Effects of Prosody Shadowing on Japanese EFL Learners' Processing of Object Relative Clauses in English

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1. Introduction

Language comprehension involves various stages, including the perception of input information, lexical processing, syntactic processing, semantic processing, contextual processing, pragmatic processing, etc. Syntactic processing, in particular, is the most cognitively demanding for Japanese learners of English, consuming most of their finite working memory (WM), which prevents them from using WM capacity for retention or higher-order processing, such as inference and contextual processing (Nakanishi & Yokokawa, 2011; Nakanishi, Narumi, Hashimoto & Yokokawa, 2019; Narumi, Hashimoto, Nakanishi & Yokokawa, 2018).

For Japanese learners of English, comprehension of sentences containing an object relative clause (e.g., "The lawyer that the banker irritated filed a hefty lawsuit") was significantly lower (Sakakibara & Yokokawa, 2015) and processing time was significantly longer (Hashimoto, 2011) than for a subject relative clause (e.g., "The lawyer that irritated the banker filed a hefty lawsuit"), indicating a higher cognitive load in the processing of the object relative clause (Sakakibara & Yokokawa, 2016; Yokokawa, Sadato & Yoshida, 2014). To understand the object relative clause, the reader must retain the head-noun phrase (e.g., "the lawyer") in the WM until it is integrated with the relative verb (e.g., "irritated") in the object relative clause. As noted in previous research, the distance between the noun and relative verb is greater in an object relative clause than in a subject relative clause (Gibson, 1998; Grodner & Gibson, 2005). This distance is one of the reasons why processing the object relative clause consumes considerable WM resources

compared to the subject relative clause.

The purpose of this study is to explore whether the low automatization of syntactic processing in Japanese learners of English can be resolved by repeated English shadowing. This study deals specifically with sentences containing object relative clauses.

English shadowing is a learning method in which learners immediately repeat the model speech presented. Previous behavioral and brain science experiments have confirmed that the rehearsal process of phonological loops is activated and made more efficient in the WM (Kadota, Kawasaki & Nakanishi, 2015; Kadota, Kawasaki, Shiki, Hase, Nakano, Noro, Nakanishi & Kazai, 2015). Shadowing sentences containing specific syntactic structures may contribute to accelerated automatization of syntactic processing, in addition to the effects on the phonetic aspect pointed out. The reason is that people tend to produce sentences that contain the syntactic structure they processed immediately before, i.e., the syntactic priming effect (Kadota, 2015). As an example of this effect, Bock (1986) indicated that participants tend to reproduce a Prepositional-Object (PO) construction immediately after a PO sentence was visually presented (e.g., "The rock star sold some cocaine to an undercover agent"). On the other hand, they tended to reproduce a double object (DO) construction immediately after a DO sentence was visually presented (e.g., "The rock star sold an undercover agent some cocaine"). This syntactic priming effect has been confirmed in L1 studies (Bock, 1986; Pickering & Branigan, 1998) and in L2 studies (Morishita, Satoi & Yokokawa, 2010). It has also been established that the greater the frequency of exposure to a certain structure, the greater the effect (Morishita & Yokokawa, 2011). Furthermore, Sakakibara and Yokokawa (2015) have shown that having Japanese EFL learners repeatedly read cognitively demanding structures facilitates their comprehension of the target structure. They trained the experimental group by visually presenting a total of 80 English sentences with subject and object relative clauses followed by comprehension questions (e.g., "The rock concert was held in an outdoor stadium. The guitarist that Beth liked began to play a hit song. Q: The guitarist liked Beth"). The control group was also visually presented with 80 total English sentences followed by comprehension questions (e.g., "During the meal, Tom was unable to concentrate. He couldn't take in what was being said around him. Q: Tom

was unable to concentrate"). In addition, 20 questions were given before and after the training to test the participants' comprehension of subject and object relative clauses (e.g., "The patient that ignored the doctor went out. Q: The patient went out"). The results showed that the percentage of correct answers for the subject and object relative clauses increased significantly in the experimental group. In particular, learners with low proficiency significantly improved their scores in object relative clause comprehension.

