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Effects of Input Frequency Distribution on L2 Acquisition of Chinese Contraction Constructions

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This study selected "再A也不V" as the target construction, examining the impact of skewed and equal input on L2 Acquisition of Chinese contraction structures (CCCs). The experiment involved 105 L2 learners with a Chinese level between HSK4 and HSK5, who were first taught CCCs with sequenced Zipfian frequency (SZF), random Zipfian frequency (RZF), or balanced frequency (BF). They then participated an untimed acceptability judgment task and a timed grammaticality judgment task. Both tasks showed the same result that SZF was more effective than RZF and BF, and this effectiveness was influenced by the participants' explicit or implicit knowledge. The article also discussed effects of the typical and regular presentation of CCCs.

Keywords: input frequency, Chinese constrictive construction, explicit and implicit knowledge

Introduction

The process of language acquisition is driven by linguistic input and influenced by human cognitive mechanisms, following a dynamic and complex process from the acquisition of concrete schemas to the formation of abstract schema patterns (Ellis, 2012). During the initial stages of schema acquisition, low variability input is particularly critical (McDonough & Trofimovich, 2013). It helps learners gradually build an understanding of the linguistic regularity. Low variability input comprises balanced and skewed distributions. Balanced input refers to an equal distribution of item exemplars with the same frequency of tagging. Skewed input features a higher frequency for key item exemplars compared to lower frequencies for other item exemplars. Skewed input can be further divided into sequenced Zipfian frequency (SZF) and random Zipfian frequency (RZF) (McDonough & Nekrasova-Becker, 2014). In SZF, key item exemplars are distributed in a high frequency and ordered sequence. In contrast, RZF involves high frequency distribution of key item exemplars without a fixed order. The role and mechanisms of frequency distribution of language input in L2 acquisition remain a subject of debate in current.

Some studies substantiated the facilitative effect of skewed input on the L2 acquisition. Chinese students tended to have an advantage in acquiring English artificial verb argumeni structures (Zhang & Ma, 2014) and English prepositional phrases in the form of past participle (Zhang & Dong, 2016; Dong & Zhang, 2017).

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Some studies suggested that balanced frequency (BF) input might be more advantageous. The acquisition of English double-object constructions by Korean children (Year & Gordon, 2009), the output of constructions like NP1-NP2-VP by adult L2 learners (Nakamura, 2012), and the learning of English double-object dative constructions by Thai students (McDonough & Nekrasova-Becker, 2014) all indicated it.

Some studies found no significant difference between two types of input. For adult L2 learners acquiring novel syntactic structures, both had similar effects (Nakamura, 2012). For Chinese learners who had not studied English subject clauses, two frequency input had the same impact on their acquisition of object clause (Zhang & Dong, 2019).

The varying research outcomes were attributed to differences in evaluation tasks, learning approaches, target structures, and the input times. Given the contradictory findings and related factors, we hypothesized that different frequencies input had varying facilitative effects on the L2 acquisition of Chinese contraction structures (CCCs). This study set SZF to six times, focusing on two issues:

1. Does SZF perform better than RZF or BF in L2 acquisition of CCCs?
2. Are different input on L2 CCCs development affected by different measure tasks?

Target Construction

The target construction was HSK5 gramma in Chinese Proficiency Grading Standards for International Chinese Language Education, and all the vocabularies in the construction were within the range of HSK1 to HSK4. It meaned that all the participants learned each word in the examples, but were not exposed to these constructions. In the target construction, the adverb "再" conveys an incremental meaning of repetition, continuation, or intensification, assuming that the object has a magnitude characteristic. When there is no relevant comparative item for the assumption object, "再A" is understood as the point at the top of a magnitude sequence, equivalent to "最A". In the sequence of negation conclusions for "不V", "再A" is located at the bottom. According to pragmatic scale theory, the least possible item on the pragmatic scale can imply the negation of other more probable items, achieving the total negation of all items on the pragmatic scale (Fauconnier, 1975). Therefore, "再A也不V" expresses a polar negation that A is at the top of the sequence and still does not V, conveying the irreversible result.

