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Impact of Supra-segmental Features on Reading Comprehension in First and Second Language: A Comparative Study of Iranian EFL learners

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Abstract

Supra-segmental features refer to various forms of intonation and how words and sentences are uttered. Such features challenge meaning and comprehension, too. Despite the importance of these features and their reported association with phonological awareness and linguistic comprehension, their effects on reading comprehension have not been explored. The current work investigated the impact of a remedial program on Persian and English reading comprehension of a group of English language learners (N=30 divided into experimental and control groups). The measurements tested the components of reading comprehension based on the Simple View of Reading (SVR). Additionally, supra-segmental features were assessed by Profiling Elements of Prosody (i.e., supra-segmentals) in Speech-communication (PEPS) in both languages. As a result, English and Persian elision and also Persian listening were affected by teaching supra-segmental features. Assessing the transfer of linguistic skills revealed that Persian listening and knowledge of supra-segmentals, in particular, recognizing short syllables and awareness of stress position in a sentence, contribute to English reading comprehension. It indicates that reading and listening comprehension are affected by similar cognitive processes that may lay in the knowledge of supra-segmentals. The findings also suggest that simpler systems of supra-segmentals are more likely to transfer. Pertinent pedagogical implications were presented, as well.

Keywords: *Supra-Segmentals, Intonation, Reading Comprehension, Cross-Linguistic Transfer*

Introduction

Reading comprehension has been reported as a challenging task for both first and second language readers (Ma, Jurczyk & Choi, 2018; Sadeghi, Everatt, McNeill & Rezaei, 2014; Perfetti

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& Liu, 2005). The task involves a range of mental activities in which the reader processes the conveyed information in the text by decoding words into a form that can be recognized by the reading system and can lead to retrieving the meaning of individual words, phrases, sentences, and the whole text. All these would be done through accessing stored information (vocabulary), previous experience/knowledge about the topic of the text, and making inferences about the intended meaning of the writer (McNamara, 2007). The former decoding processes may need to be relatively specific to reading, but the latter understanding processes may have much in common with the comprehension of verbal discourse (linguistic comprehension).

Several models have been proposed to explain how reading comprehension is processed. Among these models, the Simple View of Reading (SVR) (Gough & Tunmer, 1986; Hoover & Gough, 1990; Tunmer & Chapman, 2012) is one of the most cited, mainly due to the relative simplicity that makes it applicable across a range of language contexts. This model highlights the importance of the two components mentioned above: decoding and linguistic comprehension.

According to the SVR, once written words are decoded, processes involved in linguistic comprehension determine the message written in the text. This simple view, therefore, highlights the central role of decoding in the process of reading: not being able to decode words leads to reading disability (Gough & Tunmer, 1986; Hoover & Gough, 1990). In the redux of the SVR, which was an attempt to examine the relationship between decoding and linguistic comprehension, it was suggested that decoding and linguistic comprehension do not contribute to reading comprehension independently since vocabulary knowledge, proposed as a subcomponent of linguistic skills, explains variations of decoding (Tunmer & Chapman, 2012). Research has reported knowledge of letter-sound correspondences, phonological awareness, and morphological awareness as components of decoding (Deacon, Kieffer & Laroche, 2014; Sadeghi, Everatt & McNeil, 2016). Listening comprehension, vocabulary, and syntax knowledge, as component skills of linguistic comprehension, were also reported to have some influence on decoding(Diakidoy, Stylianou, Karefillidou & Papageorgiou, 2005; Erton, 2018).

However, knowledge of suprasegmentals has not yet fully explored, in particular among bilingual speakers, despite the reported relationship between reading comprehension and knowledge of suprasegmental features (Calet, Pérez-Morenilla & De los Santos-Roig, 2019; Rahmawati, Rosmalina, & Anggraini, 2020; Ravid & Mashraki, 2007). Suprasegmentals comprise groups of vowels and consonants within a language. Given that suprasegmental features can be applied to different units of language, ranging from phonemes and syllables to words, phrases and even sentences (Richard & Schmidth, 2011), it is worth examining whether these features contribute to reading comprehension through decoding or linguistic comprehension; the two components of the simple view of reading.

Another critique of the SVR targets the universality of the model. Although the SVR has been suggested as appropriate for a range of orthographies (Florit & Cain, 2011), Share (2008) has referred to it and most other models based on studies of English, as an anglocentric approach in reading research. For instance, Lurchin, Arciuli, and Sharma (2015) assessed the relationship between supra-segmental (prosody) features and reading comprehension in English. They

suggested that phonological awareness is the strongest predictor of reading comprehension and then introduced knowledge of supra-segmental features with the potentials to explain variations of reading comprehension. They believed that when readers are aware of changes that intonation and stress impose on meaning, they can interpret the underlying idea of a text much easier. However, such a relationship might be due to the complex system of supra-segmental features in English.

Such Anglocentrism suggests a need to verify reading models and examine the relationships between reading comprehension and the relevant cognitive-linguistic skills in different languages and scripts. In one attempt, Ravid and Mashraki (2007) investigated the relationship between knowledge of supra-segmentals and reading comprehension. They confirmed a positive relationship between the two constructs in Hebrew, but interestingly they found that it is morphological awareness which moderates this association. Since Hebrew is a language with stress and emphasis on syllables rather than phonemes (Most & Peled, 2007), morphological understanding that comprises knowledge of segments within a word and encompasses semantics and syntax seems responsible for improving both reading comprehension and knowledge of supra-segmentals. Therefore, it can be stated that a more complex system of knowledge, which comprises several simpler structures, may moderate the contribution of smaller systems to reading comprehension (Ravid & Mashraki, 2007; Wood, Wade-Woolley, & Holliman, 2009; Chan, Wade-Woolley, Heggie, & Kirby, 2019).

In another attempt, Richards and Schmidt (2010) proposed that there is a positive relationship between reading comprehension and supra-segmental features in the Cantonese language. However, they believed that among several features of supra-segmentals (e.g., stress on phonemes, words, phrases, and sentence stress), just lexical stress is determining and creates such a relationship. The reason for their finding is the tonic nature of Cantonese. They believed that this feature has caused lexical tone sensitivity among Cantonese language users and, thus, mediated the relationship between reading comprehension and supra-segmentals (Choi, Tong & Cain, 2016). Therefore, it can be suggested that the inherent features of languages can cause variations in how supra-segmental features contribute to reading comprehension. Depending on the complexity of supra-segmental features, and whether intonation and stress affect phonemes, words, phrases, or sentences within a language, the degree of contribution of supra-segmental features to reading comprehension varies. Additionally, depending on inherent supra-segmental features of different languages, all or just some features establish an association with reading comprehension. All these issues call for the need to investigate further such a relationship in different linguistic settings to cast more light on how these two constructs are linked to each other and, depending on the complexity of the supra-segmental system, how supra-segmental features may exert influence on the development of reading comprehension.

