



Single Word Spelling in English as a Native and a Foreign Language in Students with and without Dyslexia

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Abstract

The goal of our study was to examine the potential link between dyslexia and spelling difficulties in EFL (English as a Foreign Language), to identify and characterize a model of relations between Polish as a Native Language phonological awareness, rapid automatized naming, and verbal short-term memory, and spelling in EFL, and to compare these relationships with analogical ones for English as a Native Language. Our participants included junior high school students: thirteen with dyslexia, 15 without dyslexia from England, and 16 with dyslexia and 16 without dyslexia from Poland.

We found that in an English single word spelling task Polish students with and without dyslexia made more phonological errors than English students with and without dyslexia, and more orthographic errors than English students without dyslexia. Polish students with dyslexia made more orthographic errors than English students with dyslexia, but Polish students without dyslexia performed on a level with English students with dyslexia. The behavioural symptoms of phonological deficits in students with dyslexia were more conspicuous in English than in Polish.

In our study, orthographic errors were more frequent than phonological errors in the English group; opposite proportion occurred in the Polish group. This suggests that Polish students employed an earlier spelling strategy, more based on sublexical than lexical knowledge and skills, and more frequently misspelt the words practically beyond recognition.

Keywords: spelling; Polish; phonological processing, orthographic errors, phonological errors

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INTRODUCTION

Although dyslexia is fundamentally a reading disability, spelling difficulties often accompany reading problems (Lyon et al., 2003), as phonological, morphological, and orthographical knowledge constitutes a prerequisite for spelling (Joshi et al., 2008;2009). Thus, learners with dyslexia typically commit errors within word structure: orthographic errors, when they spell a word the way it sounds (e.g. **intelligent* instead of *intelligent*, **sed* for *said*) and/or phonological errors, when they spell a word not the way it sounds (e.g. **saying* for *staying*, **efry* for *every*) (Mather & Wendling, 2012). Inaccurate spelling has also been documented as characteristic of dyslexia in learning English as a Foreign Language (EFL) in native speakers of the following languages , e.g. Italian (Bonifacci et al., 2017), Swedish and Finnish (Lindgren & Laine, 2011), and Polish (Łockiewicz & Jaskulska, 2016). In this latter study, 17-year-old high school Polish students with dyslexia, as compared with their peers without dyslexia, made more phonological and orthographic errors in a single English word spelling task.

In fact, phonological and orthographic skills transfer from NL to FL (a foreign language) (Sparks, et al., 2006), as language and literacy competence in NL form a basis for such competence in FL (Cummins, 1979). For example, Palladino and Ferrari (2008) found that FL learning problems result from NL phonological processing deficits. Among these, phonological awareness, rapid automatized naming (RAN), and verbal short-term memory are crucial for the development of literacy, and impaired in dyslexia (Høien, et al., 1995; Wolf et al., 2000). EFL word spelling was predicted by phonological awareness in Norwegian as NL (Helland & Morken, 2016) and correlated with phonological awareness and verbal short-term memory, but not with RAN, in Dutch as NL (van Sette et al., 2017).

The rules of spelling are diverse between alphabetic languages. Polish, as compared with English, has a much more consistent, transparent, and regular orthography for spelling (Awramiuk, 2006). Most words can be spelt phonetically, as each phoneme maps onto 1 grapheme (Gajda, 1999), with few exceptions, e.g. phonemes that have 2 corresponding graphemes (consonantal pairs: *ż* and *rz*, pronounced as /ʒ/, *ch* and *h* - /x/, *ó* and *u* - /u/) (Łockiewicz et al., 2019). In English, phonemes map onto different grapheme and/or graphemes; this mapping changes between words (Nijakowska, 2010).

FL learning occurs in an environment in which NL of the FL learners is the language of instruction at school. Thus, learners' FL exposure is limited almost exclusively to FL classes at school, or hobbies, e.g. foreign films or video games. Such learning is formalized and artificial, as compared with NL acquisition, and usually lacking social, emotional, or personal importance. In Poland, FL instruction used to start comparatively early, around 7 years of age, at school entry. Children took 2 (elementary school) and later 3 (elementary and junior high school) FL hours per week, following the state-wide core

curriculum (Ministry of Sport and National Education, 2002). FL instruction does not involve spelling strategies, the assumption being that they are taught during NL class.

