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The Effects of Multiple-Exposure Textual Enhancement on Child L2 Learners' Development in Derivational Morphology: A Multi-Site Study

ANDREA RÉVÉSZ, LAURA BENTON, AND ASIMINA VASALOU
University College London
London, UK

LEONA BUNTING AND YLVA HÅRD AF SEGERSTAD
University of Gothenburg
Gothenburg, Sweden

ADRIAN FLOREA AND IOAN P. MIHU
Lucian Blaga University of Sibiu
Sibiu, Romania

ROGER GILABERT
University of Barcelona
Barcelona, Spain

CLIFF PARRY
British Council Greece
Athens, Greece

Abstract

Much research exists on the role of textual enhancement in instructed second language (L2) development, yet little is known about how its effectiveness is influenced by multiple exposures, whether it can facilitate the acquisition of L2 derivational morphology, and how it may affect child language learning. To fill these gaps, this study employed a six-week multiple-exposure design to investigate the extent which to textual enhancement can benefit children's knowledge of L2 derivational morphemes. The study employed a pretest-posttest design, with six treatment sessions. Participants were 91 L2 learners of English in two primary school EFL contexts (Romania, Sweden). In each context, participants were randomly assigned to two groups: the +highlight group received textually enhanced texts, whereas the –highlight group

read unenhanced texts during the treatment. The children read the texts through a digital reader application during their English lessons. The target constructions were the *–ion* and *–ment* morphemes. The pretest and posttest included a non-word derivational suffix choice and a nonword derivational suffix decomposition task. Results of linear mixed effects models found a small advantage of textual enhancement for the acquisition of the *–ion* morpheme by Swedish learners on the suffix choice task, but Romanian learners showed no benefits from highlighting.
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INTRODUCTION

In second language (L2) acquisition research, comprehensible input is regarded as a necessary condition for acquisition to occur. However, not all the input to which learners are exposed gets processed and later learned (Corder, 1967). It is generally held that only that part of the input that learners attend to become selected for subsequent processing (Robinson, 2003; Schmidt, 1990). Hence, a principal aim in instructed L2 acquisition research has been to identify ways in which learner attention can be drawn to L2 constructions effectively. As a result of extensive theorizing (e.g., Long & Robinson, 1998) and empirical research (e.g., Housen & Pierrard, 2005; Lightbown & Spada, 1990; Sato & Loewen, 2019), there is growing consensus that a beneficial way to achieve this is through directing learner attention to L2 features during meaning-based activities.

In the context of reading, textual enhancement has been proposed as a possible means to draw learners' attention to language while keeping their primary attention on meaning. Textual enhancement techniques aim to make linguistic features salient (Sharwood Smith, 1991, 1993), and thereby draw learners' attention to L2 constructions that may otherwise remain unnoticed and thus unlearned (Leow, 1997, 2001; Robinson, 2003; Schmidt, 1990). Enhancing written input typically involves some kind of textual modification, such as underlining, highlighting, or **boldfacing** (Sharwood Smith, 1991, 1993). The effectiveness of textual enhancement has been examined in much research; a meta-analysis of 16 studies (Lee & Huang, 2008) found a small but positive effect of textual enhancement on development in grammatical

CorrespondenceEmail: a.revesz@ucl.ac.uk

knowledge. Most of the existing research, however, has been short term (Han, Park, & Combs, 2008; Lee & Huang, 2008), involved adult populations, and focused on the acquisition of syntax and inflectional morphology. Little research has investigated the effects of multiple-exposure textual enhancement, included child learners, and examined whether it can facilitate L2 development in derivational morphology. These are key gaps to fill given that the effects of implicit techniques, such as textual enhancement, are expected (a) to take longer to surface (e.g., Long, 2007; Mackey & Goo, 2007), (b) most L2 instruction targets children, and (c) morphological knowledge reliably predicts L2 reading skills (Geva & Ramirez, 2015).

Against this background, this study aimed to investigate the extent to which highlighting, implemented through a digital reader application, can facilitate development in the knowledge of L2 derivational morphology. We focused on child language learners, a group that remains underexplored in the field of second language acquisition, where existing research has mainly investigated university populations (Andringa & Godfroid, 2020; Plonsky, 2016). To allow sufficient time for any effects of highlighting to emerge, the participants received exposure to the target constructions in six treatment sessions rather than on a single occasion. Another methodological strength of the study was that it was conducted in two L2 settings with learners from different first language (L1) backgrounds (Romanian, Swedish), allowing for testing the generalizability of any effects of textual enhancement across typologically different L1 groups.

BACKGROUND

Theoretical Underpinnings

The theoretical rationale for textual enhancement originates from Sharwood Smith's (1991, 1993) proposal of input enhancement. In this hypothesis, Sharwood Smith attempted to help resolve a fundamental question in SLA, that is, why L2 learners often continue to use non-target like interlanguage forms despite being exposed to a massive amount of input providing plentiful samples of target-like use. In his view, one reason underlying this phenomenon is learners' lack of ability to notice grammatical properties of the L2 in the input due to L1 processing biases or developmental issues. Another contributing factor, Sharwood Smith holds, is the low perceptual salience of certain linguistic features, making it unlikely that they are attended to and thus learned (see also Han et al., 2008). To help overcome this latter problem, he put forward the notion of input enhancement, an operation

whose aim is to make linguistic features salient through techniques such as written (e.g., highlighting) or oral (e.g., repetition) enhancement, thereby increasing the probability that learners pay attention to and potentially learn the enhanced features (Schmidt, 1990).

Sharwood Smith (1991) also makes a distinction between externally and internally created salience. Externally created salience results from deliberate manipulations of the input (e.g., through textual enhancement), typically made by the teacher. Internally created salience, on the other hand, arises from naturally occurring learning processes during which certain linguistic elements become salient to learners because they have grown ready to process them. Importantly, however, externally generated salience, as explained by Sharwood Smith, does not necessarily lead to internal salience, which is a prerequisite for development. Learners may or may not register the externally enhanced input or, even when they do register it, they may not process it further if they are not ready to learn it. Applying this to textual enhancement, the technique is only expected to be effective if the enhanced linguistic targets also become internally salient to learners.