Additionally, a positive association between knowledge of suprasegmental features and reading comprehension has been reported by Calet et al. (2019) and Rahmawati et al. (2020) among Spanish and Indonesian English language learners respectively. Rahmawati et al. (2020) asserted that among many features of suprasegmental knowledge, the pace of reading and

intonation are associated with reading comprehension. They believed lack of ELLs' familiarity with sentence structure could be accounted for as a reason for such a relationship. However, Calet et al. (2019) did not address the components of suprasegmental features to check whether all features can be accounted for as reasons for such a relationship or not. Moreover, in both studies, there is room for further examination to check if the influence of their first language causes such a relationship or not. It has been argued that suprasegmental features of one's first language may cause some cognitive skills to be stronger than the others (Watson & Hajek, 2003). Therefore, in addition to the inherent features of a language, the first language can be examined to address the cross-linguistic transfer of skills. In the case of second language learners, it is worth investigating whether the cross-linguistic transfer can be accounted for the relationship between knowledge of suprasegmental features and reading comprehension.

In addition to the need for examining the relationship between reading comprehension and supra-segmental features, it is worth investigating whether knowledge of supra-segmentals contributes to reading comprehension through decoding or linguistic comprehension. To this end, it is needed to define supra-segmental features. Supra-segmental features comprise vowels and consonants of a language (Richard & Schmidth, 2011), and involve more than single vowels and consonants (Ladefoged & Jonson, 1976). It has been argued that supra-segmental features refer to pitch, stress or loudness, duration, and pausing, which are applied to phonemes, words, phrases, or sentences (Richard & Schmidth, 2010). These features entail variation in articulating units of language, which cause variations to mean. Differences in how language units are articulated change the meaning through highness, lowness, short stops, and a strong pattern of sounds (Richard & Schmidth, 2011).

Given the general definition of supra-segmental features and their multidimensional nature, it is worth elaborating on their system and components in detail in languages under study here (i.e., Persian and English).

Supra-segmental Features in Persian

Haghshenas (2014) stated that the components of supra-segmental features in Persian comprise several elements, including stress, pitch (i.e., intonation), and that each of these features includes its categories and functions. Word-stress pattern is generally predictable, falling on the last syllable in nouns and adjectives, whether long or short. The stressed syllables in Persian verbs shift in accordance with tense, mood, and sometimes person (Comrie, 1990; Levy, 1951; Mahootian, 1997). Thus, although Persian is not a tonic language, in Persian, which is pronounced as written when spoken formally, stress is generally predictable (Mahootian, 1997). Additionally, Persian has a limited range of syllable types, only six types, which do not allow a wide range of patterns for combinations of vowels and consonants (Keshavarz, 2017).

As the second element, pitch with its two main functions can be discussed. Tone and intonation are two major functions of the pitch. When a word is articulated with higher or lower frequency (i.e., the number of times at which a sound moves up and down), the tone is functioning, and when it happens to a sentence-level, intonation is functioning. Different tones

and intonations lead to various meanings, with falling ones indicating declarative statements and rising ones indicating interrogative statements. Therefore, it can be discussed that variations in the pitch (i.e., tone and intonation) affect the meaning which is to be interpreted (Haghshenas, 2014).

Rhythm, as the third feature, refers to the amount and duration of time for producing a combination of phonemic units. It means that similar phonetic units share the same rhythmic pattern in Persian. Since stress pattern is not complex and is not applied to all words, every syllable within the word can receive the rhythm only if a similar phonetic unit is in the neighborhood. Therefore, Persian rhythm is syllabic (Moghaddam Kia, 2006).

Supra-segmental Features in English

To discuss the system of supra-segmental features in English, Ashby (2012) proposed that these features are composed of several elements, including stress, rhythm, accent, tone, and intonation. According to this categorization of elements, stress refers to syllables that stand out from others in a word and are uttered more powerfully; it can appear on the first, middle, or final syllable of a single word (Fudge, 1984; Rahmawati et al., 2020). Changing the stressed syllable of a word cause changes in its part of speech and, consequently its meaning (Calet et al., 2019; Jufri, 2019). As an instance, when the word 'content' is pronounced with a stress on its first syllable, the word is a noun, while when the stress is put on the second syllable its part of speech changes to an adjective. There are many such cases in the English language with its complex system of the syllabic pattern. There are 18 syllable patterns in English which allow a wide range of combinations for vowels and consonants (Keshavarz, 2017)

Rhythm as another element of this system indicates the rhythmic nature of the English language in which emphasis is added to particular segments (i.e., stressed syllables) of the utterance and facilitates expressing emotions and feelings. As a result, rhythm in English is applied to the stressed syllable (Carr, 1953). For instance, looking at convict or convict, the word is a noun when the first syllable is stressed, while when the second syllable is stressed, it could be used as a verb. Rhythm refers to the time span that rhythmic (having a regular pattern of sounds) units articulate (Haghshenas, 2014). Therefore, it can be seen that linguistic units are involved with more than one element of supra-segmentals in English. In addition, when there is an accent, special syllables receive more emphasis to highlight the ethnicity or the identity of the one who produces language, whether spoken or written. This feature acts as an extra element with which a single linguistic unit might be involved. Carr (1953) and Ashby (2012) believed that accent is a type of stress, which is defined as "greater emphasis on a syllable so that it stands out from other syllables in a word" (Richards & Schmidt, 2010, p. 3).

Tone and intonation, the other elements of supra-segmentals, highlight the lexical use of pitch to distinguish different meanings with the potentials to change the declarative statement to an interrogative one. This feature is not limited to syllable levels, and its effects are extended to word, phrase, and sentence level. When the frequency of articulation varies within the segments of a word, the tone is discussed. When the frequency changes within the segments of a phrase

and sentence, intonation is targeted (Lehiste, 1970). For example, in a sentence, 'anyone likes coffee' meaning can be easily affected by variations in articulating the word 'coffee.' The rising tone would lead to a change in intonation and causes the sentence to be perceived as an interrogative one while the falling tone, and then intonation would change the statement to a declarative one. (Álvarez-Cañizo, Martínez-García, Cuetos & Suárez-Coalla, 2019; Ashby, 2012; Lehiste, 1970). In the mentioned example, it is clear that how making a change in the tone of a word leads to variations in the intonation of a sentence and, consequently, in the meaning that can be interpreted.