Our main aim was to examine if phonological processing disability relates to spelling skills depending on the consistency of orthography and varied NL (Polish and English, respectively) spelling instruction. Specifically, we wanted to analyse the relationship between dyslexia, NL (Polish) phonological processing skills, and spelling difficulties in EFL (English as a Foreign Language). We also aimed to compare these relationships with analogical ones for English as NL. For this purpose, we used a single English word spelling task. Particularly, we aimed to compare the spelling accuracy of Polish and English students with and without dyslexia. English students who participated in our study had acquired English in a natural, both familial and academic environment (cf. Carroll, 2008). Our Polish participants had only studied English through formal schooling, and mostly for educational purposes. Moreover, interlingual interference due to using NL rules to spell in EFL could have resulted in transfer errors in the Polish group (Zybert, 1999). Therefore, we assumed that English students would commit fewer orthographic and phonological errors than Polish students. Moreover, a typical symptom of dyslexia is faulty spelling (Lyon et al., 2003), and literature reported poorer spelling in EFL of native speakers of different languages with dyslexia, as compared with their peers without dyslexia (e.g. Helland & Kaasa, 2005; Nijakowska, 2010). Thus, we expected that students without dyslexia would commit fewer orthographic and phonological errors than students with dyslexia.

English has more complicated grapheme-phoneme correspondence rules as compared to Polish; thus, phonological problems might be more conspicuous, and phonological errors more frequent. However, English students, being native speakers, are more experienced in the intricacies of English phonology than Polish students are; thus, orthographic errors might be more frequent, showing a better understanding of a certain type of orthography. Moreover, Romonath et al. (2005) reported that FL learners tend to make phonological, not orthographic, errors when they spell, and learners at first rely on phonology, and then on orthography (Zhao et al., 2016). Hence, though we expected a possible difference in the proportion of orthographic and phonological errors committed by English and Polish students in English, we did not assume the exact direction of this proportion. Instead, we decided to treat this question as an explanatory one.

Yeon, Bae, and Yoshi (2017) found that NL (Korean) metalinguistic awareness predicted EFL spelling. We also tried to validate a model of relations between NL (Polish) phonological abilities: phonological awareness, RAN, and verbal short-term memory, and spelling accuracy in EFL, and, additionally, to compare it to a model of relations between NL (English) phonological abilities and spelling accuracy in English as NL, following the analyses we conducted for reading accuracy and fluency (cf. Łockiewicz et al., 2020). The original aspect of this research constitutes a comparative analysis of both Polish and English students' spelling of identical words. To conclude, we intended to

provide new data about the relationship between phonological processing and FL spelling.

MATERIALS AND METHODS

Participants

Thirteen (21.67% of the total number of participants) English students with dyslexia, 15 (25%) without dyslexia, 16 (26.67%) Polish students with dyslexia, and 16 (26.67%) without dyslexia participated in the research ($\chi^2(1) = 0.08, p = .782$). All participants in the study were junior high school male students. All participants were native speakers of either English or Polish, respectively. The groups were matched for education and age ($M = 14$ years, 2 months, $SD = 13$ months for English students with dyslexia, $M = 14$ years, 3 months, $SD = 11$ months for English students without dyslexia, $M = 14$ years, 6 months, $SD = 7$ months for Polish students with dyslexia, $M = 14$ years, 5 months, $SD = 8$ months for Polish students without dyslexia, $F(1,56) = 0.09, p = .765$), and intelligence (as measured with *The Standard Progressive Matrices: Raven, 1991, 2006*). All participants with dyslexia had a report issued by professionals working in certified counselling centres confirming their dyslexia prior to the research. Both parents and students provided their written consents to the participation in the study, revealing information about a dyslexia report and diagnosis. A SENCO (Special Educational Needs Coordinator) and a school psychologist, responsible for co-ordination of the recruitment for the study in the UK and Poland respectively, gathered the necessary data. Reading tests in corresponding NLs confirmed the initial group assignment as dyslexic or non-dyslexic (for details please see Łockiewicz et al., 2020. A summary of the findings from this paper is given below, as they confirm dyslexic difficulties manifested by our participants). Specifically, English students with dyslexia scored lower in sight word and phonemic decoding efficiency than English students without dyslexia (as measured with TOWRE-2: Torgesen et al., 2012; this test includes two tasks: 1. reading single English words, and 2. reading single English nonwords, each one within 45 seconds). Polish students with dyslexia read single words with less accuracy and more slowly than Polish students without dyslexia (as measured with *Real words reading task*: Jaworowska et al., 2010; this test requires reading 89 single Polish words; there is no time limit). Moreover, Polish students with dyslexia read single nonwords with less accuracy and more slowly than Polish students without dyslexia (as measured with *Nonwords reading task*: Jaworowska et al., 2010; this task requires reading 71 single Polish nonwords, within 60 seconds). Furthermore, all Polish students commenced their EFL mandatory course in Year 1 of the elementary school. There was no difference between Polish students with and without dyslexia in the length of EFL schooling ($M = 7.18, SD = 1.17$ years for Polish students with dyslexia, $M = 7.30, SD = 0.48$ years for Polish students without dyslexia, $t(19) = 0.30, p = .770$); the students had attended on average 3 classes weekly. Additional private tutoring classes in English differentiated the groups ($\chi^2(1) = 4.57, p = 0.033$) – more Polish students with dyslexia (5 boys (18.75%)) than Polish students without

dyslexia (1 boy (3%)) participated in them for 2.5 years on average. No Polish boy participating in the study spent more than 6 months (a defined period) abroad.