Research Methodology

Experimental Design

The study draws on the experimental methods of McDonough and Nekrasova-Becker (2014) and Zhang and Dong (2016), designing three experimental groups: SZF, RZF and BF, along with control group (CG). Given that time is the critical factor in determining whether learners utilize implicit or explicit knowledge, learners typically employ explicit knowledge for evaluation when time is not constrained, whereas they tend to use implicit knowledge under time constraints (Ellis, 2004; 2005). Therefore, the experimental tasks involve timed grammaticality judgments and untimed acceptability judgments.

During the development phase, participants were trained on sentences containing goal structures using input of SZF, RZF, BF, and CG. In the assessment phase, learners completed an untimed acceptability judgments and timed grammaticality judgments. The experiment adopts a fully randomized 4*2 factorial design. The first independent variable is the frequency distribution among participants, including SZF, RZF, BF, and CG. The

second independent variable is the test task within participants. Each experimental group was required to complete two tasks. The dependent variable is the final scores for two tasks.

Participants

This study selected 105 non-Chinese-speaking international students who had passed HSK4 within the past half year, with scores ranging from 180 to 200 points, and whose Chinese proficiency is less than HSK5. They were aged between 18 and 25 years, with an average age of 22.3 years (*SD* = 0.5). They were randomly divided into four groups. The number of students in each group with different native language backgrounds was roughly balanced, and the gender ratio in each group was approximately equal. The average duration of their previous Chinese learning experience was 1.5 years (*SD* = 1.3), as detailed in Table 1.

Table 1

Participants Information in Each Group

Group	*No.*	Age	Years of learning Chinese	Length of passing HSK4	Sex ratio (M:F)
SZF	28	18-25	1.5	0.5	13:15
RZF	27	18-25	1.5	0.5	14:13
BF	25	18-25	1.5	0.5	12:13
CG	25	18-25	1.5	0.5	13:12

Experimental Materials

This study constructed learning and test sentences around "再A也不V". Ten Chinese students were selected to evaluate the acceptability of all sentences using a four-point scale. The scale includes four options. For the learning sentences, the evaluation scores were not less than 3.17 points, with an average of 3.56 points (*SD* = 0.65). In the test sentences, the acceptability assessment scores were not lower than 3.31 points, with an average of 3.57 points (*SD* = 0.66); the acceptability assessment scores were less than or equal to 1.22 points, with an average of 1.12 points (*SD* = 0.2). There is no significant difference in all experimental materials.

Sentences for Learning

The experimental materials consist of 10 learning sentences, where "A" describs the degree of attributes and behaviors of the hypothesized object (such as "漂亮、晚、胖、痛、饿"), and "不V" elucidates the final outcome (such as "不买、不睡、不减肥、不喝药、不吃"), emphasizing that the results cannot be altered and the counterintuitive effects.

Sentences for Testing

Three versions of test sentences were designed in the study, with Version 1 used for pre-testing and delayed post-testing, Version 2 for mid-testing, and Version 3 for post-testing. Each version includes timed grammaticality judgments and untimed acceptability judgments. Timed grammaticality judgments include 10 grammatical sentences (e.g., "这双鞋再便宜也不买。") and 10 ungrammatical sentences (e.g., "*她再热也不穿衣服。"). Untimed acceptability judgments include 10 grammatical sentences (e.g., "这双鞋子太大了，所以鞋子再便宜也不买。") and 10 ungrammatical sentences (e.g., "*她不喜欢穿太多衣服，所以她再热也不穿衣服。"). The test uses a 7-point scale (l = "Completely unacceptable", 4 = "Uncertain", and 7 = "Completely acceptable") for an untimed test, in order that all participants have enough time to make their judgments.

Data Collections

On the first day, four groups took a pre-test. On the second day, the experimental group students used a projection screen to learn the first five picture-assisted target constructions, followed by a mid-test. On the third

day, participants learned the last five picture-assisted target constructions and proceeded directly to the post-test. To assess the long-term effectiveness of learning the target constructions, a delayed post-test was conducted a week later. The students of CG also participated in the four tests.