Comparing the supra-segmental system in Persian and English reveals that these two languages own similar elements, but the degree of complexity of elements varies (Jenkins, 1998; Stadelmann, Glinski-Haefeli, Gerber & Dürr, 2018). Stress and syllable patterns in Persian are much simpler and predictable that can be easily learned and internalized for their learners. On the other hand, English has a more complex pattern of syllables, which is triple of Persian and more significant stress pattern, which is determining in part of speech of a word and thus the meaning (Fudge, 1984; Keshavarz, 2017). When it comes to rhythm, these two languages differ in terms of a unit that receives the rhythm. Recognizing the rhythmic unit in English depends on recognizing the stressed syllable, while in Persian, when there are similarly pronounced syllables, rhythm has been taken care of (Carr, 1953; Haghshenas, 2014). The only element which acts similarly in both languages is the pitch, which indicates tone and intonation. These functions of the pitch have the potentials to change declarative statements to interrogative ones and vice versa in both languages(Álvarez-Cañizo et al., 2019).

The Study

Given the scarcity of research conducted on supra-segmental features concerning reading comprehension, this paper is to investigate whether supra-segmental features are in direct association with reading comprehension, whether they exert influence on reading comprehension directly or through the component skills. Additionally, the present project is an attempt to investigate such a relationship and impact in the first language and second language and to examine linguistic transfer as well. To this end, the following research questions were formulated:

- Do supra-segmental features (intonation) affect reading comprehension in Persian as a first & English as a second language?
- Do supra-segmental features (intonation) transfer from Persian to English reading comprehension?

Participants

To the end of this study, participants who were native speakers of Persian were recruited, screened through English proficiency test, and were confirmed to be at the intermediate level of English proficiency. They were then assigned to the experimental and control groups randomly. The results of the t-test proved that the two groups were not significantly different from each

other in terms of English proficiency ($p > .05$). Table 1 demonstrates information about the participants.

Table 1.
Participants

Participants		Control group	Experimental group	Total
Pretest		15	15	30
Posttest		10	15	25
Gender	Female	11	8	19
	Male	4	7	11
Mean age		15.64	13.65	14.64
Age range in year		13-19.03	11.9-16.07	11.09-19.03

Remedial Program

The program included 12 half an hour-sessions in which the most important segments of a word and sentence were emphasized and taught in Persian. In the very first session of the intervention program, participants in the experimental group were to share their understanding of stress and pitch even in their first language. They were to make examples to have their understanding checked. Then the instructor explained the function of stress and pitch along with several examples from routine life to clarify how changing the stress and emphasis within a word or sentence could affect meaning. For example, the sentence: man+ ‘zur’ daram /mæn zuːr dɑræm/, meaning I am strong, or man’zur + daram /mænzuːr dɑræm/, meaning I mean in Persian(Haghshenas, 2014). In English, learners needed to pay attention if the sentence contained a single compound noun or two separate words like the sentence “I saw a **‘bluebird** today” or the other one “I saw a **blue ‘bird** today”. Two meanings can be inferred from these sentences, and it depends on intonation (i.e., rising or falling), pause or stress of a word which causes ambiguity in the utterances, and readers need to recognize them properly to comprehend the statement.

Then in the following sessions, the participants were first taught how to employ pitch to produce and understand declarative and interrogative utterances. Declarative and interrogative intonations were taught, and participants learned how to change the meaning of a statement that does not have any punctuation. For example, using rising pitch in articulating the sentence “Hasan raft” /hæsæn ræft/, meaning Hasan went indicates that it is a question; on the contrary, using a falling intonation indicates a declarative statement. For example, the word “fish” with rising intonation indicates that somebody wonders if his listener wants fish, and when the other side of the conversation responds with falling intonation and says “fish”, it is declarative tone, and it indicates that that yes, he wants fish. Additionally, participants were taught how to express their feelings by changing their tone and intonation—for instance, using a rising and happy tone to express the happiness of having your favorite meal for dinner like pizza. They also learned to use pause as a tool to convey what they want to say and direct their audience interpretation. For example, they learned that ‘chocolate ice-cream’ without a pause is a kind of ice-cream with

chocolate flavor, but when there is a pause between these two words, each can indicate a different kind of item; chocolate and ice-cream. Finally, contrastive stress as one of the components of intonation has been taught. Here students learned how emphasizing a word within a sentence can affect the intended meaning; it is when the frequency varies. For example, when one says, "I want the **white** bag" and pronounces "white" louder than other words, he indicates that the color matters to him.

In all sessions of the remedial program, each participant uttered several examples, and the other participants were to express their interpretations to see whether they perceived the intended meanings. When all participants expressed what they understood, the one who made the sentence was to explain their intention, which was then checked by the instructor if they used supra-segmental features (i.e., pause, tone, and intonation) properly.

Pre- and Posttest Measures

Participants in both the experimental and control groups were tested before and after the 12-session remedial program. Pre- and posttest batteries in Persian and English were parallel tests, including the same components. The measures are briefly explained in the subsequent sections.

Phoneme Segmentation

The Phoneme Segmentationsubtest of the Comprehensive Test of Phonological Processing (CTOPP) (Wagner, Torgesen, Rashotte & Pearson, 1999) was used to assess the ability to segment a word to its constituent phonemes. There were 15 items in this test, which was administered individually. Each item involved the examiner saying a word to the participant, who was then required to say the number of phonemes. For example, 'pig' which has three phonemes. Participants were rewarded one score for correct answers and zero for incorrect answers. The test was stopped if participants missed three items in a row. The segmentation test in Persian was developed and modeled from the English version and followed the same process of testing and scoring. For instance, the word 'کاغذ', /k*a:gæz*/ which means paper, was uttered, and the participants were to say the number of the phonemes it includes. Although four graphemes represent the word, it has five phonemes. This measure showed a reasonable level of reliability (α=.67).

