Jacet Kansai J. **12** (2010), 20-31. © Kansai Chapter, JACET 2010
ISSN 1880-2281 Printed in Japan

The effect of different latencies and sentence lengths on repeating tasks: Further analyses of Morishita (2008)

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Abstract

This study aims to investigate the speech processes of Japanese EFL learners at different proficiency levels in comparison to those of native English speakers, focusing on repeating tasks. Based on the results of Morishita (2008), who examined the effect of different latencies (artificial pauses) and sentence lengths on utterances using repeating and open question tasks, the present study further analyzes the data obtained from repeating tasks in a quantitative approach. Although no statistically significant effect of different latencies was observed, there was a tendency for upper level students to inaccurately repeat the sentences when both latencies and sentences were long, while lower level students had trouble repeating even short-length sentences when latencies were long. It was also found that speech rates (syllables per minute) decreased and response latencies (the silence before speaking) increased as the sentences became longer in the case of both upper and lower level students, which was not the case for native English speakers. The results of the present study will serve as a stepping stone to carry out further research on ways of using repeating tasks (e.g., what kind of repeating tasks should be given to different levels of learners), which have, up to now, been generally based on teachers' instincts alone.

Key words: speech processes, latency, repeating tasks

1. Introduction

Japanese EFL learners are said to be much weaker in speaking than other language skills. In fact, the mean score of native speakers of Japanese was the lowest in the world ranking in the speaking section of TOEFL® iBT (Internet-based Testing) according to Educational Testing Service (2007). This can be regarded as a very serious situation in terms of international competitiveness, not only in academic fields, but also in business (Morishita, 2008, p.17). Therefore, in order to obtain an effective speaking pedagogy for Japanese EFL learners, research on their speech processes, which has been very limited so far, should be urgently implemented.

The purpose of the present study is to investigate the speech processes of Japanese EFL learners at different proficiency levels in comparison to those of native English speakers based on the data of repeating tasks obtained from Morishita (2008). The participants were given different latencies (artificial pauses) and sentence lengths to examine the level of automaticity, a mandatory

requirement for speaking ability, from different perspectives.

2. Literature Review

2.1 Levelt's Spoken Language Processing Model

It may be no exaggeration to say that most psycholinguistic research on speaking has been based on Levelt's spoken language processing model shown in Figure 1.

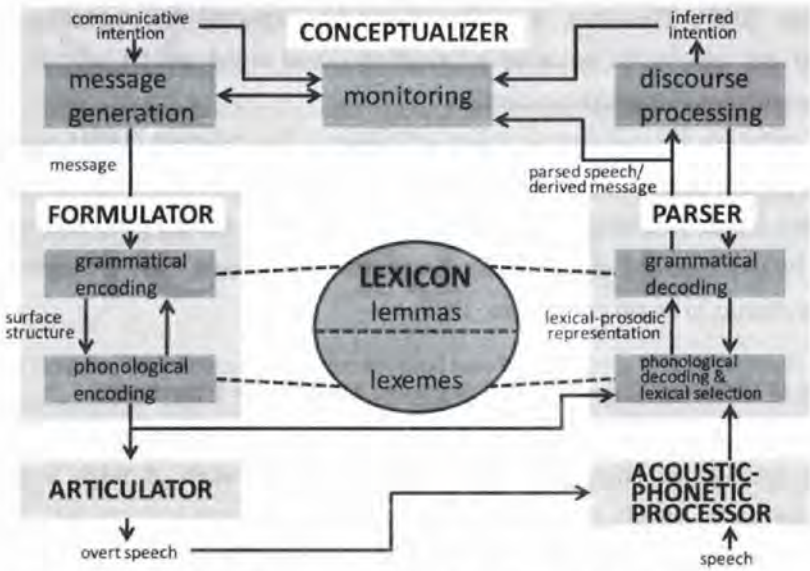

Figure 1. Schematic Representation of the Processing Components Involved in Spoken Language Use. Reprinted from Levelt, 1993, p.2.

