

Article

Measuring Chinese EFL Learners' Implicit and Explicit Knowledge of Relative Clauses

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Abstract

This study employs a mixed design to investigate the effects of time factor and clause type on Chinese EFL learners' implicit and explicit knowledge of relative clauses. Eighty Chinese EFL learners were randomly assigned to one of two-time factor conditions and then tested on a grammaticality judgment task as well as on a sentence combination task to elicit their implicit and explicit knowledge of three types of relative clauses. It was found that, the learners had more accurate performance in untimed tasks than in timed ones; this finding is consistent with some previous studies' findings. Clause type exerts a significant effect on Chinese EFL learners' implicit and explicit knowledge of relative clauses, besides time factor and clause type had interaction effects. According to these findings, the article deepens the study of NPAH and it is suggested that multiple timed and untimed tasks could be designed to measure learners' implicit and explicit knowledge.

Keywords

Clause type, time factor, relative clauses, explicit knowledge, implicit knowledge

1 Introduction

A central issue regarding second language research (SLA) is how to obtain evidence that a learner's knowledge of a second language is of the implicit or explicit kind. The construct of implicit and explicit knowledge of the L2 are central to the field of SLA (Ellis & Roever, 2021). Although it is generally believed that the ultimate goal of L2 acquisition is the development of implicit knowledge, questions still remain as to the relationship between implicit and explicit knowledge and whether factors like task conditions, time factor affect L2 learners' use of implicit and explicit knowledge in the same way. This study addresses these issues by examining Chinese EFL learners' knowledge and use of English relative clauses.

Owing to their importance and complexity in English learning, relative clauses have received considerable attention in previous studies (Izumi, 2003; Rokni & Talarposhti, 2012; Gao, 2014), their implications for typological universals (Keenan & Comrie, 1977), and the potential ambiguity of comprehending reduced relative clauses (MacDonald et al., 1999; Andrews, 2009; Diessel & Tomasello, 2005). Interest in this structure is motivated partly by its universality in world languages, partly by

its unique syntactic properties, and partly by its frequency and utility in our everyday use of language (Izumi, 2003, p.286). The construction of relative clauses offers the opportunity to study the cognitive mechanisms that underlie production and comprehension (Izumi, 2003; Hawkins, 2004; Jaeger, 2006; MacDonald, 1999). For Chinese EFL learners, English relative clause is a type of complex post nominal adjectival modifier used in both written and spoken English (Gao, 2014), which is not easy to acquire. One possible reason is that Chinese and English are typologically different with regard to the positions of RC and its head noun (HN) (Song, 2016, p. 27). In particular, an RC is used before its HN in Chinese but after the HN in English (Song, 2016). Besides, the acquisition of English relative clauses is important due to their frequent use in spoken and written production and learning difficulties arising from them (Gao, 2014; Song, 2016; Celce-Murcia & Larsen-Freeman, 1999).

To date, a body of research has been focused on understanding whether different factors directed at specific linguistic features like relative clauses would lead to L2 learners' use of implicit or explicit knowledge of these features. Although numerous studies have focused upon measures of implicit and explicit knowledge (Aline, 2016; Bowles, 2011; Dekeyser, 2003; Ellis, 2004, 2005, 2006, 2009; Ellis & Loewen, 2007; Godfroid & Winke, 2015) or L2 learners' implicit and explicit knowledge of vocabulary acquisition (Sonbul & Schmitt, 2013), few studies have been done to investigate effects of time factor and clause type on learners' use of implicit and explicit knowledge of relative clauses. For this reason, this study attempts to investigate Chinese EFL learners' implicit and explicit knowledge in processing different types of relative clauses.

2 Literature Review

2.1 The measurement on learners' implicit and explicit knowledge in previous studies

Most L2 learners possess both types of knowledge, as such, determining which type of knowledge they deploy on particular occasions is problematic (Ellis & Roever, 2021, p. 162). Akakura (2012, p. 10) claimed that implicit knowledge could be accessed instantly during unconscious comprehension or production. And Ellis (2006) defined that implicit knowledge involves unconscious awareness, which in learners' interlanguage is highly systematic (Ellis, 2006) and learners may process it naturally. Explicit knowledge differs from implicit knowledge. More specifically, Han & R.Ellis (1998) argued that explicit knowledge can be divided into analysed knowledge and metalinguistic knowledge. According to Han & R.Ellis (1998), L2 learners may not necessarily be fully conscious of analysed knowledge, which refers to the knowledge about L2 language items and structures. Analysed knowledge could exist independent of whether the learner has acquired a language or can articulate themselves in that language after many years of learning (Han & R.Ellis, 1998), although it may be more precise, clearer and better-structured if the learner has access to metalinguistic terms (Han & R.Ellis, 1998). A number of studies examined L1 and L2 learners' implicit and explicit knowledge (Green & Hecht, 1992; Ellis, 2006; Macrory & Stone, 2000; Hu, 2002). In these studies, explicit knowledge was measured as learners' explanation of specific linguistic features and implicit was determined by investigating the learners' use of these features in oral or written language.

