Dyslexics' and Normally Developing Children's Acquisition of the Inflectional Noun Morphology in the Greek Language

Grammenou Anastasia

Abstract*—The present study explores Greek dyslexic children's ability to identify orthographic violations in the ultimate and the penultimate syllable of derived nouns and pseudo –nouns in nominative and genitive cases of singular and plural number when they were attending grade 6 at primary schools, as well as their progress18 months later. In order to evaluate dyslexics' orthographic ability to represent the derived words with the appropriate suffixes three tasks were used. The first task involved identification of derived nouns with the violation or no in the penultimate or ultimate syllable in a paper and pencil task. Subjects were to decide whether the word in the second column was a correct derived form of the word presented in the first column. The articles preceding nouns in the second column guided subjects to decide on the general orthographic rule as it notes gender and the number, and words in the first column (verbs or nouns) guided students on the orthography of the penultimate syllable. In the same token, the second task involved identification of the derived pseudo-nouns resulting again from the pseudo words given in the first column. Articles in the second column as well as pseudo-nouns and pseudo-verbs guided the subjects. The third condition examined the use of derived nouns in a sentence completion close test. Subjects used the nouns and the verbs given in blankets to formulate the appropriate derived nouns. Suffixes errors were coded as orthographic processing, phonological processing, combined type and stress omission/misplacement. Eighteen months later the follow up test revealed a significant improvement on the orthography of the derived nouns with consonant change at morpheme boundaries, as *well as, on the orthographic rules of the ultimate syllable of the pseudo word tasks.

***Index Terms*—Greek language, dyslexia, inflectional morphology, orthography**.

I. Introduction

Morphology as part of the linguistic theory addressed the issue of word structure from the ancient times. Interestingly as Haspaelman points out the first scientific interest on linguistic comes from the Sumerians who studied word properties of derived and compound words [1]. In modern era properties of word construction has been used in order to indentify languages whith common origins such as the Indo-European. And the outset of the constructivism Chomsky proposed the Generative Grammar theory in order to differentiate language competence which is «subjects' ability to understand and formulate an infinite number of utterances from the performance which is «language actual use»[2]. Extending the idea of Generative Grammar from the constructivism's theory psychologists posed a series of questions concerning the course of morphology acquisition. Exploring phenomena such as the use of grammar in infants e.g. notation of the plural number, noun, verb, adverb, they demonstrated that in native language children, as early as the age of two and half years of age, use plural number in regular nouns and they note regular past number. [3]. By the age of five children's repertoire is expanded to formulate past tense in irregular verbs and plural number of exception noun e.g. mouse →mice [4], [5]. Comparative research in seven languages regarding inflectional morphology acquisition in oral language by three to five years old children revealed that rote, analogy and combination are the vehicles through which the aforementioned aptitude is accelerated (for a review see Clark [6], [7]). On the other hand acquisition of the derivational morphology in spoken language is the most well documented field of linguistics [8]. Derived suffixes are classified as non-neutral if changes of stem morphemes are necessary to formulate the new (derived) word, and are contrasted to neutral suffixes in which stem changes are not observed. In that account, the –er suffix is neutral (consider the derived word driver which comes from the word drive without phonological change in stem morpheme) and contrasted to the no neutral suffix –tion which for example is used to formulate the word magician from the word magic. Moreover, apart from changes in the original morpheme, frequency of suffixes use and phonological structure of the suffixes result in the late acquisition of the derivational noun morphology in oral language [9], [10] which is extended by the sixth grade for normally developing and eighth grade for dyslexic children [11], [12]. In light of piazetian theory, Mattigly [13] identified epilinguistic abilities and metalinguistic abilities as constructs of metalanguage awareness. The former refers to naturally acquired and unconscious use of a language for the purpose of communication. Metalinguistic ability on the other hand requires conscious awareness and it is considered a prerequisite for reading and spelling. As far as the acquisition of morphology in spoken and in written language, Carlisle [14] introduced the term morphological awareness (pp. 194) to define "conscious awareness of the morphemic structure of words and their ability to reflect on and manipulate that structure". At the same time Tyler and Nagy [15] identified three types of morphological awareness the relational morphological awareness, the syntactic morphological awareness and the distributional morphological awareness.

Manuscript received August 20, 2013; revised October 28, 2013.

Grammenou Anastasia is with the Democritus University of Thrace, Department of Primary Education, N. Chili, Alexandroupolis, Greece, TK 68100 (e-mail: agrammen@eled.duth.gr).

The former refers to children's ability to identify word structure and to produce new words from a given word. In reach morphematic languages such as Italian and Greek children should be able to decompose the original word into stem and suffixes in order to produce the derived word. This type of morphological awareness is particularly useful for vocabulary growth as it enables children to differentiate the meaning of homophone morphemes found in words. For example the stem of the word "flowerpot" is related to the word "flower" and not to the word "flour", in a way that the word pairs "corn" and "corner" are not semantically related [15]-[7]. The syntactic morphological awareness on the other hand, refers to children's ability to produce new words changing the inflection of the original word in order to comply with syntactic and semantic rules in a sentence. Syntactic morphological awareness offers a more selective knowledge from relational morphological awareness as it describes the acquisition of inflectional morphological awareness when a sentence is given as a probe. Finally, the distributional morphological awareness refers to the subjects' ability to consider a constellation of linguistic constraints such as grammatical category, historic orthography of morphemes as well as phonological and graphotactic rules, in order to formulate a derive word e.g. the word quietness is a real word in English, but playness is a nonword.

The relational morphological awareness is assed primarily by the "Comes from Task" introduced by Derwing and Baker [18] and modified by Carlisle [14]. McBride-Chang and Treiman [19] and Windsor [20], in the original version of this task, children are asked questions like "does dollar comes from doll?" or "does teacher comes from teaching?" When the derived word is embedded in a sentence children are asked to verify the information provided e.g. "The chairman is a man who makes chairs", or they are asked to analyse the derived word into the morpheme components, e.g. "is a little word in the airplane that means air?" Other variations of the same task include nonwords or low frequency words [21] [22]. More recently Carlisle [23] used a homophone resolution task to assess relational morphological awareness. In her tasks children are asked to identify the correct stem morpheme when a derived word is given in a sentence, e.g. "The letter T and the word teacup". Which contains the meaning of "tea as in tealeaf?" Although, the aforementioned task tags the relational morphological awareness, is still differentiated by the degree of cognitive demands. As a result, the acquisition of the relational derivational morphology is regarded a continues process, completed in early adolescence.