These studies indicate that when learners are repeatedly exposed to a specific syntactic structure, they can unconsciously utilize the syntactic structure activated in their brains. In this study, target sentences were not presented visually but aurally with enough prosodic information (pitch changes, pauses, etc.). Prosodic information can give significant cues for listening comprehension (Kadota, 2007; Nakamura, 2012; Yoshikawa, 2006). Sentences with such prosodic cues for syntactic construction (e.g., pausing at the main clause, raising the pitch) are assumed to reduce the cognitive load on the learner's syntactic processing.

2. Research Questions

The purpose of this study was to examine whether repeated shadowing of object relative clauses with prosodic structures (with pauses inserted between the subject and verb) would facilitate Japanese EFL learners' processing of the object relative clauses. In addition, this study explored whether the shadowing effect would differ according to individual English ability.

3. Method

3.1 Participants

A total of 29 Japanese EFL undergraduate students (8 male and 21 female) participated in the study. Their proficiencies were measured using the Oxford Quick Listening Test (OQLT; Allan, 2004). Their scores ranged from 66 to 86 out of 100 possible marks (M = 76.83, S.D. = 4.33). After converting the scores according to the Common European Framework of Reference for Languages (CEFR), the 29 participants included 1 Intermediate (B1), 9 Upper-

Intermediate (B2), 17 Advanced (C1) and 2 Proficient (C2) users.[1] Then participants were divided into two groups according to CEFR scores: the group with lower level English proficiency (10 students, CEFR B1 and B2) and the group with higher level English proficiency (19 students, CEFR C1 and C2).

3.2 Procedure

All participants completed pre/posttests (i.e., pre/post-reading-aloud tests) and shadowing training tasks. All tests were conducted in a CALL classroom, and the participants' voices in the pre/posttests and shadowing training were recorded on a computer.

3.3 Pre/Posttests

All participants were required to take a reading-aloud test before and after the shadowing training. Tests contained 18 total sentences, including 12 target sentences (relative clause) and 6 filler sentences (see Appendix A). All words used in the sentences were selected from the New JACET List of 8,000 Basic Words (Committee of Revising the JACET Basic Words, 2016). Head nouns in all experimental sentences were animate, referring to Traxler, Morris, and Seely (2002) and Hashimoto (2012), as inanimate head nouns facilitate the processing of relational clauses. In additional reference to Traxler et al. (2002) and Hashimoto (2012), the head noun phrases in all experimental sentences were unified into animate nouns so that the animate nature of nouns would not affect the difficulty of processing relative clause sentences.

All target sentences that included a relative clause consisted of 12 words (e.g., "The farmer that the lady loved grows a crop in the field"), and filler sentences consisted of 10 words (e.g., "The painter has been painting a picture for his fans"). The sentences used between pretests and posttests were different.

The reading-aloud test incorporated semantic judgment tasks, so half the

[1] Officially, CEFR scores should have been converted with both grammar test and listening test scores. In this study, the grammar test was not conducted, so only the listening scores were used to convert to CEFR.

sentences were semantically correct (e.g., "The police that the people know arrested the suspect in the crime"). Half were incorrect (e.g., "The climber that the artist wears drew a picture in the studio"). A total of 18 sentences were presented to the participants on a paper. They were required to read each sentence aloud and say "T" if the sentence was semantically plausible or "F" if it was implausible.

3.3 Shadowing Training Sessions

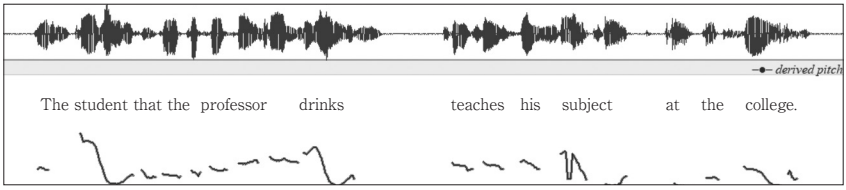
A total of 60 sentences constituted the shadowing sessions, including 40 target sentences (relative clause) and 20 fillers (see Appendix B). All words used in the sentences came from the New JACET List of 8,000 Basic Words. All target sentences consisted of 12 words (e.g., "The farmer that the lady loved grows a crop in the field"), and filler sentences consisted of 10 words (e.g., "The writer has been writing the essay for the readers").