As such, implicit knowledge is unconscious awareness for learners, and they produce it rapidly and unconsciously; however, if they are given enough time, they may develop explicit knowledge or some combination of implicit and explicit knowledge. Some scholars have investigated the effects of time with respect to this issue (Bialystok, 1979; Han & R.Ellis, 1998; Mandell, 1999; Loewen, 2009; Bowles, 2011; R.Ellis, 2004, 2005). Bialystok (1979), Han & R.Ellis, (1998) and Mandell, (1999) found that if learners are given a limited time to respond, they may be encouraged to rely on implicit knowledge; in contrast, unlimited time may allow them to access explicit knowledge. In the mid-1980s, a rapid response time to L2 grammaticality judgement items was argued to indicate the high degree of availability and

automaticity of required knowledge (Loewen, 2009). Lehtonen & Sajavarras (1985) and Alderson et al., (1997) claimed that the quicker the learners response, the more 'automatic' the decision they make. In order to test this assertion, Alanen used response time and the task of grammaticality judgement tests to examine L2 learners' linguistic knowledge, especially the relationship between the speed and accuracy of L2 learners' judgements and their language proficiency. The results revealed significant correlation between the speed and accuracy of GJTs and their L2 proficiency.

Only a few recent studies have employed two versions of a grammaticality judgement, one with time constraints and one without (Bowles, 2011; Han & R.Ellis, 1998; Loewen, 2009; Mandell, 1999). The results suggest that timed grammaticality judgement tests tap into learners' implicit knowledge and that untimed grammaticality judgement could be a measure of explicit knowledge. Loewen (2009) found that the performances of native and L2 groups in the timed grammaticality judgement were more accurate, whereas native and L2 learners showed no differences in accuracy in judging the grammatical or ungrammatical sentences in the untimed test. Loewen used the three processing types discussed above (semantic processing, noticing, and reflecting) to explain this result. In the untimed GJTs, learners have enough time to use all three types of processing, and this explained why there was no difference between learners' judgement of grammatical and ungrammatical sentences. In the timed GJTs, learners did not have enough time to use all three types of processing and only had time for semantic processing and noticing. Consequently, Loewen (2009) concluded that in timed GJTs, learners only have enough time to access their implicit knowledge to judge sentences, and are unable to access to their explicit knowledge. In contrast, in untimed GJTs, learners have time to access both their implicit and explicit knowledge to judge sentences.

Time pressure has been shown to exert a great influence on learners' linguistic knowledge in previous studies. However, different studies have used different time limits; Loewen (2009) claimed that few studies have investigated whether the time is adequate for learners to process their linguistic knowledge. Therefore, the investigation of the effects of time factor and of the necessary length of time for learners to access explicit knowledge are worthwhile.

2.2 Learners' processing of relative clause in previous studies

A relative clause is a construction that modifies a noun or noun phrase. It usually begins with a relative pronoun (that, who, whom, which and whose) or a relative adverb (where, when and why) (Kanno, 2007; Jeon & Kim, 2007; Rokni & Talarposhti, 2012). In the acquisition of relative clauses, three major hypotheses are frequently tested, namely the Noun Phrase Accessibility Hierarchy Hypothesis (NPAH), the Perceptual Differential Hypothesis (PDH), and the Subject-Object Hierarchy Hypothesis. These three hypotheses make different predictions and are based on different expectations of the processing difficulty for different relative clause sentence types (Izumi, 2003).

Many studies have been conducted to investigate the effect of relative clause type predicting the three hypotheses (NPAH, PDH, and SOHH) and on learners' processing of relative clause (Keenan & Comrie, 1977; Gass, 1982; Eckman et al., 1988; Izumi, 2003; Ozeki & Shiai, 2007; Reali & Christiansen, 2006). Gass (1982) has used a variety of testing instruments to test the direct difficulty order among different types of relative clauses, however, she employed only sentence combination tasks as a testing instrument, giving results that supported the NPAH. Eckman et al. (1988) conducted a teaching experiment on L2 adults concerning three types of relative clauses, subject relative clauses, direct object relative clauses and object relative clauses with prepositions. After being taught the target relative clauses, the subjects were asked to take part in a test of sentence combination. They found that the subjects made the fewest errors on subject relative clauses and the most on object relative clauses with prepositions. In other words, subject relative clause was the easiest for L2 adults to acquire, which supports the NPAH. Izumi (2003) tested the predictions of the NPAH, PDH and SOHH regarding relative clause acquisition by