Procedure

We developed a short survey with open questions for Polish students, which provided demographic information about EFL education and practice. This survey was completed as a first element of the group assessment, in a written form. All students participated in 2 parts of the assessment (both conducted by the 1st and 2nd author): 1. a group assessment (about 45 min. long, including e. g. the Raven Test Matrices, single word spelling in English), and 2. an individual assessment (about 30 min. long, including e.g. tasks measuring spoonerisms, phonemic segmentation, verbal short-term memory, and RAN). All assessments were carried out in school classrooms. The procedure of the study was approved by the Ethics Board for Research Projects at the Institute of Psychology, University of Gdańsk, Poland.

Methods

Spelling

English words in context:

It assesses spelling skills, as measured with the number of errors committed when spelling 30 single English words missing within given, printed sentences. When selecting the target words, we used an elementary EFL coursebook (Evans & Dooley, 1999), which was 1 level below the mandatory one in the junior high school that we cooperated with. We chose every tenth word from the reading comprehension sections, with the exclusion of proper names, specialist vocabulary, articles and repeated items. Thus, we left only nouns, verbs, adjectives and adverbs. Next, we used the list to choose 30 words and put them in the context of sentences. We selected the words specifically to ensure that they included grapheme-phoneme correspondence combinations especially difficult for learners with dyslexia. The students had to fill in the gaps with the missing words, one missing word per sentence, e.g. *Water in the _____ is cold.* They listened to a recording voiced by a native speaker of English, in which they heard each target word to be completed three times (before, in, and after the sentence): *River. Water in the river is cold. Write: river.* The examples of words were: *said, whale, disgusting.* We classified the errors as phonological and orthographic ones. These are errors within the word structure. The number of phonological errors was a measure of phonological accuracy. The number of orthographic errors was a measure of orthographic accuracy. An orthographic error occurs when the spelling used is wrong; however, the word is written as it sounds, e.g. *wale instead of whale, *polution instead of pollution. A phonological error occurs when the word is written not as it sounds, e.g. *jewler instead of jewel, *discusting instead of disgusting. A Cronbach's alpha was 0.94. The 1st and 2nd authors prepared

this measure, as there had been no available measures standardized for Polish spellers (see Łockiewicz & Jaskulska, 2016, where the original description of this task is included). This task was completed by both Polish and English students.

Phonological processing measures in NL: Polish and English:

We administered the same or corresponding measures to Polish and English students.

The same measures

For the Polish group, the tasks were administered in Polish, for the English group, the tasks were administered in English.

- ◆ **Backwards Digit Span:** Participants repeat a series of digits of increasing length said by the experimenter, in a reverse order. It assesses verbal short-term memory (*Max.* = 14 points). A test-retest reliability coefficient was .82. (Fawcett & Nicolson, 2005).
- ◆ **Rapid Naming (RAN):** It measures rapid automatized naming. Participants name 40 simple pictures (two identical sets of 20 different pictures) as fast as they can. Time (in seconds) of naming is recorded. A test-retest reliability coefficient was .85 (Fawcett & Nicolson, 2005).

Corresponding measures

Spoonerisms

1. The English group: (Fawcett & Nicolson, 2005), measuring the ability to create spoonerisms (*Max.* = 14 points). A test-retest reliability coefficient was .78. This task was administered in English.
2. The Polish group: (Bogdanowicz et al., 2012), measuring the ability to create and recognise spoonerisms (*Max.* = 12 points). This task was administered in Polish.

Phonemic segmentation

The English group: (Fawcett & Nicolson, 2005), measuring the ability to split words into sounds (*Max.* = 12 points). Participants repeat the words said by the experimenter, without certain syllables or sounds, i.e. *pan* for *panda*. A test-retest reliability coefficient was .88. This task was administered in English.

The Polish group: (Bogdanowicz et al., 2012), measuring the ability to split nonwords into sounds (*Max.* = 8 points). Participants repeat the nonwords said by the experimenter, but

they pronounce each sound separately, i.e. *b – o – t* for *bot*. This task was administered in Polish.

In order to calculate the results, a composite score was used to tap phonological awareness. Raw scores for phonemic segmentation and spoonerisms tasks were added (*Max.* = 26 points for the English group and *Max.* = 20 points for the Polish group). A Cronbach's alpha for accuracy was 0.659 (calculated for all tasks assessing auditory-linguistic functions).

