

# **AN EVALUATION OF SPELLING ERRORS OF DEAF AND HARD OF HEARING STUDENTS IN GREECE**

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## **ABSTRACT**

This study is the first that examines the spelling skills of deaf (D) and hard of hearing (HH) primary and secondary education students in Greece. The purpose of this study was to examine the kind of spelling errors deaf and HH students make in Greek language and to compare them with those made by hearing students of the same school level. In addition, the affect of factors such as the degree of hearing loss, the method of communication, the educational level and the school placement were examined in relation to the Greek word spelling errors made by deaf and HH students. A group of 52 deaf and HH students and 41 hearing students of the same school level participated in two spelling tasks. In the first task, students were required to reproduce words presented visually into a sentence context. In the second task, students had to make a multiple spelling choice.

Results showed that deaf and HH students make all kinds of spelling errors (phonological, grammatical, as well as visual-orthographic) and they are more inclined to misspellings than hearing students. Furthermore, deaf and HH students differ significantly from the hearing students in the category of phonological errors and seem to perform better in multiple choice tasks than in production spelling tasks. Finally, from all factors examined only the level of education was found to influence the spelling errors of deaf and HH students.

## **INTRODUCTION**

Spelling is a transcription of spoken language. Current theories consider the acquisition of sound-to-spelling mappings to be critical for spelling success (Ehri, 1997). Given this, it is not surprising that deaf people, who do not have access to spoken language as hearing, have difficulty in linking speech sounds to written words. Deaf people usually make spelling errors and mostly phonologically inaccurate errors such as transpositions, substitutions, omissions and insertions. Such errors alter the phonological identity of the word (Padden, 1993; Leybaert & Alegria, 1995; Aaron et al, 1998; Sutcliffe et al, 1999; Allman, 2002; Wakefield, 2006). The spelling errors of deaf children are sometimes phonologically accurate. It has been noted that they make phonologically accurate errors quite less frequently than those of the hearing children (Dodd, 1980; Leybaert & Alegria, 1995; Aaron et al, 1998; Sutcliffe et al., 1999; Leybaert & Lechat, 2001; Harris & Moreno, 2004). Studies have also found that deaf children spell more accurately words with typical spelling than words with atypical spelling (Burden & Campbell, 1994; Kyle & Harris, 2006; Leybaert & Alegria, 1995; Leybaert & Lechat, 2001; Sutcliffe et al., 1999). Finally, deaf children show a frequency effect, in that they spell more accurately words used more frequently (Burden & Campbell, 1994; Sutcliffe et al., 1999).

There is a discussion concerning English and French deaf spellers, the type of mistakes they make and the strategies they use in spelling. In Greece, although there is an increasing interest in reading, writing a story, vocabulary and syntax (Lampropoulou, 1993) spelling has not been studied. Given this and considering that research improves teaching practices, the current study examines the spelling skills of deaf and HH primary and secondary education students in Greece. The purpose of this study is answering the following questions:

1. Deaf and HH students make spelling errors compared to hearing students?
2. What kind of spelling errors deaf and HH students make?
3. Do factors such as the degree of hearing loss, the method of communication, the educational level and the school placement influence spelling?

## MATERIALS AND METHODS

A group of 52 deaf and HH students and 41 hearing students of the same school level participated in two spelling tasks. In the first task, deaf students were required to reproduce words depicted by drawings in sentence contexts in 30 minutes. In the second task, deaf students had to make a multiple spelling choice in 15 minutes. Given that the target was to make the utmost of this study and collect as many data as possible more time was given when this was required. Hearing students were asked to do the same, but in the first task words were orally pronounced. The words were selected according to the following criteria: a) they should constitute content words (noun-verb), b) they should have a spelling interest, c) they should be specific enough so as to be depicted by drawings.

## RESULTS

In the results presented below, we first test whether the population are normal using Kolmogorov - Smirnov test. The two hypotheses are:

H0: The population is normally distributed

H1: The population is not normally distributed

Then we compare the mean values of the populations:

H0: The mean values are not different

H1: The mean values are different

If the populations are not normally distributed, then we use the non - parametric Mann - Whitney U test in case of two independent samples and the non - parametric Kruskal - Wallis H test in case of three independent samples.