Phoneme Elision

The phoneme Elision subtest of the Comprehensive Test of Phonological Processing (CTOPP) (Wagner, Torgesen, Rashotte & Pearson, 1999) was used to assess the ability to recognize sounds within English words. The measure was administered individually to the participants. In this task, the examiner uttered a word and then asked the participants to repeat the word, but without one of the sounds in the word. For example, saying the word 'tan' without /t/, the participants were expected to say /an/. The number of the correct responses, out of a total of 17 items, was the score used for this test. A Persian version of this measure was also developed with 15 items and followed the same procedure of testing and scoring. An example in Persian is the

word /طلا/ which is pronounced /tælɑ:/meaning gold. In this case, the participants were asked to delete /a:/ and were expected to say /tæl/. The measure showed a reasonable level of reliability (α=.64). In both measures (English and Persian), the sound to be deleted as of a single phoneme and occurred in any position (i.e., initial, mid, or end) in the word.

Vocabulary

The Vocabulary Size Test, developed by Nation and Beglar (2007), contained 100 items that covered the 10000 frequent English words in ten levels beginning from the first 1000 frequent words comprising ten items for each level. The difficulty of the test items increased towards the end of the test. The Vocabulary Size Test, which measures words known rather than words learned, uses a stem plus a 4-choice multiple-choice format. The item stem consists of the word followed by a very simple non-defining sentence containing the word. The non-defining sentence has the roles of indicating the part of speech of the word, limiting the meaning of the word, and slightly cueing the meaning by presenting an example of the word in use. Participants were rewarded for each correct answer, and there was no penalty for incorrect replies. The Persian version of the vocabulary test was modeled on the English test, comprising 40 items and following the same procedure of testing and scoring. The difficulty of the test items increased as the individual progressed through the test. The measure provided good evidence for its reliability (α=.82).

Listening Comprehension

The Listening Comprehension measure comprised six passages with a total number of 24 questions. Each passage was followed by a different number of yes/no questions, ranging from three to six. The length and difficulty of passages increased throughout the test. Participants were to listen to the passage and then were asked comprehension questions about the content and then were required to choose yes or no to provide the answer for questions. Participants were not given extended time to check their answers and were rewarded for each correct answer with no penalty for incorrect answers. The measure showed a good level of reliability (α=.82). The Persian version of the listening comprehension test was a modified version of the one developed by Sadeghi et al. (2016). It was similar to the English version in its format and question types but different in some passages and questions. The test comprised five passages, each followed by a different number of questions, ranging from three to seven and a total number of 25 questions. The reliability index of the test proved to be at a good level (α=.87).

Reading Comprehension

The English reading comprehension measure was based on the Neale Analysis of Reading Ability 3rd edition (Neale, 1999), and comprised six passages and a total number of 24 multiple-choice questions. The multiple-choice questions included three distracters, and one correct response and questions were either referential or inferential. The length and difficulty of passages increased throughout the test. Participants were to read the texts silently and answer the

multiple-choice questions on a response sheet to allow group testing and procedural consistency with the Persian measure. For scoring, one point was considered for correct answers and zero for incorrect ones; there was no penalty for wrong responses. The reliability index of the test was at an acceptable level (α=.69). The Persian reading comprehension measure was a modified version of the test developed by Sadeghi et al. (2016) and consisted of five passages, each followed by four multiple-choice questions. The format and procedure of the test were similar to the English measure, and the test showed an acceptable level of reliability (α=.64), too.

Profiling Elements of Prosody (i.e., supra-segmentals) in Speech-communication (PEPS)

Test of PEPS developed by Peppe' (2015) assesses English intonation by covering communicative areas, including short syllables, turn-end, affect, lexical stress, phrasal stress, boundary (chunking), and contrastive (focus). The test evaluates knowledge of all areas of supra-segmentals ranging from recognizing syllables to emphasizing the stressed syllable within a word, phrase, and a sentence. Additionally, all subtests measure both receptive and expressive modes. A detailed explanation to clarify how PEPS works is presented in the subsequent paragraphs.

Since the test comprises a series of pictures for all its subtests, before the test-taking procedure, the participants were made familiar with all items to ensure that vocabulary knowledge could not interfere with obtained results. Then participants were ready to take the test on a one-on-one basis. The test was administered in a quiet room and took an hour for each participant. Each subtest started with two examples and two practice trials followed by 16 items.

The first subtest (i.e., short syllable subtest) assessed whether participants could discriminate similarities and differences between short syllables, which were not expressed clearly. For example, om/ om, which was similar or om/ looi, which were different. In the expressive part of the test, the participants heard a syllable and were to repeat it. The second subtest (i.e., turn end) assessed understanding of declarative and interrogative statements and also the ability to produce them. In this subtest, the participants were to show their knowledge of tone and intonation. For example, they were presented a picture of a peach on the screen of a computer and simultaneously were to listen to a recorded voice, which said 'peach' with a rising tone. Then participants were supposed to recognize whether it is expressed as a question or a simple statement. The third subtest (affect) assessed the ability to recognize feelings from the pitch and also produce statements that demonstrate specific feelings. For example, participants heard the name of the food which was on the screen; then, they were to choose the happy or sad face according to the tone they heard and also produce statements that demonstrate specific feelings according to the happy or sad face beside the items. The fourth subtest (lexical stress) assessed the ability to perceive and produce the place of stress in two-syllable words. For example, the participants were presented with the word 'imprint' with the first syllable made bold and were to express the word with its first syllable stressed, or have seen a word on the screen and heard the pronunciation and were to click on the syllable which was stressed. For instance, the participants heard some phrases or sentences from the computer and were to decide which picture on the

screen matches the heard utterance. The fifth subtest, which was called phrase stress, assessed the ability to distinguish between two-word phrases and compound nouns within an utterance and also produce them properly. For example, a sentence appeared on the screen, and the participants were to read it using stress patterns. They needed to pay attention if the sentence contained a single compound noun or two separate words, like the sentence "**bullseye** is red" or the other one "**bull's eye** is red". The sixth subtest (i.e., boundary) assessed the ability to comprehend syntactically ambiguous phrases that can be disambiguated through a proper pitch. This is the time that tone and intonation can work instead of punctuation. The seventh and the last subtest (i.e., contrastive stress) assessed the ability to recognize and produce different meanings that can be interpreted from the same statement by just changing the word which is stressed within a sentence. For example, when participants heard the sentence, "I wanted **green** and brown socks', they were to recognize the stressed word by clicking on the word presented on the screen. In expressive questions, participants were to correct the statements they heard based on a picture presented on the screen.