RESULTS

Accuracy of Single English Word Spelling

All students spelt correctly: 11 (37%) words in the English students with dyslexia group, 18 (60%) in the English students without dyslexia group (*improve, explained, alive, buy, beard, statue, training, said, lives, become* in English students with and without dyslexia groups, and *there* in the English students with dyslexia group, and *know, ate, chemicals, whale, complete, including, enough* in the English students without dyslexia group), and 0 in the Polish students group. The easiest words (more than half the students spelt the word correctly) for Polish students were: *buy* (88% of correct answers for Polish students with dyslexia and 88% for Polish students without dyslexia), *alive* (69% for Polish students with dyslexia and 69% for Polish students without dyslexia), *there* (69% and 81%), *survive* (69% and 69%), *improve* (63% and 69%), *training* (63% and 69%), *lives* (63% and 88%), and, additionally, for Polish students without dyslexia, *vegetable, complete, become* (75%), *streets* (69%). The majority of words that were spelt best in the Polish group were spelt perfectly in the English group.

Most Difficult Words to Spell and the Proportion of Orthographic and Phonological Errors

The most difficult words to spell in the *English word in context* task for the English group were: *vegetables* (50% of correct spellings), *pollution* (57%), *jewel* (61%). In all these words, orthographic errors were dominant (e.g. **vegtables, *vegatables, *vegatbles, *vedgetables* (12 out of 14 incorrect spellings); **polution, *pollusion, *pulation* (10 out of 12); **jewl, *jewle, *jeul* (9 out of 10)). The most difficult words to spell in the *English word in context* task for the Polish group were: *jewel* (6% of correct spellings), *pollution* (6%), *treating* (16%). In the word: *jewel* phonological errors were dominant (e.g. **juall, *child, *giol, *geol, *gillow, *gilos, *jewler, *july, *geogle, *javearly, *ganule, *youal* (14 out of 21 incorrect spellings)), in the word: *pollution* - orthographic ones (**polution, *pollusion, *pelucion, *polition*, (18 out of 24), and in the word: *treating* both categories were distributed equally (orthographic errors: **treeting*, phonological errors: **threeteen, *traitin, *triteen*). Interestingly, as our lector native speaker did not produce the final g in

the latter word, Polish students tended to omit it in their spellings, either ignoring or not recognising the *-ing* ending in Present Participle. The same recurring (committed by at least 2 students) errors in Polish and English groups were orthographic: **no* for *know* (41% of spellings in the Polish group and 7% in the English group), **streats* for *streets* (6% and 7%), **polution* for *pollution* (8% and 8%), **vegatables* for *vegetables* (6% and 14%), and **Europian* for *European* (12.5% and 7%), and phonological: **eat* for *ate* (50% and 11%, respectively), **discusting* for *disgusting* (9% and 14%).

Phonological Processing Skills of Students With and Without Dyslexia in Their Respective NLs

Mean comparison. When comparing reading (see Participants section) and phonological processing skills of students with and without dyslexia in their respective NLs, we calculated differences only within the two groups: English and Polish, to confirm dyslexic deficits in our criterion group. The main point of interest of the study was spelling; however, we also aimed to examine a potential relationship between other cognitive tasks; thus, a range of further data was also investigated. We found that Polish students with dyslexia did worse in the RAN task in comparison with Polish students without dyslexia. English students with dyslexia had poorer results in the verbal short-term memory task in comparison with English students without dyslexia. Between Polish students with and without dyslexia no further differences were observed in the NL phonological processing skills. Similarly, no differences between English students with and without dyslexia occurred, though in all administered measures the students with dyslexia were outperformed by their non-dyslexic peers. The exact numbers for these comparisons are given in Łockiewicz, Jaskulska, and Fawcett (2020, p. 26)².

Spelling Skills in EFL of Polish Students With and Without Dyslexia and in English as NL of English Students With and Without Dyslexia

Mean comparison. When comparing spelling skills in English of Polish and English students with and without dyslexia, we calculated differences between the two groups: a 2 x 2 (dyslexia and country) ANOVA test was used (Table 1).

In the *English word in context* task, the ANOVA test 2 x 2 (dyslexia x NL) and Tukey post hoc tests (Table 1) showed that dyslexic students made more orthographic errors as compared with their non-dyslexic peers (main effect for dyslexia). Moreover, Polish students made more orthographic errors than their English peers (main effect for NL). Specifically, Polish students with dyslexia ($M = 6.69$, $SD = 2.33$, $Min = 2.00$, $Max = 10.00$) made more orthographic errors than both English students without dyslexia ($M = 1.53$, $SD = 1.25$, $Min = 0.00$, $Max = 3.00$) and English students with dyslexia ($M = 3.38$, $SD = 3.20$, $Min = 0.00$, $Max = 8.00$), and Polish students without dyslexia ($M = 4.63$, $SD = 2.87$, $Min = 1.00$, $Max = 12.00$) made more errors than English students without dyslexia.

