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Processing of Numeral + Noun structures by L1 Persian learners of L2 English, using an online reading task

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Abstract

Within the last two decades, researchers have begun to investigate how L2 learners process syntactic, morpho-syntactic, and lexical information during the comprehension of L2 sentences. The present study aimed to add to research by investigating how L1 influences L2 processing of sentences indicating plurality in constructions involving numerals. More specifically, the research investigated whether Persian speaking low-proficient L2 learners of English showed L1 transfer effects performing a self-paced online reading task. To address this issue, employing the IBEX software, reaction times on critical regions and accuracy rates of learners' performance were measured on four types of structures (i.e., *Numeral + Count Noun, Numeral + Classifier + Mass Noun, Numeral + Classifier + Count Noun, and Numeral + Non-referential Noun + Noun*) and two sentence types (*ill-formed* vs. *well-formed*). Statistical analysis indicated the effect of both structure and sentence type on reaction times on the critical regions studied. Results also indicated traces of L1 effect in processing *Numeral + Classifier + Mass Noun* and *Numeral + Classifier + Count Noun* structures. Concerning the *Numeral + Count Noun* and *Numeral + Classifier + Non-referential Noun + Noun*, no clear evidence for L1 transfer effect was observed. Further studies employing a larger sample size, investigating the issue at higher proficiency levels, and having native English speakers as control group are suggested.

Keywords: Reaction time, Accuracy rate, L1 transfer effect, Plurality

Introduction

Clahsen and Felser (2006) have discussed four major potential factors for differences between L1 and L2 processing, i.e., lack of related grammatical knowledge, influence of L1, cognitive resource shortage, and changes due to maturational puberty. The focus of the present study is on the second proposed factor; that is, L1 influences during L2 processing. There has been an abundance of research on the effect of L1 transfer on syntactic, phonological, and lexical domains; however, the available experimental findings in the area of morpho-syntax are far from convincing. There have been some studies related to online sentence processing which have found evidence for the effect of L1 transfer on parsing (Dussias & Sagarra, 2007; Frenck-Mestre, 2002; Juffs, 2005) while

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there are other studies which did not reveal any effect of L1 on learners' L2 processing (e.g., Felser, et al., 2003; Papadopoulou & Clahsen, 2003). To shed more light on this issue, the present study aimed to investigate how first language (Persian) knowledge of plurality constrains or facilitates the course of L2 sentence processing. The author limited the investigation to the processing of plural morphemes in the structures involving numerals.

Review of the related literature

Some researchers have disapproved L1 transfer as a significant factor in L2 performance. Ellis (1994) suggested that L2 learners with different mother tongues go through the same process of L2 development; hence, she emphasized the universal process and considered no role for L1 transfer. Sabourin (2003) attempted to investigate L1 transfer effects on subject verb agreement violations in Dutch language, using the event-related potential (ERP) technique to explore second language learner brain responses. The results found the same ERP pattern for all the participants, hence no transfer of the properties of L1 while processing L2. Likewise, Felser et al. (2003) and Papadopoulou and Clahsen (2003) disconfirmed the L1 transfer effects. A study by Juffs (2005) suggested that the existence of wh-movement in L1 benefited the learners' processing of wh-movement in L2, which means that L1 does exert an effect. Dussias and Sagarra (2007) indicated evidence for learners' transfer of parsing strategies into L2.

Some studies have found proficiency as a significant factor, which means the higher the level of L2 learners, the less the interference of L1 (e.g., De La Colina & Garcia Mayo, 2007; Di Camilla & Anton, 2012; Elston-Güttler et al., 2005; Frenck-Mestre, 2002; Storch & Wigglesworth, 2003; Su, 2001; Swain & Lapkin, 2000; Tian & Jiang, 2021). For example, Frenck-Mestre (2002) showed that L1 transfer of relative clause attachment preferences was more evident in low-proficiency L2 English learners while proficient L2 learners could do native-like processing and decrease the amount of L1 transfer. Su (2001) also found that L1 transfer decreased with increasing proficiency.

Transfer of morphology/morpho-syntax

L1 effects in morphology/morpho-syntax have been investigated less adequately than in L2 syntactic processing. Similarly, investigations in this area have revealed that the presence or absence of certain morpho-syntactic features in L1 influences the L2 acquisition and processing. Research has generally indicated that if a morphological marking is absent in L1, L2 speakers rarely show native-like processing of this feature in L2. On the other hand, in cases the feature is present in L1, L2 speakers can show native-like processing. For instance, Jiang (2004) suggested that Chinese learners were insensitive to number disagreement, probably as Chinese lacks morphological number marking. Similar result on the importance of L1 and L2 similarity in the acquisition of L2 morphology has been obtained by Jiang (2007). Barto-Sisamout, et al. (2009) employed a self-paced reading task to test the influence of the presence or absence of morpho-syntactic rules in L1, employing a group of Spanish learners of English, Chinese learners of English, and a native control group. The findings suggested lack of clear interference effects.

In Persian, an abundance of research has addressed the effects of Persian, as the first language, on the acquisition of a second or third language (e.g. Heidari Darani, 2012,

Jabbari, 2018; Khany & Bazyar, 2013; Molaie et al., 2016). However, studies on morpho-syntactic features are rare. Ghilzai (2017), examining the effect of L1 (Urdu, Japanese, and Persian) on L2 English case and agreement processing, concluded that learners indicated similar patterns in terms of reaction time and accuracy, refuting the possible effect of L1. Mobaraki and Mohammadpour (2011) investigated ten children's L2 English acquisition of functional categories and the role and degree of L1 influence in this regard. Findings revealed no presence of the features at the initial stages or the learners' reliance on their L1. Nevertheless, there has been no empirical study investigating the acquisition of English plurality markers by Persian learners.

Plurality in English and Persian

In English, plurality is marked by adding the morpheme "*s*" to the singular word form. In Persian, the morpheme "*ha*" is the common plural maker; however, some other markers are also used. There are a number of nouns that are pluralized with *"an", "at", and "in"* (e.g., moalem (teacher), Moaleman (teachers); heyvan (animal), heyvanat (animals); mosafer (traveler), mosaferin (travellers)). As Ghomeshi (2003, P.57) noted, "Choice of plural marking is therefore rather complicated and may be determined by factors such as register, level of education of the speaker, etc."

However, the pattern changes in the cases in which a cardinal number is used. In Persian we have:

a Se mard
Three person (Three persons)

b Se medad
Three pencil (Three pencils)

As the examples indicate, the singular noun is used with the numeral ***se*** (three). According to Ghomeshi, in Persian, plural marker and overt numerals cannot co-occur, except when the noun phrase involving numerals is definite. See the examples below:

a Do ta Sib xord-am
Two CL-apple eat. past-1SG
(I ate two apples.)

b *Do ta sibha khordam
Two-CL apple-PL eat. past-1SG
(I ate two apples.)

c Do ta sibha ro khordam
Two-CL apple-PL-OM eat. past-1SG
(I ate the two apples.)