learners of different levels of language proficiency. He employed the sentence combination test adapted from Doughty (1988, 1991), the interpretation test used by Van Patten and his colleagues (Van Patten, 1996) and grammaticality judgement test. His study's results showed that tests of sentence combination and grammaticality judgement partially followed the predictions of the NPAH, in that subject clauses received higher scores than did direct object and object of the preposition clauses, but the prediction was not supported by the difficulty order of direct object and object of preposition clauses. Furthermore, the interpretation test also did not support the NPAH. All the tests, however, were in line with the predictions of the PDH and the SOHH.

Researchers in China also have made some important findings regarding different types of relative clause and their effects on the processing of relative clauses (Wang, 2006; Dai et al., 2008). In the study of Wang (2006), sixty English major sophomores were asked to finish grammaticality judgement and writing tasks. The accuracy order in both tasks was SU > DO > GEN > IO > OPREP > OCOMP, which was consistent with the Noun Phrase Accessibility Hierarchy Hypothesis (S > DO > IO > OPREP > GEN > OCOMP). A more comprehensive study of Chinese EFL learners' acquisition of relative clauses was carried out by Dai et al. (2008), who conducted two experiments in which two groups of Chinese EFL learners were asked to complete sentence combination and writing tasks to test eight related hypotheses. In the first experiment, 36 sophomores with intermediate English proficiency level volunteered to take part. The acquisition difficulty order in the sentence combination test was OS > SS > ODO > SDO > OIO > OOPREP/SOPREP > SIO (">" means easier than), while in the writing task it was OS > SS > ODO > SDO > OIO/OOPREP > SIO/SOPREP (">" means easier than). In the second experiment, 140 freshmen with a low-intermediate English proficiency level participate in the sentence combination test. Their acquisition difficulty order was OS > SS > OIO > ODO > OOPREP > SDO > SIO > SOPREP (">" means easier than).

However, some researchers argued that the type of relative clause did not always affect the processing of relative clauses (Lv, 2006) and that the type of task also affected EFL learners' processing of relative clauses (Chen, 1999; Cai & Wu, 2006; Tang & Xu, 2011). Lv (2006) used sentence combination and sentence interpretation tasks to test Chinese EFL learners' production and comprehension of relative clauses. He found that the type of relative clause type had a significant influence on the processing of relative clauses in the sentence combination test as a production task. In general, the participants got the highest scores in GEN, followed by SU, OPREP, DO and OCOMP. However, in the sentence interpretation test, relative clause type had no significant influence on the participants' acquisition of relative clauses. Tang & Xu (2011) found that relative clause type did influence the processing of relative clauses. Four types of relative clauses, SU, DO, IO and OPREP, were included in their experiment. The results showed that in the sentence combination test, the relative clause acquisition order of difficulty was SU > DO > IO > OPREP; in the grammaticality judgement test, it was SU > OPREP > IO > DO; and in the translation test (from Chinese to English), it was DO > SU > OPREP > IO. Therefore, in their study, the Noun Phrase Accessibility Hierarchy was only confirmed by the sentence combination test, whereas the Perceptual Difficulty Hypothesis was confirmed by the grammaticality judgement test and the translation test. Based on these different results, this research investigated the difficulty order of clause type and the Noun Phrase Accessibility Hierarchy.

While previous studies have increased our understanding of L2 learners' implicit and explicit knowledge of linguistic features in SLA, the current studies attempted to investigate whether time factor and clause type would have effects on Chinese EFL learners' implicit and explicit knowledge of relative clauses, both individually and interactively. The main purpose of the study was to answer the following questions:

1. How does time factor (i.e., timed and untimed) affect Chinese EFL learners' implicit and explicit knowledge of relative clauses?
2. How does clause type (i.e., subject relative clause, object relative clause, object of preposition

- relative clause) affect Chinese EFL learners' implicit and explicit knowledge of relative clauses?
3. How do time factor and clause type affect Chinese EFL learners' implicit and explicit knowledge of relative clauses?