Table 1. English Spelling in the Compared Groups

Errors	dyslexic		Non-dyslexic		F	p	η^2	ED/ END	ED /PD	ED/ PND	END/ PD	END/ PND	PD/ PND	p (Tukey post hoc test)
	M	SD	M	SD										
ortho- graphic	English	3.38	3.32	1.53	1.25	9.12 ^a	.14	.218	.005**	.549	≤.001	.006	.103	
	Polish	6.69	2.33	4.63	2.87	24.36 ^b	.30							
phono- logical	English	1.54	1.05	0.47	0.74	1.66 ^a	.03	.857	≤.001	≤.001	≤.001	≤.001	.726	
	Polish	9.56	4.62	8.25	4.97	73.18 ^b	.57							
					0.02 ^c	.897	.00							

Note: ^a - Main effect for dyslexia; ^b - Main effect for Native Language; ^c Effect for interaction of dyslexia and Native Language; ** - $p \leq .01$
 ED = English students with dyslexia, END = English students without dyslexia, PD = Polish students with dyslexia, PND = Polish students without dyslexia

However, Polish students without dyslexia performed on a level with English students with dyslexia. No other significant differences were observed.

In the *English word in context* task, the ANOVA test 2 x 2 (dyslexia x NL) and Tukey post hoc (Table 1) tests showed that Polish students made more phonological errors as compared with their English peers (main effect for NL). No main effect for dyslexia was observed. Specifically, Polish students with dyslexia ($M = 9.56$, $SD = 4.62$, $Min = 4.00$, $Max = 19.00$) made more phonological errors than both English students without dyslexia ($M = 0.47$, $SD = 0.74$, $Min = 0.00$, $Max = 2.00$) and English students with dyslexia ($M = 1.54$, $SD = 1.05$, $Min = 0.00$, $Max = 3.00$). Moreover, Polish students without dyslexia ($M = 8.25$, $SD = 4.97$, $Min = 1.00$, $Max = 15.00$) made more phonological errors than both English students without dyslexia and English students with dyslexia. No other significant differences were observed. Moreover, the t-test with repeated measures showed that Polish students with dyslexia ($t(15) = 2.17$, $p = .047$, $d = 0.62$) and Polish students without dyslexia ($t(15) = 2.84$, $p = .012$, $d = 0.73$) made more phonological than orthographic errors. Conversely, English students with dyslexia ($t(12) = 2.36$, $p = .036$, $d = 0.87$) and English students without dyslexia ($t(14) = 4.00$, $p \leq .001$, $d = 1.19$) made more orthographic than phonological errors.

Relations Between Spelling in English, Dyslexia, and Phonological Processing Skills in NL (Polish and English, Respectively) of Polish and English Students With and Without Dyslexia

Correlational analysis:

To analyse the relations between the investigated variables (dyslexia, orthographic and phonological errors, and phonological processing skills), Pearson's product-moment and point-biserial coefficients were computed (Table 2 and Table 3).

A correlation study showed the expected links (Table 2 includes data for the Polish group, and Table 3 includes data for the English group).

Regression analyses:

The same comparative data was used in a series of regression analyses. Several hierarchical multiple regression analyses were calculated. Dyslexia was entered as independent variable in Step 1. Phonological processing skills in NL: either English or Polish (phonological awareness, verbal short-term memory, and RAN) were entered as independent variables in Step 2. English spelling skills (as measured with the number of committed orthographic and phonological errors) were entered as dependent variables (Table 4).

Table 2 Correlations Between the Study Variables – the Polish Group

variable	orthographic errors ^b	phonological errors ^b
dyslexia ^{ac}	-.377*	-.140
phonological awareness	.036	-.083
verbal short-term memory	-.224	-.272
RAN (in sec.) ^b	.330 ^d	.205

Note: ** $p \leq .01$; * $p \leq .05$; Pearson product-moment correlations, except:

^c point-biserial correlation coefficients; ^a 1 = dyslexia, 2 = lack of dyslexia; ^b higher score signifies worse performance; ^d = statistical trend.

Correlation co-efficient between orthographic and phonological errors was .153.

Table 3. Correlations Between the Study Variables – the English Group

variable	orthographic errors ^b	phonological errors ^b
dyslexia ^{ac}	-.376*	-.526**
phonological awareness	.040	-.012
verbal short-term memory	-.431*	-.300
RAN (in sec.) ^b	.119	.196

Note: ** $p \leq .01$; * $p \leq .05$; Pearson product-moment correlations, except:

^c point-biserial correlation coefficients; ^a 1 = dyslexia, 2 = lack of dyslexia; ^b higher score signifies worse performance

Correlation co-efficient between orthographic and phonological errors was .592**.

In the English group (see Table 4) the regression analysis for English as NL orthographic accuracy of single word spelling showed that the independent variable: dyslexia explained a total of 9% of the variance ($F(1,25) = 3.59$, $p = .070$, statistical trend). The only significant independent variable in Step 1 was dyslexia ($\beta = -.354$), showing that participants without dyslexia made fewer orthographic errors. The regression analysis for English as NL phonological accuracy of single word spelling showed that the independent variable: dyslexia explained a total of 23% of the variance ($F(1,25) = 8.77$, $p = .007$). The only significant independent variable in Step 1 was dyslexia ($\beta = -.510$), showing that participants without dyslexia made fewer phonological errors.

