World Journal of Research and Review (WJRR)
ISSN:2455-3956, Volume-6, Issue-2, February 2018 Pages 90-95

# Discriminant Analysis of Deaf Persons Communication Systems

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***Abstract*- Deaf persons, in their communications, use verbal and non-verbal communication systems, as well as bilingual communication. The aim of this article is to determine which communication system the deaf people prefer, and to determine whether there is a statistically significant difference between the sub-samples of the respondents in the preference of the communication systems using discriminant analysis. Study findings have shown that deaf people prefer a non-verbal communication system and a bilingual manner of communicating, and do not reject the verbal communication system because it is essential to communicating with hearers but, they do not prefer it. Discriminant analysis revealed that there was no statistically significant difference between the sub-groups of the respondents at a statistical significance level of 0.01.**

***Index Terms*- deaf persons, communication systems, verbal, nonverbal, bilingual**

## I. INTRODUCTION

Communication is shaped by language, and language results from linguistic experience, or exposure to spoken or sign language and inherent abilities to adopt certain types of language forms (1). The adoption of language, or the formation of language competence, arises exclusively under the conditions of active speech communication that enables the understanding and use of numerous spoken language constructs (2). Many studies in the world has shown that the majority of hearing impaired children, even children with a mild degree of impairment, have significant delays in language development and academic achievement (3).

The deaf persons in relation to their physical and mental abilities within everyday communication, both within the population and in communication with the hearers, use the nonverbal communication system in which they are spontaneously through their education, and a verbal communication system in which they are systematically educated through the process of education and re/habilitation, as well as bilingual mode of communication that includes simultaneous use of verbal and non-verbal communication systems. Which of the communication systems will be developed as dominant depends on the nature of hearing impairment (4). To the use of acquired speech-language skills and communication with listening persons, deaf people are „forced“also because of their daily interaction with listening people (5). Deaf people in most cases, irrespective of age and environment, avoid communicating with listening people and have a negative attitude towards oral-voice speech and language as a means of communication, regardless of the fact that their daily activities are exposed to the need for its use (6). The inadequate communication of the deaf with its environment is present for two reasons, insufficient knowledge of oral speech and language by deaf people, and inadequate knowledge of sign language by the hearers on the other (5).

***The subject of the study*** is to determine the preference of a verbal or non-verbal communication system or the bilingual mode of communication among deaf persons during the education and re/habilitation process and the deaf people who have undergone the process of education and re/habilitation. Likewise, besides systematic training of verbal communication, which is indispensable for their daily communication interactions with the listening environment in which they live, their communication within the population continues through the non-verbal communication system, rejecting the verbal communication system. In this manner, deaf people marginalize verbal communication, which we define as a problem that hinders the ultimate goal of re/habilitation and social integration of these persons.

***The goal of the study*** was to examine the preference for verbal, nonverbal and bilingual communication through variables that define the role of the above mentioned deaf people communication systems, and by discriminant analysis to determine whether there is a statistically significant difference between the subgroups of the respondents.

## II. HYPOTHESIS

$H_1$. It is presumed that deaf persons prefer the verbal communication system with hearing and deaf people due to many years of education in oral communication.

$H_2$. It is presumed that deaf persons prefer the non-verbal communication system as their natural communication system due to inherent loss of hearing experience.

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$H_3$. It is presumed that deaf persons prefer bilingual communication, or simultaneous use of verbal and non-verbal communication system.

$H_4$. It is presumed that deaf personswho are in the educational re/habilitation process and the deaf persons who completed the educational re/habilitation process differ statistically significantly according to the preferred communication system.

## III. METHODS

### A. Sample

The total sample of 80 respondents consisted of two equal subgroups of deaf persons. The first sub-group was consisted of students of older age, high school students (15-19 years old) who are in the course of or at the end of education and re/habilitation, and who use the verbal communication system in the education and school environment and partly the non-verbal. The second sub-group is formed from a group of deaf adults (from 19 to 55 years of age) who live and work in the environment of the hearing and realize communication that is unique to each individual.