If the populations are normally distributed, then we use the parametric t - test in case of two independent samples and Analysis of Variance (ANOVA) in the case of three independent samples. Before using one of these methods, we must test the equality of variance of the populations by the Levene's test, i.e.

H0: The variances are not different

H1: The variances are different

When we compare two populations, the t - test is always used, based on the assumption either of equal or unequal variances. But when we compare three population with unequal variances, it is not possible to use ANOVA method, so the non - parametric Kruskal - Wallis H test is used.

For every parametric or non - parametric test, it has been calculated the value of the statistical function, as well as the corresponding p - value. When p - value is less than the significance level  $\alpha\%$ , H0 is rejected. The significance level has been selected to be 5%. In each category of errors that the difference is statistically significant, we compare the respective subcategories of errors (Appendix 1).

Spelling errors were classified into three major categories according to Protopapas, Fakou, Drakopoulou, Skaloumbakas και Mouzaki (2012):

a) Phonological: errors that affect the pronunciation of the word, altering its phonological identity (e.g., *θάλασσα* *Thalassa* /, "sea" spelled *φάλασσα* /*falassa*/).

b) Grammatical: errors concerning spellings of inflectional suffixes even though phonologically do not include an error (e.g., *δέντρων* □ *δέντρον* /*dedron*/ "trees"-omega is appropriate for the plural genitive case in Greek language).

c) Visual-orthographic (alternatively etymological or historical): errors concerning spellings of word stems, including roots and any derivational morphemes preceding the obligatory

inflectional suffix even though phonologically do not include an error (e.g., *ώμορφη* □ *όμορφη* /omorfi/ “beautiful”; *μυριζώ* □ *μυρίζω* /mirizo/ “I smell”- the affix /iz/ produces a verb).

In filler spelling task, a significant difference is noticed in relation to the mean value of errors between students with and without hearing impairments. Furthermore non-parametric test Mann-Whitney U showed significant variation in the category of phonological errors and almost all of its subcategories. This difference between the two groups of students is not observed in the multiple choice spelling test (See Table 1).

Deaf and HH students made all types of errors. Phonological errors presented the highest rate (57,12%) (Figure 1). Specifically subcategory P1-substitutions (e.x. *φωτογράφος* /fotografos/ “photographer” spelled *φωτογράτος* /fotogratos/) accounted to 33,06% and P2-omissions (e.x. *τροχονόμοι* /troxonomoi/ “traffic warden” spelled *τροχνόμοι* /troxnomoi/) reached 34,42%.

On the other hand, grammatical errors presented the lowest rate (11,92%) (Figure 1). Deaf and HH students misspelled at a rate of 15,58% the G6-noon neuter suffix -υ /i/ and of 11,69% G4-noon female suffix -η /i/. There was no mistake in subcategory G7-noon neuter suffix -ο /o/, while G8-verb suffix -ω /o/ presented 14,28%. In passive voice, G10-verb suffix -μαι /mai/ and G12-verb suffix -ται /tai/ reached a percentage of 10,39% and 11,68% respectively. In active voice, G9-verb suffix -ει /ei/, G11-verb suffix -με /me/ and G13-verb suffix -τε /te/ presented a rate of misspelling amounted to 7,8%, 3,9% and 7,8%.

The category visual-orthographic errors were up to 30,96% (Figure 1). Deaf and HH students misspelled mostly stems (V1: 64,5%) and less derivational morphemes (V4: 27,5%). Subcategory V2-consonant substitution in stem was not misspelled. Actually, target word *σφουγγαρίζει* /sfouggarizei/ “mopping” includes cluster -γγ- /gg/, which has two different graphemic representations, -γγ- /gg/ or -γκ- /gk/. Deaf and HH students omitted a letter altering the phonological identity of the word, so those errors were counted in category phonological. (See Figure 1)

Regarding individual characteristics of the deaf and HH students it was found that the level of education affects spelling. Specifically, deaf and HH primary (P) students made more errors than secondary (S) students as table 2 depicts (P vs. S, Phonological: 8 , 89 vs. 6.15, Visual-orthographic: 6,11 vs. 2,65, Grammatical: 1,45 vs. 1,44). Parametric t-test showed statistically significant differences in the category of visual-orthographic errors (p-value = 0,028 < α = 0,05). Further analysis shows statistical significance (p-value = 0,023) in subcategory V1-vowel substitution in stem. Finally, in the other subcategories V, the average error rates of primary students were higher, but without significant difference. (See Table 2)