As the examples represent, unlike in English, Persian, except in the case of definite nouns, does not allow the pluralization of the noun in *Numeral* + *Noun* construction. Besides, the two languages differ in the case of *Numeral* + *Classifier* + *Noun* structure. This aspect is discussed more deeply in the following section.

Numeral + Mass / Count Nouns

As in English, some nouns in Persian are typically semantically individuated into separate units (count nouns); however, others cannot be partitioned (mass nouns). In English, mass nouns are typically accompanied by a measure phrase in order to be countable *(a loaf of bread, two glasses of water).* Likewise, in Persian, mass nouns are referred to via classifiers. However, an important property of Persian, which is not seen in English, is that the classifier in Persian is not marked for plurality and the singular form of the classifier is used. For example, we have:

a Se livan Shir
Three glass milk
(Three glasses of milk)
b Se kase berenj
Three bowl rice
(Three bowls of rice)

Returning now to count nouns, in Persian and not in English, it has been shown that they may optionally appear with classifiers. For example:

a Do jeld ketab
Two CL-volume book
(Two books)
b Se ras asb
Three CL-head horse
(Three horses)
c Se nafar kargar
Three CL-person worker
(Three workers)

However, there is another marker, "*ta*", which is used in the place of a more specific one. *Ta* can be used with both count and mass nouns. For instance, we have:

a Se ta namak
Three-CL salt
(Three salts)
b Se-ta ketab
Three—CL book
(Three books)

Here, *se ta namak* means three packs of salt, indicating that the type of coercion effect found in English is not absent in Persian and is identified in classifier constructions (Ghomeshi, 2003).

Hence, the difference between the two languages is that English uses number morphology whereas Persian uses count-classifiers. According to Doetjes (1996), in some languages such as English, number morphology is the grammatical marker whereas in languages that lack number morphology (e.g., Chinese), the grammatical marker is the (count) classifier. As such, count classifiers and number morphology both can indicate number. According to this speculation, in the case of Persian, it seems that

as Persian, unlike English, lacks number morphology, it uses count classifiers. This is also confirmed by Ghomeshi (2003):

> *We have seen that English realizes the count/mass and the singular/ plural distinction at the level of NumP. Chinese and Persian make the count/mass distinction at the level of the classifier. However, Persian, unlike Chinese, also has plural marking, the absence of which is often tied to the use of obligatory classifiers (P.67).*

To sum up, we can say that in Persian, just as one must say *three unit (of) (a mass noun)*, one might say *three unit (of) (a count noun)*. However, in English, no classifier is used with the count nouns, and plurality is indicated through number morphology. Hence, it seems that Persian differs from English in that it lacks a NumP projection.

However, in the case of non-referential nouns acting as classifiers following a numeral, there is no difference between English and Persian concerning the use of plural marker. See the examples below:

a Yek taraneye 10 daghighei
A song ten minute
(A ten-minute song)
b Yek masire dah maili
A way ten mile
(A ten-mile way)

In referential nouns, there is just one noun which is the head noun and the numeral and classifier are plurality markers. However, in non-referential nouns, there are two nouns in a noun phrase. For instance, in *a ten-mile way*, the two nouns in this example are "mile" and "way". The head noun is "way" and "mile" is the noun modifier. In fact, the English noun phrase *a ten-mile way* originates from the clause *a way which is ten miles*. Since "mile" becomes the head noun modifier for "way", it cannot be pluralized. The same is true for Persian.

Taken together, based on the Transfer Hypothesis, such differences discussed above might be challenging for L2 learners of either English or Persian having acquired the other one as L1. Hence, through this study, the author aimed to investigate how first language (Persian) knowledge of plurality constrains and determines processing of similar L2 (English) structures. More specifically, this paper aimed to assess the predictions of Transfer Hypothesis in low-proficient Persian learners' processing of English plural morphemes in structures involving numerals. Therefore, the authors' prediction is that if there is an L1 effect, respondents will read more slowly at the critical regions (show longer reaction times (RTs)) and require more time answering the following question (longer response latency). Such predictions can be more specifically summarized as below:

Hypotheses

H1 As Persian lacks number morphology, Persian speaking learners with low proficiency in English will not expect the plural form of the noun *in the Numeral + Count Noun* construction.

H2 Persian speaking learners of English with low proficiency might tend to use singular classifier (instead of the plural one) in the *Numeral* + *Classifier* + *Mass Noun* construction in English.

H3 As Persian also inserts classifiers into *Numeral* + *Count Noun* construction, Persian speaking learners of English with low proficiency might consider the *Numeral* + *Classifier* + *Count Noun* as acceptable in English.

H4 As there is no difference between the two languages in the case of *Non-referential Nouns* acting as classifiers following a numeral, Persian learners with low Proficiency in English will not have problem processing the structure in English; that is, there should not be long reaction times, response latencies at such regions, or inaccurate responses.

Both correct and incorrect sentences were used to test these predictions. Learner reaction times, response latencies, and their answers to the comprehension questions could provide clues to support or refute these predictions.

Method

Subjects

A total of 99 English learners, from three language institutes in Iran and with the age range of 13 to 18, took part in the first phase of the study which aimed to measure their English proficiency. Of these, 71 subjects whose proficiency was recognized to be low (A2, according to DIALANG), were selected to participate in the second phase of the study, i.e., the main experiment. The other subjects who were recognized to be beginners or at a higher level were excluded from the study. This decision was made based on the prediction that lower-level L2 learners are more likely to reveal L1 transfer in L2 processing, following reports in the literature regarding the role of proficiency.

Instruments

Proficiency test

The DIALANG (available at http://www.lancs.ac.uk/researchenterprise/DIALANG/about), which is a test based on the Common European Framework of Reference (CEFR), was used to assess the subjects' proficiency level. In DIALANG, the test results are reported on a six-level scale from A1, being the lowest level (beginner) to C2, the highest level (native-like).

The self-paced online reading task

The present study used an online psycholinguistic experimental method (using IBEX, available at: http://spellout.net/ibexfarm) to examine the role of L1 transfer in the processing of L2 English plurality. Twenty-five self-paced English sentences, covering the four areas discussed, were utilized as the stimuli for the main experiment. The experimental sentences were either grammatical or contained errors. Each sentence was proceeded by the comprehension question (The sentence was…?, with two options of correct/incorrect answer).

Procedure

The initial test (comprising 35 items) underwent some revisions by the researcher. To ensure the content validity of the test, two experts were requested to provide feedback. They were asked to examine the suitability of the items and underlying constructs and the fitness of the items to the four structures of concern. They were also asked to check for bias and language issues, such as mechanics, word choice, etc. In general, it was concurred that the designed test was an appropriate tool for measuring the intended structures. The comments were used to revise the test accordingly, enhancing the validity of the instrument. Reliability statistics were derived from pilot testing conducted on 20 students and the test was finalized with 25 items (see Appendix A).