In the Polish group (see Table 4) the regression analysis for English as FL orthographic accuracy of single word spelling showed that the independent variable: dyslexia explained a total of 10% of the variance ($F(1,29) = 4.48, p = .043$). The only significant independent variable in Step 1 was dyslexia ($\beta = -.366$), showing that participants without dyslexia made fewer orthographic errors. No other significant models were observed.

Table 4 Results of Hierarchical Regression Analyses in Which Dyslexia and Native Language Phonological Processing Abilities in Either a Foreign (for the Polish Group) or a Native Language (for the English Group) Were Regressed upon Spelling in English

Step	predictor	ENGLISH GROUP		POLISH GROUP	
		orthographic	phonological	orthographic	phonological
		errors ^b			
1	dyslexia ^a	-.354 (1.90) ^c	-.510 (2.96)**	-.366 (2.12)*	-.157 (0.86)
	ΔR^2	.126 ^c	.260**	.134*	.025
	Total R ² /Adj. R ²	.126/.091 ^c	.260/.230**	.134/.104*	.025/-.009
2	dyslexia ^a	-.156 (0.66)	-.487 (2.14)*	-.254 (1.26)	-.002 (0.01)
	PA	.038 (0.18)	-.104 (0.52)	.319 (1.62)	.084 (0.39)
	VM	-.353 (1.42)	.047 (0.20)	-.229 (1.20)	-.270 (1.30)
	RAN ^b	.004 (0.21)	.086 (0.46)	.273 (1.35)	.201 (0.91)
	ΔR^2	.077	.014	.115	.085
	Total R ² /Adj. R ²	.202/.057	.274/.142	.249/.133	.110/-.027

Note: ** $p \leq .01$; * $p \leq .05$; ^c = statistical trend; β given (t in parenthesis); ^a 1 = dyslexia, 2 = lack of dyslexia; ^b higher score signifies worse performance; PA – phonological awareness, VM = verbal short-term memory

DISCUSSION

When comparing the phonological and orthographic accuracy of single word spelling in English as either NL or FL between English students with dyslexia, English students without dyslexia, Polish students with dyslexia, and Polish students without dyslexia we found main effects of NL in both measures, and a main effect of dyslexia for orthographic accuracy. The impact of NL on spelling performance demonstrated an expected native speaker advantage, that we observed also for word and nonword decoding and word recognition accuracy and fluency in the same group (cf. Łockiewicz et al., 2020). Our participants were of the same age, and expected to spell fluently in their respective NLs. However, when exposure to English as NL and FL was compared, English students learnt English in preferential circumstances: for a longer time, from birth, and in a both familial and academic environment (cf. Carroll, 2008), as opposed to a shorter, limited, and formalised education that Polish students received. These differences turned out to be crucial, even though in both cases the actual spelling instruction likely took place mainly through schooling. Interestingly, 2 out of 3 most difficult words for both Polish and English students were identical: pollution and jewel, showing that problems with silent letters in consonantal pairs (hence the error in pollution) and less frequent spellings (hence the error in jewel) are common, regardless of NL. The observed link between dyslexia and orthographic accuracy is in agreement with the deficits typical for dyslexia (Lyon et al., 2003). The lack of an analogical link between dyslexia and phonological accuracy could be due to the selected words (elementary level) being very easy for both English students with and without dyslexia, and very difficult for both Polish students with and without dyslexia. This assumption matches with another finding, that in our study, contrary to expectations and reports of EFL spelling deficits in dyslexia in other alphabetic languages (Bonifacci et al., 2017; Lindgren & Laine, 2011), Polish students with dyslexia did not differ from Polish students without dyslexia, and English students with dyslexia did not differ from English students without dyslexia. In addition, an earlier study of 3-year older, high school Polish students with dyslexia demonstrated that they committed more orthographic and phonological errors in the same single word spelling task as used in the present study, as compared with typical readers (Łockiewicz & Jaskulska, 2016). They had studied English, however, 2 years longer. Moreover, Polish EFL learners do not practise spelling to dictation during EFL classes, which puts them at another disadvantage when compared with English peers, as this task was unfamiliar to them.

We found that both Polish students with and without dyslexia made more phonological errors than both English students with and without dyslexia. Phonological, morphological, and orthographical competence constitute prerequisites for mastering spelling skills (Joshi et al., 2008/2009); these are different for English and Polish (cf. Awramiuk, 2006; Jaskulska & Łockiewicz, 2017). Likely, both Polish students with and without dyslexia struggled with the EFL phoneme-to-grapheme conversion, due to lack of knowledge and practice, and possible application of Polish rules. Figueredo (2006) claims that FL learners base their FL performance on NL, namely, that there is a transfer from NL to FL.