Processes on the right represent listening and those on the left represent speaking. We first think about what we are going to say in the *conceptualizer*. Then, in the *formulator*, grammatical encoding accesses lemma information stored in one's mental lexicon and builds syntax, while phonological encoding accesses lexeme information to retrieve a phonetic or articulatory plan for each lemma and for the utterance as a whole. The *articulator* retrieves successive chunks of internal speech and unfolds them for execution (Levelt, 1989, 1999).

Although this speech process is automatic and simultaneously processed in the case of native speakers, it is a demanding one for non-native speakers and trade-off effects are often observed between fluency, complexity and accuracy of the speech.

2.2 Repeating Tasks

The idea of giving different latencies in repeating tasks in the present study came from a teaching method called "Read and Look Up" (West, 1960), a kind of oral reading method where learners read a sentence and look up and say it (i.e., not simply reading aloud). In this method, learners require concentration and cognitive load in order to access their mental lexicon and retrieve

the right word(s), especially when certain pauses are given until they are allowed to speak. This ultimately leads to language acquisition. Giving different latencies to repeating tasks may also have a similar effect to that of "Read and Look Up" on learners, or, because they are listening rather than reading, the effect may be stronger.

Unlike other similar tasks such as oral reading and shadowing, which mainly act on the articulator in Levelt's spoken language processing model, repeating tasks require processing functions such as grammatical encoding and phonological encoding in the formulator (Kadota, 2007; Morishita, 2008). Therefore, it can be reasonably expected that repeating tasks stimulate one's access to and retrieval of syntactic information stored in the mental lexicon, which leads to increased automaticity in language production.

Repeating tasks can be regarded as a part of Palmer's Oral Method (1921), where language is taught through pattern practice. Given they are not mechanical tasks in reality but cognitively more demanding ones, where structural understanding is required, we should have another look at them. Being able to be implemented in nearly any classroom environment, they are especially useful for relatively large classes in Japan (Morishita, 2008).

2.3 The Effect of Different Latencies and Sentence Lengths on Utterances

Morishita (2008) examined the effect of different latencies and sentence lengths on utterances of Japanese EFL learners in comparison to native English speakers through a psycholinguistic experimental approach based on Levelt's spoken language processing model. The participants consisted of 15 native English speakers and 36 Japanese university students, who were divided into upper and lower proficiency groups. They were given six sentences for repeating tasks with three types of latencies (0, 5 and 10 second artificial pauses provided before speaking) and three questions for open question tasks with three types of latencies (0, 10 and 20 second artificial pauses). Their utterances were recorded and transcribed to count the number of words produced. The results demonstrated that different latencies in both tasks did not affect either native English speakers or Japanese EFL learners, while different sentence lengths in repeating tasks affected only the latter.

Since Morishita (2008) did not fully observe the effect of different latencies on utterances in repeating tasks, the present study aims to further examine the interaction effect of different latencies and sentence lengths on such tasks. It also investigates their effect on other aspects of utterances such as speech rates, articulation rates and response latencies.

3. Experiment

3.1 Research Questions

The present study addresses the following research questions:

1: How do different latencies and sentence lengths affect the accurate reproduction in repeating tasks?

2: How do different latencies and sentence lengths affect fluency in repeating tasks?

3: How do different latencies and sentence lengths affect response latencies in repeating tasks?

3.2 Methods

Participants, tasks and utterance data were the same as those of Morishita (2008).

Participants

Thirty-six Japanese undergraduate and postgraduate students learning English as a foreign language and 15 native English speakers living in Japan participated in the experiment. None of them had auditory or visual disorders. The Japanese EFL learners were divided into high (n = 17) and low (n = 19) English proficiency groups according to their scores on the *Versant English Test,* a 10-minute computerized telephone test (Versant with Ordinate® Technology, 2006). It evaluates general ability of test-takers to understand spoken English and to respond appropriately in English, and has meaningful correlations with related tests of English proficiency, such as TOEFL®. The score range of the high proficiency group was 40 to 57 and that of the low proficiency group was 24 to 39 (Full score = 80).