Sharwood Smith's conceptualization of external and internal salience shows parallels with Chun, Golomb, and Turk-Browne's (2011) recent account of attention as a multiple system, including an external and an internal attentional system. External attention can be thought of as perceptual attention. It denotes the selection and modulation of modality-specific sensory information, which can be induced by external cues (e.g., manipulation of a visual stimulus). Internal attention is concerned with selecting and modulating internally generated information, including the contents of working memory and long-term memory. Internal attention is also responsible for cognitive control. While the internal and external systems are separate, the two systems are assumed to interact, with working memory being the interface. For example, internal attention includes executive functioning and cognitive control operations, which, in turn, are responsible for the selection of perceptual information that gets encoded and maintained in working memory. Vice versa, the contents of working memory can affect perceptual attention via biasing attention towards information similar to what is being maintained in working memory. There is also evidence that long-term memory representations encoded in the past can guide attention (Fan & Turk-Browne, 2016). The implications for textual enhancement appear to be that visually enhanced features can capture learners' external attention (Issa & Morgan-Short, 2019), but whether the enhanced information gets encoded and rehearsed in working memory will be influenced by existing long-term memory representations.

If a piece of information gets rehearsed in working memory and thus a memory trace is created in long-term memory, then the item

needs to be retrieved again to strengthen the memory trace for long-term retention to occur (Chun et al., 2011; Leow, 1998). L2 studies yielded different results as to whether how many exposures might be needed for establishing and consolidating new long-term memory representations (e.g., Indrarathne, Ratajczak, & Kormos, 2018; Leow, 1997; Pellicer-Sánchez, 2016). There is an agreement, however, that incidental learning is typically a slow process requiring repeated exposure. There is also growing evidence suggesting that distributed exposure, when information is presented in shorter sessions over a period of time, is more likely to lead to substantial and longer-term gains than massed practice, when the same material is practiced in fewer longer sessions (Rogers, 2015). What follows is that, for textual enhancement to be effective, learners need to be exposed to target constructions repeatedly over a period of time.

Previous Empirical Research on Textual Enhancement

The results of empirical studies of textual enhancement, overall, are consistent with the insights drawn from previous work in cognitive psychology and L2 acquisition. A growing number of eye-tracking studies attest that textual enhancement has the capacity to draw external attention to visually enhanced linguistic features (Indrarathne et al., 2018; Issa & Morgan-Short, 2019; Simard & Foucambert, 2013; Winke, 2013; see, however, Loewen & Inceoglu, 2016), assuming that the typographical modification is sufficiently salient (Indrarathne & Kormos, 2017). At the same time, studies employing think-aloud protocols show that externally induced salience achieved via textual enhancement does not necessarily lead to further, deeper processing (Leow, 2015; Leow & Martin, 2018). Taken together, existing research confirms a possible dissociation of external and internal attention, that is, even though textual enhancement may succeed in inducing external attention due to increased perceptual salience, this might not result in further processing (Indrarathne & Kormos, 2017; Leow, 2015; Leow & Martin, 2018; Winke, 2013).

Turning to the relationship between textual enhancement and L2 development, Lee and Huang's (2008) meta-analysis yielded a small positive impact for textual enhancement. Nevertheless, the overall findings of developmental research are rather mixed, with some studies showing positive while others generating null results (see Han et al., 2008; Leow & Martin, 2018 for reviews). Besides a lack of ample external attention or appropriate interface between internal and external attention, null findings, as discussed above, might have been due to the fact that learners were not exposed to the targeted feature with adequate frequency (Leow, 1998).

Previous accounts put forward to explain the possible absence of textual enhancement effects are broadly aligned with these conclusions. Researchers have attributed null results, among other things, to incongruence between internally and externally generated salience (Indrarathne & Kormos, 2017), low depth of processing (Leow, Donate, & Gutiérrez, 2019), low prior knowledge (Park, 2004; Winke, 2013), low motivation (Winke, 2013), lack of perceived relevance to task completion (Indrarathne & Kormos, 2017), and use of simple, non-conflated (i.e., enhancement used alone) versus compound, conflated textual enhancement (i.e., enhancement combined with other techniques) (Han et al., 2008; Leow, 2009). Of special relevance to this study are two additional explanatory factors that have been proposed: the choice of linguistic target and the primary adoption of single-shot rather than multiple-exposure designs.

Textual Enhancement and Linguistic Targets

While researchers agree that the nature of the target construction is likely to impact on the effectiveness of textual enhancement (Han et al., 2008; Leow, Donate, & Gutierrez, 2019; Leow, Egi, Nuevo, & Tsai, 2003), the jury is still out about what features may be more or less susceptible to textual enhancement. Thus far, empirical studies have primarily focused on the acquisition of syntax and inflectional morphology, it remains unexplored the extent to which textual enhancement may facilitate development in derivational morphology.

In general, few instructed SLA studies have focused on learners' knowledge and acquisition of derivational morphemes. The small number of previous studies found that learners have better receptive than productive knowledge of L2 derivational morphology (Schmitt & Meara, 1997), noun and verb derivatives are easier to learn than adjective and adverb forms (Schmitt & Zimmerman, 2002), and having an L1 with rich derivational morphology constitutes an advantage (Friedline, 2011). Researchers also observed that even intermediate and advanced learners have relatively little mastery of derivational morphemes, and thus highlighted the need to explore pedagogical techniques that can facilitate the acquisition of L2 derivational morphology (Friedline, 2011; Schmitt & Zimmerman, 2002). The few studies that had taken on this challenge yielded positive effects of instruction. Morin (2003, 2006) generated evidence in support of explicit strategy instruction, whereas Friedline (2011) found that pushed-output and input-processing conditions led to comparable gains. It remains unexplored, however, whether these positive results can be extended to textual enhancement.

Textual Enhancement and Multiple-Exposure Designs

To obtain a fuller picture of the effectiveness of textual enhancement, it is also vital that studies, involving several treatment sessions over a more extended period of time, are conducted (Han et al., 2008). Short-term, single-exposure studies may not afford sufficient time for any benefit of textual enhancement to surface. Unlike explicit interventions which tend to display more instant positive effects, implicit techniques, such as textual enhancement, are expected to take repeated exposures to show gains, but their impact is assumed to be more durable (Long, 2007; Mackey & Goo, 2007). Nevertheless, most textual enhancement studies have employed one-shot designs (e.g., Winke, 2013) or included few treatment sessions (e.g., Indrarathne & Kormos, 2017; Indrarathne et al., 2018; Meguro, 2019). Doughty's (1991) seminal study, with 10 treatment sessions, is a notable exception. This study, however, conflated textual enhancement with other types of instruction, providing no evidence for the isolated effects of textual enhancement (Han et al., 2008; Leow, 2009).

RESEARCH QUESTIONS

Against this background, the present study aimed to investigate the effects of textual enhancement on the acquisition of L2 derivational morphology through a multiple-exposure design, where the target constructions were enhanced repeatedly over a 6-week period. We focused on the *-ion* and *-ment* noun derivational suffixes, and investigated development with respect to two aspects of receptive morphological knowledge: (1) the ability to recognize the syntactic category indicated by the target morphemes and (2) the ability to recognize the morphological structure of words including the target suffixes (i.e., how the derived forms relate to the base). We formed the following research questions:

1. To what extent does textual enhancement promote the ability to recognize the syntactic category marked by the *-ion* and *-ment* derivational morphemes?
2. To what extent does textual enhancement promote the ability to recognize the morphological structure of nouns including the *-ion* and *-ment* derivational morphemes?