Development of Target Constructions

The experimental group was taught target constructions accompanied by images, where each structures' meaning was conveyed through specific visual effects. All learning materials were presented via PowerPoint. As Figure 1, the description sentence was presented firstly (e.g., "a.这件衣服很贵。"), then the target construction was presented (e.g., "b.这件衣服再漂亮我也不买。"). The participants pressed a button to turn to the next page immediately after finishing to read one page and were not allowed to repeat or return.

(a) 这件衣服很贵。 (b) 因此这件衣服再漂亮她也不买。

Figure 1. Target construction: "这件衣服再漂亮她也不买".

Based on Zhang and Ma (2014), six repetitions were sufficient for L2 learners to acquire a new structure, thus this study designed the skewed frequency of six times, the BF of two times. The learning materials were inputted in three frequencies: SZF in 6-1-1-1-1, BF in 2-2-2-2-2, and RZF in random frequency. CG was inputted in the conventional way.

Assessment

Timed grammaticality judgments. Timed grammaticality judgments were designed to measure participants' ability to comprehend constructions by using implicit knowledge. Participants answered by pressing a designated key independently in a computer lab to minimize interference from peers. The accuracy of the learners was recorded by using E-Prime 1.1. Given that L2 processing took longer, each sentence's response time was set at 20% above the average time used by native Chinese speakers (Ellis, 2009).

Untimed acceptability judgments. Untimed acceptability judgments aimed to measure the participants' ability to comprehend constructional tasks using explicit knowledge. All participants must use a 7-point scale for their assessment.

Results

The untimed acceptability judgments rating based on the average of participants, while the timed grammaticality judgments were converted into a proportion. The significance level was set at $p < 0.05$.

Untimed Acceptability Judgement

The untimed acceptability judgments task included grammartical and ungrammartical sentences, therefore, the study adopted a two-independent 4 * 4 (frequency type * test times) mixed ANOVA design. Frequency type was the factor between experimental groups, while test times were the factors within experimental groups. Comparisons of scores for each group in four times were made to further test the effects of different frequency types learning outcomes.

Mixed ANOVA results indicate significant main effects for frequency type (grammatical CCCs: $F(3, 404) = 155.34$, $p < 0.001$, $\eta^2 = 0.278$; ungrammatical CCCs: $F(3, 404) = 9.37$, $p < 0.001$, $\eta^2 = 0.065$), test time (grammatical CCCs: $F(3, 404)= 191.89$, $p < 0.001$, $\eta^2 = 0.342$; ungrammatical CCCs: $F(3, 404) = 152.70$, $p < 0.001$, $\eta^2 =0.274$), and the interaction between frequency type and test time (grammatical CCCs: $F(9, 404) = 20.34$, $p < 0.001$, $\eta^2 = 0.097$; ungrammatical CCCs: $F(9, 404) = 18.93$, $p < 0.001$, $\eta^2 = 0.081$). The data from four groups showed that learners exhibited varying performances across different types of input.

In grammatical sentences (see Figure 2):

1. There were no significant differences among all groups in the pretest (all *P*s > 0.05), confirming that all participants had no difference before learning;

2. the SZF, RZF, and BF groups showed significantly higher scores than their pretest in all post¬test (all *P*s < 0.001), while CG maintained stable scores, indicating that the SZF, RZF, and BF accepted grammatical sentences more than CG;

3. There were no significant differences among SZF, RZF, and BF across all tests (all *P*s > 0.05), suggesting that skewed or balanced input did not affect in accepting grammatical sentences.