Tasks

In the experiment, six sentences for repeating tasks were prepared as shown in Table 1. They were adapted from the sample repeating tasks of the Versant English Test, with minor modification to control the number of syllables.

Table 1. Experimental Sentences and Their Conditions

		words (#)	syllables (#)	speech time (sec)
Short	1 War broke out suddenly.	4	6	1.46
	2 Leave town on the next train.	6	6	1.50
Medium	3 It's supposed to rain hard tomorrow, isn't it?	8	11	2.17
	4 Traffic is a huge problem in California.	7	11	2.31
Long	5 They play loud music all through the night when he is trying to sleep.	14	16	3.77
	6 There are three basic ways where a story might be told to someone.	13	16	3.73

Sentence lengths were not based on the number of words but on the number of syllables with reference to Kohno (1993). He defined seven plus or minus two syllables, whose intervals are less than about 330 ms, as a Perceptual Sense Unit (PSU), a perceptible unit of human memory. Therefore, tasks are considered to be increasingly difficult to process for Japanese EFL learners as the sentences become longer. In contrast, native English speakers can generally repeat the sentences that contain more than seven syllables because they can use the method of "chunking," a process of grouping individual information into larger units (Miller, 1956).

Auditory memory is believed to disappear within a few seconds unless being rehearsed in the phonological loop in working memory (Baddeley, 1986, 2000). This means that, short-length

sentences, whose speech time (duration) in the original recordings was around 1.5 seconds, require no rehearsal, while long-length sentences do require rehearsal for accurate reproduction, and medium-length sentences are situated on the border.

Three different latencies were given for articulatory rehearsal and each condition had two sentences as shown in Table 2.

Table 2. Latency Conditions

No latency	2
Short latency (5 seconds)	2
Long latency (10 seconds)	2
Total	6

All sentences were recorded by a native speaker of English. Beeps were inserted after each sentence with three types of latencies (0, 5 and 10 seconds), and after 10 seconds of the response time, a sentence was subsequently given. In order to counterbalance latencies to avoid the impact on each sentence, three types of sound files were made with a combination of different latencies.

Procedure

Each participant in the experiment was tested individually while seated next to the experimenter. Before the experiment started, the instructions were given and the participants were required to sign a letter of consent. Then, the participants put on headphones and a miniature microphone and listened to a set of practice tasks. After each beep, latencies of different lengths were provided, and participants were required to repeat three sentences with different latencies.

After the practice session, they were able to ask questions if needed and when they were prepared, the main tasks started. The main tasks were conducted in the same manner as the practice session on a laptop personal computer running Microsoft Windows XP. Their utterances were recorded with an IC recorder and transferred to the computer.

After the experiment, all the utterances were transcribed in an orthographic manner, not based on phonetics. Each word was counted only once even if it was repeated more than twice. Minor pronunciation errors were allowed, but words pronounced in a way where participants obviously did not know them were not counted.

Speech rates were produced by dividing the number of syllables by the speech time (duration) and then multiplying it by 60 to obtain the number of syllables per minute (Riggenbach, 1991). Articulation rates were produced by subtracting silent pauses (longer than one second) from the speech time of each response before following the same method as speech rates.

In addition, response latencies, or the silence after the beep before the participants spoke, were measured using Sound Engine (ver. 3.10).

4. Results

Data of the rates of accurately repeated words, speech rates, articulation rates and response

latencies were analyzed in a three-way analysis of variance (ANOVA) with proficiency levels as a between-participants factor, lengths of latencies and those of sentences as within-participants factors (significance level = .05). Tukey's HSD post hoc test was used for multiple comparisons.

4.1 Mean Rates of Accurately Repeated Words

The mean rates of accurately repeated words are shown in Table 3.