We operationalized textual enhancement in the form of highlighting, a function that was available in the Amigo reading application (https://iread-project.eu/amigo-reader/) used in the study.

METHODOLOGY

Research Design

The study took the form of a multi-site experiment, involving two English as a Foreign Language (EFL) contexts (Romania, Sweden). First, we administered a proficiency test. Then, we employed a pre-test–post-test design with six treatment sessions (one session per week). In both contexts, the participants were randomly assigned to two groups: an experimental and a control group. During the treatment, the experimental groups read texts with the target morphological constructions highlighted (+highlight groups), whereas the control groups read texts without highlighting (−highlight groups). Under both conditions, participants completed comprehension questions after reading. The pre-test and post-test included different versions of two assessment tasks, a non-word derivational suffix choice task and a non-word derivational suffix decomposition task.

Participants

Altogether, 127 child EFL learners participated in the experiment (Romania: 66, Sweden: 61). From this pool, we included 40 Romanian (+highlight: 20, −highlight: 20) and 51 Swedish (+highlight: 24, −highlight: 27) learners in the study. We excluded participants who missed any treatment or testing sessions and/or achieved higher than 60% of the total score for each target morpheme on the two assessment tasks at the pre-test (i.e., provided a correct response for at least two of the three target items). The proficiency level of most participants fell into the A2 band in terms of the Common European Framework of Reference (CEFR), with only a few participants going slightly below or above the A2 threshold according to the reading part of a practice Cambridge Preliminary English Test (see Results section).

The participants had similar demographic characteristics in the two contexts. The Romanian children fell into the 11–12 age range, whereas the Swedish children were all 10–12 years old. There were more female participants in each context (Romania: 25 females, 15 males; Sweden: 27 females, 24 males). The children were recruited from 4 and 3 schools in Romania and Sweden, respectively, with half the participants from each class being randomly assigned to the experimental versus control groups. The Romanian children were all in Year 5, and the Swedish participants were enrolled in Years 5 or 6. In each context, children had 2–3 English lessons a week. The Romanian children were receiving a mixture of form-based and meaning-based

instruction, whereas Swedish children were exposed to a primarily meaning-based teaching approach. The aim of the curriculum in both contexts was to foster development in all four skills. The teachers in both contexts were asked not to focus on derivational morphology during the period of the study.

Linguistic Target

We chose the noun derivational suffixes *-ion* and *-ment* as the linguistic focus for two reasons. First, they are highly productive morphemes in the English language. Out of 240 derivational suffixes in Morpholex, a derivational morphological database compiled as part of the English Lexicon Project, *-ion* and *-ment* are ranked high in terms of token frequency (the number of words in which they appear, *-ion*: 1st, *-ment*: 11th) and family size (the number of word types containing them, *-ion*: 2nd, *-ment*: 22th), respectively. Given their high frequency, it was likely that CEFR A2 learners would be familiar with some common words containing them. Second, as expected, we found that nouns ending in *-ion* and *-ment* had a naturally high frequency in texts deemed suitable for the participants in terms of lexical difficulty. We included two rather than a single noun derivational morpheme as linguistic targets with a view to avoiding overgeneralization by learners. Had the learners only been exposed to one noun derivational morpheme, there would probably have been a greater likelihood that they overuse that one morpheme.

In neither Romanian nor Swedish are *-ion* and *-ment* productive morphemes. In Romanian, however, the derivational morpheme *-ţie* is often used to derive nouns from the same Latin roots as *-ion* in English (e.g., Romanian: *coaliţie*, English: *coalition*). In Swedish, the *-ion* morpheme only appears in loan words (e.g., *information*). The *-ment* morpheme is uncommon in both languages. It is also worth noting that, Romanian, being a Romance language, has richer morphology than Swedish and English. Given these cross-linguistic differences, we expected that textual enhancement will differentially affect the two L1 groups, especially in the case of the *-ion* morpheme.

Treatment

Treatment texts. During each treatment session, participants read one text, that is, altogether six different texts throughout the treatment. The texts were the same in both contexts. They were taken from the reading practice section of the British Council Learn English website, but were slightly manipulated to include the target vocabulary and to control vocabulary difficulty. The resulting texts ranged from 217 to 267 words

in length. Approximately 95% of the words in each text were within the 2000 most frequently used words (K2 words) according to the BNC-COCA corpus, as established by the program Lextutor (https://www.lextutor.ca/vp/comp/). This made it likely that CEFR A2 participants would achieve an acceptable level of comprehension (Laufer & Ravenhorst-Kalovski, 2010; Milton, 2010), thereby having attentional capacity to notice (Schmidt, 1990) the targeted morphological forms.

In each text, the two target morphemes occurred four times, that is, eight morphemes were highlighted altogether. Thus, participants were exposed to 24 instances of each derivational suffix across the six treatment sessions. Our rationale for the relatively low incidence of target forms was to keep the texts natural and avoid input flood, which has been cited as a potential cause for overuse in previous studies (Han et al., 2008). The words with the target suffixes (see Table 1) were within the 1000 most frequently used English words (K1 words) using the BBC-COCA corpus as a reference. Exceptions to this were four K2 words (*direction*, *improvement*, *instruction*, and *population*), but these were likely to be familiar to the participants as confirmed by their teachers. We ensured that no other words contained word-final letter sequences identical to the target noun derivational suffixes (e.g., *comment*, *lion*). For the +highlight group, the target morphemes were highlighted in yellow via the Amigo Reader application (see Figure 1 for an example text).

Comprehension questions. Each treatment text was accompanied by six short-answer comprehension questions. The questions were included to ensure that the participants also process the texts for meaning. Additionally, the comprehension questions made it possible to assess whether textual enhancement affected text comprehension. The researchers and teachers judged the L2 words and morphosyntax included in the questions to be appropriate for A2 level. This was also confirmed through piloting with children of similar backgrounds to those participating in the study. The meaning of the target words was not tested in the comprehension questions, but the target words were embedded in parts of the text that participants were expected to process when looking for answers to the comprehension questions (see the Appendix for the comprehension questions to go with the example text in Figure 1). The internal consistency reliability for the comprehension questions (n = 36) was found to be high (Cronbach's alpha: .86).