3 Methods

3.1 Research design

This study was an examination of how time factor and clause type would affect Chinese EFL learners' implicit and explicit knowledge of relative clauses, employing a mixed design. It is important to analyze both the production data and the comprehensive data, because tasks in different modalities may present different degrees and/or types of difficulty in learner's language processing (Song, 2016, p. 30). Time available is concerned with whether learners are pressured to perform a task or whether they have an opportunity to plan their response carefully (Ellis, 2005). Operationally, allocating different time limits to different tasks was due to the relationship between task performance and task time, thus distinguishing tasks that make significant demands on learners' short-term memories and those that lie comfortably within their L2 processing capacity. Time factor as a between-subject factor had two levels, i.e., timed and untimed. Different time limits were assigned for each task (i.e., grammaticality judgment task and sentence combination).

Explicit knowledge of relative clauses was measured by the untimed grammaticality judgement and sentence combination task, while implicit knowledge by timed ones. The whole experiment was conducted in class, during which, all participants were asked to do the same grammaticality judgment and sentence combination tasks within the allocated time.

3.2 Participants

The participants in this study were 80 third year intermediate English majors from a Chinese university. The overwhelming majority of them are females (50 females vs. 30 males), their ages ranging from 19 to 22 years old. These participants had at least seven years of English tuition prior to university, with compulsory English classes for their first two years of university.

All are native Chinese speakers having learned English mainly through in class tuition. Before the experiment, the researcher ensured that all the participants had passed Test for English Majors-4 (TEM-4) with scores ranging from 70% to 80%. These participants were randomly assigned into two groups: group one of 40 participants timed and group two of 40 participants under untimed.

3.3 Instruments

3.3.1 Timed and untimed grammaticality judgment task

In much of the research, grammaticality judgment tasks have been exploited to measure learner' knowledge of grammatical target structures (Ellis & Roveever, 2018). Therefore, this study used GJTs as a measure of Chinese learners' linguistic ability. The timed and untimed grammaticality judgment tasks were designed to tap on EFL learners' implicit and explicit knowledge of relative clause. The timed and untimed grammaticality judgement tests consisted of 21 sentences, seven items for each kind of relative clause, including sentences that embedded in the position of subject, that of the direct object position and that of the object of preposition. Of the seven items for each specific kind of relative clauses, four were correct and three incorrect. In order to prevent students from taking this chance, this research designed tests with an unequal number of correct and incorrect items. Four error types were included in

the incorrect items, based on Gass (1982). Pronoun retention, nonadjacency, incorrect relative marker morphology, and inappropriate relative marker omission were listed as four common errors in processing relative clauses by Gass (1982). Examples of the four common errors are given (7a-7d):

(7a) The woman who you met her went to the hospital.

[Pronoun retention]

(7b) The woman is young who likes John.

[nonadjacency]

(7c) I looked for the book who Tom was talking about.

[Incorrect relative pronoun]

(7d) The girl was in pain saw the dentist.

[Inappropriate relative marker omission]

Note: Examples are from Izumi (2003), p. 300.

Grammaticality judgment task with limited response time predisposes learners to draw more on implicit knowledge, while unlimited response time can allow learner to access more explicit knowledge (Loewen, 2009, p. 97). Based on Izumi (2003), 15 minutes were given to participants for the timed grammaticality judgement, the participants were asked to judge whether a sentence was “F (False)” or “T (True)”. Participants needed to decide whether the sentences were grammatical or ungrammatical. If the sentences were determined to be ungrammatical, participants were asked to correct the ungrammatical sentences in the attached brackets. The items included in the untimed grammaticality judgement were the same as those of the timed grammaticality judgement, but the participants were given as much time as they wanted to make a judgment and error correction.

3.3.2 Timed and untimed sentence combination task

As described above, the sentence combination test as a production task has been used frequently in many studies to explore the L2 learners’ acquisition of relative clauses and especially the order of difficulty of the acquisition of different types of relative clause (Izumi, 2003; Yabuki-Soh, 2007; Lv, 2006; Li & Wang, 2007; Tang & Xu, 2011). It is a task that gives learners practice at combination or linking two independent sentences, and adding a conjunction to conjoin two simple sentences into one sentence (Phelps-Gunn & Phelps-Terasaki, 1982; Strong, 1982). Crowhurst (1983) supported that sentence combination resulted not only in increased syntactic fluency in writing, but also in improved quality.

In this study, the sentence combination task, which was adapted from Izumi (2003), was used as a production task with time pressure. Izumi (2003) designed 18 items, with 6 items for each of the subject, direct object and object relative clauses with prepositions in the sentence combination task. The sentence combination task in this study contained 21 items, and each relative clause type had 7 items, with seven items each embedding the relative clause in the subject position, the direct object position and the object of preposition position. Following to Izumi (2003), 15 minutes were given for timed sentence combination task. The items included in the untimed sentence combination task were the same as those in the timed sentence combination task; the only difference was that learners could finish their tests without a time limit. In this task, the learners were instructed to conjoin the two sentences by following the underlined words in the first sentence with the information included in the second sentence. In addition, the participants were also told that the combination should begin with the first sentence. Examples are given by (8a–8c):

(8a) The first sentence: The woman met her best friend in the street.