### B. Instrument

For the purposes of this study, a questionnaire contains 19 variables with Likert's type responses (yes, yes/no, no) was constructed. The questionnaire refers to the use of verbal and non-verbal communication systems, as well as bilingualism as a combined approach in the education and communication of deaf persons. The answers are quantified in a manner that the answer „yes“is coded by the number 1, the answer „yes/no“by the number 2 and the answer „no“by the number 3. The variables are selected according to the system of questions relative to the preference of a particular communication system. Questions in the questionnaire were constructed in a manner that they referred to the preference of one of three modes of communication. The first group of questions is related the preference of the verbal communication system, and include the variables numbered: 3,9,11,16 and 18 (Table 1). The second group of questions is related to the preference of the non-verbal system of communication, and include variables number 6, 7, 10, 12, 13, 14, 15 and 17 (Table 1). The third group of questions referred to the preference for bilingualism, including variables number 1, 2, 4, 5, 8 and 19 (Table 1). The instrument contains the 19 applied variables, according to their uniformity in the process of verifying the representativeness of the variables for the applied measurement, met the coefficients in relationto the criteria of reliability, validity, objectivity and sensitivity of the measurements, and the criterion of sample number of respondents was also compared with the number of applied variables.

### C. Data processing methods

In this studyare used methods of descriptive and discriminatory analysis. Parametric and nonparametric statistics have determined relevant facts defining the relation of deaf persons to the preferred communication system. Basic statistical parameters, frequencies and percentages were calculated, as well as determination of differences between the two subgroups of the respondents.

## IV. RESULTS AND DISCUSSION

### A. Analysis of frequenciesand percentages of responses among deaf persons

*Table 1. Comparison of frequency distributions and percentagesof responses withinsubgroups of respondents by individual variables*

| | Variable | YES | | | | YES/NO | | | | NO | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | I | II | I | II | I | II | I | II | I | II | I | II |
| | | N | N | % | % | N | N | % | % | N | N | % | % |
| 1. | I often talk to deaf persons and hearers | 18 | 23 | 45.0 | 57.5 | 15 | 9 | 37.5 | 22.5 | 7 | 8 | 17.5 | 20.0 |
| 2. | I talk more to deaf persons than to hearers | 35 | 37 | 87.5 | 92.5 | 0 | 1 | 0.00 | 2.5 | 5 | 2 | 12.5 | 5.0 |
| 3. | I talk more with the hearers than with deaf persons | 6 | 3 | 15.0 | 7.5 | 0 | 2 | 0.00 | 5.0 | 34 | 35 | 85.0 | 87.5 |
| 4. | I prefer to talk to deaf persons than to hearers | 33 | 29 | 82.5 | 72.5 | 1 | 8 | 2.5 | 20.0 | 6 | 3 | 15.0 | 7.5 |
| 5. | I do not like at all to talk with the hearers | 21 | 17 | 52.5 | 42.5 | 6 | 12 | 15.0 | 30.0 | 13 | 11 | 32.5 | 27.5 |
| 6. | I'm talking to persons only if they use the sign language | 19 | 28 | 47.5 | 70.0 | 4 | 1 | 10.0 | 2.5 | 17 | 11 | 42.5 | 27.5 |
| 7. | I do not understand the hearers | 31 | 14 | 77.5 | 35.0 | 7 | 11 | 17.5 | 27.5 | 2 | 15 | 5.0 | 37.5 |
| 8. | I'm glad when hearers are talking using signs | 38 | 33 | 95.0 | 82.5 | 0 | 7 | 0.0 | 17.5 | 2 | 0 | 5.0 | 0.0 |