Assessments

Proficiency test. In both contexts, participants were administered the reading section of a practice Cambridge English Preliminary test (PET) to determine their reading proficiency. This test included 35

TABLE 1
Target Words

Text 1	Text 2	Text 3	Text 4	Text 5	Text 6
Accommodation	Attraction	Attraction	Communication	Attraction	Communication
Location	Communication	Discussion	Discussion	Connection	Connection
Pollution	Connection	Exhibition	Instruction	Direction	Discussion
Population	Education	Location	Location	Education	Location
Development	Argument	Advertisement	Development	Development	Development
Entertainment	Entertainment	Argument	Equipment	Employment	Employment
Excitement	Government	Entertainment	Government	Entertainment	Improvement
Movement	Movement	Excitement	Movement	Excitement	Movement

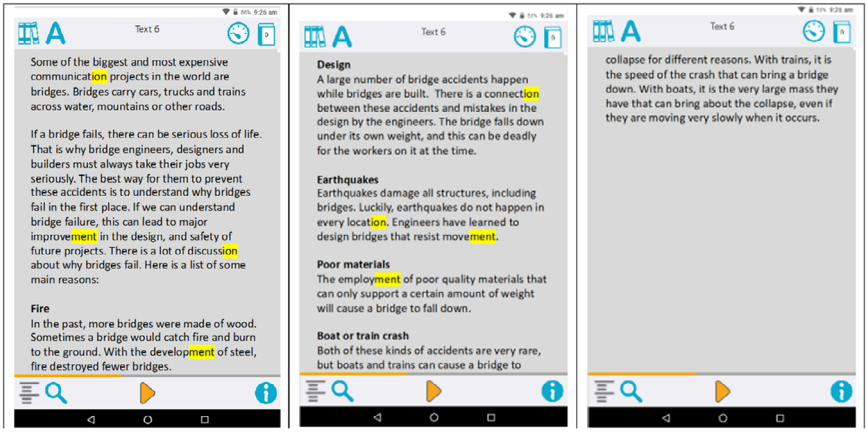

FIGURE 1. Sample text demonstrating the highlighting function of the Amigo Reader

questions, each question worth 1 point (see Results section for the proficiency scores).

Pre-test–post-test measures. The pre-test and post-test comprised equivalent versions of two written morphological tasks adapted from L1 research investigating children's morphological knowledge (e.g., Carlisle, 2000; Spencer et al., 2015): a non-word derivational suffix choice task and a non-word derivational suffix decomposition task. Two versions were developed for each task, which were administered in a counterbalanced order across the two testing sessions. Each test version included an example item and L2 English written instructions. The instructions were also presented orally in the participants' L1 by the facilitating researchers. Each test version was piloted with L1 English adults as well as L1 and L2 children with similar backgrounds to the participants. The very few items which yielded non-consistent responses were revised until consistency was achieved. Piloting revealed that participants had no difficulty in comprehending the carrier sentences and understanding the task instructions.

The non-word derivational suffix choice task aimed to test participants' ability to recognize the grammatical information indicated by the suffix separate from the semantic content of the base. Participants were required to select a correct response from four derivationally related options to complete a sentence, as illustrated below:

They had a nice _____.

a. tweaged b. tweagish c. tweagable d. tweagment

There were 12 items in each test version, of which 3 items targeted *-ion* and 3 items focused on the *-ment* morpheme. Thus, the maximum score was 3 points for both the *-ion* and *-ment* morphemes. The rest were distractors. We included a relatively large proportion of distractors to ensure that participants did not identify the target morphemes at the pre-test. Cronbach's alpha was .74 and .72 for the target items on versions A and B of all pre-test participants, respectively.

The non-word derivational suffix decomposition task aimed to evaluate participants' ability to recognize morphological structure, in particular, the relationships between base and derived forms. This task asked participants to decompose derived non-words to complete sentences, as demonstrated below:

Bancement She is teaching them to _____.

(correct response: bance)

The test included 12 items, 6 items testing the target morphemes (3 items each) and 6 items serving as distractors. Participants received one point for each correct response, resulting in a maximum score of 3 points for each morpheme. Including all pre-test participants, we obtained Cronbach's alpha values of .79 and .82 for versions A and B of the test.

Procedure

The study spanned 9 weeks, with the experiment taking place during the same regularly scheduled English class every week. In the first session, participants were administered the proficiency test. In the second session, they completed the pre-test, including the two assessment tasks. Next, the six treatment sessions followed, with each lasting about 30 minutes. During each treatment session, participants were asked to read one text in their respective conditions using the Amigo reader application, followed by comprehension questions. The comprehension questions were administered in pen and paper format while the text remained available. The children received no other instruction. In the last session, participants completed the post-test. The experiment was facilitated by two researchers in each context.

Statistical Analyses

First, we compared the proficiency, comprehension, and pre-test scores of the Romanian and Swedish participants overall and those of the +highlight and −highlight groups in the two contexts separately. We conducted independent samples *t*-tests to establish any differences in reading proficiency scores. To compare participants' comprehension

TABLE 2
Descriptive Statistics for Proficiency, Comprehension, and Pre-test Scores by Context

				95% CI	
	N	*M*	*SD*	*Lower*	*Upper*
Proficiency					
Romania	40	20.83	4.63	19.38	22.23
Sweden	51	18.16	3.39	17.25	19.08
Comprehension					
Romania	40	24.90	6.83	22.78	27.05
Sweden	51	25.69	5.60	24.08	27.20
Pre-test					
Suffix choice *–ion*					
Romania	40	1.40	.93	1.10	1.70
Sweden	51	1.35	.77	1.14	1.57
Suffix choice *–ment*					
Romania	40	.98	.77	.75	1.23
Sweden	51	1.10	1.02	.82	1.37
Suffix decomposition *-ion*					
Romania	40	1.65	1.12	1.30	2.00
Sweden	51	.80	.85	.59	1.04
Suffix decomposition *-ment*					
Romania	40	1.95	1.06	1.63	2.28
Sweden	51	1.88	1.13	1.59	2.16

Maximum score for the proficiency, comprehension, and pre-test scores were 35, 36, and 3 points, respectively.

and pre-test scores, we constructed a series of binomial mixed-effects models using the *glmer* function in the *lme4* package in the R statistical environment (R Core Team, 2016). To address the research questions, we ran another series of mixed-effects models for the Romanian and Swedish groups separately. An alpha level of $p < .05$ was set for all tests. For the independent samples *t*-tests, effect size was expressed as Cohen's *d*, and *d*-values of .4, .7, and 1.00 were considered as small, medium, and large, respectively (Plonsky & Oswald, 2014). For the binomial mixed-effects regressions, we calculated the amount of variance explained by the fixed effects and the model overall using marginal and conditional *r*-squared values. These were obtained with the command 'r.squared GLMM' from the *MuMin* package.

