. WRITE	.15	.06	.18	.64		.42	-.23	-.10
6. SRT	.14	-.05	.35	.67	.56		.22	-.41
7. MRT	.10	.09	-.05	-.20	-.12	-.03		.21
8. PTA	-.14	.06	-.24	-.30	-.33	-.57	.25	

[a] n = 72 for males, n = 63 for females

Table 5

Summary of Results of Multiple Regression Analysis for Males (n=72)

Dependent variable	Independent variables	F value to Enter	R	R^2
GEFT	SRE	62.83^{**}	.67	.45
	PTA	4.51^{*}	.70	.49

$^{*}\ p < .05$

$^{**}\ p < .01$

Table 6

Summary of Results of Multiple Regression Analysis for Females (n = 63)

Dependent variable	Independent variables	F value to enter	R	R^2
GEFT	SRE	18.83**	.62	.39
	READ	9.83**	.67	.45
	MRT	4.31*	.70	.49

* $p < .05$

** $p < .01$

Appendix 1

Mean Scores on eight tests for two groups of deaf students with practice section scores on the GEFT 1) above 5 and 2) below 6.

Table 1A

Mean Scores on Eight tests for Two Groups of Deaf Students with Practice Section Scores on The GEFT 1) Above Five and 2) Below Six (standard deviations in parentheses)

	Group 1			Group 2			
Tests	n	M	SD	n	M	SD	F
GEFT	113	9.95	(4.76)	31	4.97	(3.56)	29.36**
SRE	111	37.06	(11.94)	31	28.48	(10.59)	13.09**
ABT	107	33.49	(11.95)	31	28.52	(13.34)	3.94*
READ	112	9.39	(1.50)	31	8.99	(1.38)	1.79
WRITE	112	4.15	(.55)	31	4.16	(.68)	.15
SRT	112	77.80	(19.69)	31	81.74	(20.37)	.96
MRT	110	53.49	(29.33)	30	52.20	(31.26)	.44
PTA	112	91.42	(15.78)	31	86.55	(19.94)	2.05

* $p < .05$

** $p < .001$.

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