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 9. | I try to understand people when they use oral-voice language | 27 | 19 | 67.5 | 47.5 | 9 | 10 | 22.5 | 25.0 | 4 | 11 | 10.0 | 27.5 |
| 10. | I'm happiest when I'm in the company of deaf persons | 34 | 36 | 85.0 | 90.0 | 5 | 4 | 12.5 | 10.0 | 1 | 0 | 2.5 | 0.0 |
| 11 | I am happy to learn the language of the hearers | 22 | 18 | 55.0 | 45.0 | 12 | 11 | 30.0 | 27.5 | 6 | 11 | 15.0 | 27.5 |
| 12 | Hearing persons avoid us, deaf persons | 23 | 21 | 57.5 | 52.5 | 5 | 7 | 12.5 | 17.5 | 12 | 12 | 30.0 | 30.0 |
| 13 | I'm not interested at all in the language of the hearers | 17 | 11 | 42.5 | 27.5 | 8 | 13 | 20.0 | 32.5 | 15 | 16 | 37.5 | 40.0 |
| 14 | I communicate exclusively with the signs | 15 | 26 | 37.5 | 65.0 | 5 | 1 | 12.5 | 2.5 | 20 | 13 | 50.0 | 32.5 |
| 15 | The language of the hearers is unacceptable for me | 13 | 9 | 32.5 | 22.5 | 9 | 15 | 22.5 | 37.5 | 18 | 16 | 45.0 | 40.0 |
| 16 | I always like to be in the company of hearers | 13 | 5 | 32.5 | 12.5 | 9 | 15 | 22.5 | 37.5 | 18 | 20 | 45.0 | 50.0 |
| 17 | I can only communicate with deaf persons | 16 | 27 | 40.0 | 67.5 | 3 | 9 | 7.5 | 22.5 | 21 | 4 | 52.5 | 10.0 |
| 18 | I can only communicate with hearers | 0 | 4 | 0.0 | 10.0 | 5 | 12 | 12.5 | 30.0 | 35 | 24 | 87.5 | 60.0 |
| 19 | I like to know both, the language of hearing and the language of the deaf | 25 | 34 | 62.5 | 85.0 | 10 | 6 | 25.0 | 15.0 | 5 | 0 | 12.5 | 0.0 |
| | **Total** | **406** | **394** | **53.4** | **51.8** | **113** | **154** | **14.9** | **20.3** | **241** | **212** | **31.7** | **27.9** |

*Table 2. Comparison of total percentages of responsesin subgroups of respondents according to communication systems*

| | Verbal communication system (%) | | | Non-verbal communication system (%) | | | Bilingual approach in communication (%) | | |
|---|---|---|---|---|---|---|---|---|---|
| | YES | YES/NO | NO | YES | YES/NO | NO | YES | YES/NO | NO |
| First subsample | 34.00 | 17.50 | 48.50 | 52.50 | 14.38 | 33.12 | 70.83 | 13.33 | 15.83 |
| Second subsample | 24.50 | 25.00 | 50.50 | 53.75 | 19.06 | 27.19 | 71.66 | 18.33 | 10.00 |

Table 1 shows comparisons of the frequencydistribution and percentages of the responses in subsamples to all variables that define three communication systems, and Table 2 shows the comparison of the total percentages of responses in subsamples to each communication system individually, and based on the claims defining this communication system. In the applied variables of the alternative scale (yes, yes/no, no) which we declared as confirmative, negative and neutral responses of the respondents, in relation to the preference of a particular communication system that the deaf persons use, both in mutual communication and in communication with the hearers, we wish to test which communication system, in majority of cases, prefer deaf persons.

By analyzing the frequencies and percentages of the deaf persons responses, it can be concluded that ***the highest percentage of respondents of both subgroups have confirmative relation to the statements defining the bilingual system of communication***. According to this approach in communication, 70.83% of the respondents of the first subgroup and 71.66% of the respondents of the second subgrouphave affirmative response. Based on the above, it can be concluded ***that deaf persons prefer a bilingual approach to communication.*** According to the claims that define ***the non-verbal communication system, the highest percentage of respondents have provided confirmative answer***, 52.50% of the first respondents subgroups and 53.75% of the second respondents subgroup.

These results point to the conclusion that ***deaf respondents also prefer a non-verbal communication system.Responses of deaf persons to claims that define the verbal communication system are in the largest percentage negative.*** On the basis of the obtained results we can conclude ***that deaf people in their communication, in most cases, do not prefer a verbal communication method,*** regardless of long-term systemic education and rehabilitation, because 48.50% of respondents of the first subgroup and 50.50% of the second subgroup answerednegative to the claims defining this communication system. According to the verbal communication system, about 1/3 of the respondents of the first subgroup and 1/4 of the second subgroupanswered affirmative, which indicate that the deaf persons did not completely reject this communication system, but did not prefer it as dominant.