Subjects went through two separate phases. Through the first phase, in which they were physically present, their proficiency was assessed using DIALANG. Initially, they were explained about DIALANG orally. Before the main test, DIALANG presents a short placement test comprising 75 vocabulary items through which existing words in English have to be distinguished from non-words. Following, based on their performance score, subjects receive one of the three versions of the grammar test with varying difficulty levels. Those learners who achieved A2 on the grammar test were considered low-proficient and were selected to take part in the main experiment.

The second phase, i.e., the main experiment, was the self-paced online reading task in which subjects were again physically present. The experiment was conducted in a quiet room. IBEX was used to present the material and to record their choices and reaction times. Prior to the experiment, they were told about how to work on IBEX. They were also asked to judge each sentence based on grammar rules; however, they were not told about the grammatical point tested. Attempts were made to choose the simplest vocabularies; nevertheless, to avoid possible interference of lexical difficulty in grammatical processing of the sentences, the meaning of likely difficult words was explained prior to the experiment. The self-paced online reading task started off with three practice items which were presented to familiarize the subjects with the self-paced reading format. All items were randomly presented to the learners. For the dashed sentences in IBEX, each trial involves a set of dashes on the computer screen in place of the words. The first press of the space bar replaces the first dash with the first word in the sentence. Upon the following space-bar presses, the next word appears, and the preceding word disappears. Each sentence was followed by a comprehension question with two options (correct/incorrect) for the answer. The processing time of each word, i.e., the time between space bar presses and the time subjects took to answer each comprehension question were recorded by the computer. After the experiment was completed, the results were automatically sent to the server. Cronbach's analysis indicated an acceptable reliability index of 0.88.

Analyses were performed on reaction times on critical regions and accuracy rate of the response to the comprehension question proceeding the stimuli. The analyses mainly focused on how each type of condition and sentence (ill-formed vs. well-formed) was processed by the subjects. Prior to the analysis, all response times longer than 10000 ms and shorter than 400 ms were eliminated. In the next step, reaction times 3SD above and below the mean for each condition were excluded. Critical regions for the reading time analyses were defined and reading times on these words were averaged. The

Table 1 The overall accuracy per condition

Condition	Percentage (%)
Num + Count noun	30
Num + CL + Count noun	8
Num + CL + mass noun	14
Num + Non-ref N + N	6
Total	58

Table 2 The overall mean reaction times per region across the four conditions

Condition region	Num + Count N	Num + CL + mass N	Num + CL + Count N	Num + Non- ref N + N
Preceding word	1463 (525)*	1532 (624)	1884 (631)	1336 (550)
Numeral	1564 (630)	1514 (622)	1667 (838)	1480 (505)
Classifier		2015 (802)	1966 (617)	2180 (1417)
Noun	2294 (975)	2473 (1011)	2865 (1353)	2070 (864)
Following word	1714 (830)	2313 (939)	2678 (1102)	1498 (641)
Response	3275 (1935)	4363 (2324)	4499 (1467)	3463 (1641)

*Standard deviations are added in parentheses

preceding and subsequent words were also analyzed to capture a better understanding of the potential processing of the critical regions. RT preceding the numeral was presented to ensure baseline for comparison. RT on the word following the noun was presented to determine whether subjects experienced any delayed or prolonged processing of the experimental conditions. According to Barber and Carreiras (2005), late processing effects are important because differences between constituents often have a delayed onset. In addition, performance on comprehension questions was analyzed to gain understanding of the processing outcome.

Results

The overall analysis

The overall accuracy rate and mean reading times for each condition and sentence type are presented in this section.

Based on the analysis of the accuracy rates (see Table 1), just 58% of the answers to the question presented after the stimuli was correct, meaning that the test had been somewhat hard for these low-proficient learners. As Table (1) shows, sentences involving the *Numeral + Count Noun* structure seemed to be the easiest (30% of the total accuracy) and sentences involving the *Non-referential Noun* could be considered as the most difficult one, with only 6% of the total accuracy.

Further analysis was conducted to find out whether RTs on different regions differed for different conditions. See Table 2 for the results.

Analysis of reaction times on critical regions for each condition suggested the longest RTs in the case of *Numeral + Count Noun* structure to be on *noun*, for both *Numeral + Classifier + Mass Noun* and *Numeral + Classifier + Count Noun* structures on *classifier*, *noun,* and *following word* and for the *Numeral + non-referential*

Table 3 Univariate tests (the effect of condition)

Dependent variable		Sum of squares	df	Mean Square	F	Sig.	Partial Eta squared
RT, preceding word	Contrast	1,673,495.00	2	836,747.00	2.000	.097	.021
	Error	77,090,163.00	217	355,254.00			
RT, numeral	Contrast	1,009,156.00	2	504,578.00	1.000	.000	.011
	Error	88,528,771.00	217	407,966.00			
RT, classifier	Contrast	1,636,138.00	2	818,069.00	.000	.000	.007
	Error	227,388,578.00	217	1,047,873.00			
RT, noun	Contrast	17,751,056.00	2	8,875,528.00	8.039	.000	.069
	Error	239,591,590.00	217	1,104,108.00			
RT, following word	Contrast	17,851,576.00	2	8,925,788.00	11.000	.000	.094
	Error	172,529,518.00	217	795,066.00			
RT, response	Contrast	62,088,647.00	2	31,044,323.00	7.000	.001	.067
	Error	870,034,153.00	217	4,009,373.00			

Table 4 Overall mean RTs for each region per sentence type

Sentence Type	Preceding word	Numeral	Classifier	Noun	Following word	Response
Ill-formed	1458 (550)	1540 (676)	2093 (1970)	2520 (1122)	1953 (954)	3911 (2125)
Well- formed	1456 (722)	1512 (528)	1066 (892)	2132 (919)	1763 (862)	3698 (1891)

Noun + *Noun* structure on *classifier* and *noun*. Hence, in the case of the second and third conditions, there seems to be prolonged processing after the noun. Except for the *Numeral* + *non-referential Noun* + *Noun* structure, the results on RTs seem to be consistent with those of accuracy rates, with the lowest RTs on critical regions for *Numeral* + *Count Noun*, indicating the ease of processing and the longest RTs for *Numeral* + *Classifier* + *Mass Noun* and *Numeral* + *Classifier* + *Count Noun* structures, proving them to be more challenging.

In addition, based on the overall results (see Table 3, below), there was an effect of condition for all regions except for *preceding word (p = 0.097).* The main effect seemed to be for the following word [Wilks' Lambda = 0.000, F(2, 217) 11.000, p = 0.0005, partial eta squared = 0.094], indicating almost large effect size, for the *noun* [Wilks' Lambda = 0.000, F(2, 217) 8.039, *p* = 0.0005, partial eta squared = 0.069], indicating moderate effect size, and for the *response* [Wilks' Lambda = 0.000, F(2, 217) 7.000, p = 0.001, partial eta squared = 0.067], suggesting moderate effect size.