The same instruction was used to score all subtests. Receptive questions were scored by the software, by considering one point for correct answers and zero for incorrect ones. However, expressive questions were scored by the tester. When the participants produced the targeted word, phrase, or sentence, the tester scored one for utterly proper answers, 0.5 for fair (not so good not so bad) responses, and zero for utterly incorrect answers.

The Persian version of the PEPS was developed by Khodadadi, Khodami, Ghorbani, and Amani (2015). It assesses Persian intonation and includes following communicative areas: short syllables, turn-end, affect, long syllables, boundary (chunking), and contrastive (focus). The test is similar to its English version in many aspects; like the English version, the Persian measure assesses both receptive and expressive modes and is administered individually. The scoring procedure for receptive and expressive questions was identical to the English version.

The only difference between the Persian and English versions is the number of subtests. Two subtests of lexical and phrase stress have not been developed in the Persian measure. This is because Persian is a syllable-timed language (i.e., having a regular rhythm of syllables) (Haghshenas, 2014), despite the English language, which is a stress-timed language (i.e., having a regular rhythm of a primary stressed syllable) (Carr, 1953).

Results

In order to examine the obtained results and answer the research questions, descriptive data from the Persian tests are first presented, followed by effect sizes, then, the same are presented for the English measures. Finally, potential linguistic transfer is calculated. Table 2 demonstrates descriptive statistics (i.e., mean scores, SD, range, and total possible scores) for each measure taken from the results of the pre- and posttests performed by the participants in Persian for both experimental and control groups.

Table 2.
Descriptive Statistics for the Persian Measures (Pre- & Posttest)

			Elision	Seg.	Vocab.	LC.	RC.	PEPS
Total Score			15	15	40	25	20	16
Exp. Group	Mean	Pre-test	10.87	8.40	18.07	12.53	8	14.73
		Posttest	13.73	9.80	18.20	15.07	8.27	15.81
	SD	Pre-test	3.46	2.44	4.28	3.31	2.85	1.84
		posttest	1.48	2.73	3.66	3.91	2.15	.67
	Range	Pre-test	5- 15	3- 11	11- 26	7- 18	3- 13	11.50- 16
		posttest	10-15	6-14	14- 24	8- 21	5- 12	15- 16
Con. Group	Mean	Pre-test	10.20	8.33	20	13.07	8.67	14.71
		posttest	12.70	7.30	20.45	15	8.91	15.63
	SD	Pre-test	3.21	3.13	5.05	3.55	2.35	1.20
		posttest	2.45	3.43	4.61	2.86	2.46	.97
	Range	Pre-test	5-15	3-13	13- 29	7- 18	6- 13	13.50- 15.50
		posttest	7-15	2-13	12- 27	11-19	4-12	15-16

Seg. = Segmentation, Vocab. = Vocabulary,LC = Listening Comprehension, RC = Reading Comprehension, Exp.= Experimental, Con. = Control

In order to analyze the participants' performance in the Persian version of PEPS, mean scores of the test's components (i.e., short syllables, turn end, affect, boundary, and contrastive stress) are presented in Figure 1. According to Figure 1, most of the scores from the subtests of PEPS approached the maximum possible score, which is in line with what Khodadadi et al. (2015) believed. They stated that the scores rise as test-takers get older and consequently more experienced with the language.

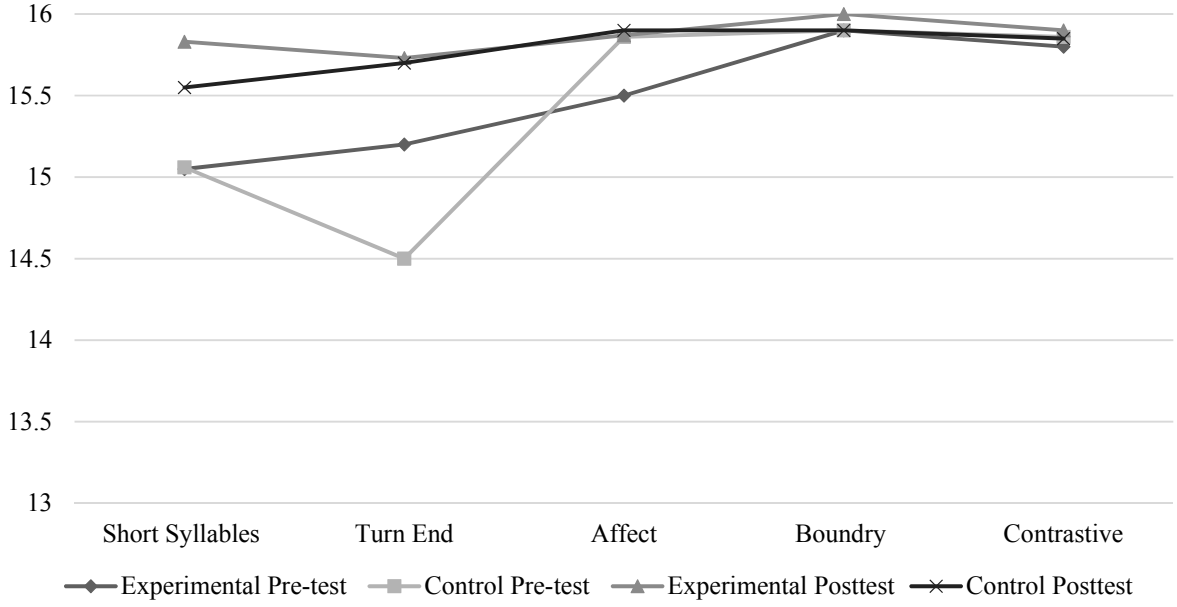

Figure 1. Subtests of Persian PEPS Mean Scores

Before drawing comparisons between the participants' performance in the experimental and control groups, correlations needed to be calculated. Correlations indicated that elision and segmentation tasks which assumed to assess the same skill (i.e., phonological awareness) were interrelated (r = .42, p< .01) and reading comprehension was correlated with vocabulary (r = .47, p< .01) and listening comprehension (r = .38, p< .01). Among the elements of PEPS, Turn End and Affect subtests were correlated with each other (r = .59, p< .01), which indicates the fact that the ability to recognize modes of sentences is associated with being able to recognize feelings from an uttered statement. These two subtests were also correlated with contrastive stress subtest (r = .55 and .62 respectively, p< .01). Such a relationship has been expected since the changing mode of a sentence and expressing various feelings in tone and intonation is bound to knowledge of stress position in a sentence and how it may affect the meaning (Torppa, Faulkner, Laasonen, Lipsanen, & Sammler, 2020).