By descriptive analysis and parametric estimates pertaining to frequencies and percentages of the claims to statements within the examined samples, it can be concluded globally that deaf persons prefer a nonverbal communication system rather than a verbal communication system, but does not reject it, although most answered negative in relation to this communication system. Not to reject the verbal communication system also shows responses to claims defining the bilingual access to communication, where the respondents in the highest percentage have answered in the affirmative manner. All this leads to the conclusion that deaf persons have nothing against using all available means of communication.

In support of these statements are also conclusions from the available literature.

Due to the inability to communicate with oral-verbal speech and language, or verbal communication system, deaf people are forced to develop a non-verbal communication system, or sign language (7).

Given that deaf persons do not have the phonological experience of words, it is to be expected that word-based structures for recognizing and naming content will be better implemented in non-verbal form or gesture. For this reason, in learning languages, it is necessary to prefer the use of gestures as the first language of the deaf to develop the language of the hearers by using abundant covert and other obvious means in language education (8).

Deaf people in most cases, irrespective of age and environment, avoid communicating with listening people and have a negative attitude towards oral-voice speech and language as a means of communication, regardless of the fact that their daily life activities are exposed to the need for its use, which suggests that deaf people resort to the use of sign language as their first and natural language (6).

In children with severe hearing impairment at the earliest age, a sign language should be dominant, that will allow adequate communication with children to develop cognition, and its development will further enable the adoption of oral-voice language (9).

Language skills of hearing impaired students are at a lower level compared to their hearing peers (10).

The use of bilingual, bicultural modules brings positive changes in the field of education for deaf and hearing-impaired people (11).

Language learning research has shown that bilingual learning cannot have a negative impact on the learning of another language (12).

**B. Discriminant analysis**

Given the research goal, the total sample of respondents is divided into two sub-groups. It was intended to determine whether there are any differences between the subgroups when it comes to preferring a verbal, non-verbal or bilingual mode of communication. Differences according to the preference of a particular communication system of the examined samples were also apparent on the basis of distribution of response frequencies in individual variables. In order to verify the hypothesis $H_4$ that the deaf respondents in the course of the educational rehabilitation process and the deaf respondents who completed the educational re/habilitation process differed statistically significantly according the preferred communication system, the method of discriminant analysis was used. Discriminant analysis the acquisition of discrimination functions and given the size of a sample of respondents in relation to the number of applied variables, a discrimination function was isolated. The statistical significance of the difference between subgroups of the single sample of deaf respondents was determined at the level of 0.05. ***The strength of discrimination L=0.510, standard deviation of the tested groups, $x^2$ test, degrees of freedom, and probability of differences in the group of respondents in the isolated discriminatory function indicate that the tested groups differ statistically significantly at the significance level of p=0.01.*** Since the respondents differs across the whole measurement scale, ***we have a scientific justification to search which variables are contributing to the distinction between the groups.***

*Table 3. Statistical significance of variability of means between groups with Lambda, F test of significance and coefficients of discriminant function*

| Variable | L | F | The canonical coefficient of discriminant function | p |
|---|---|---|---|---|
| 1 | 0.97 | 1.97 | -0.24 | 0.16 |
| 2 | 0.99 | 0.90 | 0.52 | 0.75 |
| 3 | 0.98 | 2.42 | 0.56 | 0.12 |
| 4 | 0.96 | 3.43 | 0.33 | 0.07 |
| 5 | 0.97 | 1.96 | 0.05 | 0.16 |
| **6** | **0.94** | **4.99** | -0.20 | **0.03** |
| **7** | **0.90** | **8.89** | 0.44 | **0.04** |
| **8** | **0.93** | **5.62** | 0.73 | **0.02** |
| 9 | 0.98 | 1.44 | -0.29 | 0.23 |
| 10 | 0.99 | 0.27 | -0.25 | 0.60 |
| 11 | 0.99 | 0.15 | -0.59 | 0.70 |
| 12 | 0.99 | 0.36 | -0.02 | 0.55 |
| 13 | 0.97 | 2.52 | 0.04 | 0.18 |
| 14 | 0.91 | 7.60 | -0.55 | 0.07 |
| 15 | 0.97 | 2.18 | 0.32 | 0.14 |
| **16** | **0.94** | **4.89** | 0.45 | **0.03** |
| 17 | 0.99 | 0.57 | -0.21 | 0.45 |
| 18 | 0.99 | 0.47 | -0.05 | 0.50 |
| 19 | 0.96 | 3.31 | -0.39 | 0.07 |