As indicated in Table 4, below, reaction times for ill-formed sentences seemed to be longer than those for well-formed sentences. Univariate analysis suggested the effect of sentence type on RTs per region; however, the effect size seemed to be small (see Table 5).

The larger effect of sentence type seems to be for noun, [Wilks' Lambds = 0.087, F (2, 218) 7.400, p = 0.018, partial eta squared = 0.065], indicating a moderate effect size. Accuracy rates per sentence type are illustrated for each condition in Table 6, below.

A more detailed individual analysis of each condition is provided in the following section.

Table 5 Univariate analysis (the effect of sentence type)

Dependent variable		Sum of squares	df	Mean square	F	Sig.	Partial Eta squared
Preceding word	Contrast	118.00	1	118.00	1.000	.000	.000
	Error	78,763,539.00	218	361,300.00			
Numeral	Contrast	33,923.00	1	33,923.00	1.083	.000	.000
	Error	89,504,004.00	218	410,568.00			
Classifier	Contrast	659,746.00	1	659,746.00	1.000	.000	.003
	Error	228,364,970.00	218	1,047,545.00			
Noun	Contrast	6,482,275.00	1	6,482,275.00	7.400	.018	.065
	Error	250,860,371.00	218	1,150,735.00			
Following word	Contrast	1,560,871.000	1	1,560,871.00	1.000	.000	.008
	Error	188,820,223.00	218	866,147.00			
Response	Contrast	1,959,027.00	1	1,959,027.00	1.080	.000	.002
	Error	930,163,773.00	218	4,266,806.00			

Table 6 Accuracy rates per sentence type for each condition

condition sentence type	Num + Count N (%)	Num + CL + Mass N (%)	Num + CL + Count N	Num + Cl + Non-ref N (%)
Overall accuracy	30	14	8%	6
Ill-formed	70	32	41%	26
Well-formed	91	73	–	36

Individual analysis for each condition per sentence type

Numeral + Count Noun

As mentioned in the previous sections, unlike English, Persian lacks number morphology. Hence, it was predicted that L2 English learners might expect depluralizing of nouns in sentences including *Numeral + Count Noun* structure. Ten items tested *Numeral + Count Noun* structure, with 7 items ill-formed in English and 3 items consistent with the English grammar. Included in the ill-formed items was the depluralized form of the noun, which is consistent with the structure in Persian. Below, the analyses of the accuracy rate and reaction times are provided.

Accuracy analysis Concerning the first condition, i.e., the *Numeral + Count Noun* structure, as mentioned above (Table 1), the overall accuracy, in comparison to the whole test, was 30%. The overall accuracy for well-formed sentences involving the *Numeral + Count Noun* structure was 91% and for the ill-formed sentences was 70%. High accuracy of the responses indicated that these low-proficient learners were aware of the structure. This provided evidence that learning the *Numeral + Count Noun* structure had been easy. This also ruled out the strong effect of L1 in the processing of this structure at this stage of the learners' language development.

Reaction time analysis As Table 2 indicated, the overall average RT was 1463 ms for *preceding word,* 1546 ms for *numeral*, 2294 ms for *noun*, and 1714 ms for *following*

word. The overall mean RT for *response* to the subsequent question was 3275 ms. Mean reaction time for ill-formed and well- formed sentences including the mean RTs for the critical regions, preceding and following words, and for the response to the subsequent comprehension question are presented in Table 7, below.

As mentioned earlier, the overall analysis indicated differences in RTs for different sentence types. In accordance with the general results obtained, for the *Numeral* + *Count Noun* structure, the data collected on mean RTs to the ill-formed sentences differed from those on the well-formed. Paired sample t-test was employed to see whether the RT differences for regions within and between sentence types were significant. Analysis indicated them not to have occurred by chance (see Tables 11 and 12 in Appendix B). As RTs for the noun took longer in ill-formed sentences, compared to the well-formed sentences, it can be claimed that the inaccurately depluralized nouns received generally longer response latencies than the accurately pluralized nouns (2208 ms vs. 1760 ms), indicating learners' awareness of the discrepancy. Generally, RTs to the preceding *word* and the *numeral* did not differ very much (mean difference = 197). The longest RTs seemed to be on the *noun*. Besides, looking at the results for mean RT to the word following the noun, it can be inferred that participants showed no prolonged processing of the structure in both ill-formed and well-formed sentences. The nearly high accuracy rate mentioned above also supports participants' sensitivity to the structure and reduces the probability of L1 transfer.

Numeral + *Classifier* + *Mass Noun*

As discussed, in English, mass nouns are always singular and appear with morphology only for taxonomic reading or for known quantities. The condition is the same in Persian; however, in Persian, the classifier accompanying the mass noun is not pluralized. Hence, Persian speaking learners of English with low proficiency might tend to use singular classifier (instead of the plural one) in the *Numeral* + *Classifier* + *Mass Noun* structure in English. The prediction was that such influence might be observed while processing the structure in English. Seven items tested participants' knowledge of mass nouns in English. Two items were compatible with the English structure, in which *Classifier (PL)* + *Mass Noun (SIG)* was used, as in *she gave her two bowls of soup*, and five items, ill-formed in English, were in accord with the Persian grammar, in which the singular form of the classifier was used along with the singular mass noun, as in *she drank two glass of cold water*. Results for accuracy rate and reaction time are presented below.

Analysis of accuracy The overall accuracy of the *Numeral* + *Classifier* + *Noun* structure is 14%. Only 32% (see Table 6, above) of the responses to the ill-formed sentences were correct, meaning that the majority of subjects recognized the structure *Numeral* + *Classifier(SIG)* + *Mass Noun (SIG)* as acceptable in English (68% inaccurate response). This can

Table 7 Mean RTs for *Numeral* + *Count Noun* for sentence types

Condition	W1	Num	Noun	W2	Response
Ill-formed sentences	1312 (299)	1701 (756)	2208 (591)	1718 (594)	3329 (1434)
Well-formed sentences	1510 (499)	1606 (466)	1760 (532)	1340 (432)	3012 (1334)

be an evidence for the negative transfer of the corresponding structure from L1. However, the unexpected point is that 73% of the responses to the grammatically well-formed sentences was accurate too.

Reaction time analysis As indicated in Table 2, the overall average RT was 1532 ms for *preceding word*, 1514 ms for *numeral*, 2015 ms for *classifier*, 2473 ms for the *mass noun*, and 2313 ms for *following word*, with the longest RTs on *noun* and *following word*. The overall mean RT for *response* to the subsequent question was 4363 ms. Mean reaction time for each sentence type are presented in Table 8, below.