Table 3 shows how the dependent variables of the study were correlated with elements of PEPS. According to Table 3, the subtest of the boundary is the only element that was correlated with reading comprehension (r = .45, p< .01). This subtest requires the ability to disentangle grammatically ambiguous sentences by knowing where to pause or change the intonation from rising to falling or vice versa, and it is mainly necessary when there is no proper punctuation. Therefore, it seems rational to observe such an association.

Table 3.
Correlations

	Elision	Segmentation	vocabulary	LC	RC
Short Syllables	.03	.27	.23	.00	.13
Turn End	.25	.17	.17	.00	.00
Affect	.07	.03	.27	.06	.03
Boundary	.18	.26	.44**	.38	.45**
Contrastive Stress	.35	.22	.24	.38	.25

(** p < .01)

The effect sizes were calculated to compare the experimental and control group's gains from the remedial program and investigate any possible direct impact of the intervention on the study variables.

Table 4.
Impact of Supra-segmentals on Persian Variables

	Elision	Segmentation	Vocabulary	LC	RC
Exp. Group Cohen's *d*	1.07	.31	.03	.69	.10
Con. Group Cohen's *d*	.89	.51	.09	.59	.09

LC = Listening Comprehension, RC = Reading Comprehension

According to Table 4, interventions on how to change the utterances' meaning by changing tone and intonation in Persian had large impacts on elision (d> .80). Therefore, it can be

concluded that phonological awareness has been partly improved. Additionally, listening comprehension of the experimental group was positively affected (*d*> .50). However, reading comprehension was roughly at the same level in both groups, and no direct impact could be detected for this construct in Persian.

Table 5 shows descriptive statistics (i.e., mean scores, SD, range, and total possible scores) for each measure taken from results of the participants' performance in English pre- and posttests; statistics are presented for both experimental and control groups.

Table 5.
Descriptive Statistics for English Measures (Pre- & Posttest)

			Elision	Seg.	Vocab.	LC.	RC.	PEPS
Total Score			17	15	100	24	24	16
Exp. Group	Mean	Pre-test	13.33	8.53	26.40	16.40	12.27	12.63
		Posttest	14.53	9.47	30.47	16.07	12.13	13.50
	SD	Pre-test	2.44	2.58	5.44	1.50	2.60	2.12
		posttest	1.35	2.03	6.01	2.25	4.15	1.89
	Range	Pre-test	8- 16	2- 12	15- 36	14- 19	8- 17	10- 14
		posttest	12- 16	4- 13	15- 39	11- 19	3- 19	12- 14
Con. Group	Mean	Pre-test	13.13	8.33	26.27	15.20	12.67	12.61
		posttest	13.20	9.40	30.45	16.18	12.64	13.50
	SD	Pre-test	3.66	1.79	6.67	2.59	4.03	1.34
		posttest	2.65	2.22	4.29	2.60	5.04	2.35
	Range	Pre-test	6- 17	4- 10	15- 36	11- 20	5- 21	11.50- 13.50
		posttest	6- 15	4- 12	25- 39	11- 20	2- 18	12- 14.50

Seg. = Segmentation, Vocab. = Vocabulary,LC = Listening Comprehension, RC = Reading Comprehension, Exp.= Experimental, Con. = Control

In order to analyze participants' performance in the English version of PEPS, mean scores of the test's components (i.e., short syllables, turn end, affect, lexical stress, phrasal stress, boundary, and contrastive stress) are presented in Figure 2. According to Figure 2, although participants in the experimental group could improve their knowledge of supra-segmentals in short syllables, affect, phrase stress, and boundary subtests, the control group could also gain the same status without any pieces of training. Moreover, participants of both groups retained a similar level of knowledge before and after intervention in turn end, lexical and contrastive stress subtests.

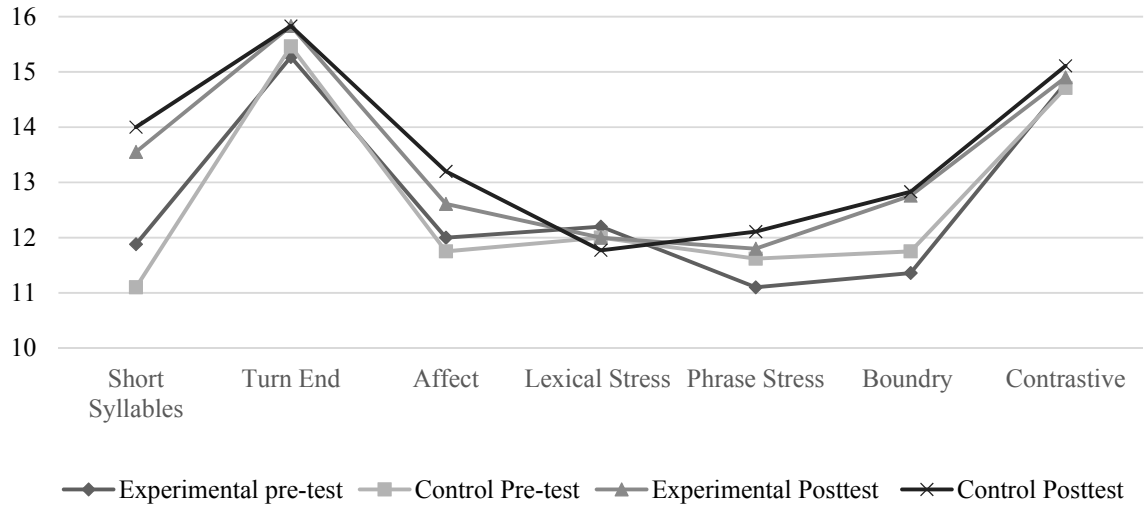

*Figure 2.*Subtests of English PEPS Mean Scores

Looking at the mean scores would not seem enough to detect the impact of the remedial program. To this end, effect sizes and correlations among similar variables were calculated. Correlations indicated that among the subtests of PEPS, lexical stress and turn end are correlated with contrastive analysis (r = .62 and .68 respectively, $p < .01$). It means that, similar to Persian, recognizing sentence mode and word's stress position are linked to the ability to understand stress position within a sentence and how it may affect meaning (Hasselgård, 2018; Lambert, 1963).

Table 6 shows how English dependent variables of the study were correlated with the subtests of the English version of PEPS. According to Table 6, no correlations were observed. Since none of the subtests of PEPS was associated with reading comprehension, it was less likely that it could be affected by the intervention.