Syntactic morphological awareness is passed by the word completion task. Children are presented an initial word which had to transform in order to fit the meaning of an incomplete sentence, e.g. "my uncle teaches, he is a teacher (teach) [23] [24]-[26]. Adoption of this task is the four choice task, in which the proper word is presented with other three and children choose the correct type, e.g. «He had to put his ……on the contract (sign, signature, name, mark)». This aspect of morphological awareness is regarded more sophisticated as it provides information about the syntactic role of suffixes [27], [28]. Finally, the distributional morphological awareness is a more demanding process as it requires explicit knowledge of the allowable stem –suffix combinations taking into account semantic information, syntactic role and phonological constraints [8].

A number of studies examined the relationship between derivational morphological awareness and reading ability. Carlisle [29], [30] demonstrated a significant relation between children's ability to produce derived words orally and in written form and their decoding ability and reading comprehension. To the same token, Singson and colleagues [31], [32] used syntactic morphological awareness tasks and relation morphology tasks to explore the effect of MA to decoding ability. Both studies reported a significant contribution of the former to the latter after controlling the phoneme awareness, the STM and the age effect. Moreover the MA improved with age [33], [8], [34]. It has been proposed that analysis of polymorhematic words facilitates decoding ability especially in languages with rich morphology, such as Italian [33]. [34], German [35], Dutch [36], French [37], Hebrew [38] and Chinese [8].

With regard to morphematic structure awareness many studies addressed the question of the timing and mechanism which underlie the process of writing polymorphematic and derived words [39]-[41]. It was designated that children as young as the age of eight are able to infer spelling of a derived word e.g. Signature of the root word (sing), but overall the spelling of derived words proved more difficult than rule-governed words, in which spelling is predicted by phonological-orthographic rules. Carlisle [23] and Tsesmeli and Seymour [40], explored spelling of derived words with regard to generation rules from the root word. Words that required phonological and combined (phonological and orthographic transformations) proved more difficult even for 13 years old. Moreover, derived words were more probable to be spelled correctly when the root word was also correct, a phenomenon known as a consistency effect. Those findings were replicated by and Deacon and Kirby [41]. The latter study showed that unit of coding can influence conclusions about children's morphemic structure awareness. Specifically when only the initial word part was coded (either a morpheme or an orthographic unit) the morphological effect was observed, with words like turning spelled more frequently correctly than in monomorphematic words like turnip.

The aim of the present study was to describe the Greek dyslexics children's profile in writing the nominative and genitive singular and plural of masculine and famine nouns and their progress from 6th grade to 8th grade.

II. Method

A. Participants

Eighty five students (30 Dyslexics, 30 Chronological Age Control students and 25 Reading Age Control Students participated in the study. There were all native speakers of Greek with no history of hearing or neurological problems; they have received monolingual education, and at the time tested Dyslexics and Chronological Age Controls were attending Grade 6, whereas Reading Age control group were grade 4 students. The control groups came from the three

Experimental Primary Schools in Alexandroupolis, Greece, after obtaining permission from the Department of Primary Education Supervision Board, and the parents. Dyslexics were informed about the study at the local Diagnostic, Evaluation and Support Centre, after completing the evaluation procedure. The inclusion criteria for all three groups regarded nonverbal I.Q.>90 as measured by the Raven Matrices Progressive Test and Reading Comprehension Score>85, as measured by the Triga Reading Ability Test [42]. Moreover, the dyslexics' criteria included an inferior performance on three phonological awareness task of the ATHENA Test [43]. Reading and spelling ability was tested with two tests constructed for the purpose of the present research project. Each test comprised of a 92 words and a 92 nonwords lists with all possible combinations of consonant-vowel (CV), consonant cluster-vowel (CCV, CCCV), vowel-consonant (VC) of the Greek Language. Particular interest was given to include allophones and letter strings that result in phonological processes observed in spoken language. Test –retest reliability, for the reading tests, after a two months period, was reported 0.80 (word list reading) and 0.83 (nonword list reading). Reliability of the spelling test was somewhat higher 0.91 (word spelling) and 0.90 (nonword spelling). Table I, Table II and Table III portray three groups' performance on the inclusion criteria tests.

B. Procedure

All students were tested by the author in the Diagnostic, Evaluation, and Support Centre. The material was presented in a random order.

III. Material

In order to evaluate dyslexics' cognitive ability, a battery of tests set up the inclusion criteria and aimed to elaborate the cognitive processes involved in reading and spelling. Students completed the four tasks of phonological sensitivity and phonological awareness from the ATHENA test [45]. In the phoneme blending, a 32-item task, subjects have to combine the orally presented phonemes, ranging from 4-7, to a word. The phoneme sensitivity task involves a same/different identification of phoneme strings comprising a pair of nonwords. The grapheme identification is a paper and pencil task in which a pair of nonwords is presented in written form and the subjects had to cross out the different spelling stings without to read the nonwords. Finally, in the word completion task, subjects listen to a word missing an initial or intermediate phoneme and they have to pronounce it in the correct form. The Reading Ability test is a sentence completion test in which subjects have to choose between four candidates the proper word, to fit the meaning and the syntax. The spelling and reading tests were developed for the purpose a larger project and the criteria used were discussed in the former section. The reading time and the spelling errors were included as the best predictors of reading and spelling ability among dyslexics according to the double deficit theory [46]-[49]. In order to evaluate dyslexics' ability to use the correct noun inflection in the genitive singular and plural in masculine famine and neutral nouns three tasks were used. The first task involved identification of exemplars and homophone foils of nouns in various cases in a paper and pencil task. Subjects were to decide whether the word in the second column was a correct form of the word given in the nominative case of singular number presented in the first column. The articles preceding nouns guided subjects to decide on the case and the number appropriately. In the same token, the second task involved identification of nonword foils resulting again from the nonwords given in the nominative case of singular number. Articles again guided the subjects. The third condition examined noun inflection in a sentence completion close test. Subjects used the nouns in the nominative case of singular number to formulate nouns in appropriate case and number so as to fit the meaning. All conditions contained 32 items, one item for each type of nouns and the non-words came from real words belonging to the same noun type. For each item the inflected noun had a violation in stress, orthography or both, which subjects were to identify.