As with the *Numeral* + *Count Noun*, RT analysis in the *Numeral* + *Classifier* + *Mass Noun* structure also revealed an effect of sentence type, with faster RTs for well-formed than for ill-formed structures. Paired sample t-test analysis indicated the differences to be meaningful (see Tables 11 and 12 in Appendix B). However, there were not strict differences between the mean RTs for the *word* and the *numeral preceding the classifier* (1384 ms and 1391 ms for the ill-formed and 1601 ms and 1596 ms for the well-formed sentences, respectively). However, there were larger RT differences between the classifiers (2129 ms vs. 1641 ms), longer for the depluralized classifier in the ill- formed sentences. This might be due to the participants' recognition of the mismatch between the preceding numeral and the depluralized classifier, a structure which is inaccurate in English. Hence, being sensitive to number agreement, participants exhibit longer RTs when number agreement is violated. There were longer RTs on the mass noun, the word following the noun, and the response to the subsequent question, as well. Besides, as mentioned in the analysis of the accuracy rates, 68% of the response to the ill-formed sentences indicated them as correct. This might be an indication of the L1 influence; that is, participants, after having struggled with the structure, have finally nativized the structure. Therefore, the decision of whether to mark the classifier as correct or not might have been contaminated by the influence of Persian in which the singular form of the classifier is used.

Numeral* + *Classifier* + *Count Noun

It was discussed in the review of the literature that Persian uses classifiers to make nouns countable and numerals are often accompanied by a classifier even in the case of a count noun. However, as mentioned, in English, count nouns can be directly modified by numerals. Accordingly, it was predicted that Persian speaking learners of English with low proficiency might expect to have classifiers into the *Numeral* + *Count Noun* structure in English. Three items were testing the participants' reaction to the erroneous *Numeral* + *Classifier* + *Count Noun* structure in English. The presented stimuli included an erroneous part such as in *three person workers*.

Table 8 Mean RTs for Num + CL + Mass Noun structure per sentence types

Condition	W1	Num	CL	Noun	W2	response
Ill-formed sentence	1384 (497)	1391 (622)	2129 (686)	2558 (944)	2410 (817)	4360 (1956)
Well-formed sentence	1601 (791)	1596 (534)	1641 (627)	2200 (1045)	2109 (945)	3763 (1929)

Accuracy analysis As mentioned in the previous sections, the overall accuracy of the *Numeral* + *Classifier* + *Noun* structure was 8%. Fifty-nine percent of the responses to the ill-formed structures indicated them to be correct, yielding an accuracy rate of 41%. This is consistent with the results obtained from the analysis of the sentences testing mass nouns. Therefore, L1 Persian L2 English learners might have difficulty processing the *Numeral* + *Classifier* + *Mass Noun* and *Numeral* + *Classifier* + *Count Noun* structures, and it seemed that these L2 learners processed plurality in the case of these two structures more natively.

Reaction time analysis The overall average RT was 1884 ms for *preceding word*, 1667 ms for *numeral*, 1966 ms for *classifier*, 2865 ms for *count noun*, and 2678 ms for *following word*. The overall mean RT for *response* to the subsequent question was 4449 ms. The longest RTs were found to be on *classifier, noun,* and *following word*. The analyses for the critical regions are presented in Table 9.

Analysis of t-test within and between each sentence type also indicated the differences to be significant (see Tables 11 and 12 in Appendix B). As was the case with the ill-formed sentences involving mass noun, discussed in the previous section, in *Numeral* + *Classifier* + *Count Noun* structure, the classifier accompanying the noun got longer RTs. This might be because of the quantifier that precedes the classifier and the kind of mismatch recognized on the part of the subjects. There were also longer RTs on the noun, the following word, and the response to the question which might indicate learners having challenge with the structure. An error rate of 59% suggested that these L2 learners might have processed the structure as in Persian.

Numeral + *Classifier* + *Non-referential noun* + *Noun*

As there is no difference between the two languages with respect to the use of plural marker in the case of non-referential nouns acting as classifiers, it was predicted that Persian learners with low proficiency in English would have no problem processing this structure. That is, there should not be long reaction times, response latencies at such regions, or inaccurate responses. Here, if L1 played any role, it would be facilitatory. Five items, two of which were grammatically correct in both Persian and English, i.e., the singular form of the classifiers was used as in *she listened to a ten-minute song*, were used to test the prediction. The other three items, in which the pluralized form of the classifier was used as in *she had two-inches nails*, were inaccurate in both languages. See below for the analysis of accuracy rate and reaction times.

Accuracy analysis As indicated earlier, in Table 2, the overall accuracy for all sentences involving the non-referential noun structure in themselves was 6%. Overall accuracy rates (see Table 6) were quite low for both well- formed sentences (36%) and ill-formed sentences (26%). These low accuracy rates might show that learners have not acquired the rule in Eng-

Table 9 Mean RTs for Num + CL + Count N (Ill-formed)

Condition	W1	Num	CL	Noun	W2	Response
Sentence (ill-formed)	1884 (631)	1677 (838)	1966 (617)	2865 (1353)	2678 (1102)	4449 (1467)

lish. There seemed to be no clear evidence for L1 effect which was expected to be positive and lead the learners to process the structure more easily and produce more correct answers. Analysis of the reaction times might provide more information.

Reaction time analysis According to Table (2), the overall average RT was 1336 ms for *preceding word,* 1480 ms for *numeral*, 2180 ms for *classifier*, 2070 ms for *noun*, and 1498 ms for *following word*. The overall mean RT for *response* to the subsequent question was 3463 ms. For both ill-formed and well-formed sentences, the longest reaction times were recorded for *classifier* and *noun* with no delayed RTs (see Table 10).

T-test analysis indicated the differences to be meaningful (see Tables 11 and 12 in Appendix B). However, for this structure, an effect of sentence type, contrary to that of the previous structures, was observed. Namely, there were longer RTs on the main regions for the well-formed sentences. The results were in accord with those of accuracy rate analysis which yielded low accuracy rates. Seventy-four percent of the responses indicated the ill-formed sentences as accurate, and only 36% of the response to the well-formed sentences was correct. This indicated that learners tended to use the pluralized form of the noun for the non-referential noun.

Discussion

This study aimed to investigate whether L1 morpho-syntactic features affect L2 processing. The evidence presented above suggests that Persian plurality influences English processing; however, there are situations in which the answer to this question is not so clear. Generally, accuracy rates differed significantly across the four conditions, with the lowest accuracy rates for the structure including *Numeral* + *Non-ref Noun* + *Noun* and the highest accuracy for *Numeral* + *Count Noun* construction, indicating them to be, respectively, the most challenging and the easiest structures at the learners' present level of proficiency. Nevertheless, the state of the accuracy rates across the conditions was not completely into the expected direction. In the case of *Numeral* + *Count* Noun, accuracy rates above expectations were obtained. Concerning the second and third conditions, i.e., *Numeral* + *Classifier* + *Mass Noun* and *Numeral* + *Classifier* + *Count Noun* structures, expectations came out to be true as participants mostly considered the ill-formed structures as correct. However, it needs to be pointed that in these two cases, accuracy rates for the well-formed sentences were also moderately high. These contradictory results might be task- oriented; that is, exposing the subjects to the erroneous structure might have deviated them from the correct structure and has triggered the influence of the Persian structure. To find the reasons for such a discrepancy, employing different tasks such as on-line production tasks in future experiments could be insightful. In the case of the fourth condition, for which L1 and L2 do not contradict, accuracy rates below expectations were observed.