Table 3. Mean Rates of Accurately Repeated Words (%) and SDs

	Latencies	Short		Medium		Long	
NS	0	98.3	(0.50)	100.0	(0.00)	92.0	(0.99)
	5	100.0	(0.00)	93.8	(1.88)	95.4	(0.92)
	10	100.0	(0.00)	100.0	(0.00)	96.4	(0.66)
Upper	0	75.8	(2.12)	73.2	(2.41)	52.5	(1.66)
	5	86.1	(1.61)	78.1	(2.15)	57.8	(1.53)
	10	93.8	(1.13)	81.8	(2.11)	46.2	(2.10)
Lower	0	71.2	(1.98)	57.5	(2.31)	32.4	(1.47)
	5	75.0	(1.54)	64.3	(1.93)	34.6	(1.89)
	10	60.6	(2.52)	54.7	(2.56)	37.5	(1.52)

The ANOVA obtained significant main effects for proficiency levels, $F(2, 28) = 107.91$, $p < .01$, and for sentence lengths, $F(2, 56) = 51.67$, $p < .01$. The interaction of sentence lengths and proficiency levels was also significant, $F(4, 56) = 8.45$, $p < .01$. Neither main effect nor two-factor interactions for latencies were significant. Three-factor interaction was also not significant.

The results of multiple comparisons for the interaction of sentence lengths and proficiency levels showed that the significant differences were observed in all conditions except short-length and medium-length sentences between native English speakers and upper level students as well as short-length sentences between upper and lower level students.

Upper level students tended to accurately repeat short-length and medium-length sentences, and their utterances gradually increased as latencies became longer with the only exception being the case of long-length sentences in the 10 second condition. Lower level students increased their utterances when they were given 5 second latencies, but the figures decreased under the 10 second condition for short-length and medium-length sentences. This means that 10 seconds might have been too protracted for lower level students to effectively rehearse the sentences in the phonological loop (see 3.2).

4.2 Mean Speech Rates and Mean Articulation Rates

Speech rates and articulation rates based on the number of syllables per minute were examined to compare the level of fluency between each group.

The mean speech rates are shown in Table 4.

Table 4. Mean Speech Rates (syllables per minute) and SDs

	Latencies	Short		Medium		Long	
NS	0	247.91	(22.90)	296.55	(33.86)	283.74	(52.53)
	5	218.10	(29.10)	296.33	(74.25)	287.44	(19.00)
	10	254.11	(50.47)	312.31	(41.76)	284.92	(43.81)
Upper	0	187.94	(31.48)	179.92	(71.58)	124.57	(42.31)
	5	190.00	(46.93)	176.03	(58.80)	111.51	(36.20)
	10	208.31	(32.13)	192.85	(61.03)	128.07	(46.65)
Lower	0	187.65	(43.07)	131.52	(50.07)	85.54	(45.90)
	5	148.23	(44.27)	135.02	(51.36)	108.03	(40.94)
	10	147.70	(70.88)	140.77	(63.28)	100.00	(33.98)

The ANOVA obtained significant main effects for proficiency levels, $F(2, 27) = 111.91$, $p < .01$, and for sentence lengths, $F(2, 27) = 28.94$, $p < .01$. The interaction of sentence lengths and proficiency levels was also significant, $F(4, 54) = 28.81$, $p < .01$. Neither main effect nor two-factor interactions for latencies were significant. Three-factor interaction was also not significant.

The results of multiple comparisons for the interaction of sentence lengths and proficiency levels showed that the significant differences were observed in all conditions except short-length sentences between native English speakers and upper level students as well as short-length, medium-length and long-length sentences between upper and lower level students.

Native English speakers tended to speak slowly when the sentences were short, while the speech rates of Japanese EFL learners gradually decreased as the sentences became longer. Overall, both upper and lower level students spoke much more slowly than native English speakers.

The mean articulation rates are shown in Table 5.