TABLE I: 6th Graders' Performance on ATHENA Test

	Mean (SD)	K.S. Test	*P*
Phoneme Blending	23.80 (5.09)	1.09	0.185
Phoneme Discrimination	24.15 (4.387)	0.90	0.391
Grapheme Discrimination	24.03 (3.68)	2.45	0.00
Word Completion	29.74 (4.89)	0.72	0.682
Nonword:Phonetic Implausible errors	1.29 (0.46)	2.37,	0.00
Word :Phonetic Implausible errors	0.96 (0.5)	2.04	0.00*
Word Orthographic Processing errors	1.96 (1.14)	1.22	0.00*
Word Grammatical errors	1.29 (0.81)	2.43	0.103

TABLE II: 4th Graders' Performance on ATHENA Test

	Mean (SD)	K.S. Test	*P*
Phoneme Blending	23 (3.38)	1.021	0.249
Phoneme Discrimination	22.21 (2.43)	0.984	0.288
Grapheme Discrimination	25.42 (3.64)	0.606	0.86
Word Completion	21.92 (2.25)	0.778	0.580
Nonword:Phonetic Implausible errors	2.96 (3.04)	1.198	1.113
Word :Phonetic Implausible errors	2.29 (2.33)	0.856	0.456
Word Orthografic Processing errors	5.04 (4.38)	0.0835	o.488
Word Grammatical errors	2.29 (1.73)	0.94	0.34*

A. Performance on the Literacy Measurements

In order to evaluate children's acquisition of phonemic awareness and their knowledge of grapheme –phoneme

convention rules the ATHENA test and two dictation to spelling of words and nonwords tests were used. Comparison on three groups' performance on phoneme blending was statistically significant (Kruskal –Wallis test (H(2)=45.268, p=0.01)). This task did not differentiate dyslexic' and 4rth grade students (W=1.561, p=0.118), whereas 6th grade students outperformed 4rth grade students (W=6.607, p>0.001), and dyslexics (W=4.478, p=0.01). The same pattern of results was also observed for phoneme discrimination task (Kruskal –Wallis test (H(2)=36.58, p>0.001), dyslexics' performance was similar to 4rth Graders (W=0.780, p>0.001) and 6th Graders performance were superior both to 4rth Graders' (W=5.367, P<0.001) and to dyslexics' performance (W=5.45, P<0.001). In the grapheme discrimination test

TABLE III: DYSLEXICS' PERFORMANCE ON ATHENA TEST

	Mean (SD)	K.S. Test	P
Phoneme Blending	21.08 4.399	0.914	0..373
Phoneme Discrimination	22.41 4.55	0.650	0.776
Grapheme Discrimination	27.65 4.837	1.566	0.015
Word Completion	22.89 3.688	0.811	0.526
Nonword: Phonetic Implausible errors	13.92 (6.87)	1.168	0.113
Word :Phonetic Implausible errors	6.27 (4.06)	1.293	0.071
Word Orthographic Processing errors	16.43 5.7	1.078	0.196
Word Grammatical errors	8.70 5.61	0.941	0.339

The three groups' performance reached statistical significance (H(2)=27.85 p>0.001). Further comparison showed that 6th Graders outperformed 4rth Graders (W=5.24, P<0.001), and the normally developing children had better performance compared to dyslexics (W=-2.444, P<0.001 4rth Graders versus dyslexics), and (W=3.257, P<0.001 6th Graders compared to dyslexics). Finally, in the word completion task three groups were also differentiated (H(2)=45.53, P<0.001) with 6th Graders to outperfom 4rth Graders (W=-1.440, p=0.001), and dyslexics (W=-5.203, and P<0.001), whereas comparison of 4thr Graders' and dyslexics' performances did not reach statistical significance (W=-1.440, p>0.001).

Children's spelling abilities was tested by the dictation to spelling of words and nonwords tasks and errors were classified as 1) grammatical in the noun or verb suffixes, 2) as orthographic processing errors in the word stems and as phonological errors when children changed the phonological construction of the dictated word or nonword. Internal consistency was moderate for total sample α=0.686 (N=32) as well as for all groups (Cronbach's α=0.758, M=25.29 SD=3.75 for 6rth Graders, Cronbach's a=0.46, M=22.80, SD=3.028 for 4rth Graders, and Cronbach's a=0.67 M=20.86, SD=5.30 for dyslexics. A one ANOVA revealed statistical significant differences between three groups (F(2, 85)=8.333, P<0.001 and further analysis with the Bonferroni test revealed that dyslexics' performance is inferior to 6th Graders P<0.001, but is in similar lever to 4rth Graders (p=0.260).

Kruskal-Wallis test revealed that all three groups were differentiated with regard to phonological errors(H(2)=49.060, P<0.00), orthographic processing errors (H(2)=61.768, P<0,001) and grammatical errors (H(2)=54.782 P<0,001). Mean ranking for dyslexics phonological processing errors is 66.665 whereas for 6th Graders is 23.74 and 4rth Graders 36.38. Pairwise test revealed that there was statistically semantically differences between 6th Graders and (H(2)=-7.5, P<0.001) as well as between 4rth Graders and dyslexics (H(2)=-5.232 P<0.001). Mean ranks for orthgraphic processing errors are 21.39 for 6th Graders 34.44 for 4rth Graders and 69.72 for dyslexics. Dyslexics' number of errors reached statistical significance compared to 6th Graders ((H(2)=-7.05, P<0.001) and to 4rth Graders ((H(2)=-4.94 P<0.001) The two groups of normally developing children did not differ on this type of errors (H(2)=-1.694 P<0.001). With regard to grammatical processing errors mean raking were as follow 23.16 for 6th Graders 35.10 for 4rth Graders and 67.95 for dyslexics. Paiwise test did not differentiate the two groups of normally developing children (H(2)=-1.920, p=0.056), whereas dyslexics' performance were inferior to 6rth Graders (H(2)=-7.698, P<0.001) and to 4rth Graders(H(2)=-5.330 , P<0.001).

Similar procedure was followed for phonological processing errors in nonword spelling. Further control with Bonferroni test, showed that dyslexics' number of phonological errors was statistically significant different compared to normally developing children P<0.000, and 6th Graders outperformed 4rth Graders (p=0.05). Mean ranking were 22.5 for 6th Graders, 32.56 for 4rth Graders and 70.56 for dyslexics.