## DISCUSSION

The main conclusion to be drawn is that there are differences in spelling performance between deaf or HH and hearing students. Deaf and HH students are more inclined to misspellings than hearing students. Specifically, in the filler spelling task deaf and HH students made more phonological errors than their hearing peers as it is also reported by several studies (Leybaert & Alegria, 1995; Aaron et al., 1998; Wakefield, 2006). In this task students should recall words stored in mental dictionary, separate phonemes and correspond them to graphemes. Graphophonological processes as well as phonological awareness (namely the ability to perceive and manipulate oral representations of words) were necessary. The findings indicate a phonological awareness deficit in deaf students compared to hearing peers and results in deaf and HH students having difficulty in establishing sound-letter mapping and phoneme to grapheme

sequencing for spelling production and leading them to phonological errors. Meanwhile in the multiple choice spelling task deaf or HH and hearing students' spelling performance was identical. In this task students had direct access to lexical units stored in memory and recall them as a whole. It is shown that deaf and HH students with little or no auditory input try to spell using logographic strategies according to Frith 's model of spelling (1985).

The above results indicate that deaf and HH students make all kinds of spelling errors (phonological, grammatical, visual-orthographic). The category of phonological errors reached highest rate, as Dodd (1980), Leybaert & Alegria, (1995), Aaron, Keetay, Boyd, Palmatier & Wacks, (1998), Sutcliffe et al. (1999), Leybaert & Lechat (2001) and Harris & Moreno (2004) have reported. To the contrary the category of grammatical errors had the lowest rate. Grammatical errors concern inflectional suffix that is the end of the word, which is visually directly accessible and its spelling is stabilized faster than the stem. More specifically the vast majority of grammatical errors were made at suffixes of verbs instead of those of nouns. As far as concern the phoneme /i/ in neuter nominal suffix position deaf use the grapheme 'ι' even for exceptions (i.e. words not written with /i/). According to Diakogiorgi, Baris and Valmas (2005) these exceptions are very rare. Research has shown that the frequency affect spelling. Deaf and HH children spell more accurately high frequency words than low frequency words (Burden & Campbell, 1994; Sutcliffe et al., 1999 ).

The total percentage of errors in the end of nouns containing the phoneme /i/ was greater than the percentage of errors in suffixes containing the phoneme /o/. The phoneme /i/ has five different graphemic representations ('ι', 'η', 'υ', 'ει', 'οι'), but the phoneme /o/ only two ('ο', 'ω'). It was also observed that verbs' suffix /o/ was written with 'ο' /omicron/ instead of 'ω' /omega/, while none neuter nominal suffix with /o/ was mistaken. Moreover the grapheme 'ε' /epsilon/ was the preferred one even for verbs which should be written with the digraph /ai/ 'αι'. Deaf and HH students have chosen the simplest visual graphemic representation and do not consider syntax rules about the agreement between subject and verb (Lampropoulou, 1993). As far as concern the category of visual-orthographic errors, stems were misspelled more than derivational morphemes. Spelling stems requires deep knowledge of Greek language and is connected with etymology. Meanwhile derivational morphemes are repetitive orthographic patterns, which are taught as a visual regularity. Research has shown (Padden, 1993; Aaron, Keetay, Boyd, Palmatier & Wacks, 1998; Olson & Caramazza, 2004) that deaf children from an early age internalize and utilize usual spelling visual-orthographic knowledge.

Regarding the third question, educational level (primary and secondary education) affects deaf and HH students' spelling choices. Generally, the mean value of errors made by students in primary education were greater in all categories of errors. However, only in the category of visual-orthographic the difference was significant. It is noticed that deaf and HH students in primary education were worst in spelling than students in secondary. This is reasonable regarding that students in secondary are better educated.