However, such transfer or influence from NL decreases when the knowledge of FL increases. As the competence in EFL in Polish students with and without dyslexia who participated in our study was still elementary or lower, we think that they relied heavily on their NL, which led to transfer errors. In addition, phonemes not existing in Polish (e.g. /θ/, /ð/, /æ/) might have caused confusion as to which word was read, despite the words having been given within a sentence, to facilitate comprehension and recognition. We observed that Polish students with dyslexia made more orthographic errors than both English students with and without dyslexia, and Polish students without dyslexia made more such errors than English students without dyslexia, which agrees with our previous findings. However, Polish students without dyslexia performed on a level with English students with dyslexia. They heard the word correctly, but failed to spell it right, possibly completing the gap with any word with the given pronunciation that they knew. This might be due to an underdeveloped mental lexicon: a faulty and/or non-existent link between semantic, phonological, and orthographic data. This could explain why Polish students with dyslexia did not manage to equal English students with dyslexia score; even if they selected an inappropriate, but otherwise existing, English word, they might have changed its spelling so severely that it altered the plausible pronunciation, resulting in a phonological error. However, sometimes they manifested similar spelling errors patterns, showing that they learnt the possible pronunciations of letter combinations unfamiliar to Polish, e.g.: ea for /i:/, no for /nəʊ/. For English students with dyslexia, their dyslexic disabilities were so deep that they nullified the advantage of native speakers' status, which we also observed for decoding skills (Łockiewicz et al., 2020).

Within the group of English native speakers, we observed that English students with and without dyslexia made more orthographic than phonological errors. These students were aware of the irregularities and low consistency of phoneme-to-grapheme mapping in their NL, thus their spelling mistakes rather did not change the pronunciation. Moreover, learners progress from using a phonological to an orthographical strategy for spelling (Zhao et al., 2016). As we observed a reversed proportion in Polish students with and without dyslexia, who made more phonological than orthographic errors, we assume that Polish students with and without dyslexia might have used an earlier spelling strategy than English students with and without dyslexia did. Moreover, the category of phonological errors includes also serious distortions of a word structure, resulting in it being practically unrecognisable, especially should the context not be provided. Possibly, some participants failed to recognise a word, yet tried to spell it anyway, as encouraged by the instruction to complete all the gaps. However, we did not question our participants which strategies they applied. Our findings confirm Romonath et al.'s (2005) report that FL learners usually make phonological errors in spelling. Yeon et al. (2017) suggested that when EFL learners spell unknown words, they apply phonological processing skills, if their NL is an alphabetic, in particular shallow, orthography. A meta-analysis by Zhao et al. (2016) found that bilingual students, who attended English-medium schools (so they had more exposure to English than our participants did), spelt real words in English as a Second Language (ESL) better than monolingual students (the

difference decreased with students' age). Conversely, monolingual students spelt nonwords in English, which was their NL, better than bilingual students, for whom English was SL. The latter task (i. e. nonword spelling) taps phoneme-to-grapheme conversion more than the former one (i. e. real word spelling) (cf. Coltheart, 2007), which is probably less developed in bilingual learners (Zhao et al., 2016). We found a similar relationship for EFL learners, as our Polish students without dyslexia, as compared with English students with dyslexia, made equal number of orthographic, but more phonological errors, failing in a task more deeply rooted in phoneme-to-grapheme mapping.

In the English group, all the most difficult words were inaccurate orthographically. Both English students with and without dyslexia were familiar with the irregularities, non-consistency, and non-transparency of grapheme-phoneme relations in their NL, thus, their spelling errors rather did not change the pronunciation. Frequent error in the Polish group was the word pollution, spelt incorrectly as **polution* (letter deletion), demonstrating that silent letters in consonantal pairs are a mutual difficulty for English and Polish students. However, another orthographically difficult word for Polish learners, treating, was not among the most difficult for English learners. The most frequent faulty spelling that occurred in the Polish group, **triting*, manifested replacing the vowel digraph **ea* (which in Polish represents 2 phonemes, pronounced as /ea/) with a monograph i. This is due to a lack of distinction into long and short vowels and of no dependence of vowel pronunciation on whether a syllable is stressed or not in Polish. Thus, when students heard /tri:tiŋ/, they made a faulty approximation that English phoneme /i:/ is the same as Polish phoneme /i/, represented by grapheme i. Another common difficult word, jewel, resulted in orthographic errors in the English group, but in phonological errors in the Polish group. This noun includes two vowels non-existent in Polish: /u:/ and /ə/, and a silent consonant /w/, a concept also unfamiliar to Polish orthography. Though letter deletions, substitutions, and reversals also appeared, as in the English group, these frequently distorted the word beyond recognition, and thus impacted pronunciation. In addition, Polish learners often replaced j with g (unlike English learners), showing the knowledge of g - /dʒ/ grapheme-phoneme correspondence, typical of English, but not of Polish (g is realised phonetically as /g/ or, rarely, as /ʒ/). Generally, in the Polish group phonological errors dominated over orthographic ones in the most difficult words, which results from poor knowledge of the grapheme-phoneme relations in FL, not compatible with analogical rules in NL (cf. Łockiewicz & Warmbier, 2018; in this study, the most difficult English words for Polish junior and high school students to spell were these words, which were characterised with a low grapheme-phoneme correspondence). Faulty usage of NL (Polish) rules was observed in spelling igloo (/ˈɪɡlu:/ as **iglo* (a phonological error), which is a Polish spelling with the same meaning (though pronounced as /iglo/). However, transfer of Polish rules to English was sometimes helpful, as manifested in another difficult word: disgusting. Usually, the gerund ending was rendered correctly as -ing, with errors in the first two syllables; this could be attributed (though we did not measure that in our study) in Polish learners' tendency to pronounce such ending as: /ing/, retaining final g.