B. Word Identification Test

With regard to formation of the genitive plural cases in masculine and famine nous, subjects were presented with 8 misspelled words respectively and they had to identify the orthographic violation (substitution of –ων by –ον) ((Cronbach's α=0.906, n=16, overall, Cronbach's α=0.896, (M=10.59, SD=4.64) for dyslexics, Cronbach's α=0.846 (M=14.24, SD=2.74) for 6th Graders, Cronbach's α=0.876 (M=10.59, SD=4.67). for 4rth Graders. One sample kolmogorov-Smirnov Test was used to test data distribution of misspelled genitive plural cases. H0 hypothesis were accepted for all tasks suggesting normally distribution of data (K-S test N=39, Z=1.62, P<0.01 for dyslexics, K-S test N=29, Z=1.61, P<0.01 for 6th Graders, K-S test N=22, Z=1.65, P<0.01 for 4th Graders). Kruskal Wallis test revealed statistical significant differences between three groups (H(2)=17.033, p<0.001) and Mean Ranks 58.76 (6th Graders), 49.34 (for 4th Graders) and 33.47 (for dyslexics).

The same procedure was used for the correctly spelled genitive plural cases of masculine and famine nous. ((Cronbach's α=0.811 (N=16), overall, Cronbach's α=0.845 (M=11.23, SD=3.79) for dyslexics, Cronbach's α=0.705, (M=13.21, SD=2.59) for 6th Graders and Cronbach's

α=0.677, (*M*= 13.59, *SD* =2.21) for 4th Graders. One sample kolmogorov-Smirnov Test was used to test normally distribution of data of the correctly spelled genitive plural cases (*K-S* test *N*=39, *Z*=0.652, *p*>0.01 for dyslexics, *K-S* test *N*=29, *Z*=0.753, *p*>0.01 for 6th Graders, *K-S* test *N*=22, *Z*=0.453, *P*<0.01 for 4rth Graders), Kruskal Wallis test revealed statistical significant differences between three groups (*H*(2)=7.258, *P*<0.05) and Mean Ranks 50.12 for 6th Graders, 54.00 for 4rth Graders and 37.27 for dyslexics.

The third group of words examined formation of genitive singular in famine nouns. The correct suffix –ης was replaced by the –ις, a suffix which was used for formulating this case in Ancient Greek Language and in Katharevousa, the official Modern Greek language until 1976. Cronbach's α=0.827 were found in a satisfactory level for all subjects. Internal consistency for each group has as follow: Cronbach's α=0.71 (*M*=6.76, *SD*=1.66 for 6th Graders), Cronbach' α=0.699 (*M*=6.14, *SD*=1.19) for 4rth Graders, Cronbach's α=0.865 (*M*=5.05, *SD*=2.77) for dyslexics. One sample kolmogorov-Smirnov Test was used to test data distribution of misspelled genitive singular cases in famine nouns. Only for 6th Graders the H0 hypothesis was accepted (*K-S* test *N*=29, *Z*=1.33 *P*>0.05 for 6th Graders, *K-S* test, *N*=39, *Z*=1.56 for dyslexics and *K-S* test, *P*<0.01, *N*=22, *Z*=1.84, *P*<0.01 for 4rth Graders), Kruskal Wallis test revealed statistical significant differences between all groups (*H*(2)=8.665, *P*<0.05) and Mean Ranks 55.90 (6th Graders), 45.80 (4rth Graders) and 37.60 (dyslexics).

Forth group of words are comprised by nominative singular famine nouns with orthographic violation in the pen ultimate syllable as they are derived words from verbs. Internal consistency was calculated for all subjects (Cronbach's *a*=0.708, *N*=5) and each group separately, Cronbach's α=0.761, (*M*=4.14 *SD*=1.356 for 6th Graders), Cronbach's α=0.852 (*M*=3.82 *SD*=1.656 for 4rth Graders) (*M*=3.82 *SD*=1.656) and Cronbach's α=0.714 (*M*=2.87, *SD*=1.735 for dyslexics). 6th Graders' and dyslexics' performance met normally distribution criteria (*K-S* test, *N*=29, *Z*=1.206, *P*>0.102 and *K-S* test, *N*=39, *Z*=0.953, *P*>0.01) in contrast to 4th Graders' performance (*K-S* test, *N*=22, *Z*=1.145, *P*<0.01). Statistical significant differences were found between three groups with normally developing children to outperform dyslexics ((*H*(2)=11.930, *P*=0.01) and Mean Ranks 58. for the 6th Graders, 39.64 for 4rth Graders and 32.09 for dyslexics.

Seven masculine nouns with orthographic violation in pen ultimate syllable of the nominative case consisted the fifth group of words. Internal consistency were very high for all subjects (Cronbach's α=0.932 *N*=6) as well three groups of subjects (Cronbach's α=0.961 (*M*=3.41, *SD*=2.78) for sixth Graders, Cronbach's α=0.950 (*M*=3.36, *SD*=2.718), for 4rth Graders and Cronbach's α=0.902 (*M*=3.77 *SD*=2.367) for dyslexics. One sample kolmogorov-Smirnov Test was used to test data distribution. H0 hypothesis were accepted for 4rth Graders only (*K-S* test, *N*=22, *Z*=1.275, *P*>0.01). and it was rejected for 6th Graders and dyslexics (*K-S* test, *N*=29, *Z*=1.476 *P*<0.026, and *K-S* test, *N*=39, *Z*=1.476 *P*<0.000, respectively). It was the only orthographic violation in real words which did not differentiated the three groups of subjects (*H*(2)=0.28, *p*>0.05) and Mean Ranks 46.50(for sixth Graders), 45.48(for 4rth Graders) and 45.06 (for dyslexics).

C. Non-Word Identification Test

Five groups of nonwords were constructed to examine normally developing children's' as well as dyslexics' acquisition of inflectional morphological awareness in written Greek language.