(8b) The second sentence: Her best friend just came back from China.

(8c) Expected answer: The woman met her best friend who just came back from China in the street.

Participants were not allowed to delete information or add additional information to the two sentences. The coordinating conjunctions *and*, *because*, *since*, *so* and *when* were prohibited.

3.4 Procedures

One week before the experiment, the researcher explained to two EFL teachers instructions and research purpose, and trained them how to handle the materials and answer questions about the instructions in their classes. The experiment was conducted during the regular class periods. Since the teaching schedules differed, each teacher was allowed to administer the experiment in their own class sessions on separate days of the same week.

3.5 Scoring and data analysis

The grammaticality judgement and sentence combination tasks in this study were hand-scored separately by the researcher and checked by other two English teachers. For grammaticality judgment task, if participants could determine grammaticality correctly and give the right correction, responses were scored as 1 for the correct judgment and version provided, 0 for not identifying the ungrammatical items and right correction, and 0.5 for just underlying the ungrammatical times with wrong correction.

For sentence combination task, 1 point was assigned for a sentence only with a correctly used relative clause and no point for a sentence with an incorrect one. Although this research designed settled items for each relative clause type, points were given providing participants produced a correct relative clause. A necessary condition for a test to be valid is proven reliability. Reliability in statistics means ensuring that the participants behave as the study needs them to behave in order to produce quality data. In light of this aim, this research adopted Cronbach's Alpha coefficient to indicate the reliability of the tests and discern whether the tests used were reliable. The reliability of the grammaticality judgement task scores and the sentence combination task scores was subjected to checks concerning its reliability. It was found that the Cronbach's Alpha coefficients for the grammaticality judgement task and for the sentence combination task test were 0.78 and 0.82, respectively, indicating that this research could state its findings confidently and that these two tests good reliability.

To address the research questions, a mixed ANOVA was conducted on Chinese EFL learners' implicit and explicit knowledge separately, with time factor as the between-subjects factor and clause type as a within-subjects factor. The statistical software was SPSS 22.0

4 Results

4.1. Effect of time factor on Chinese EFL learners' implicit and explicit knowledge of relative clauses

It was predicted with regard to the first research question that time factor has an effect on learners' implicit and explicit knowledge of relative clauses. L2 learners rely on their implicit knowledge in the timed contexts, while also using explicit knowledge in the untimed contexts. Table 1 shows the accuracy

scores on L2 learners' timed and untimed tests. The number of participants, mean value, standard deviation, and minimum, and maximum are included in Table 1.

Table 1

Descriptive Statistics for Timed and Untimed Task

	Mean	Minimum	Maximum	N	Std. Deviation
TGJT	8.78	3	14	40	3.19
UGJT	9.58	3	14	40	2.51
TSC	12.88	6	20	40	3.96
USC	15.08	9	20	40	2.84

Note: TGJT=Timed Grammaticality Judgement Test; UGJT=Untimed Grammaticality Judgement; TSC=Timed Sentence Combination; USC=Untimed Sentence Combination.

Table 1 shows that learners obtained a higher mean score in the untimed grammaticality judgement test than they did in the timed grammaticality judgement test ($UGJT = 9.58 > TGJT = 8.78$), which matches the prediction. In the sentence combination test, learners also have higher mean scores for the untimed sentence combination test than they do for the timed test ($USC = 15.08 > TSC = 12.88$), which also matches the prediction. In addition, the standard deviation between the timed and untimed grammaticality judgement tests and the timed and untimed sentence combination tests show a slight variance. Table 2 presents the results of a one-way ANOVA addressing the first research question.

Table 2

The Result of Time Factor on Chinese Learners' Implicit and Explicit Knowledge of Relative Clause

Source	SS	df	F	p	η_p^2
Time Factor	22.23	1	7.77	.008	.17
Error	103.5	38	2.72		

Table 2 reports the effect of time factor on learners' implicit and explicit knowledge. It indicates that time factor had a significant effect on EFL learners' implicit and explicit knowledge ($F = 7.77, p < .05$) with a large effect size ($= 0.17$), indicating that there were differences in the learners' scores between the timed and untimed task. Participants showed better performance on the untimed task than they did on the timed task, which is consistent with the previous studies discussed in the literature review (Bialystok, 1979; Han & R.Ellis, 1998; Mandell, 1999; Loewen, 2009; Bowles, 2011; R.Ellis, 2004, 2005; Suzuki & Dekeyser, 2017). It can be concluded that the variable of time factor influenced learners' knowledge of relative clauses in this study.