## **CONCLUSION**

It is concluded that deaf and HH students have difficulties in spelling and are more inclined to misspellings than hearing. Their spelling errors are mainly phonological indicating poor phonological awareness. On the other hand, deaf had a considerably better performance in spelling inflectional suffixes and derivational morphemes containing phonemes which have more than one graphemic representation and sound similar. In that case phonological strategy is not necessary and deaf use visual and morphological strategies. Furthermore, the educational level is considered to affect spelling. However, deaf population is heterogeneous and the present study is descriptive. Regarding the overall handling of the issue at stake it describes deaf and HH students' spelling performance in Greece and does not provide a general conclusion.

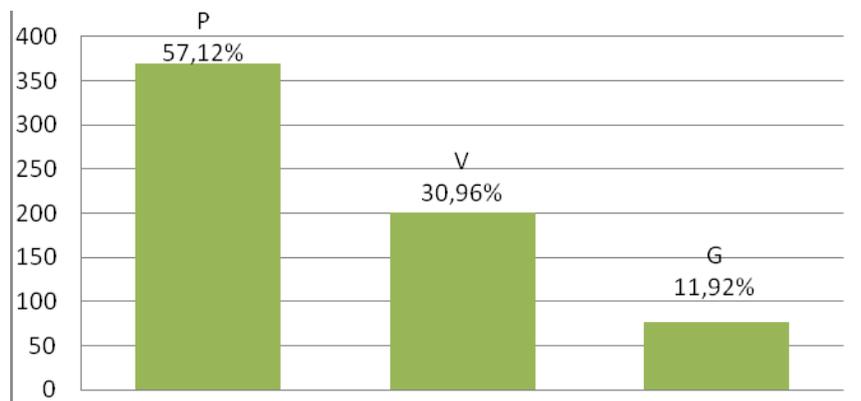
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**Table 1: Comparison of errors-Students with or without hearing impairments**

	Deaf	Kolmogorov-Smirnov Z	P – value	Mean Value	Standard Deviation	Levene’s & P- value	Mann - Whitney U ŋ t	P - value
<b>Errors (filler)</b>	Yes	0,708	0,697	8,04	5,434	-	U = 637	<b>0,001</b>
	No	1,407	<b>0,038</b>	4,9	5,856			
<b>Errors (choice)</b>	Yes	1,488	<b>0,024</b>	2,88	3,16	-	U = 856,5	0,093
	No	2,16	<b>0</b>	2,41	4,26			

**Figure 1: Rate of spelling errors per category-Students with hearing impairment**



**Table 2: Comparison of errors as per the educational level-Students with hearing impairment**

Errors	School Level	Kolmogorov-Smirnov Z	P – value	Mean Value	Standard Deviation	Levene’s & P- value	Mann - Whitney U ŋ t	P - value
<b>P</b>	P	1,126	0,158	8,89	8,188	F =2,272 P=0,138	T=1,456	0,152
	S	1,122	0,161	6,15	5,355			
<b>V</b>	P	1,020	0,249	6,11	5,979	F=19,684 <b>P = 0</b>	T = 2,376	<b>0,028</b>
	S	0,854	0,459	2,65	2,173			
<b>G</b>	P	0,952	0,324	1,45	1,542	-	U = 273,5	0,505
	S	1,590	<b>0,013</b>	1,44	2,205			

## **APPENDIX 1: SUB-CATEGORIES ERRORS**

### **PHONOLOGICAL ERRORS**

- P1 letter substitution
- P2 letter omission
- P3 letter insertion
- P4 letter transposition
- P5 consonant digraph inversion
- P6 consonant digraph simplification
- P7 vowel digraph inversion
- P8 vowel digraph simplification
- P9 syllable omission
- P10 syllable insertion

### **GRAMMATICAL ERRORS**

- G1 masculine -ης /is/
- G2 masculine -οι /oi/
- G3 masculine -ος /os/
- G4 feminine -η /i/
- G5 neuter -ι /i/
- G6 neuter -υ /i/
- G7 neuter -ο /o/
- G8 verb -ω /o/
- G9 verb -ει /i/
- G10 verb -μαι /mai/
- G11 verb -με /me/
- G12 verb -ται /tai/
- G13 verb -τε /te/

### **VISUAL - ORTHOGRAPHIC ERRORS**

- V1 vowel substitution in stem
- V2 consonant substitution in stem
- V2 consonant doubling
- V3 vowel substitution in derivational morpheme (regularity)
- V4 vowel substitution in derivational morpheme (exception)