Table 6.
Correlations

	Elision	Segmentation	vocabulary	LC	RC
Short Syllables	.01	.02	.53**	-.24	.01
Turn End	.13	.27	.13	-.39	.10
Affect	.10	-.17	-.14	.05	-.31
Lexical Stress	.38	.21	-.18	-.25	.27
Phrase Stress	-.23	.31	-.14	-.12	.00
Boundary	.09	-.08	-.20	.04	.04
Contrastive Stress	.09	.11	-.34	.37	.02

(** $p < .01$)

Table 7.
Impact of Supra-segmentals on English Variables

	Elision	Segmentation	Vocabulary	LC	RC
Exp. Group Cohen's *d*	.60	.52	.70	.17	.04
Con. Group Cohen's *d*	.02	.53	.74	.37	.00

LC = Listening Comprehension, RC = Reading Comprehension

According to Table 7, Persian intervention on syllable awareness and the fact that how utterances' meaning might be affected by variations in tone and intonation had moderate impacts on English phoneme elision ($d > .50$). This was similar to the results in Persian; i.e., phonological awareness was partly affected in English as well. Although English vocabulary knowledge of the experimental group seems moderately affected ($d > .50$) after implementing the intervention, the control group also improved in lexical resource even a bit more than those in the experimental group. Therefore, it can be concluded that phoneme elision was the only English skill which could be affected by the program.

Having examined obtained data from Persian and English and detecting the impact of the program on Persian and English phoneme elision and Persian listening comprehension, it is worth to investigate cross-language transfer to investigate whether knowledge of supra-segmentals or affected skills by the intervention in Persian could transfer to English reading comprehension and contribute to its development. To this end, several regression analyses were performed to calculate the transfer of Persian phonological awareness, listening comprehension, and knowledge of supra-segmentals to English reading comprehension. As a result of regression analyses, Persian phonological awareness does not seem to potentially explain variations in English reading comprehension (Δ: .00, $p > .05$). It is while Persian listening comprehension significantly contributes to English reading comprehension (Δ: 22.04, $p \leq .01$), and Persian knowledge of supra-segmentals could also contribute to English comprehension (Δ: 16.07, $p < .05$). Therefore, it can be concluded that English reading comprehension is directly related to knowledge of supra-segmentals (through the transfer of knowledge of supra-segmentals in Persian) and is indirectly affected by the intervention plan (through the transfer of Persian listening comprehension).

To have a more detailed view of the contribution and transfer of Persian supra-segmentals to English reading comprehension, the beta value of the test components were computed. This way, it can be revealed which subtest and its pertinent skill transfers to English reading comprehension. Table 8 shows the detailed examination of Persian supra-segmentals when it transfers to English reading comprehension.

Table 8.
Persian Supra-segmentals Transfer to English Reading Comprehension

		Reading Comprehension		
		R^2 change	p-value	Final beta
Age & gender		17	.14	
	Age			.54
	Gender			.26
English PEPS		4	.32	.02
Persian PEPS		16.7	.03	
	Short Syllables			.56
	Turn End			.24
	Affect			.24
	Boundary			.17
	Contrastive			.32
Total variability explained		37.6		

The final beta values reveal that Persian supra-segmentals contribute to English reading comprehension mostly through short syllables (β = .56) and contrastive (β = .32) subtests, which have the largest beta values. It might be due to the simplicity of the Persian syllable patterns, which is assumed to be generally easy to master. Such simple syllable patterns may provide language users with a tool that works in every language system and help them recognize segments within a word (Hasselgård, 2018; Lambert, 1963). Additionally, contrastive stress needs awareness of the stress position in a sentence. Since stress plays a significant role in the English language and interpretation of English statements, the ability to recognize stress position, regardless of the source language, has the potentials to contribute to understanding English texts (Hasselgård, 2018; Lambert, 1963).

Discussion

The current research examined the impact of improving supra-segmental features on reading comprehension in the first and second languages. To this end, elements of supra-segmentals were assessed in two languages (Persian as the first and English as the second language) along with linguistic skills that were proposed to be in association with reading comprehension (i.e., phonological awareness, vocabulary knowledge, and listening comprehension). Proposed reading models like The SVR (Gough & Tunmer, 1986; Hoover & Gough, 1990; Tunmer & Chapman, 2012) have mentioned a few cognitive-linguistic skills (i.e., decoding and linguistic comprehension including vocabulary and listening comprehension) with potentials to contribute to reading comprehension, but not the supra-segmental features. It is while previous research has confirmed the relationship between knowledge of supra-segmentals and reading comprehension in different linguistic settings (Ravid & Mashraki, 2007; Lurchin et al., 2015; Richards & Schmidt, 2010). Therefore, the present research designed an intervention program to investigate whether improving the knowledge of supra-segmental features in Persian can affect reading comprehension positively and thus can be known as a component of reading models.

To examine such an impact in Persian as a first and English as a second language, a remedial program was developed with a focus on syllable awareness, recognizing stress position within a word, phrase, and sentence and also expressing feelings and changing sentence mode through tone and intonation variations. The program was taught to a group of second language learners. As a result of training, Persian and English elision and also Persian listening comprehension were affected (see Tables 4 and 7). To further tease the relationships apart, linguistic transfer was also examined, and a direct relationship between Persian supra-segmentals and English reading comprehension was found; in particular, awareness of word syllables and recognizing stress position within a sentence as elements of supra-segmentals contributed to English reading comprehension. Additionally, Persian listening comprehension contributed to English reading comprehension, and it showed an indirect impact of Persian supra-segmental features on English reading comprehension.

Given the difference between Persian and English supra-segmental systems, English supra-segmental features seem to be more complex with a wider range of syllable patterns and determining stress patterns. To make it clearer, it is worth looking at the number of syllable patterns in both languages; there are six patterns in Persian, while the number is 18 in English (Keshavarz, 2017). Moreover, English stress patterns have even impacts on the words' part of speech; for example, when the first syllable is stressed in word 'content' it is a noun, while when the second syllable is stressed, it is an adjective. However, such stress patterns cannot be found in Persian. (Carr, 1953; Fudge, 1984; Jenkins, 1998; Keshavarz, 2017; Stadelmann et al., 2018). According to the findings, the Persian system of supra-segmentals, which is assumed to be less complicated than those in English, could explain variations of English reading comprehension. Additionally, Persian supra-segmental features seem to be easier to be learned fully and, therefore, contribute to cognitive-linguistic processes much faster than a complex system, which might be hard to be recognized (Farrokhi, Ghaemmaghami & Sheikhan, 2004).