4.2. Effect of clause type on Chinese EFL learners' implicit and explicit knowledge of relative clauses

The prediction related to the second research question is that learners have different performances for different relative clause types, thereby revealing the different types of knowledge. For example, the subject and direct object relative clauses are learned explicitly, whereas the object of preposition is acquired implicitly by learners. Table 3 shows the descriptive statistical results for the second research

question. It presents the three relative clause type in both timed/untimed sentence combination and grammaticality judgement tests. From the result shown in Table 3, in the tests of sentence combination, participants did best for subject relative clauses ($M = 11.48$) followed by direct object relative clauses ($M = 8.78$) and then object relative clauses with prepositions ($M = 7.86$). In the grammaticality judgement tests, the order of success for different relative clause types was subject, object of preposition and direct object relative clauses ($M = 6.95$, $M = 5.30$, $M = 5.11$). Participants performed better in the subject relative clause than in direct object relative clause for both task types.

Table 3

Descriptive Statistics for Clause Type

Task Type	N	Mean		
		Relative Clause Type		
		SU	DO	OPREP
GJTs	80	6.95	5.11	5.30
SC	80	11.48	8.78	7.86

Note: GJTs=Grammaticality Judgement Tests; SC=Sentence Combination; SU= subject; DO = direct object; OPREP = object of preposition.

The interesting finding shown in Table 4 is that the mean score for the object of preposition in the untimed sentence combination test is higher than that for the subject and direct object relative clauses, which is not seen in the timed and untimed grammaticality judgement tests.

Table 4

Descriptive Statistics for Clause Type in Timed and Untimed Tasks

Task Type	Group	Mean			N
		Relative Clause Type			
		SU	DO	OPREP	
TSC	1	6.15	4.43	2.46	40
USC	2	5.33	4.35	5.4	40
TGJT	1	3.65	3.18	2.75	40
UGJT	2	3.30	2.93	2.55	40

Note: TSC=Timed Sentence Combining; USC=Untimed Sentence Combination; TGJT=Timed Grammaticality Judgement; UGJT=Untimed Grammaticality Judgement Test; SU = subject; DO = direct object; OPREP = object of preposition.

Table 5

The Result of Clause Type on L2 Learners' Implicit and Explicit Knowledge of Relative Clauses

Source	SS	df	F	p	η_p^2
Clause Type	216.63	2	63.22	.000	.63
Error	170.08	76	2.25		

Table 5 reports the result of the clause type as the effect examined by a one-way ANOVA. The result in Table 5 shows that there was a significant difference for relative clause type ($F = 63.22$, $p = < .05$), with a large effect size ($= .63$), indicating that learners were significantly more accurate on the subject

and direct object relative clauses than they were on object relative clauses with prepositions, and that clause type has a strong explanatory power related to learners' implicit and explicit knowledge of relative clauses.

4.3 The interaction effects of factors on Chinese learners' implicit and explicit knowledge of relative clauses

Table 6 presents the result that the mixed-ANOVA revealed a significant interaction for *Time Factor*Clause Type*, ($F = 23.64, p < .05$), with a larger explanation power on processing the knowledge of relative clauses ($\eta^2 = .38$).

Table 6

Interaction Effects of Time Factor and Clause Type on Learners' Implicit and Explicit Knowledge of Relative Clauses

Source	<i>SS</i>	<i>df</i>	<i>F</i>	<i>p</i>	η_p^2
TF*CT	23.64	88.65	2	.000	.38
Error	142.5	76	1.88		

Note: TF = Time Factor; CT = Clause Type.