Table 10 Mean RTs for Num + CL + Non-ref N (Ill-formed)

Condition	W1	Num	Cl	Noun	W2	Response
Ill-formed sentence	1285 (470)	11,578 (579)	2460 (489)	2052 (882)	1450 (495)	2953 (1533)
Well-formed sentence	1386 (611)	1518 (541)	2302 (395)	2200 (715)	1595 (812)	3666 (1902)

RT patterns were also somewhat variant across the four conditions. In all four cases, RTs were slow in the *word preceding the numeral* and high on *classifier* and *noun*; however, they mostly differed in the degree of RT on the *word proceeding the noun*, indicating prolonged processing or lack of it. The results indicated that L2 learners will process the *Numeral* + *Classifier* + *Mass Noun* and *Numeral* + *Classifier* + *Count Noun* structures in a prolonged fashion. For *Numeral* + *Count Noun* and *Numeral* + *Non-referential Noun* + *Noun,* no such delays were recorded; hence, the reaction times surfaced quickly after the noun itself. It was also found that these low-level L2 learners required longer time to answer the comprehension questions on the sentences with *Numeral* + *Classifier* + *Mass Noun* and *Numeral* + *Classifier* + *Count Noun* structures than for those on the *Numeral* + *Count Noun* and *Numeral* + *Non-referential Noun* + *Noun* structures. There was also a moderate effect of sentence type in all analyses with longer RTs for the ill-formed sentences than the well-formed ones for the first three conditions and the reverse for the fourth.

As such, it can be concluded that the tendency towards a transfer effect was more observable in the results for *Numeral* + *Classifier* + *Mass Noun* and *Numeral* + *Classifier* + *Count Noun* conditions. As evidence for lack of L1 effect, the results for *Numeral* + *Count Noun* were more conclusive. It might be speculated that in the case of easy-to-learn rules, L2 influences might overrule and L1 effect might not even arise. However, the results obtained for the fourth condition were not significant enough to confirm or disconfirm any transfer effect. It was predicted that as there is no difference between the two languages in the case of *Non-referential nouns* acting as classifiers following a numeral, Persian learners with low proficiency in English will not face difficulty processing the structure in English. In the case of this structure, learners' sensitivity to number or overgeneralization of the *Numeral* + *Count Noun(PL)* rule to this structure might have played an inhibitory role in activating the L1 influence or employing the correct rule in English, leading the learners to the erroneous processing of the structure. Therefore, the results in the by-item analysis of this structure might indicate that there are other factors in addition to L1 effect in L2 learners' processing of such structures, as also claimed by some researchers (e.g., Cohen & Brooks-Carson, 2001; Kellerman, 1983; Mahmoud, 2000). Hence, further research is demanded to spot other possible factors in processing of these structures in English.

Taken together, the results disconfirmed the claims proposed in the literature that L1 plays no role in the L2 process of acquisition (e.g., Ellis, 1994; Felser et al., 2003; Papadopoulou & Clahsen, 2003). Findings also fit well with the research reports in L2 processing that low proficient learners seem not to be able to acquire the structures properly (e.g., De La Colina & Garcia Mayo, 2007; Di Camilla & Anton, 2012; Elston-Güttler et al., 2005; Frenck-Mestre, 2002; Storch & Wigglesworth, 2003; Su, 2001; Swain & Lapkin, 2000; Tian & Jiang, 2021). Nevertheless, further tracking of the participants' language development could provide more insightful understanding of their L1 transfer effect.

Conclusion

The purpose of this study was to find out whether Persian, as the first language, affects the processing of L2 English structures indicating plurality. Four different conditions were studied. It was hypothesized that if L1 transfer occurs, RTs to the incongruent

conditions should be slower than those to the congruent condition. Hence, in the case of interfering transfer (conditions I, II, &III), participants were expected to read more slowly at the critical regions, take more time responding to the proceeding question, and accept the erroneous structures as correct. In the case of L1 effect being positive, i.e., the fourth condition discussed, faster RTs and higher accuracy rates were expected. An overview of accuracy rates and RTs across the conditions revealed that it is likely that these L2 learners did not utilize transfer to a similar extent across the four conditions and the two sentence types. However, if L2 learners were using their English-derived knowledge with structures indicating plurality, they would have been expected to react equivalently to all conditions, sentence types, and number mismatches. Hence, the findings suggested that these L2 learners employed at least some degree of transfer in their parsing of number mismatches.

This study can have implications for instructional practices in L2 classrooms. Students' success in using the structures will be more feasible if they are aware of the differences between L1 and L2. As such, teachers can help students understand the differences and take actions to make benefits of L1 and reduce the impeding effects. They can also be trained to reflect on the way they process the structure in both L1 and L2.

Nevertheless, it is possible that a larger sample population would have produced more robust data. Therefore, future directions should include conducting experiments employing different tasks with a much larger sample size and with regard to different proficiency levels. Particularly, similar procedure should be conducted with near-native speakers as well as advanced groups to determine more accurately the true nature of L1 effect in L2 processing.

Appendix A

List of the sentences used for the experiment

1. There are two store near my grandmother's house.
2. There are more than one billion cell in our body.
3. Petersons had two boy, John eight and Tom two years older.
4. The building has twenty floors with a big parking space.
5. I read the first three book immediately after the school.
6. She has bought two nice spacious bags from a bargain.
7. She ate the second three sandwich one hour later.
8. She brought two fantastic novel to the classroom.
9. These three flowers are originally from Netherlands.
10. Our house has three closet with a spacious bathroom.
11. We are in need for two kilo meat for the dinner.
12. She drank two cup of coffee after the lunch.
13. She gave her two bowls of soup.
14. The factory needed two kind of salt.
15. We waste about two hundred liter water every day.
16. She got two box of apple for the picnic.
17. Losing two pounds of weight every day is dangerous for the health.

18. She bought two volume of book yesterday.
19. Three person workers were paving the way.
20. She drank two glass of cold water.
21. She listened to a ten minute song yesterday.
22. He had to walk a hundred miles way from home to work.
23. She had two inches nails before she went to school.
24. He climbed a one thousand meter mountain last week.
25. We had a two hours walk from school to home.

Appendix B

See Tables 11 and 12.