Table 5. Mean Articulation Rates (syllables per minute) and SDs

	Latencies	Short		Medium		Long	
NS	0	247.91	(22.90)	296.55	(33.86)	283.74	(52.53)
	5	218.10	(29.10)	296.33	(74.25)	287.44	(19.00)
	10	254.11	(50.47)	312.31	(41.76)	284.92	(43.81)
Upper	0	187.94	(31.48)	210.51	(54.89)	155.04	(43.78)
	5	197.23	(38.33)	178.12	(54.01)	135.15	(39.05)
	10	208.31	(32.13)	198.19	(48.20)	161.59	(47.34)
Lower	0	187.65	(43.07)	160.07	(31.09)	122.08	(36.77)
	5	155.55	(39.28)	141.24	(44.86)	125.96	(36.63)
	10	160.57	(58.16)	151.00	(58.78)	129.15	(31.99)

The ANOVA obtained significant main effects for proficiency levels, $F(2, 27) = 98.50$, $p < .01$, for sentence lengths, $F(2, 54) = 18.74$, $p < .01$, and for latencies, $F(2, 54) = 3.47$, $p < .05$. The interaction of sentence lengths and proficiency levels was also significant, $F(4, 54) = 23.47$, $p < .01$. Three-factor interaction was not significant.

The results of multiple comparisons for the interaction of sentence lengths and proficiency levels showed that the significant differences were observed in all conditions except short-length sentences between native English speakers and upper level students as well as short-length, medium-length and long-length sentences between upper and lower level students.

Overall, Japanese EFL learners' mean articulation rates were much higher than those of their mean speech rates in Table 4, meaning that they produced many silent pauses (longer than one second) in their utterances. In the case of short-length sentences, the mean articulation rates of both upper and lower level students were almost the same as their mean speech rates, showing that they produced fewer silent pauses in comparison to the case of medium-length and long-length sentences. Both upper and lower level students tended to pause a lot in the 0 second condition for medium-length and long-length sentences, and the former produced quite a few silent pauses especially when they tried to repeat long-length sentences in the 10 second condition.

4.3 Mean Response Latencies

Response latencies (the silence before speaking) were examined to compare the automaticity level (processing speed) between each group.

Table 6. Mean Response Latencies (second) and SDs

	Latencies	Short		Medium		Long	
NS	0	0.46	(0.19)	0.53	(0.15)	0.57	(0.21)
	5	0.51	(0.22)	0.48	(0.14)	0.47	(0.18)
	10	0.52	(0.17)	0.47	(0.17)	0.50	(0.14)
Upper	0	0.70	(0.21)	0.93	(0.62)	1.27	(0.78)
	5	0.64	(0.27)	0.84	(0.75)	0.95	(0.81)
	10	0.72	(0.37)	0.62	(0.23)	1.04	(0.52)
Lower	0	0.69	(0.19)	1.05	(0.41)	1.25	(0.85)
	5	0.82	(0.72)	1.15	(0.65)	1.10	(0.64)
	10	0.91	(0.45)	1.04	(0.87)	0.87	(0.38)

The ANOVA obtained significant main effects for proficiency levels, $F(2, 27) = 11.99$, $p < .01$, and for sentence lengths, $F(2, 54) = 8.05$, $p < .01$. The interaction of sentence lengths and proficiency levels was also significant, $F(4, 54) = 2.56$, $p < .05$. Neither main effect nor two-factor interactions for latencies were significant. Three-factor interaction was also not significant.

The results of multiple comparisons for the interaction of sentence lengths and proficiency levels showed that the significant difference was only observed in long-length sentences between native English speakers and lower level students.

Native English speakers' mean response latencies were around 0.5 seconds, while those of Japanese EFL learners were around one second, almost the same length as a silent pause in the present study. Upper level students tended to take longer to respond in the 0 second condition than in other conditions, and the longer the sentences became, the longer it took for them to respond. In

contrast, lower level students' response time already exceeded one second for medium-length sentences, revealing the difference in the automaticity level between upper and lower level students.

5. Discussion

This section discusses the findings of the present study and attempts to answer the three research questions presented in Section 3.1.