RESULTS

Preliminary Analyses

First, we ran a series of tests to establish any overall differences between the Romanian and Swedish participants in terms of their proficiency, comprehension, and pre-test scores. The descriptive statistics

TABLE 3

Results for Logistic Mixed-effects Models Comparing Comprehension and Pre-test Scores Across Contexts

	Fixed effects				Random effects					
					by par		*by item*			
	Est	*SE*	*z*	*P*	*var*	*SD*	*var*	*SD*	R^2m	R^2c
Comprehension										
Intercept	1.05	.21	5.07	<.01	.96	.98	.50	.71	<.01	.24
Context	−.04	.71	−.06	.95						
Pre-test										
Suffix choice *-ion*										
Intercept	−.18	.31	−.57	.57	<.01	<.01	.36	.60	<.01	.08
Context	−.05	.25	−.20	.84						
Suffix choice *–ment*										
Intercept	−.75	.22	−3.40	<.01	.03	.17	.05	.22	<.01	.02
Context	.18	.26	.71	.48						
Suffix decomp *–ion*										
Intercept	.26	.43	.61	.54	.79	.89	.36	.60	.09	.29
Context	−1.49	.32	−4.69	<.01						
Suffix decomp *-ment*										
Intercept	.69	.23	3.00	<.01	.45	.67	<.01	<.01	<.01	.10
Context	−.17	.28	−.60	.55						

*decomp = decomposition, par = participant, R^2m = R^2marginal, R^2c = R^2conditional

for these measures are presented in Table 2. An independent samples *t*-test found that the Romanian participants had significantly higher reading proficiency, as measured by the PET, than their Swedish counterparts with a small effect size, t (89) = 3.17, p = .002, d = .66. To compare the Romanian and Swedish participants' performance on the comprehension questions and the pre-tests, we conducted a series of logistic mixed-effects models. In each model, context (Romanian vs. Swedish) served as the fixed effect, the random effects were participant and item, and the dependent variable was participants' score on the respective test. As shown in Table 3, the analyses yielded a significant difference for the *-ion* morphemes on the non-word derivational suffix decomposition task. The Romanian participants outperformed the Swedish learners, with context explaining 9% of the variance in scores. No significant difference emerged for the rest of the pre-test or the comprehension scores between participants in the two contexts. Given that the Romanian and Swedish participants did not prove comparable in terms of reading proficiency and performance on the suffix decomposition task, we ran the remaining analyses for the two contexts separately.

Next, we conducted a series of tests to examine whether any difference existed between the +highlight and –highlight groups in terms of

TABLE 4
Descriptive Statistics for Proficiency and Comprehension Scores by Condition and Context

				95% CI	
	N	*M*	*SD*	*Lower*	*Upper*
Proficiency					
Romania					
+Highlight	20	20.15	4.84	18.10	22.20
–Highlight	20	21.50	4.44	19.60	23.60
Sweden					
+Highlight	24	18.79	4.01	17.33	20.42
–Highlight	27	17.59	2.68	16.63	18.63
Comprehension					
Romania					
+Highlight	20	23.90	6.42	21.15	26.55
–Highlight	20	25.90	7.24	22.90	28.85
Sweden					
+Highlight	24	25.38	6.63	22.50	27.88
–Highlight	27	25.96	4.60	24.19	27.74

Maximum score for the proficiency, comprehension, and pre-test scores were 35, 36, and 3 points, respectively.

proficiency, comprehension, and pre-test scores in the two contexts. The descriptive statistics for the proficiency and comprehension data appear in Table 4 and for the suffix choice and decomposition tasks in Tables 6 and 8, respectively.

The independent samples *t*-tests, which were carried to compare the proficiency scores of the +highlight and –highlight groups, found no significant difference for either the Romanian, t (38) = .92, p = .36, d = .29, or Swedish participants, t (49) = −1.27, p = .21, d = .35. To examine whether there were significant differences between the +highlight and −highlight groups' performance in terms of comprehension or pre-test performance, we constructed a series of logistic mixed-effects models for the two contexts separately, where group (+highlight vs. −highlight) was the fixed effect, participant and item were the random effects, and participants' score on the respective test was the dependent variable. As Table 5 shows, none of the analyses found a significant difference between the +highlight and −highlight groups in either context. The effect sizes were also very small. The only exception was Romanian participants' pre-test scores for the *-ion* items on the derivational suffix choice task, where experimental condition explained 6% of the variance, meaning that the findings for this task would need to be interpreted with some caution. Overall, however, the proficiency, comprehension, and pre-test results suggest that the +highlight and −highlight groups were comparable at the outset of the study in both contexts.

TABLE 5

Results for Logistic Mixed-effects Models Comparing Comprehension and Pre-test Scores of the +Highlight and −Highlight Groups

	Fixed effects				Random effects					
					by par		*by item*			
	Est	*SE*	*z*	*p*	*var*	*SD*	*var*	*SD*	R^2m	R^2c
Comprehension										
Romania									<.01	.23
Intercept	1.09	.26	4.14	<.01	.98	.99	.40	.63		
Condition	−.12	.34	−0.35	.73						
Sweden										
Intercept	1.33	.25	5.31	<.01	.72	.85	1.00	1.00	<.01	.26
Condition	−.28	.27	−1.04	.30						
Pre-test										
Suffix choice *-ion*										
Romania										
Intercept	−.85	.42	−2.05	.04	<.01	<.01	.03	.19	.06	.07
Condition	1.02	.53	1.92	.06						
Sweden										
Intercept	−.05	.44	−.10	.92	<.01	<.01	.79	.87	<.01	.17
Condition	−.42	.35	−1.19	.24						
Suffix choice *−ment*										
Romania										
Intercept	−.77	.28	−2.77	<.01	<.01	<.01	<.01	<.01	<.01	<.01
Condition	.08	.39	.20	.85						
Sweden										
Intercept	−.37	.38	−.97	.33	1.34	1.16	.17	.41	.03	.28
Condition	−.81	.53	−1.53	.13						
Suffix decomp *−ion*										
Romania										
Intercept	.71	.48	1.46	.14	2.14	1.46	.04	.19	.03	.37
Condition	−.82	.65	−1.26	.21						
Sweden										
Intercept	−1.26	.61	−2.05	.04	<.01	<.01	.88	.94	<.01	.15
Condition	.10	.38	.27	.78						
Suffix decomp *-ment*										
Romania										
Intercept	1.38	.50	2.75	<.01	1.77	1.33	<.01	<.01	.04	.32
Condition	−1.02	.65	−1.58	.12						
Sweden										
Intercept	.54	.30	1.82	.07	.59	.77	<.01	<.01	<.01	.12
Condition	.03	.43	.06	.95						