First group of non words were 16 masculine and famine pseudo words with orthographic violation in the genitive plural. The correct suffix *–ων* was replaced the allophone/allomorph –on. Internal consistency were very satisfactory overall (Cronbach's: α=0.926 *N*=16) as well as for normally developing and dyslexic children: Cronbach's: α=0.849 (*M*=14.59, *SD*= 2.5) for 6th Graders, Cronbach's: α=0.899 (*M*=13.55, *SD*=3.64) for 4rth Graders and Cronbach's: α=0.935 (*M*=11.18, *SD*=5.26) for dyslexics. *H*0 hypothesis were accepted for 4rth Graders suggesting normal distribution of data (*K-S* test, *N*=22, *Z*=1.168, *P*>0.01) and it was rejected for 6th Graders (*K-S* test, *N*=29, *Z*=1.99 , *P*<0.01) and dyslexics (*K-S* test, *N*=39, *Z*=1.59, *P*<0.01,). Statistical significant differences were observed between three groups (*H*(2)=12.043, *P*<0.05), and Mean Ranks 56.93 for 6th Graders, 47.59 for 4rth Graders and 35.82 for dyslexics.

Identification of correct spelling of genitive plural suffix *–ων* in masculine and famine pseudowords was examined in the second group of nonwords. Internal consistency was moderate for research sample (Cronbach's α=0.766, *N* =16) as well as for the three groups respectively (Cronbach's α=0.768, *M*=13.07, *SD*=2.711 for 6th Graders), Cronbach's α=0.756 (*SD*=12.56, *SD*=2.79) for 4rth Graders) and Cronbach's α=0.70 (*M*=10.36, *SD*=3.056 for dyslexics)). Normal distribution of data was accepted for three groups of subjects (*K-S* test, *N*=29, *Z*=0.918, *P*>0.01, for 6th Graders, *K-S* test, *N*=22, *Z*=0.720, *P*>0.01 for 4rth Graders *K-S* test, *N*=39, *Z*=0.462, *P*>0.01 for dyslexics). Kruskal-Wallis Test revealed statisticall significant differences between three groups (*H*(2)=14.522, *P*<0.001), Mean Ranks 59.93 (6th Graders), 47.89 (4rth Graders) and 33.42 (dyslexics).

Correct spelling of famine nominative singular noun inflection *-ης* in Modern Greek and its allomorph from kathareuousa was also tested in pseudowords identification task with eight nonwords spelled incorrectly. Internal consistency was very high for total sample data (Cronbach's α=0.926 *N*=16) as well as for data from each group individually (Cronbach's α=0.956 (*M*=7.45, *SD* =1.804) for 6th Graders, α=0.906 (*M*=6.77, *SD* =2.45) for 4rth Graders and α=0.896 (*M*=5.13, *SD* =2.949) for dyslexics). Normally distribution of data was accepted for dyslexics (*K-S* test, *N*=39, *Z*=1.12 *P*>0.05) but not for normally developing children (*K-S* test, *N*=29, *Z*=2.512, *P*<0.01, for 6th Graders, *K-S* test, *N*=22, *Z*=1.69, *P*<0.01 for 4rth Graders *K-S* test, *N*=39, *Z*=1.12 *P*>0.05). Kruskal Wallis test revealed statistical difference between three groups (*H*(2)=20.829, *P*<0.001 and Mean Ranks 59.93 (6th Graders), 47.89 (4th Graders) and 33.42 (for dyslexics).

The fourth group of nonwords was consisted by five pseudoword famine nouns in nominative case with orthographic violation in the penultimate syllable of the

disyllabic suffix. Internal consistency was not acceptable for total sample α=0.563, (M= 3.73, SD=1.107), as was as for 6th Graders, (α=0.559, M=4.00 SD=1.00 for 4rth Graders) and for dyslexics (α=0.690, M=3.86, SD=1.207, α=7.45, M=3.67 SD=3.67). Normal distribution of data was accepted for normally developing children (K-S=1.207, N=29, p>0.05, for 6th Graders and K-S =1.106, N=22, P>0.173 for 4rth Graders) contrary to dyslexics' data for which the H0 was accepted (K-S=1.108, N=39, P<0.05). Statistical significant differences was found between all three groups (H(2)=1.619, P>0.05 and Mean Ranks 49.19 for 6th Graders, 47.27 for 4rth Graders and 41.76 for dyslexics.

The fifth group of nonwords was consisted by six pseudo words masculine nouns in nominative case with orthographic violation in penultimate syllable. Internal consistency was acceptable for total sample α=0.883 (M=3.73, SD =1.107). As well as for three groups (α=0.955 M=3.45 and SD=2.72 for 6th Graders, α=0.784, M=4.14 and SD=1.95 for 4rth Graders, and α=0.841, M=4.21 and SD=2.028 for dyslexics. H0 hypothesis was acceptable for dyslexics only (K-S =2.153, N=39, P<0.001) and it was rejected for normally developing children (K-S=1.476, N=29, P<0.05 for 6th Graders, and K-S =2.153 N=39, P>0.001, for 4rth Graders), (K-S =2.153, N=39, P<0.00). This subset of nonwords did not differentiated the three groups (Wilcoxon (W=9.77, Z=-0.303 P>0.05).

D. Words Versus Pseudo Words

Five groups of words and equivalent number of nonwords were constructed to test spelling of genitive cases in singular and plural number of masculine and famine nouns. Children's performance in these tests was not differentiated suggesting that both type of linguistic material is processed in a similar manner. Incorrect use of –on instead of the correct sufix –ων was tested by the Wilcoxon test and revealed no statistical significant differences for all groups, with regard to word and nonwords spelling (N1=34.53, N2=38.18, Z=-0.99, P>0.05 for all subjects, N1=9, N2=10, Z=-0.45, P>0.05, for 6th Graders N1=8, N2=9, Z=-1.028, P>0.05, for 4rth Graders and N1=16, N2=20, Z=-0.472 for dyslexics).

The second subgroup of words and nonwords tagged the identification of correct suffix $-\omega v$ in genitive plural of masculine and famine nouns. Comparison of words and non words revealed again no statistical difference, N1=49, N2=31, Z=-1.374, P>0.05, for total sample, N1=14, N2=11, Z=0.98 P>0.05 for 6th Graders, N1=11.00, N2=6, Z=-1.45, P>0.05, for 4rth Graders and N1=23, N2=14, Z=-0.111, P>0.05 for dyslexics.