To conclude, even though some of the most difficult words for English and Polish students with and without dyslexia were the same, the most frequent errors not always were of the same type, but depended on the characteristic of the phonology and orthography of the language. Thus, we noticed both signs of a positive and a negative transfer (Figueredo, 2006) from NL (Polish) to FL (English).

In both groups, we observed that dyslexia predicted NL (English, in a group of English students) and FL (English, in a group of Polish students) orthographic accuracy of single word spelling. In the English group, but not in the Polish group, phonological accuracy of single word spelling was also predicted by dyslexia; participants with dyslexia made more phonological errors. These findings confirm earlier reports of phonological impairments in dyslexia (Høien et al., 1995), and of spelling difficulties in EFL learners with dyslexia (Bonifacci et al., 2017; Lindgren and Laine, 2011). Also in an earlier study with different participants (junior high and high school students) we found that dyslexia, along with other educational and cognitive factors, predicted the accuracy of EFL single word spelling (Jaskulska & Łockiewicz, 2018). Although in the current study we did not find a predictive function of phonological awareness, RAN, and verbal short-term memory on FL spelling, they are all related to dyslexia (Høien et al., 1995; Wolf et al., 2000), as spelling is, which our study showed. For example, FL spelling correlated with phonological awareness and verbal short-term memory, but not with RAN, in Dutch as NL (van Sette et al., 2017). Korean as NL metalinguistic awareness (a construct underlying phonological, orthographic, and morphological awareness) predicted EFL spelling. When analysed separately, however, orthographic awareness in NL did not contribute to EFL spelling (Yeon et al., 2017).

The biggest limitation of our research is a comparatively small number of participants. Moreover, since our Polish participants did not know all English phonemes, they could have attempted to spell similar Polish phonemes. In future studies, we would like to ask the participants to read the spelt words, and to transcribe their pronunciations. Moreover, we would like to include an older Polish group, with reading age level matched with English students with dyslexia.

CONCLUSIONS

We found that both Polish students with and without dyslexia, who struggled with the EFL phoneme-to-grapheme conversion, made more phonological errors than both English students with and without dyslexia, and more orthographic errors than English students without dyslexia. Similarly, Polish students with dyslexia made more orthographic errors than English students with dyslexia; however, Polish students without dyslexia performed on a level with English students with dyslexia. Likely, both Polish students with and without dyslexia had underdeveloped EFL mental lexicons, as compared with their English peers' NL lexicons, but Polish students with dyslexia additionally misspelt the words so substantially that it resulted in phonological errors. Moreover, English students

with dyslexia deficits were so deep, that they failed to outperform Polish students without dyslexia despite being native speakers, with much more language exposure and practice. Moreover, in our study dyslexia predicted orthographic accuracy of single word spelling in both Polish and English students, but phonological accuracy only in the English learners. This suggests that the symptoms of the phonological deficits at the behavioural level in students with dyslexia are more conspicuous in the English language rather than Polish. Moreover, despite differences in the consistency, regularity, and transparency of compared orthographies, similar words turned out to be most difficult for both native speakers and EFL learners.

We also found that orthographic errors were more frequent than phonological errors in the English group, while phonological errors were more frequent than orthographic errors in the Polish group. This suggests that despite being the same age, Polish students employed an earlier spelling strategy, more based on sublexical than lexical knowledge and skills, as compared with their English peers, and more frequently misspelt the words practically beyond recognition. We believe that teaching spelling rules should be introduced in EFL instruction, to facilitate the development of writing skills. In the future, we would like to conduct longitudinal studies, in which we would investigate the stages of EFL acquisition of Polish children, both in preschool and elementary school, and compare their reading and spelling ages and the trajectories of common errors with English learners.

Footnotes

1. The same group participated in a study by Łockiewicz, Jaskulska, and Fawcett (2019) and Łockiewicz, Jaskulska, and Fawcett (2020). Therefore, the numbers given in the Participants section are identical in these three papers, as these are necessary to report characteristics of the same students.
2. The results concerning phonological processing skills presented in this paragraph are also reported in Łockiewicz, Jaskulska, and Fawcett, 2020, a paper presenting the relationship between these skills and reading (cf. Introduction).

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