*decomp = decomposition, par = participant, R^2m = R^2marginal, R^2c = R^2conditional

Results for the Non-word Derivational Suffix Choice Task (RQ1)

To address research question 1, we ran another series of binomial mixed-effects models. In each model, the fixed effects were time, condition, and their interaction; the random effects were participant and item; and the dependent variable was participants' *-ion* or *-ment* scores

TABLE 6
Descriptive Statistics for the Non-word Derivational Suffix Choice Task

	-ion				*-ment*			
			95% CI				95% CI	
	M	*SD*	*Lower*	*Upper*	*M*	*SD*	*Lower*	*Upper*
Romania								
+Highlight (N = 20)								
Pre-test	1.60	1.05	1.15	2.00	1.00	.65	.75	1.25
Post-test	1.60	.82	1.25	1.95	1.80	.89	1.40	2.20
–Highlight (N = 20)								
Pre-test	1.20	.77	.85	1.50	.95	.89	.60	1.35
Post-test	1.90	.55	1.65	2.15	2.00	.92	1.60	2.40
Sweden								
+Highlight (N = 24)								
Pre-test	1.21	.93	.83	1.58	.88	1.03	.50	1.29
Post-test	1.63	1.01	1.25	2.04	1.13	.99	.71	1.50
–Highlight (N = 27)								
Pre-test	1.48	.58	1.26	1.70	1.30	.99	.89	1.63
Post-test	1.22	.80	.93	1.56	1.26	.76	.96	1.56

Maximum score: 3 points

on the non-word derivational suffix choice task. Our predictor of interest was the time-by-condition interaction, as a significant interaction would mean that participants had achieved differential gains depending on whether they read highlighted or non-highlighted texts.

Table 6 provides the descriptive statistics for the non-word derivational suffix choice task, and Table 7 summarizes the results of the mixed-effects analyses. As shown in Table 7, the mixed-effects analyses yielded a significant time-by-condition interaction for the Swedish participants' scores on the *-ion* items. As illustrated in Figure 2, the +highlight group showed small gains from the pre-test to the post-test, whereas the −highlight group displayed a small decline. The rest of the analyses generated no effects for highlighting. Overall, these results indicate that highlighting helped develop the Swedish participants' ability to recognize the grammatical information encoded by the *-ion* morpheme. However, we found no evidence that highlighting affected the Swedish participants' ability to recognize the *-ment* morpheme or the Romanian participants' ability to recognize either the *-ion* or *-ment* morpheme.

Results for the Non-word Derivational Suffix Decomposition Task

To address research question 2, we carried out a last series of binomial mixed-effects analyses. Again, time, condition, and their

TABLE 7

Logistic Mixed-effects Results Comparing the +Highlight and −Highlight Groups' Pre-test–Post-test Performance on the Non-Word Derivational Suffix Choice Task

	Fixed effects				Random effects					
					by par		*by item*			
	Est	*SE*	*Z*	*p*	*var*	*SD*	*var*	*SD*	R^2m	R^2c
-ion										
Romania										
Intercept	−1.46	.65	−2.24	.03	<.01	<.01	.31	.56	.03	.10
Condition	1.44	.86	1.68	.09						
Time	1.02	.39	2.62	.01						
Con*Time	−.92	.55	−1.68	.09						
Sweden										
Intercept	.34	.64	0.52	.60	.29	.54	.64	.80	.02	.20
Condition	−1.50	.82	−1.84	.07						
Time	−.39	.35	−1.13	.26						
Con*Time	1.07	.51	2.10	.04						
-ment										
Romania										
Intercept	−2.47	.70	−3.54	<.01	.32	.57	.15	.39	.11	.20
Condition	.34	.93	.37	.71						
Time	1.62	.42	3.83	<.01						
Con*Time	−.31	.58	−.54	.59						
Sweden										
Intercept	−.24	.53	−.46	.65	.30	.54	<.01	.08	.01	.08
Condition	−1.12	.80	−1.39	.16						
Time	−.05	.33	−.16	.88						
Con*Time	.45	.49	.92	.36						

*par = participant, con = condition, R^2m = R^2 marginal, R^2c = R^2 conditional

interaction served as the fixed effects; participant and item were the random effects; and participants' *-ion* or *-ment* scores on the non-word derivational decomposition task served as the dependent variable. The descriptive statistics for the decomposition task are given in Table 8, and the results of the mixed-effects models are presented in Table 9. As shown in Table 9, none of the mixed-effects analyses yielded a significant interaction between time and condition. This means that we found no evidence that highlighting facilitated development in the Romanian or Swedish participants' ability to recognize the targeted morphological structures, that is, the relationship between the base and nouns derived with the *-ion* or *-ment* morpheme.

DISCUSSION

This study aimed to explore the effects of textual enhancement over multiple exposures on development in the ability to recognize derivational morphology by child L2 learners. In particular, our research

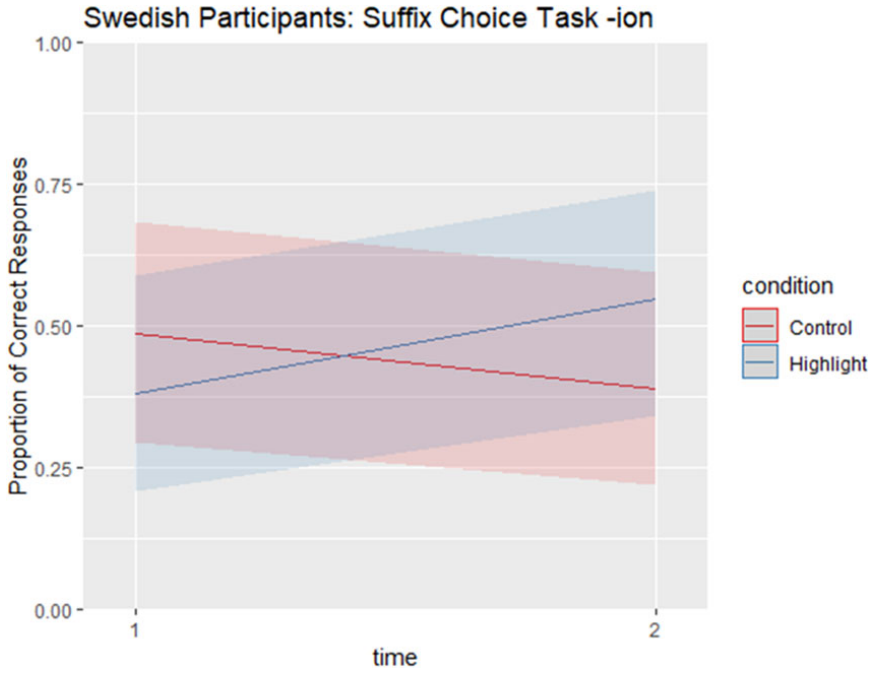

FIGURE 2. Swedish participants' performance on the non-word derivational suffix choice task