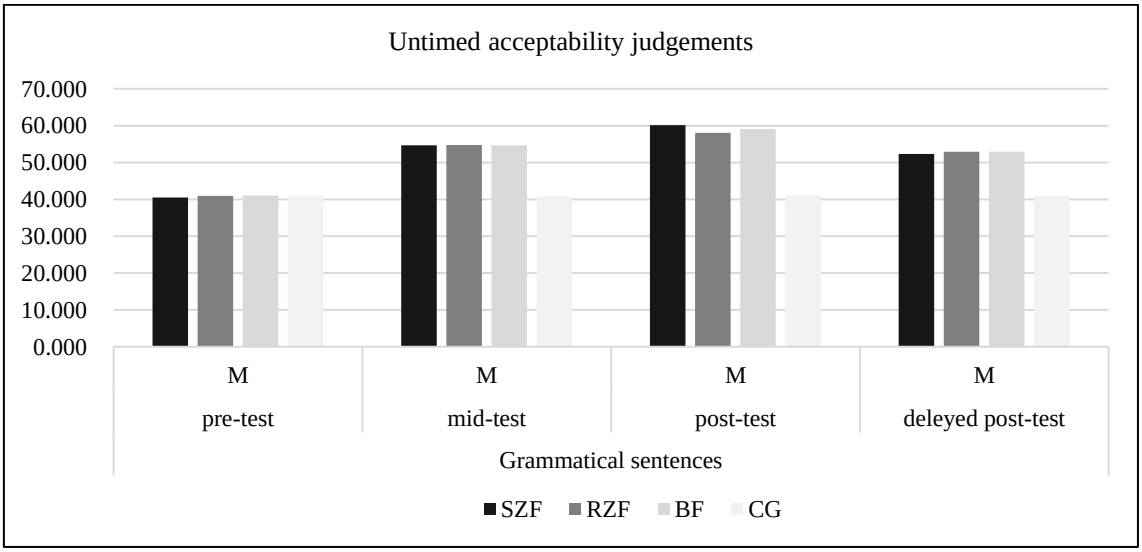

Figure 2. Grammatical CCCs in the untimed acceptability judgments task.

In ungrammatical sentences (see Figure 3):

1. There were no significant differences among all groups in the pretest (all *P*s > 0.05);

2. The SZF, RZF, and BF performed worse than CG during the mid-test, but surpassed CG in both post-tests and delayed post-tests (all *P*s > 0.05), indicating that all three experimental groups overgeneralized the target structures after the first learning. However, the phenomenon decreased after the second learning, suggesting that

a typical input is only effective in excluding ungrammatical sentences when learning has reached a certain duration;

3. SZF outperformed RZF and BF in excluding ungrammatical sentences in both post-tests and delayed post-tests (all *P*s < 0.001), while RZF and BF showed similar performances across all tests (all *P*s > 0.05). It indicated that SZF was more advantageous than RZF and BF in excluding ungrammatical sentences in the long term.

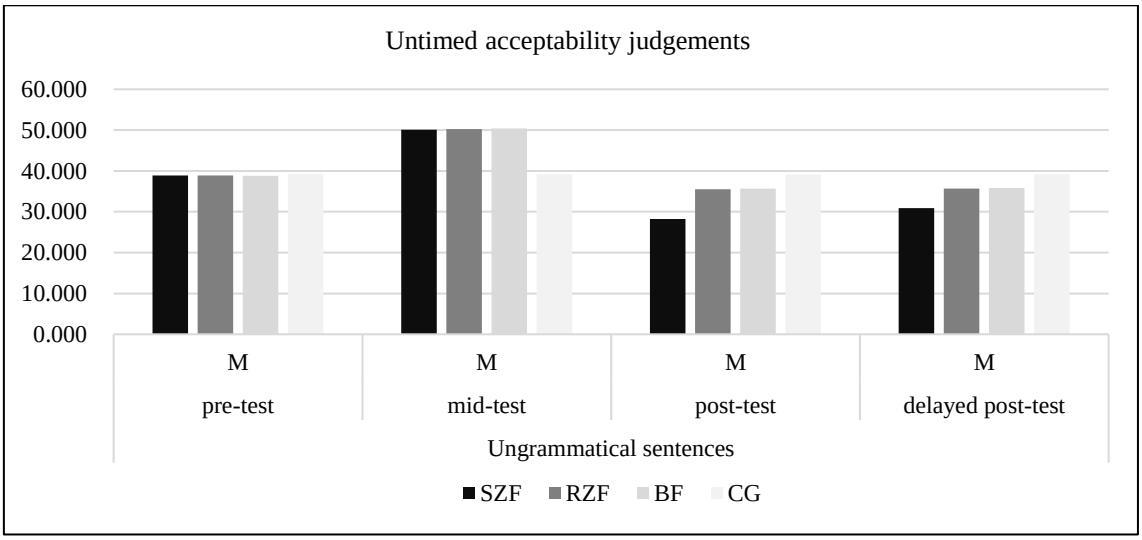

Figure 3. Ungrammatical CCCs in the untimed acceptability judgments task.