In similar manner there were not statistical significant difference for the identification of incorrect morpheme $-\iota\varsigma$ of genitive singular in famine nouns (N1=22, N=44, Z=-1.44, P>0.05, for total sample, N1=16, N2= 8, Z=-2.12, P<0,05for 6th Graders, N1=4, N2=11, Z=-1.24 for 4rth Graders, N1=16, N2=18, Z=-0.111, P>0,05 for dyslexics), as well as for the orthographic violation in the penultimate syllable of the nominative case of masculine nouns and their counterpart pseudonouns. (N1=39, N2=30, Z=-0.998, P>0.05 for total sample), (N1=12, N2=8, Z=_0.038, P>0.05 for 6th Graders, N1=10, N2=6, Z=-1.146, P>0.05 for 4rth Graders and N1=18.44, N2=14.56, Z=-0.593, P>0.05 for dyslexics). The only subgroup of material which differentiated dyslexics performance in words and in non words was the incorrectly spelled nominative case of famine masculine nouns with orthographic violation in pen ultimate syllable (N1=18.44, N2=14.56, Z=-0.593, P>0.05). Normally developing children's performance was similar for words and for nonwords (N1=39, N2=30, Z=-0.998, P>0.05) for 6th Graders, and (N1=12, N1=10, N2=6, Z=-1.146, P>0.05 for 4rth Graders.

E. The Sentence Completion Test

With regard to sentence completion test, errors were coded as follow: 0 when children did not produced correct inflected noun, 2, when children produced an inflected noun with orthographic and phonological errors, 3 when only orthographic errors were observed, and 4 when children failed to give correct punctuation. Internal consistency was very high for total sample data (Cronbach's: α= 0.88 (M= 136.33, SD=19.40) as for each group separately (α=0.858, M=123.7, SD=21 for dyslexics, α=0.792, M=149.37, SD=10.79 for 6th Graders and α=0.712, M=140.80, SD =1.27. for 4rth Graders). Normal distribution of data was test by the Kolmogorov-Smirnov test and H0 hypothesis were accepted for all groups (K-S test N=27, Z=0.992, P>0.05 for 6th Graders, K-S test N=25, Z=0.958, P>0.05 for 4rth Graders, K-S test N=37, Z=1.128, P>0.05 for dyslexics). An one way ANOVA, differentiated three groups, F(2,88)=21.00, P<0. 001. Further examination by the Bonferroni test revealed that normally developing children outperformed dyslexics P<0.001, whereas comparison of the two control group's performance did not reached statistical significance p=0.18.

IV. Discussion

This study aimed to shed light in Greek dyslexic's performance in a series of phoneme awareness and spelling of inflected nouns. With regard to phoneme awareness, dyslexics profile is well documented in the literature and results of the present study fits well with current theories. Subjects of the present study were attainting Grade 6 and their performance was compared to 4rth Graders and to 6Graders. The first group of normally developing children had the similar profile to dyslexics' at the time tested. As it was discussed previously, dyslexics' performance, on the phoneme blending and the phoneme discrimination tests, lagged behind at least two years. On the other hand dyslexics' performance on the word completion and the grapheme identification tasks were affected to a lesser extend. Dyslexic's superior performance on the word completion tasks, compared to the phoneme discrimination tasks, could be explained in terms of the poor auditory perception skills as demonstrated by Tallal [50] and Pino Magan and Écalle [48]. According to this theoretical account poor perception of phonological information may explain degraded phoneme representation in dyslexics' memory, which affects directly Grapheme-phoneme correspondence, a key process in the acquisition of literacy skills [51], [52]. More over, the phoneme blending and the word completion tasks have been used to assess phoneme awareness in the Greek and the English language [53]-[57]. Merits of the ATHENA test was discussed previously [58]. The Phoneme discrimination task

was developed to tag the phonological processes similar to those observed to first language acquisition [59]. The systemic processes is a) backing that is substitution of bilabial and alveolar consonants to velars ($v \rightarrow \gamma$, $p \rightarrow t$, $f \rightarrow \theta$), b) Fronting of velars to alveorals ($f \rightarrow v$), c) epenthesis of a vowel in a consonant cluster ($\gamma r \rightarrow \gamma ir$), and voicing of voiceless consonant ($m \rightarrow n$, $s \rightarrow z$,).

In the phoneme blending task children were asked to combined a range of 4 -7 phonemes in order to produce a real word. Dyslexics' performance was similar to 4rth Graders probably, due to working memory load which presuppose this test [60].

Dyslexics' performance on the identification of the correctly spelled genitive singular and plural cases demonstrated that acquisition of grammatical morphemes lagged behind more than two years. This is contrasted to their performance on phoneme awareness task in which dyslexics had a similar profile to 4rth Graders. These results fit well with previous research in languages with reach morphology as it was shown that morphological awareness contributes above 5% in reading and spelling ability after controlling the phonological awareness, the vocabulary and the age effect. It seems that the proposed dual route model by Levandi could explain dyslexics' difficulties to acquire precise orthographic representation of the Greek morphology. She has argued that morphological analysis in the Greek language occur in a stage like manner just after activation of word phonological information followed by morphematic analysis of lexemes and morphemes. In this account there is a hierarchy in information processing with information coded in the inflections (such as number gender and case for noun as well as persons and attitudes for verbs,) to activate syntactic function e.g. subject, verb, object, whereas. Lexemes and inflections determine, in the final stage, the grammatical category of the presented word. The innovation of Levendi model is that phonological representations may be not necessary when readers process inflection morphemes and lexemes. This stands very well with current data as dyslexics have acquired phoneme awareness similar to 4rth Graders abut they lagged behind more than three years with regard to inflection processing.

REFERENCES

[1] M. Haspaelman, *Understanding Morphology*, London, Hodder edition, 2002.

[2] N. Chomsky, *Aspect of the Theory of Syntax*, Cambridge, MIT Press, 1965.

[3] J. Berko, "The child's learning of English morphology," *Word*, vol. 14, pp. 150-177, 1958.

[4] S. A. Kuczaj, "The acquisition of regular and irregular past tense forms," *Journal of Verbal Learningand Verbal Behavior*, vol. 6, pp. 589-600, 1977.

[5] G. Marcus, M. Ullman, S. Pinker, M. Hollander, T. J. Rosen, and F. Xu, "Overregularization in language acquisition," *Monographs of the Society for Research in Child Development*, vol. 57, 1992.

[6] E. V. Clark, "Later lexical development and word formation," in P. Fletcher & B. MacWhinney (Eds.), *The handbook of child language*, Oxford, Basil Blackwell Inc., pp. 393-412, 1995.

[7] E. V. Clark, "Children's language," in *Understanding children: Essays in honour of Margaret*, Donaldson, R. Grieve & M Hughes (Eds.), Oxford: Blackwell, pp. 11-25, 1990.