From Table 3 we can observe that the variables: 6 (F=4.99), 7 (F=8.89), 8 (F=5.62) and 16 (F=4.89) participated with the highest power in discrimination of the groups. The highest discriminatory power was shown by the variable under number 8, at the significance level of p=0.02, which reads „I'm glad when people are talking using signs"; then the variable under number 16 and the variable under number 6, at the significance level p=0.03, which state; „I always like to be in the company of hearers" and „I talk to people only if they use a sign language"; then the variable number 7, at the significance level p=0.04, which state„I do not understand the hearers". Variables: 4, 14, and 19 at the significance level p=0.07, have no statistical significance at a particular level of significance 0.05, but are significant for the interpretation and state: „I prefer to talk to deaf people than to hearers"; „I communicate exclusively with gesture" and „I love to know the language of hearing and the language of the deaf". Other variables statistically do not differ significantly between the two subgroups.

*Table4. Centroidsof the groups*

| Subsamples of deaf persons | Discriminant function |
|---|---|
| | 1 |
| 1 | -0.97 |
| 2 | 0.97 |

Differences between the subgroups of the examined sample of deaf respondents can also be observed based on the ***distance between the centroids of the examined groups*** (Table 4). Based on the distance of the standard deviations, we can state that the subgroups of the examined sample are sufficiently distant, which is standardized at 1 ***and that we can claim that the groups of respondents statistically differ significantly in the examined space by preferring a particular mode of communication***.

## V. HYPOTHESIS VERIFICATION

Based on the study results, by descriptive frequency and percentage analysis, by looking at the mean values of the responses to the variables estimation, **hypothesis $H_1$**, which reads ***„It is presumed that deaf persons prefer the verbal communication system with hearing and deaf people due to many years of education in oral communication"***, we can safely ***reject it*** because most of the respondents (48.50% of the respondents of the first subgroups and 50.50% of the respondents of the second subgroup) have negated the claims that define the verbal communication system.

**Hypothesis $H_2$** reading ***„It is presumed that deaf persons prefer the non-verbal communication system as their natural communication system due to inherent loss of hearing experience"***. with certainty ***we can accept*** because the highest percentage of respondents have answered affirmative (52.50% of the first subgroup and 53.75% of respondents of the second subgroups) to the claims that define the non-verbal communication system.

***Hypothesis $H_3$,*** which reads ***„It is presumed that deaf persons prefer bilingual communication, or simultaneous use of verbal and non-verbal communication system"*** we can safely ***accept*** because the majority of the respondents of both subgroupsconfirmed heavily on statements defining a bilingual approach in communication. According to this approach in communication, 70.83% of the respondents of the first subgroup and 71.66% of the respondents of the second subgroups answered affirmative.

***Hypothesis $H_4$*** reading ***„It is presumed that deaf persons who are in the educational re/habilitation process and the deaf persons who completed the educational re/habilitation process differ statistically significantly according to the preferred communication system"***, we can safely ***accept*** because the results of discriminant analysis, statistically significantly discriminated between the groups at the level of statistical significance of 0.05, and the greatest contribution to differentiation of the subgroups was shown by the variables: „I'm glad when people are talking Using signs"; „I always like to be in the company of the hearers"; „I'm only talking to people if they use the sign language" and „I do not understand the hearers".

## VI. CONCLUSION

Based on the results of the research we can conclude that deaf persons, in general, prefer the nonverbal communication system as their natural communication model due to inherent loss of hearing experience.

They do not prefer a verbal communication system, regardless of multiple yearsof education, but they do not reject it, even though the majority have negated this communication system. That they do not reject the verbal communication system also demonstrate answers to statements defining a bilingual approach in communication where the respondents in the highest percentage have confirmed and demonstrated the highest preference for bilingualism.

All this leads to the conclusion that deaf people have nothing against using all available means of communication. Discriminant analysis, based on isolated discrimination functions and the distance between centers of the examined subgroups of the respondents, found that deaf people during the educational and rehabilitation process and the deaf people who completed the educational and rehabilitation processes differ

statistically significantly in preferring a particular communication system.

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