Note: The accuracy was higher when the ungrammatical sentence data was smaller, conversely, it decreased when the data was larger.

There was no distinction among the three experimental groups in acquiring the grammatical sentences. However, after a long time of acquisition, SZF performed better than RZF and BF in excluding the ungrammatical sentences, and the effectiveness lasted to the deleyed post-test.

Timed Grammaticality Judgment

Due to the target construction yielding two dependent variables, we conducted independent analyses using logistic mixed-effects models. For the grammatical sentences, there was no significant effect of frequency type on the results (β = -0.101, Wald χ^2 = -0.328, p = 0.743), but there was a significant impact of testing time (β = 0.640, Wald χ^2 = 10.621, p = 0.000), and a significant interaction between the two (β = -0.640, Wald χ^2 = -7.510, p = 0.000). In the ungrammatical sentences, the frequency type had a significant effect on the results (β = -0.181, Wald χ^2 = 21.537, p < 0.001), testing time also significantly affected the results (β = -0.920, Wald χ^2 = -9.226, p = 0.000), and there was a significant interaction between frequency type and testing time (β = 1.000, Wald χ^2 = 7.091, p = 0.000). This indicated that across four tests, learners receiving different input frequencies showed significant differences in performance at testing time.

For the grammatical sentences (see Figure 4):

1. There were no differences across all groups during the pre-test (all *P*s > 0.05);

2. Compared to the pre-test, SZF, RZF, and BF showed significant improvements on all post-tests (all *P*s < 0.001), while CG remained (all *P*s > 0.05), indicating that SZF, RZF, and BF were easier to acquire grammatical sentences than CG;

3. No significant differences were observed between SZF, RZF, and BF on all tests (all *P*s > 0.612), suggesting that skewed or balanced input did not make a difference.

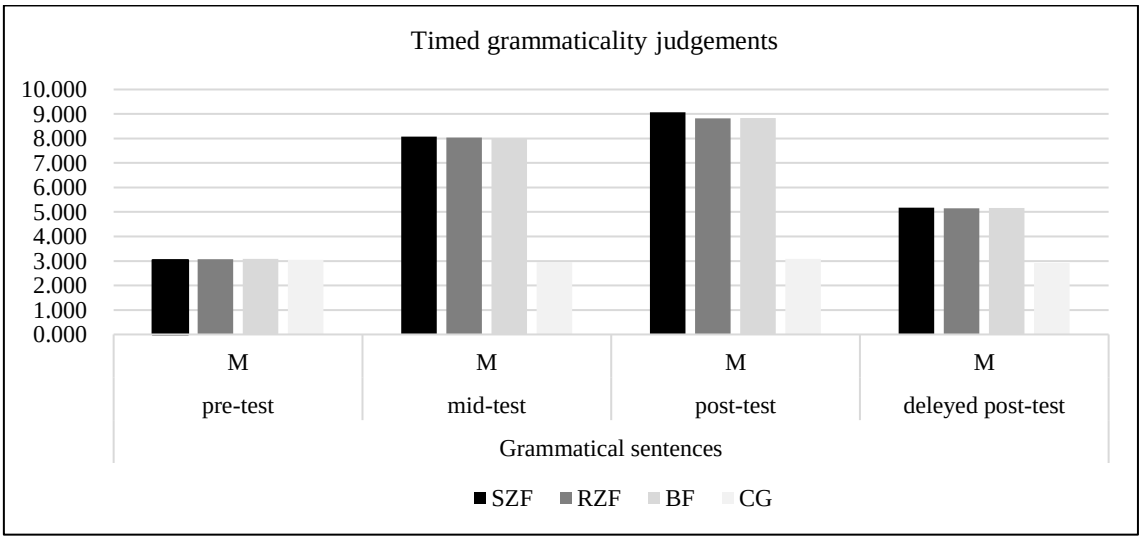

Figure 4. Grammatical CCCs in the timed grammaticality judements task.