5 Discussion

The current study sought to investigate how time factor and clause type affect Chinese EFL learners' implicit and explicit knowledge of relative clauses. Implicit and explicit knowledge of relative clauses were elicited by the grammaticality judgment and sentence combination tasks within time limits. The first research question concerned the effect of time factor on the learners' implicit and explicit knowledge of relative clauses. The results of descriptive statistics showed that learners had higher mean scores on the untimed sentence combination test ($M = 15.08$) than on the timed one ($M = 12.88$). In the timed sentence combination test, participants could only use their implicit knowledge of relative clauses to combine the two sentences because of the time limit; while in the untimed sentence combination test, participants could use their implicit knowledge and their explicit knowledge of relative clauses. In addition, participants also had higher score in the untimed grammaticality judgement test ($M = 9.58$) than in the timed grammaticality judgement test ($M = 8.78$). These two results confirmed the prediction and indicated that Chinese learners have significantly better performance on the untimed tasks than on the timed ones. They are also consistent with other studies that have investigated the effect of time factor. Gutierrez (2013) and Loewen (2009) both found that learners' scores were significantly more accurate on an untimed grammaticality judgement test than on a timed one. The result of mixed-ANOVA also showed that time factor has a significant effect on the scores of the sentence combination and grammaticality judgement tests. Ellis (2004) explained that learners might undergo a three-step process when they performed GJTs: 1) semantic processing (i.e. understanding the meaning of the sentence). 2) noticing (i.e. searching to establish if something is formally incorrect in the sentence). 3) reflecting (i.e. considering what is incorrect about the sentence and why it is incorrect). Ellis proposed that giving learners unlimited time to perform GJTs and learners potentially finished all three operations; if there is not enough time provided, only the semantic and noticing processing could be carried out using learners' implicit knowledge, learners didn't have much time to perform the third operation of reflecting requires learners' explicit knowledge. Learners could understand the meaning of sentences and determine automatically determine sentence grammaticality without conscious awareness; implicit knowledge can be accessed rapidly, while reflecting requires learners not only to understand and determine grammaticality, but to

correct the ungrammatical sentences, which cannot be done by semantic processing and noticing alone. Reflecting therefore involves learners' conscious awareness and ability to verbalise grammatical rules, using their explicit knowledge with no time pressure. This explanation is supported by R. Ellis (2009) and Guitierrez (2013). The implicit knowledge here is similar to automatic or procedural knowledge, which is assumed to be retrieved in parallel thus more rapidly than explicit retrieval, which is thought to be serial and thus slower (R.Ellis, 2006; Bowles, 2011). According to these explanations participants in the timed grammaticality judgement test could access their explicit knowledge of relative clauses if there were no time limit, but are prevented from doing so by the time pressure. Similarly, in the timed sentence combination test, participants only have time to combine the sentences into relative clause structure with their implicit knowledge; in the untimed sentence combination test, participants have enough time to draw on their explicit knowledge and thereby compensate for their limited implicit knowledge (Loewen, 2009; William, 2009).

Although time factor has a close relationship with linguistic knowledge, there remains some problems. The ideal time that should be allocated for the completion of tasks is unclear. Some researchers chose to use a fixed time such as 10 or 15 minutes to control the task (Izumi, 2003; Doughty, 1991); some chose to use a computer-generated time range (Han, 2000; Mandell, 1999; Guitierrez, 2013; Loewen & Nabei, 2007; Loewen, 2009; Godfroid & Winke, 2015). The length of time that allows learners to use their explicit knowledge as of yet still requires further investigation. Furthermore, Loewen (2009) has asked whether a limited time design is adequate for learners to process their implicit knowledge automatically and whether it prevents them from drawing on their explicit knowledge. Some advanced learners may use their explicit knowledge even on the timed tasks. Therefore the adequate amount of allocated time for learners still requires exploration in future studies.

The second research question concerned the effect of clause type on Chinese learners' implicit and explicit knowledge of relative clauses. In the sentence combination task, participants demonstrated the most knowledge of subject relative clause, ($M = 11.48$) followed by direct object relative clause ($M = 8.78$) and then the least of object relative clauses with prepositions ($M = 7.86$), which support the Noun Phrase Accessibility Hypotheses. In the grammaticality judgement tests, the difficulty order of relative clause acquisition was subject ($M = 6.95$) > object of preposition ($M = 5.30$) > direct object ($M = 5.11$), which support the Perceptual Difficulty Hypothesis. These results are consistent with many studies' findings about learners' processing of relative clauses. For instance, Eckman et al., (1988), Izumi (2003) and Roberts (2000) found that in a production task (such as sentence combination tests) the difficulty order of different relative clauses type was SU, DO, OPERP or other relative clauses type, supporting the predictions of the NPAH. Additionally, the mixed ANOVA showed that there was significant main effect ($F = 63.22, p < .000$) on learners' implicit and explicit knowledge of relative clauses, and its Partial Eta Squared is large ($= .63$), indicating that participants were significantly more accurate using subject and direct object relative clauses than using object relative clauses with prepositions. The results of the second research question support the Noun Phrase Accessibility Hierarchy hypothesis of Keen & Comrie (1977) and are consistent with the previous studies (Eckman et al., 1988; Izumi, 2003; Roberts, 2000; Ozeki & Shiai, 2007).