For the sound models, a male native speaker of American English was recorded at a speaking rate of approximately 143 words per minute. The pause (0.4 seconds) was inserted at appropriate syntactic boundaries (e.g., "The farmer that the lady loved % grows a crop in the field." : % indicates a prosodic boundary) with free sound editing software, Audacity 3.2.1 (Audacity Team, 2021). Figure 1 shows the waveforms and pitch tracks of the sentences.

Participants received the sentences printed onto paper to ensure sentence processing. While following the text, they were required to repeat the sound model immediately after listening.

Figure 1

The student that the professor drinks % teaches his subject at the college.



4. Results and Discussion

4.1 Results of Pre/Posttest Performances for All Participants

Table 1 provides the descriptive statistics for accuracy (Score), reading time (RT: sec.), and solution time (ST: sec.) in the reading-aloud tests. Score shows the number of sentences processed correctly, RT indicates the reading time per syllable for correct responses, and ST represents the response time per sentence for correct responses. RT and ST were measured using Praat software. RT was calculated by dividing the total time spent reading by the number of syllables. ST was measured as the length of time from immediately after the end of the oral reading to the beginning of answering the semantic judgment task.

Table 1
Descriptive statistics of the reading-aloud test data for all participants

	Score		RT		ST	
Test	Pre	Post	Pre	Post	Pre	Post
Avg.	7.65	8.63	0.25	0.25	1.79	1.58
Max.	4.00	3.00	0.12	0.10	0.39	0.39
Min.	12.00	12.00	0.46	0.46	5.78	5.78
S.D.	2.25	2.53	0.02	0.11	1.20	0.87

To measure the effects of shadowing training, Score, RT, and ST were analyzed statistically with t-tests. The results of the t-tests revealed that posttest Scores were significantly better than those in the pretests ($t(28) = -6.86$, $p < .01$). RT and ST in the posttests were significantly faster than those in the pretests (RT: $t(28) = 9.69$, $p < .01$, ST: $t(28) = 2.96$, $p < .01$). This means that shadowing training improved participants' accuracy, RT, and ST.

4.2 Results of Pre/Posttest Performances by Proficiency

Tables 2 and 3 show the reading-aloud test data (Score, RT, and ST) for individuals with higher and lower proficiency.

Table 2

Descriptive statistics of the reading-aloud test data for the lower proficiency group

	Score		RT		ST	
Test	Pre	Post	Pre	Post	Pre	Post
Avg.	6.40	8.90	0.36	0.14	2.32	1.26
Max.	4.00	6.00	0.31	0.12	0.99	0.39
Min.	9.00	12.00	0.46	0.17	5.78	2.40
S.D.	1.90	1.91	0.05	0.02	1.43	0.62

Table 3

Descriptive statistics of the reading-aloud test data for the higher proficiency group

	Score		RT		ST	
Test	Pre	Post	Pre	Post	Pre	Post
Avg.	8.00	10.21	0.32	0.18	1.61	1.31
Max.	3.00	7.00	0.21	0.10	0.60	0.40
Min.	12.00	12.00	0.40	0.40	3.47	2.09
S.D.	2.73	1.81	0.06	0.09	0.75	0.40

To measure the effects of shadowing by proficiency group, we did a two-way ANOVA analysis for lower/higher proficiency and pre/posttest. Regarding score, the results of the two-way ANOVA revealed a significant main effect in terms of proficiency ($F(1, 54) = 5.80$, $p < .05$, partial $\eta 2 = .097$) and pre/posttest ($F(1, 54) = 15.19$, $p < .01$, partial $\eta 2 = .220$). The analysis indicated no interaction between the variables of proficiency and pre/posttest at $F(1, 54) = 0.06$, ns., partial $\eta 2 = .001$.