Table 11 Paired samples test (within sentence type analysis)

		Paired Differences					t	df	Sig. (2-tailed)
		Mean	Std. Deviation	Std. Error Mean	95% Confidence Interval of the Difference				
					Lower	Upper			
Pair 1	C1_W1_ILL - C1_NUM_ILL	− 190.00000	751.00000	74.00000	− 339.00000	− 42.00000	− 2.000	100	.012
Pair 2	C1_NUM_ILL - C1_N_ILL	− 597.00000	991.00000	97.00000	− 790.07688	− 404.00000	− 6.000	103	.000
Pair 3	C1_N_ILL -C1_W2_ILL	204.00000	1010.00000	99.00000	608.00000	1001.00000	8.000	103	.000
Pair 4	C1_W1_WELL -C1_NUM_WELL	− 3.00000	442.00000	66.01752	− 136.00000	129.00000	− .059	44	.000
Pair 5	C1_NUM_WELL -C1_N_WELL	− 279.00000	427.00000	63.00000	− 408.00000	− 151.00000	− 4.000	44	.000
Pair 6	C1_N_WELL -C1_W2_WELL	293.00000	508.00000	75.00000	140.00000	446.00000	3.000	44	.000
Pair 7	C2_W1_ILL -C2_NUM_ILL	− 22.00000	553.00000	64.00000	− 150.00000	105.00000	.000	73	.000
Pair 8	C2_NUM_ILL -C2_CL_ILL	− 645.00000	796.00000	92.00000	− 830.00000	− 461.00000	− 6.000	73	.000
Pair 9	C2_CL_ILL -C2_N_ILL	− 420.05405	1281.00000	148.00000	− 716.00000	− 123.00000	− 2.000	73	.006
Pair 10	C2_N_ILL -C2_W2_ILL	416.00000	1047.00000	120.00000	175.00000	657.00000	3.000	74	.001

Table 11 (continued)

		Paired Differences					t	df	Sig. (2-tailed)
		Mean	Std. Deviation	Std. Error Mean	95% Confidence Interval of the Difference				
					Lower	Upper			
Pair 11	C2_W1_WELL - C2_NUM_WELL	114.00000	606.00000	110.00000	− 111.00000	340.00000	1.034	29	.000
Pair 12	C2_NUM_WELL -C2_CL_WELL	− 141.00000	724.00000	132.00000	− 412.00000	128.00000	− 1.072	29	.000
Pair 13	C2_CL_WELL -C2_N_WELL	− 551.00000	1105.00000	201.00000	− 964.00000	− 138.00000	− 2.000	29	.011
Pair 14	C2_N_WELL -C2_W2_WELL	274.00000	1172.00000	214.07205	− 162.00000	712.00000	1.000	29	.052
Pair 15	C3_W1 - C3_NUM	− 153.00000	840.00000	126.00000	− 408.00000	102.00000	− 1.000	43	.000
Pair 16	C3_NUM - C3_CL	− 291.00000	858.08024	127.00000	− 549.06251	− 33.00000	− 2.000	44	.028
Pair 17	C3_CL - C3_N	− 908.00000	1269.00000	189.00000	− 1290.00000	− 527.00000	− 4.000	44	.000
Pair 18	C3_N - C3_W2	802.00000	1683.00000	253.00000	290.00000	1314.00000	3.000	43	.063
Pair 19	C4_W1_ILL -C4_NUM_ILL	− 129.00000	634.00000	94.00000	− 320.00000	60.00000	− 1.000	44	.000
Pair 20	C4_NUM_ILL -C4_CL_ILL	− 695.00000	1642.00000	244.00000	− 1189.00000	− 202.08511	− 2.000	44	.007
Pair 21	C4_CL_ILL -C4_N_ILL	100.00000	1865.00000	278.00000	− 460.00000	660.00000	.000	44	.000
Pair 22	C4_N_ILL -C4_W2_ILL	670.00000	914.00000	136.00000	395.00000	945.00000	4.000	44	.000
Pair 23	C4_W1_WELL -C4_NUM_WELL	− 232.00000	440.00000	81.00000	− 400.09564	− 64.00000	− 2.000	28	.008
Pair 24	C4_NUM_WELL -C4_CL_WELL	− 783.00000	1041.00000	193.00000	− 1179.00000	− 387.00000	− 4.051	28	.000
Pair 25	C4_CL_WELL -C4_N_WELL	239.00000	1263.00000	234.00000	− 241.00000	720.00000	1.021	28	.000
Pair 26	C4_N_WELL -C4_W2_WELL	466.00000	1070.00000	198.00000	59.00000	873.00000	2.000	28	.026

Table 12 Paired samples test (between sentence type analysis)

		Paired Differences					t	df	Sig. (2-tailed)
		Mean	Std. Deviation	Std. Error Mean	95% Confidence Interval of the Difference				
					Lower	Upper			
Pair 1	C1_W1_ILL - C1_W1_WELL	− 197.00000	534.00000	79.00000	− 358.00000	− 37.00000	− 2.000	44	.017
Pair 2	C1_NUM_ILL -C1_NUM_WELL	195.00000	795.00000	119.00000	− 46.00000	437.00000	1.000	43	.000
Pair 3	C1_N_ILL -C1_N_WELL	447.00000	883.00000	133.00000	178.00000	716.06608	3.000	43	.002
Pair 4	C1_W2_ILL - C1_W2_WELL	235.00000	759.00000	114.00000	4.00000	465.00000	2.053	43	.046
Pair 5	C1_RES_ILL -C1_RES_WELL	316.00000	1772.00000	264.00000	− 215.00000	849.00000	1.000	44	.000
Pair 6	C2_W1_ILL -C2_W1_WELL	− 237.00000	981.09918	179.00000	− 603.00000	129.00000	− 1.000	29	.000
Pair 7	C2_NUM_ILL -C2_NUM_WELL	− 108.00000	687.09369	127.00000	− 370.00000	152.00000	.000	28	.000
Pair 8	C2_CL_ILL -C2_CL_WELL	488.00000	928.00000	172.00000	135.00000	842.04547	2.000	28	.008
Pair 9	C2_N_ILL -C2_N_WELL	358.00000	1506.00000	274.00000	− 203.00000	920.00000	1.000	29	.000
Pair 10	C2_W2_ILL -C2_W2_WELL	4.03448	1136.00000	211.09594	− 428.00000	436.00000	.019	28	.000
Pair 11	C2_RES_ILL -C2_RES_WELL	596.00000	2767.00000	505.00000	− 436.00000	1630.00000	1.000	29	.000
Pair 12	C4_W1_ILL -C4_W1_WELL	.00000	578.00000	107.00000	− 220.00000	219.00000	− .007	28	.000
Pair 13	C4_NUM_ILL -C4_NUM_WELL	59.00000	745.00000	138.00000	− 224.00000	343.00000	.000	28	.000
Pair 14	C4_CL_ILL -C4_CL_WELL	164.00000	2289.00000	425.00000	− 706.00000	1035.00000	.000	28	.000
Pair 15	C4_N_ILL -C4_N_WELL	− 148.00000	1113.00000	206.00000	− 571.00000	275.07894	.000	28	.000

Table 12 (continued)

		Paired Differences					t	df	Sig. (2-tailed)
		Mean	Std. Deviation	Std. Error Mean	95% Confidence Interval of the Difference				
					Lower	Upper			
Pair 16	C4_W2_ILL -C4_W2_WELL	− 145.00000	785.00000	145.00000	− 444.00000	153.00000	.000	28	.000
Pair 17	C4_RES_ILL -C4_RES_WELL	− 713.06897	2644.00000	491.00000	− 1719.00000	292.00000	− 1.000	28	.000

Abbreviations

CEFR	Common European framework of reference
CL	Classifier
L1	First language
L2	Second language
N	Noun
Num	Numeral
PL	Plural
RT	Reaction time
SG	Singular
W1	Preceding word
W2	Following word

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Author contributions
The author of the paper was responsible for data collection, data analysis, preparing, and reviewing the work. The author read and approved the final manuscript.