For the ungrammatical sentences (see Figure 5):

1. There was no significant difference in performance for all participants in the pretest (all *P*s > 0.05);

2. The scores of the SZF, RZF, and BF were significantly lower than CG during the mid-test, but significantly higher than CG during the post-test and delayed post-test (all *P*s < 0.001);

3. The SZF outperformed the RZF and BF in both the mid-test and post-test, but this advantage did not persist until the delayed post-test; the RZF and BF showed similar performances across all tests.

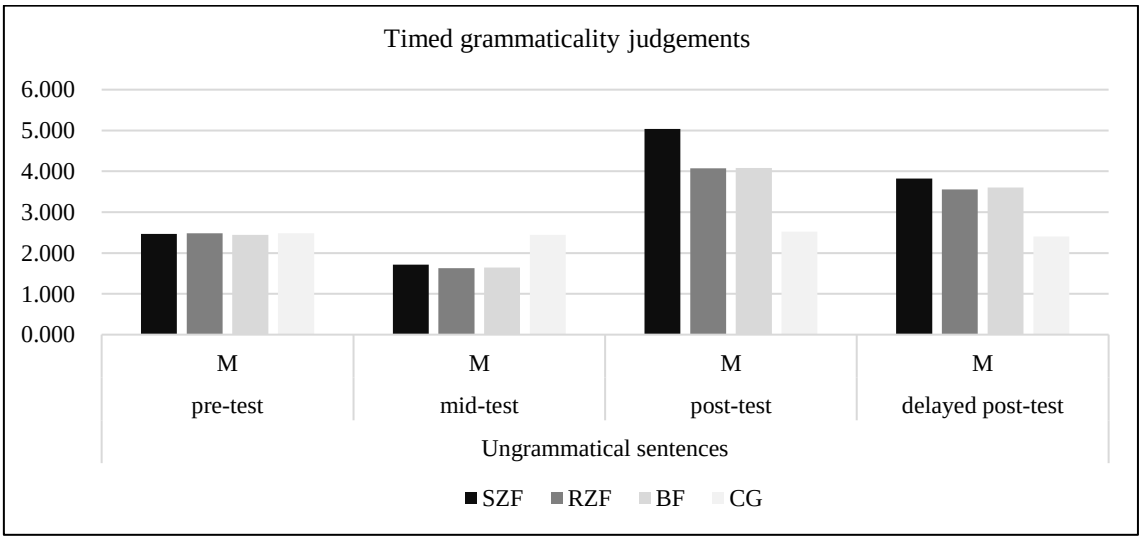

Figure 5. Ungrammatical sentences in the timed grammaticality judgments task.

Based on above analysis, it could be concluded that in terms of implicitly judging the grammatical target constructions, SZF was not superior to RZF and BF. However, after a short-term learing, SZF outperformed RZF and BF in excluding ungrammatical sentences, but this advantage failed to persist through delay post-test.

Discussion

The present study conclude that the effectiveness of L2 CCCs acquisition varies with different input frequencies, and this effectiveness was influenced by the assessment task.

Question 1: Does SZF Perform Better Than RZF or BF in L2 Acquisition of CCCs?

The effect of SZF on L2 CCCs acquisition is significantly superior to RZF and BF.The conclusion of the study by Zhang and Dong (2016) aligned with this perspective. Construction acquisition was a process of building a system of construction knowledge incrementally, with abstract schemas emerging from concrete examples (Ellis, 2012; Zhang & Ma, 2014). Upon acquiring abstract schemas, learners used analogy as a basis for judging other instances, and as the learning process advanced, the category effects of abstract schemas became increasingly pronounced (Mussweiler, 2001). Given their previous formal language learning habits (McDonough & Nekrasova-Becker, 2014; Nakamura, 2012), learners tended to focus on the form of constructions before their meanings. As a result, in the initial phase of acquisition, all experimental groups noticed the "再A也不V" construction form but not its meaning. This resulted in all three experimental groups overgeneralized the target construction and accepted both grammatical sentences and ungrammatical sentences simultaneously during the middle test. After the second learning, the three experimental groups showed significantly enhanced ability to exclude violations. This indicated that as the learning process progressed, CCCs' representation in the learners' mind strengthened, and all three groups constructed the target construction prototype.