questions asked the extent to which highlighting would lead to increased ability to recognize the syntactic category indicated by the *-ion* and *-ment* derivational morphemes and resulted in increased ability to recognize the morphological structure of nouns including these morphemes. Our results revealed a small advantage for highlighting among Swedish learners. While the +highlight group displayed pre-test–post-test gains in their ability to recognize the grammatical information marked by the *-ion* morpheme, the −highlight group showed a small loss. The rest of the analyses generated no significant effects. Overall, these results indicate that highlighting helped develop the Swedish participants' ability to recognize the syntactic information encoded by the *-ion* morpheme. However, we found no evidence that highlighting affected either the Romanian or Swedish participants' ability to recognize the syntactic category associated with the *-ment* morpheme or their ability to recognize the morphological structure of words including the *-ion* or *-ment* morpheme. Importantly, the presence versus absence of highlighting did not affect comprehension scores.

Given that we found positive effects of textual enhancement for only one out of the eight comparisons we made, these results, overall, seem more aligned with those of previous studies that yielded null findings

TABLE 8
Descriptive Statistics for Performance on the Non-word Derivational Suffix Decomposition Task

	-ion				*-ment*			
			95% CI				95% CI	
	M	*SD*	*Lower*	*Upper*	*M*	*SD*	*Lower*	*Upper*
Romania								
+Highlight (N = 20)								
Pre-test	1.45	1.00	1.00	1.90	1.70	1.08	1.25	2.15
Post-test	1.70	1.03	1.30	2.10	2.15	1.09	1.65	2.60
–Highlight (N = 20)								
Pre-test	1.85	1.23	1.30	2.35	2.20	1.01	1.75	2.60
Post-test	2.35	.81	2.00	2.70	2.45	0.94	2.05	2.80
Sweden								
+Highlight (N = 24)								
Pre-test	.83	.92	.50	1.21	1.83	1.09	1.38	2.29
Post-test	.79	.98	.38	1.21	1.67	1.17	1.21	2.08
–Highlight (N = 27)								
Pre-test	.78	.80	.48	1.07	1.93	1.17	1.48	2.33
Post-test	1.00	.88	.67	1.33	2.22	0.93	1.85	2.59

Maximum score: 3 points

for textual enhancement. A possible explanation for the lack of more substantial development might be that, although participants were exposed to the target linguistic features on multiple occasions, the length of the treatment was still relatively short (3 hours altogether). An even longer treatment might have been necessary for textual enhancement to yield more positive results, given that implicit exposure to target features is expected to take longer to generate benefits than explicit interventions (e.g., Long, 2007; Mackey & Goo, 2007).

The nature of the linguistic targets may be another factor that might account for the lack of convincing evidence in favour of textual enhancement. Assuming that textual enhancement succeeded in drawing learners' attention to the target morphemes, the findings of this study do not appear to provide robust evidence that enhancement also led to deeper and further processing (Leow, 2015), subsequently resulting in increased knowledge of the morphemes. Given the non-salient nature of morphology constituting a relatively weak cue in sentence processing in the English language (MacWhinney, Bates, & Kliegl, 1984), more explicit instructional interventions such as strategy instruction (Morin, 2003, 2006), pushed output (Friedline, 2011), and input processing (Friedline, 2011) may be more effective in making L2 learners process these forms more robustly.

Although the findings, in general, provide little support for the effectiveness of textual enhancement in promoting L2 morphological

TABLE 9

Logistic Mixed-effects Results Comparing the +Highlight and −Highlight Groups' Pre-test–Post-test Performance on the Non-Word Derivational Suffix Decomposition Task

	Fixed effects				Random effects					
					by par		*by item*			
	Est	*SE*	*z*	*P*	*var*	*SD*	*var*	*SD*	R^2m	R^2c
-ion										
Romania										
Intercept	−.45	.85	−.53	.59	1.49	1.22	.41	.64	.07	.36
Condition	−.10	1.05	−.09	.93						
Time	1.11	.48	2.31	.02						
Con*Time	−.66	.63	−1.04	.30						
Sweden										
Intercept	−1.58	.73	−2.16	.03	<.01	<.01	.58	.76	<.01	.11
Condition	.57	.84	.67	.50						
Time	.39	.36	1.08	.28						
Con*Time	−.47	.53	−.88	.38						
-ment										
Romania										
Intercept	.77	.86	.89	.37	2.08	1.44	<.01	<.01	.05	.34
Condition	−1.34	1.16	−1.15	.25						
Time	.65	.52	1.26	.21						
Con*Time	.27	.69	.39	.70						
Sweden										
Intercept	.12	.58	.20	.84	.11	.33	.08	.27	.02	.06
Condition	.62	.80	.77	.44						
Time	.49	.36	1.36	.17						
Con*Time	−.75	.52	−1.45	.15						

*par = participant, con = condition, R^2m = R^2marginal, R^2c = R^2conditional

knowledge, it is worth discussing why highlighting might have benefited, albeit to a small degree, the Swedish but not the Romanian participants. One reason why Romanian participants might have gained less from exposure to textual enhancement may have to do with their L1. Romanian, being a Romance language, has richer morphology than Swedish, which might have made the Romanian learners more likely to generate internal attention (Chun et al., 2011) to morphological features on their own (Jarvis & Odlin, 2000; Park, 2011). This, in turn, might have caused any impact of textual enhancement, a technique that is expected to promote external attention, more negligible. Alternatively or additionally, the instructional approach adopted in the Romanian context might have made the Romanian participants more prone to paying internal attention to the target morphological features. The teaching received by Romanian participants was more form-oriented as compared to that experienced by their Swedish counterparts, which might have induced more internal attention to the morphemes by the Romanian learners.

Another question to address is why the positive effects of textual enhancement on the Swedish learners' ability to recognize the *-ion* morpheme were observed on the suffix choice task but not the suffix decomposition task. The principle of transfer-appropriate processing may help account for this finding. According to this principle, learning is more likely to succeed 'if the cognitive processes that are active during learning are similar to those that are active during retrieval' (Lightbown, 2008, p. 27). Following this view, any morphological knowledge that participants had accrued during the treatment might have been easier to apply during the suffix choice task, as it prompted learners to engage in processes more similar to the ones in which they were involved during the treatment. In the suffix choice task, participants had to process the syntax of sentences to identify the syntactic category of missing constituents. Similarly, participants also had to engage in syntactic processing of sentences to comprehend texts during the treatment. The suffix decomposition task, on the other hand, was more decontextualized, requiring learners to identify the base of derived forms out of context, an activity which bore less resemblance to the treatment.