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Declarations

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Competing interests
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References

Barber, H., & Carreiras, M. (2005). Grammatical gender and number agreement in Spanish: An ERP comparison. *Journal of Cognitive Neuroscience, 17*(1), 137–153. https://doi.org/10.1162/0898929052880101

Barto-Sisamout, K., Nicol, J., Witzel, J., & Witzel, N. (2009). Transfer effects in bilingual sentence processing. *Arizona Working Papers in SLA & Teaching*, *16*, 1–26.

Clahsen, H., & Felser, C. (2006). Grammatical processing in language learners. *Applied Psycholinguistics, 27*(1), 3–42. https://doi.org/10.1017/S0142716406060024

Cohen, A., & Brooks-Carson, A. (2001). Research on direct versus translated writing: Students' strategies and their results. *The Modern Language Journal, 85*(2), 169–188.

De la Colina, A., & Garcia Mayo, M. P. (2007). Attention to form across collaborative tasks by low-proficiency learners in an EFL setting. In M. P. Garcia Mayo (Ed.), *Investigating tasks in formal language learning* (pp. 235–253). Multilingual Matters.
DiCamilla, F. J., & Anton, M. (2012). Functions of L1 in the collaborative interaction of beginning and advanced second language learners. *International Journal of Applied Linguistics, 22*, 160–188. https://doi.org/10.1111/j.1473-4192.2011.00302.x
Doetjes, J. (1996). Mass and count: Syntax or semantics? In *Proceedings of meaning on the HIL (HIL occasional papers in linguistics)*, Vol. 1, pp. 34–52.
Dussias, P. E., & Sagarra, N. (2007). The effect of exposure on syntactic parsing in Spanish–English bilinguals. *Bilingualism: Language and Cognition, 10*(01), 101–116. https://doi.org/10.1017/S1366728906002847
Ellis, R. (1994). *The study of second language acquisition*. Oxford University Press.
Elston-Güttler, K., Paulmann, S., & Kotz, S. A. (2005). Who's in control? Proficiency and L1 influence on L2 processing. *Journal of Cognitive Neuroscience, 17*(10), 1593–1610. https://doi.org/10.1162/089892905774597245
Felser, C., Roberts, L., Marinis, T., & Gross, R. (2003). The processing of ambiguous sentences by first and second language learners of English. *Applied Psycholinguistics, 24*(03), 453–489. https://doi.org/10.1017/S0142716403000237
Frenck-Mestre, C. (2002). An on-line look at sentence processing in the second language. In R. R. Heredia & J. Altarriba (Eds.), *Bilingual sentence processing* (pp. 217–236). Elsevier Science Publishers. https://doi.org/10.1016/S0166-4115(02)80012-7
Ghilzai, Sh. A. (2017). Sensitivity to morphosyntactic features in L2 sentence processing: evidence from Persian, Urdu, and Japanese. *Insights in Language Society and Culture, 2*, 86–103.
Ghomeshi, J. (2003). Plural marking, indefiniteness, and the noun phrase. *Studia Linguistica, 57*(2), 47–74. https://doi.org/10.1111/1467-9582.00099
Heidari Darani, L. (2012). Persian-English interlanguage wh-questions: Do they experience patterned variation? *Archives Des Sciences, 65*(7), 28–41.
Jabbari, A. A. (2018). Acquisition of noun modifiers in third language Arabic (L3) by Iranian Persian (L1) learners of English as a second language. *Foreign Language Research Journal, 8*(1), 83–104.
Jiang, N. (2004). Morphological insensitivity in second language processing. *Applied Psycholinguistics, 25*(04), 603–634. https://doi.org/10.1017/S0142716404001298
Jiang, N. (2007). Selective integration of linguistic knowledge in adult second language learning. *Language Learning, 57*(1), 1–33. https://doi.org/10.1111/j.1467-9922.2007.00397.x
Juffs, A. (2005). The influence of first language on the processing of wh-movement in English as a second language. *Second Language Research, 21*(2), 121–151. https://doi.org/10.1191/0267658305sr255oa
Kellerman, E. (1983). Now you see it, now you don't. In S. Gass & L. Selinker (Eds.), *Language transfer in language learning* (pp. 112–134). Newbury House.
Khany, R., & Bazyar, A. (2013). A Generative analysis of the acquisition of negation by Iranian EFL learners: a typological study. *RALS, 4*(1), 62–87.
Mahmoud, A. (2000). Modern standard Arabic vs. non-standard Arabic: Where do Arab students transfer from? *Language, Culture and Curriculum, 13*, 126–136. https://doi.org/10.1080/07908310008666594
Mobaraki, M., & Mohammadpour, E. (2011). Functional categories in the L2 acquisition of English Morpho-syntax: a longitudinal study of two Farsi-speaking children. In *Proceedings of the 3rd international conference of teaching and learning (ICTL 2011) INTI International University*, Malaysia.
Mollaei, A., Jabbari, A. A., & Rezaei, M. J. (2016). The acquisition of French (L3) Wh-question by Persian (L1) learners of English (L2) as a foreign language: Optimality theory. *International Journal of English Linguistics, 6*(7), 36–47. https://doi.org/10.5539/ijel.v6n7p36
Papadopoulou, D., & Clahsen, H. (2003). Parsing strategies in L1 and L2 sentence processing: A study of relative clause attachment in Greek. *Studies in Second Language Acquisition, 25*, 501–528.
Sabourin, L. (2003). *Grammatical gender and second language processing: an ERP study.* GRODIL: Groningen Dissertations in Linguistics, 42.
Storch, N., & Wigglesworth, G. (2003). Is there a role for the use of the L1 in an L2 setting? *TESOL Quarterly, 37*, 760–770. https://doi.org/10.2307/3588224
Su, I. R. (2001). Transfer of sentence processing strategies: A comparison of L2 learners of Chinese and English. *Applied Psycholinguistics, 22*(1), 83–112. https://doi.org/10.1017/S0142716401001059
Swain, M., & Lapkin, S. (2000). Task-based second language learning: The uses of the first language. *Language Teaching Research, 4*, 251–274. https://doi.org/10.1177/136216880000400304
Tian, L., & Jiang, Y. (2021). L2 proficiency pairing, task type and L1 use: A mixed-methods study on optimal pairing in dyadic task-based peer interaction. *Frontiers in Psychology, 12*, 699774. https://doi.org/10.3389/fpsyg.2021.699774

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