When Persian supra-segmental features, which were measured in the Persian version of PEPS, were analyzed, it revealed that awareness of word syllables and recognizing stress position within a sentence as the components of supra-segmentals play a more significant role in the process of linguistic transfer in comparison to other components. When one is aware of syllables within a language and can recognize them competently, stressed syllables would be found more properly, and word reading would be facilitated (Carr, 1953; Veenendaal, Groen & Verhoeven 2016). This way, those parts of speech differences that can be determined through stress position would be recognized much more competently. Therefore, syllable awareness can make a bridge between syllabic and syntactic levels. Such a level of awareness and ability to bring linguistic components together causes more speed and accuracy in the reading process and leads to better comprehension (Groen, Veenendaal & Verhoeven, 2019).

As mentioned, being able to segment words into syllables properly contributes to knowledge of stress position. In addition to recognizing stress patterns at the word level, being sensitive toward stress patterns within a sentence and its impacts on utterances' meaning causes mastery overexpressing and understanding feelings and changing sentence mode using proper tone and

intonation. As a result, the intended meaning can be comprehended much effortlessly (Ashby, 2012; Lehiste, 1970; Torppa et al., 2020). This is the ability to make a bridge between syllabic and semantic level and improves text comprehension (Groen et al., 2019). Therefore, syllable awareness and ability to apply stress patterns into words and sentences lead to unifying different linguistic levels ranging from syllables to syntactic and semantic levels. This way, processing a written text would be facilitated and done more proficiently (Calet e al., 2019; Veenendaal et al., 2016).

It has been argued that knowledge of suprasegmental features contributes to levels of reading comprehension (Calet et al., 2019; Groen et al., 2019; Veenendaal et al., 2016). This finding is in line with the current paper's findings. Given knowledge of syllables and stress patterns are the most important components of intonation and suprasegmental features (Chela-Flores, 2003), these two components allow language users to bring linguistic levels together and have more competent text processing (Groen et al., 2019; Veenendaal et al., 2016). In terms of the SVR (the Simple View of Reading), it can be argued that knowledge of suprasegmental features cannot be allocated to either decoding box or linguistic comprehension. Knowledge of suprasegmental features comprises different abilities ranging from word reading to disentangling syntactic and semantic layers; it rather belongs to both decoding and linguistic comprehension boxes. This extension of linguistic knowledge has the potentials to create a connection between two boxes of word reading and linguistic comprehension and bring them together. It facilitates the transition from word reading to the comprehension of word strings. Benefiting from knowledge of suprasegmental features enables language users faster process and comprehend written texts.

Furthermore, the findings can be discussed in terms of learning strategies. It has been reported that language learners tend to use linguistic constructs that solve problems and work in many areas and also tend to use a mixture of linguistic skills from different languages they know, particularly in lower levels of language proficiency (Hasselgård, 2018; Lambert, 1963). This might be considered as a justification for the findings in the current study; the components of the Persian supra-segmental system that directly contribute to English reading comprehension are chosen as a strategy to solve challenges of reading comprehension in English as a second language.

Additionally, less complicated Persian supra-segmental system affected Persian listening comprehension, and this linguistic skill transferred to English and contributed to its reading comprehension skills; in short, English reading comprehension was indirectly affected by knowledge of supra-segmentals. This indicates that reading and listening comprehension are affected by similar cognitive processes (Diakidoyet al., 2005; Wolf, Muijserlaar & de Bree, 2018) that may lay in the knowledge of prosodical features. It demonstrates that linguistic transfer happens due to strategies that language learners pick (Hasselgård, 2018; Lambert, 1963). Such strategies can be included in reading models as cognitive-linguistic skills that underlie the main predictor of reading comprehension. There might be some underlying linguistic skills, which could transfer to a second language due to their simplicity. Hence, knowledge of supra-segmentals as a learning strategy can be considered as one of these underlying skills.

Every study has some limitations; the current study was not an exception. The first issue is the utilized measures. The current study focused on the relationship between reading comprehension and knowledge of suprasegmental features. However, it is worth examining the relationship at word level as well. Given the results of this study, among all suprasegmental features, syllable patterns were found significant in explaining variations of reading comprehension. Syllables are words' segments, and being sensitive toward these segments is likely to affect word reading accuracy and fluency as well. Therefore, including measures of word reading and calculating its accuracy and fluency would clarify whether knowledge of suprasegmental features contributes to reading comprehension at the word level or text level more. In order to address the mentioned shortcomings, future projects can include pertinent measures.

Moreover, given the findings of the current study, improving knowledge of suprasegmentals result in improvements in reading comprehension, and such an amelioration transfers from simpler systems of suprasegmentals to more complex ones. However, the current study investigated the issue among normally developed readers. Future projects can be designed to target poor comprehenders to examine whether such an impact and transfer trend can be found among poor comprehenders or not. If it would be confirmed for poor comprehenders, making language learners equipped with knowledge of suprasegmental features, particularly the simpler systems or simplified systems, have the potentials to benefit all language learners in terms of retrieving more and more out of a written text.

Implications

Findings of the current research have some pedagogical implications for those who develop material for second language learning. We found that simple systems of supra-segmentals, in particular syllable and stress patterns, are easier to be learned and, as a result, are more likely to be used as tools and strategy while reading written texts. Therefore, in case systems of supra-segmentals in the second language, in particular syllable and stress patterns, are complex and hard to be learned, need to be simplified at primary levels of language learning. This way, learners are allowed to benefit from this system as a tool to improve their reading comprehension in both their first and second languages.

Simplifying supra-segmental systems does not mean randomly eliminating some components. It rather means modifying the learning material with learners' linguistic level, removing learning barriers, and facilitating the learning process. This method of material development could include mixing rules and structures from the first and second language to help less-skilled language learners be more competent in a language being learned (Atkinson, Smith & Kirby, 2018; Chaudron, 1983; Leow, 1993).

Moreover, given the critical role of syllable and stress patterns in cross-linguistic transfer in processing written texts, focusing on these two suprasegmental features in simpler systems and simplifying them in more complex systems equip language learners with a strategy that facilitates both words reading and reading comprehension. This strategy can interestingly aid them in improving their cognitive-linguistic skills in their first and second language. However,

due to the small number of participants in the control and experimental group, the implications of the current study must be taken cautiously.

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