It is also worthwhile to consider why highlighting did not lead to development in the Swedish learners' use of the *-ment* morpheme on the derivational suffix choice task. A possible reason may be that participants had lower average pre-test scores for the *-ment* morpheme. Some researchers have argued that low prior knowledge might make it less likely that textual enhancement leads to development in grammatical knowledge (Park, 2004; Winke, 2013).

LIMITATIONS AND DIRECTIONS FOR FURTHER RESEARCH

There are some limitations to the current study that need to be acknowledged and considered in further research. One weakness concerns the fact that the treatment targeted two derivational suffixes rather than a single feature. While this decreased the likelihood that the learners would overgeneralize either of the target morphemes, it might have made it more challenging for them to create the target form-function mappings. The study would also have benefited from the inclusion of a delayed post-test to assess the longer-term effects of the treatment. The delayed post-test results, however, would have been unlikely to generate trustworthy findings, as the period between the post-test and delayed post-test would have included school breaks, increasing the possibility that any effects of outside exposure confound

the findings. A further test-related weakness of the current research is that, due to the constrained time slots we had in the schools each week, we had to limit the length of the tests, resulting in a relatively small number of target items. The multiple-choice format of the suffix choice derivational task also had the inherent limitation of students having a 25% chance of answering the questions correctly. The study would additionally have benefited from larger group sample sizes. Another limitation of the study is that we collected no process data through techniques such as eye-tracking and think-aloud protocols. Although this enabled us to conduct a more ecologically valid experiment, our research cannot offer direct insights into attentional processes. In future research, it would be worthwhile to examine the effects of multiple-exposure textual enhancement on attentional allocation. A further limitation is that we focused on a limited number of derivational morphemes and aspects of derivational morphology knowledge. Future studies could explore the effects of textual enhancement on other morphological features and types of derivational knowledge such as the relational and distributional properties of derivational morphemes (Tyler & Nagy, 1989). It would also be interesting to examine whether having more frequent sessions over a shorter period would lead to more learning, as compared to the weekly treatments in the present study. Replications of the present study are also needed, involving different proficiency levels, adult learners, and participants from different L1 backgrounds (e.g., learners with typologically more distant languages).

CONCLUSIONS AND PEDAGOGICAL IMPLICATIONS

The current study aimed to investigate the effects of textual enhancement in the form of highlighting using the Amigo Reader application. Little previous research had examined the impact of applying textual enhancement on multiple occasions, included child L2 populations, and investigated whether textual enhancement can promote L2 knowledge in derivational morphology. Thus, we focused on child learners and the acquisition of derivational morphology through adopting a 6-week multiple-exposure design. Another methodological strength of our research was that it constituted a multi-site experiment, with the same study design followed in two different EFL contexts (Romania, Sweden).

We found an advantage for highlighting for only one of the target morphemes (*-ion*) on one of the assessment tasks by the Swedish children. Highlighting did not seem to benefit the Romanian participants, and did not generate development in the ability to recognize the

other target morpheme (*-ment*). Taken together, our results imply that textual enhancement may promote the knowledge of some derivational morphemes for certain L2 learners, but, even if used repeatedly, it may not be an effective pedagogical tool to promote knowledge of all aspects of L2 derivational morphology for all types of learner groups. Our findings suggest that factors that may influence the efficacy of textual enhancement include participants' L1 background, prior knowledge of the target morpheme, and reading ability. Before drawing more concrete pedagogical implications, however, future research is needed to establish the exact influence of these factors.

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THE AUTHORS

Andrea Révész is a Professor of Second Language Acquisition at the UCL Institute of Education, University College London. Her research interests include the roles of task, input, and individual differences in SLA. Currently, she is also involved in projects investigating the cognitive processes underlying L2 use and learning.

Leona Bunting is a PhD student in Applied Information Technology at the University of Gothenburg. Her research interests include what happens when out-of-school content and resources are brought into the L2 classroom. Currently, she is also involved in research regarding teachers' appropriation of an Artificial Intelligence tool for reading.

Adrian Florea is a Professor of Computer Science at Lucian Blaga University, Sibiu. For more than 20 years, he has worked on interdisciplinary research projects investigating optimization problems in different engineering domains, creating digital tools and training materials for supporting communities of practice, working on mobile computing.

Roger Gilabert is currently an Associate Professor and Researcher at the University of Barcelona. His research interests include second and foreign language production and acquisition, task-based needs analysis, task design and task complexity, individual differences and L2 production and acquisition, multimedia learning, and game-based learning and SLA.

Ylva Hård af Segerstad is an Associate Professor of Applied Information Technology at the University of Gothenburg. Her primary research interests are aspects of text-based interaction in digital communication technologies. Her current

research focuses on the role and use of digital communication technologies and social media.

Ioan P. Mihu is a Professor at Lucian Blaga University, Sibiu. Ioan has many years of experience in teaching electronics and digital signal processing. He has a long-term interest in developing methods and technologies which make the process of learning more accessible to disadvantaged learners.

Cliff Parry is the Academic Manager at British Council Greece. He is interested in the whole-child approach to teaching of English as a Foreign Language to young learners. As well as developing educational programmes for international organizations, he has presented work on innovative language models at a number of conferences.

Laura Benton is a Research Associate at the UCL Knowledge Lab within the UCL Institute of Education. Her research focuses on education technology design for children. She is currently a researcher on the EU-funded iRead project.

Asimina Vasalou is an Associate Professor and Researcher at the UCL Knowledge Lab within the UCL Institute of Education. Her research focuses on interaction design for children's learning, methods for involving people in the design process, and designing for disability.

ETHICAL APPROVAL

Full ethical approval for REC 1201 iRead Data protection registration number: Z6364106/2019/03/91 social research.

CONTRIBUTION AND FUNDING STATEMENT

Andrea Révész designed and coordinated the study, and wrote the article. Leona Bunting, Adrian Florea, Ylva Hård af Segerstad, and Ioan P. Mihu helped conduct the experiments. Roger Gilabert, Cliff Parry, and Laura Benton assisted with piloting and developing the instruments. Asimina Vasalou is the coordinator of the EU Horizon 2020 project (No731724), as part of which the study was conducted.

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APPENDIX

Sample comprehension questions

1. What would be a good title for the text?
2. What is the best way to prevent bridge accidents?
3. Are wooden or steel bridges safer?
4. Why do many accidents happen while building bridges?
5. Can engineers protect bridges from earthquakes?
6. What is the problem with using poor quality materials?