[8] Y.-M. Ku and R. C. Anderson, "Development of morphological awareness in Chinese and English," *Reading and Writing: An Interdisciplinary Journal*, vol. 6, pp. 399-422, 2003.

[9] E. V. Clark, "Later lexical development and word formation," in *The handbook of child language*, P. Fletcher & B. MacWhinney (Eds.) Oxford, Basil Blackwell Inc, pp. 393-412, 1995.

[10] J. M. Anglin, "Vocabulary development: A morphological analysis," *Monographs of the Society for Research in Child Development*, vol. 58, no. 10, 1993.

[11] J. Carlisle, "Knowledge of derivation morphology and spelling ability in fourth, six, and eight graders," *Applied Psycholinguistics*, vol. 9, pp. 247-266, 1988.

[12] N. Kemp, J. Nilsson, and J. Arciuli, "Noun or verb? Adult readers' sensitivity to spelling cues to grammatical category in word endings," *Reading and Writing*, vol. 22, pp. 661-685, 2009.

[13] G. Mattingly, "Reading, the linguistic process, and linguistic awareness," in *Language by ear and by eye*, J. F. Kavenagh and G. Mattingly (Eds.), Cambridge Mass: MIT Press, 1972.

[14] J. F. Carlisle, "Morphological awareness and early reading achievement," in *Morphological aspects of language processing*, L. B. Feldman (Ed.), Hillsdale, NJ: Lawrence Erlbau M, 1995, pp. 189-209.

[15] A. Tyler and W. Nagy, "The acquisition of English derivational morphology," *Journal of Memory and Language*, vol. 28, pp. 649-667, 1989.

[16] D. Cutchen, L. Green, and R. D. Abbott, "Children's morphological knowledge: Links to literacy," *Reading Psychology*, vol. 29, no. 4, pp. 289-314, 2008.

[17] S. F. Cormick, K. Rastle, and M. H. Davis, "Adore-able not adorable? Orthographic underspecification studied with masked repetition priming," *European Journal of Cognitive Psychology*, vol. 2, no. 6, pp. 813-836, 2008.

[18] B. L. Derwing and W. J. Baker, "Recent research on the acquisition of English morphology," in *Language acquisition*, P. Fletcher and M Garman (Eds.), Cambridge: Cambridge University Press, pp. 209-223, 1979.

[19] C. B. Chang and R. Treiman, "Hong Kong Chinese kindergartners learn to read English analytically," *Psychological Science*, vol. 14, pp. 138-143, 2003.

[20] J. Windsor, "The role of phonological opacity in reading achievement," *Journal of Speech, Language, and Hearing Research*, vol. 43, pp. 50-61, 2000.

[21] M. Sénéchal, "Morphological effects in children's spelling of French words," *Canadian Journal of Experimental Psychology*, vol. 54, pp. 76-86, 2000.

[22] K. Wysocki and J. R. Jenkins, "Deriving word meanings through morphological generaliz ation," *Reading Research Quarterly*, vol. 22, pp. 66-81, 1987.

[23] J. F. Carlisle, "Awareness of the structure and meaning of morphologically complex words: Impact on Reading," *Reading and writing: An Interdisciplinary Journal*, vol. 12, pp. 169-190, 2000.

[24] J. F. Carlisle and D. Nomanbhoy, "Phonological and morphological development," *Applied Psycholinguistics*, vol. 14, pp. 177-195, 1993.

[25] A. E. Fowler and I. Y. Liberman, "The role of phonology and orthography in morphological awareness," in *Morphological aspects of language processing*, L. B. Feldman (Ed.), Hillsdale, NJ: L. Erlbaum, pp. 157-188, 1995.

[26] D. McCutchen, L. Green, and R. D. Abbott, "Children's morphological knowledge: Links to literacy," *Reading Psychology*, vol. 29, no. 4, pp. 289-314, 2008.

[27] W. Nagy, V. Berninger, and R. Abbott, "Contributions of Morphology beyond phonology to literacy outcomes of upper elementary and middle-school students," *Journal of Educational Psychology*, vol. 98, pp. 134-147, 2006.

[28] N. Kemp, "Children's spelling of base, inflected, and derived words: Links with morphological awareness," *Reading and Writing: An Interdisciplinary Journal*, vol. 19, pp. 737-765, 2006,

[29] R. Schreuder and R. H. Baayan, "Modelling morphological processing," in *Morphological aspects of language processing*, L. B.Feldman (Ed.), Hillsdale, NJ: Lawrence Erlbaum Associates, Inc., 1995, pp. 131– 154.

[30] M. Singson, D. Mahony, and V. Mann, "The relation between reading ability and morphological skills: Evidence from derivational suffixes," *Reading and writing: An Interdisciplinary Journal*, vol. 12, pp. 219-252, 2000.

[31] D. L. Mahony, M. Singson, and V. Mann, "Reading ability and sensitivity to morphological relation," *Reading and Writing: An Interdisciplinary Journal*, vol. 12, pp. 191-218, 2000.

[32] S. Casalis and M. F. L. Alexandre, "Morphological analysis, phonological analysis, and learning to read French: A longitudinal study," *Reading and Writing: An Interdisciplinary Journal*, vol. 12, pp. 303-335, 2000.