The construction of schematic prototypes in RZF and BF was not as stable as in SZF. The reason lied in that the input in SZF was presented in an ordered manner, which strengthened the typical examples. SZF facilitated learners' generalization of the target schema, and promoted the extension of learned linguistic forms to other non-structured contexts through analogy, thus avoiding the overgeneralizing and eliminating structures incapable of producing counterintuitive effects. However, in the RZF and BF input methods, typical examples were not orderedly reinforced and it was difficult for learners to fix language input. Therefore, it was hard to find a breakthrough in acquiring the target schema. Thus, we speculated that SZF is more effective than RZF and BF in inhibiting the overgeneralization and outperforms the RZF and BF.

Question 2: Are Different Input on L2 CCCs Development Affected By Different Measure Tasks?

The employed experimental tasks in this study impacted the effectiveness of L2 CCCs acquisition for different frequency. Following the acquisition of the target structure, SZF demonstrated superior performance in timed exclusion of ungrammatical sentences compared to RZF and BF, whereas there was no significant difference in their performances in untimed exclusion. Under time constraints, learners primarily utilized implicit knowledge to focus on the meaning of the target structure. SZF effectively facilitated the acquisition of implicit knowledge for the target structure, further substantiating the role of high-frequency prototypical input in promoting the acquisition of implicit knowledge (Goldberg, Devin, & Nitya, 2004; Murphy, 2002). Moreover, it also confirmed that ordered reinforcement of SZF was more advantageous than unordered reinforcement of RZF and the balanced approach of BF in promoting the acquisition of implicit knowledge.

The explanation might be that the target construction used in this study combineed a simple "再A也不V" form with comprehensible counterintuitive semantics to create a structure that was easy to remember, facilitating the development of tacit knowledge among learners. Secondly, it could be related to the learning process. In this study, learners were required to learn the compacted construction "再A也不V" with the aid of images, during which they inductively derived linguistic rules based on relevant language knowledge input rather than analyzing

language rules for understanding. This learning process aided learners in forming their implicit knowledge of the target construction (Ellis, 2005). Based on this study, the input from typical core members facilitated learners in forming more accurate schemata. Therefore, teachers can enhance the teaching by emphasizing prototypical examples. By repeatedly presenting prototypical instances, teachers can alleviate cognitive burdens for learners during the learning process, assisting learners in effortlessly identifying schematic constructions (Ellis, O'Donnell, & Römer, 2013).

This study, through the examination of L2 CCCs acquisition, substantiated that SZF aided learners in effectively avoiding overgeneralization of target structures, fostering an automated information processing approach. Consequently, teachers can assist learners by adjusting the regular sequence of prototypical examples presented, enabling them to repeatedly practice. Learners, after regularly and frequently encountering prototypical instances of the target structure, preliminarily generalize the structural knowledge. They can cluster and abstract schematic constructions using acquired target constructional knowledge.

Conclusion

The paper selected CCCs as the subject of study due to their complex semantics, unique functions, and strong Chinese characteristics, which poseed difficulties for L2 learners. At the same time, it explored the impact of different frequency inputs on the acquisition of such constructions, addressing the existing research gap that primarily focused on inflectional or agglutinative languages as target languages.

Based on previous studies, this paper made corresponding improvements: Firstly, considering that the effect of skewed input diminished as the learning process extending, making it hard to observe the outcomes effectively, the frequency of skewed input in this study was set at six times. Secondly, employing acceptability and correctness judgments under both implicit and explicit knowledge, the paper investigated how different frequency distributions affected L2 CCCs acquisition. It also discussed the effects of the typicality of constructions and the regularities in their presentation on the L2 CCCs acquisition.

Simultaneously, this study also has certain limitations. The study only deals with "再A也不V". Therefore, it is possible to expand the research scope, making the research conclusions more generalizable.

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