As reported above, learners had the lowest score on OPREP and the highest score for SU on the sentence combination test, which was consistent with Eckman et al. (1988). Eckman et al. (1988) found that the subjects made the fewest errors on SU and the most on OPREP; in other words, SU was the easier for L2 learners to acquire, which supported the NPAH. Additionally, L2 learners received higher scores for SU than for DO and OPREP on the grammaticality judgement and sentence combination tests, but received different scores for DO and OPREP. This finding is consistent with Izumi (2003). For the sentence combination tests, the order of difficulty for the relative clause types was $SU > DO > OPREP$, which matched the prediction of this research; but in the grammaticality judgement tests, the order difficulty for the relative clauses was $SU > OPREP > DO$, which did not match the prediction made by this research. SU and DO were taught earlier to English L2 learners than other relative clause types such

as OPREP (Rokni & Talaposhti, 2012; Kanno, 2000; Izumi, 2003; Dai et al., 2008; Tang & Xu, 2011). L2 learners can be expected to have explicit knowledge of SU and DO through formal study or classroom instructions; therefore, when they were asked to combine the sentences into English relative clause with SU, DO or OPREP, they might use their conscious awareness of relative clause types to combine the sentences in ways with which they were confident. This may explain the difficulty order of SU, DO and OPREP in the sentence combination test. In contrast to the sentence combination test, the order difficulty in the grammaticality judgement test was $SU > OPREP > DO$. For grammaticality judgement tests, learners should complete the three processing operations processing, which demands the use of their implicit and explicit knowledge (Ellis, et al., 2009). It can be seen that L2 learners had implicit and explicit knowledge of SU, DO and OPREP, but the different scores for the different types of clause could be explained by the learners having inaccurate or incomplete metalinguistic knowledge within their explicit knowledge. In this study, learners had explicit knowledge of OPREP or DO, but it may not have been as accurate or complete as their explicit knowledge of SU.

The results revealed that the difficulty order of relative clauses type supported that of the NPAH and PDH, which was in accord with many previous studies' findings (Izumi, 2003; Ozeki & Shiai, 2007; Reali & Christiansen, 2006). To sum up, time factor and clause type both have significant effects on learners' use of their implicit and explicit knowledge of relative clauses.

6 Conclusions

Overall, the present study came at three major findings. First, there was found to be a significant effect of time factor on learners' implicit and explicit knowledge of relative clauses. This finding is supported by a large body of studies showing that time factor requires consideration when exploring implicit or explicit knowledge. Second, the explanatory power of relative clause types is very strong, indicating that subject relative clauses and direct object relative clauses are significantly easier than object relative clauses with prepositions for Chinese learners to process. Third, both time factor and clause type have significant effects on learners' implicit and explicit knowledge of relative clauses, showing that learners had different performances on the processing of relative clauses across time factor.

This study supports the Noun Phrase Accessibility Hierarchy hypothesis and Perceptual Difficulty Hypothesis. It was found that subject relative clauses and direct object relative clauses were easier for Chinese EFL learners to process than object relative clauses with prepositions. This study also provides evidence that learners use their implicit knowledge during the timed tasks and their explicit knowledge during untimed tasks. Loewen (2009) illustrated that the design features of GJTs in terms of time pressure and grammatical or ungrammatical sentences may predispose L2 learners to draw on different types of linguistic knowledge when making their judgements. Teachers could therefore assess L2 learners' syntactic knowledge by designing the special features of GJTs.

SLA researchers persist in establishing to what extent learners (especially adult learners) are capable of implicit learning and to this end they need to be able to assess whether the learning that results from exposure to specific linguistic features such as English relative clauses results in implicit knowledge. The present study has pedagogical implications for the instruction, testing and teaching of English relative clauses for EFL learners. One implication comes from the result that compared subject relative clauses with object relative clauses; object of preposition relative clauses pose a greater difficulty for EFL learners to process. From language instructors who are keen to know whether instruction directed at English relative clauses lead to implicit or explicit knowledge of these features and whether some types of instructions are more likely to achieve this than others. Therefore, during relative clause instruction, English teachers should emphasize the object of preposition relative clauses by analyzing their structure and helping students to understand how it is formed. Meanwhile, for language testers and teachers who also want to know what aspects of a learner's language proficiency their tests measure. The students

should do more exercises concerning objects of prepositions relative clauses to promote the skillful processing of the target structure. Multiple tasks could be used in future teaching to help learners to convert explicit knowledge into implicit knowledge through practice.

The most unexpected finding of this research was that learners performed better at using object relative clauses with prepositions rather than subject and direct object relative clauses in the untimed sentence combination test, despite performing worse at using the same clauses in the other tests. This finding suggests that learners have explicit knowledge of object relative clauses with prepositions; however, teachers could therefore use classroom instructions to enhance learners' implicit knowledge of object relative clauses with prepositions or other complicated relative clauses type.

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