[33] V. Berninger, R. Abbott, W. Nagy, and J. Carlisle, "Growth in phonological, orthographic, and morphological awareness in grades 1 to 6," *Journal of Psycholinguistic Research*, vol. 39, no. 1, pp. 141-163, 2010.
[34] C. Burani and A. Laudanna, "Morpheme-based lexical reading: Evidence from pseudo-word naming," in *Reading complex words*, E. Assink & D. Sandra (Eds.), Dordrecht: Kluwer, pp. 241-264, 2003.
[35] C. Burani, S. Marcolini, D. Luca, and P. Zoccolotti, "Morpheme-based reading aloud: evidence from dyslexic and skilled Italian readers," *Cognition*, vol. 108, pp. 243-262, 2008.
[36] J. A. Stolz and L. B. Feldman, "The role of orthographic and semantic transparency of the base morpheme in morphological processing," in *Morphological aspects of language processing*, L. B. Feldman (Ed.), Hillsdale, NJ, Lawrence Erlbaum, pp. 109-154, 1995.
[37] C. Varnhagen, M. McCallum, and M. Burstow, "Is children's' spelling naturally stage-like?" *Reading and Writing: An Interdisciplinary Journal*, vol. 9, pp. 451-481, 1997.
[38] S Casalis and M. F. L. Alexandre, "Morphological analysis, phonological analysis, and learning to read French: A longitudinal study," *Reading and Writing: An Interdisciplinary Journal*, vol. 12, pp. 303-335, 2000.
[39] C. K. Leong, "Rapid processing of base and derived forms of words and grades 4, 5, and 6 children's spelling," *Reading and writing: An Interdisciplinary Journal*, vol. 12, pp. 277-302, 2000.
[40] J. Walker and L. B. Hauerwas, "Development of Phonological, morphological, and orthographic knowledge in young spellers: The case of inflected verbs," *Reading and Writing: An Interdisciplinary Journal*, vol. 19, pp. 819-843, 2006.
[41] S. N. Tsesmeli and P. H. K. Seymour, "Derivational morphology and spelling in dyslexia," *Reading and Writing*, vol. 19, pp. 587-625, 2006.
[42] S. H. Deacon and J. R. Kirby, "Morphological awareness: Just "more phonological? The roles of morphological and phonological awareness in reading development," *Applied Psycholinguistics*, vol. 25, pp. 223-238, 2004.
[43] A. Tringa, *Reading Ability Test*, Athens, Greek Letters, 2000.
[44] I. N. Paraskevopoulos, A. K. Azizi, and N. Giannitsas, "Athina test for the Diagnosis of Learning Disabilities," *Greek Letters Athens*, Greece, 2001.
[45] M. Wolf and P. C. Bowers, "The "Double-Deficit Hypothesis" for the developmental dyslexias," *Journal of Educational Psychology*, vol. 91 no. 3, pp. 415-438, Sep 1999.
[46] H. W. Catts and A. G. Cahmi, "Defining reading disabilities," in *Language and Reading disabilities*, H. W. Catts and A. G. Camhi, Eds. (2nd ed)., Boston, Pearson, pp. 50-71 2005.
[47] J. N. M. Pino, A. Magan, and Écalle, "The nature of phonological processing in French dyslexic children: Evidence for the phonological syllable and linguistic features' role in silent reading and speech discrimination," *Annals of Dyslexia*, vol. 60, pp. 122-148, 2010.
[48] P. Rack, M. J. Snowling, and R. K. Olson, "The nonword reading deficit in developmental dyslexia: A review," *Reading Research Quarterly*, vol. 27, no. 1, pp. 28-53, 1992.
[49] P. Tallal, "Auditory temporal perception, phonics and reading disabilities in children," *Brain and Language*, vol. 9, no. 2, pp. 182-198, Mar. 1980.
[50] F. R. Vellutino, J. M. Fletcher, M. J. Snowling, and D. M. Scanlon, "Specific reading disability (dyslexia): What have we learned in the past four decades?" *Journal of Child Psychology and Psychiatry*, vol. 45, no. 1, pp. 2-40, Jan. 2004.
[51] M. Bruck and R. Treiman, "Phonological awareness and spelling in normal children and dyslexics: The case of initial consonant clusters," *Journal of Experimanta lChild Psychology*, vol. 50, no. 1, pp. 156-178, Augst. 1990.
[52] M. Bruck and G. Waters, "An analysis of spelling errors of children who differ in their reading and spelling skills," *Applied Psycholinguistics*, vol. 9, no. 1, pp. 77-92, Mar. 1988.
[53] N. Goulandris, *Dyslexia in Different Languages: Cross-linguistic* Comparison, London: Whurr Publishers, 2003.
[54] P. H. K. Seymour, M Aro, and J. M. Erskine, "Foundation literacy acquisition in European orthographies," *British Journal of Psychology*, vol. 94, no. 2, pp. 143-174, May 2003.
[55] C. Porpodas, "Patterns of phonological and memory processing in beginning readers and spellers of Greek," *Journal of Learning Disabilities*, vol. 32, pp. 406-416, 1999.
[56] D. Nikolopoulos, N. Goulandris, C. Hulme, and M. J. Snowling, "The cognitive basis of learning to read and spell in Greek: Evidence from a longitudinal study," *Journal of Experimental Child Psychology*, vol. 94, no. 1, pp. 1-17, May 2006.
[57] A. Grammenou, "Spelling errors in the Greek Language. Can be described in terms of phonological processes?" in *Proc. IALP Cong. International Association of Logopedics and Phoniatrics (IALP 2010)*, IALP Press, pp. 281-286, August 2010.
[58] B. Dodd and P. Cormack, "A model of speech processing for diferential diagnosis of phonological disorders," in B. Dodd (ed.), *Differential Diagnosis and Treatment of Children with Speech Disorder*, London, Whurr, 1995.
[59] L. Bradley and P. E. Bryant, "Categorising sounds and learning to read: A causal connection," *Nature*, vol. 301, pp. 419-421, 1983.
[60] T. C. Papadopoulos, G. K. Georgiou, and P. Kendou, "Investigating the double deficit hypothesis in Greek: Evidence from a longitudinal study," *Journal of Learning Disabilities*, vol. 42, no. 6, pp. 528-547 Nov/Dec2009.
[61] A. J. Fawcett and R. I. Nicolson, "Persistent deficits in motor skill of children with dyslexia," *Journal of Motor Behavior*, vol. 27, no. 3 pp. 235-240, Sept. 2005.
[62] E. Cunningham, P. E. Kathryn, K. E. Stanovich, and D. L. Share, "Orthographic learning during reading: examining the role of self-teaching," *Journal of Experimental Child Psychology*, vol. 82, no. 3, pp. 185-199, Jul. 2002.
[63] D. Swan and U. Goswami, "Phonological awareness deficits in developmental dyslexia and the phonological representation hypothesis," *Journal of Experimental Child Psychology*, vol. 66, no. 3, pp. 18-41, July 1997.

Anastasia Grammenou was born in Alexandroupolis, Greece. She works as a director in the Centre for the Diagnosis and Support of learning disable students. She has obtained a degree at Democritus University of Thrace Department of Primary Education and a Master Degree at the University of Newcastle upon Tyne, Department of Speech. Currently she is a PHD student at Democritus university of Thrace. Her scientific interests are dyslexia, Greek language orthography and working memory development.