As for RT, the results of the two-way ANOVA revealed a significant main effect for proficiency ($F(1, 54) = 0.95$, $p < .01$, partial $\eta 2 = .000$), whereas the main effect of the pre/posttest was not significant ($F(1, 54) = 0.00$, ns, partial $\eta 2 = .647$). The RT revealed a significant interaction between proficiency and testing, $F(1, 54) = 4.93$, $p < .05$., partial $\eta 2 = .084$. Analysis of the simple main effect of proficiency and testing disclosed that the RT in the posttest was significantly faster than that in the pretest for the higher proficiency group ($p < .01$) and the lower proficiency group ($p < .01$).

Regarding ST, the two-way ANOVA revealed no significant difference between lower and higher proficiency groups, $F(1, 54) = 2.22$, ns, partial $\eta 2 = .040$. However, a significant difference exists between the pretest and posttest, $F(1,54) = 9.33$, $p < .01$, partial $\eta 2 = .147$. In addition, ST produced a marginally significant interaction between proficiency and testing, $F(1, 54) = 2.92$, $p = .09$, partial $\eta 2 = .051$. An analysis of the main effect of proficiency and testing disclosed that the STs of participants with higher proficiency were significantly faster than participants with lower proficiency in the pretest ($p < .05$), but no significant difference was seen in the posttest.

The findings of this section can be summarized as follows:

(1) For all participants, repeated shadowing of sentences containing object relative clauses improved accuracy, RT, and ST in the posttest more than in the pretest.

(2) The group with higher proficiency performed better than the group with lower proficiency when it came to accuracy and RT for sentence processing of object relative clauses. On the other hand, in terms of ST, the group with lower proficiency took longer than the group with higher proficiency in the pretest, yet this difference was not apparent in the posttest.

5. Conclusion and Further Study

The present study showed that prosody shadowing training facilitated the processing of object relative clauses. In particular, the comprehension speed of learners with low proficiency was accelerated.

Previous studies have shown that repeatedly exposing learners to visually presented constructions promotes automaticity in syntactic processing. Further learning effects are also expected from the audio presentation of the stimulus sentences. The reason is that prosodic information (e.g., pitch, pause,

etc.) in speech is a cue for syntactic construction, as shown in studies with native English speakers (Schafer et al., 2000) and with second language learners (Nakamura, 2012; Yoshikawa, 2006). This tendency is stronger among second language learners, which is consistent with the "shallow processing hypothesis" proposed by Clahsen & Felser (2006). This hypothesis states that second language learners have incomplete syntactic processing skills and are unable to construct complex syntactic structures like native English speakers. They instead rely on non-structural cues such as lexical, semantic, and contextual information for processing. Prosodic information as cues to syntactic construction (e.g., using a pause or raising the pitch at the main clause) are also assumed to reduce the cognitive load on learners' syntactic processing (Nakamura, Arai & Harada, 2015). This study showed that presenting speech rich in prosodic information directs the learners' attention to prosodic aspects and that repeatedly shadowing complex constructions such as object relative clauses facilitates sentence processing.

One of the limitations of this study, which has the nature of a pilot study, is the need to set up a control group (e.g., a listening training group) in order to see the unique effects of shadowing. In addition, it is also necessary to compare acoustic analysis before and after shadowing to see whether repeated shadowing not only improves processing accuracy and speed, but also enables the realization of prosodic boundaries (indicated by %) on syntactic boundaries (indicated by /) when reading aloud object relative clauses as in the following sentences, "The farmer that the lady loved %/ grows a crop in the field".

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Appendix A

Sample Target Sentences for Pre/Post-Reading-Aloud Test

The farmer that the lady loved grows a crop in the field.
The student that the expert drinks teaches his subject in the university.
The mother that the actor loves married her husband in the church.
The owner that the bakery cooked made the sandwich in the morning.

Appendix B

Sample Target Sentences for Shadowing Training

The actor that the daughter respects won an award for the movie.
The swimmer that the singer ate sings a song on the spot.
The singer that the swimmer follows sings a song from his heart.
The batter that the fans watch hits the ball in the stadium.