5.1 *How do different latencies and sentence lengths affect the accurate reproduction in repeating tasks?*

There was a tendency for upper level students to accurately repeat the sentences as latencies became longer except in the case of long-length sentences in the 10 second condition. Lower level students increased their utterances when they were given 5 second latencies, but the figures decreased under the 10 second condition except in the case of long-length sentences (see Table 3). It might be assumed that although 10 second latencies were too long for both upper and lower level students to effectively rehearse the sentences in the phonological loop (see 3.2), the former tended to be affected by sentence lengths rather than different latencies and it was the other way around in the case of the latter. However, the reason why upper level students decreased their utterances in the case of long-length sentences in the 10 second condition, while lower level students increased them, cannot be fully explained. Since this seems to be partly because of the lack of data, the number of samples should be further increased in order to obtain more tangible results.

It was also found that upper level students repeated only about half of the long-length sentences and lower level students repeated about one third of them. This means that they could repeat less than 10 words even if the sentences were much longer than that, possibly because either they forgot the words after listening to them or did not recognize them in the stage of listening before speaking. Considering that native English speakers could accurately repeat long-length sentences in the 10 second condition, where they fully understood the sentence structures and effectively rehearsed them, it is too early to say that we should give Japanese EFL learners only sentences consisting of less than 10 words and latencies shorter than 10 seconds. At any rate, it is definitely important to carefully choose lengths of latencies and sentences according to learners' proficiency levels as well as their own individual goals.

5.2 *How do different latencies and sentence lengths affect fluency in repeating tasks?*

The fact that native English speakers tended to speak slowly when the sentences were short might mean that they simply repeated the sentences at the same speed as the original recordings since they could easily control their speech rates. In contrast, the speech rates of Japanese EFL learners gradually decreased as sentences became longer. One possible reason for this is that they took time to repeat the sentences in proportion to the number of syllables without making any phonetic changes, unlike the case of native English speakers.

Overall, Japanese EFL learners' mean articulation rates were much higher than their mean

speech rates except in the case of short-length sentences (see Tables 4 and 5), meaning that they produced a huge number of silent pauses even in repeating tasks, while native English speakers produced almost no pause. Therefore, trying to avoid producing silent pauses, which are often included in the calculation of the speech rate, is the key to become a fluent speaker.

5.3 *How do different latencies and sentence lengths affect response latencies in repeating tasks?*

Native English speakers' mean response latencies were around 0.5 seconds, regardless of lengths of latencies and sentences, while those of Japanese EFL learners exceeded one second when long-length sentences were given to upper level students as well as when medium-length and long-length sentences were given to lower level students (see Table 6). In addition, the fact that it gradually took longer for upper level students to respond as the sentences became longer might indicate that they experienced higher cognitive load when they processed longer sentences. Furthermore, there was a tendency towards slow responses among upper level students in the 0 second condition compared to other conditions. This might mean that it was hard for them to respond quickly when no time was given for rehearsal.

6. Concluding Remarks and Further Research

Although no statistically significant interaction of different latencies and sentence lengths was observed, some important findings were obtained in the present study. Both upper and lower level students increased their utterances in the 5 second condition regardless of sentence lengths, which implies that they effectively rehearsed the sentences in the phonological loop and elaborated their short-term memory. Therefore, it was found in the present study that 5 seconds, where they could rehearse each sentence a few times (about 3 times for short-length, 2 times for medium-length and 1.5 times for long-length sentences, respectively), was the most appropriate latency. However, since upper level students did better under the 10 second condition (except in the case of long-length sentences), there is a need to further examine the effect of giving longer latencies for additional rehearsal, especially to upper level students. Considering that Japanese EFL learners reacted differently to the interactions of different latencies and sentence lengths, it is important to give appropriate latencies and sentence lengths to the learners in repeating tasks according to their proficiency levels.

It was also found that both speech rates and articulation rates decreased as the sentences became longer in the case of Japanese EFL learners. This means that they rarely made phonetic changes, knowledge of which plays an integral part both in speaking and listening.

In addition to the above implications, several questions remain to be discussed. The mean rates of accurately repeated words in Table 3 show that Japanese EFL learners repeated less than 10 words even when the sentences were longer than that. Besides the fact that long-length sentences consisting of 13-14 words (16 syllables) were too long for them to repeat, speech rates of the original recordings for long-length sentences were much faster than those of short-length sentences. Since speech rates have a great effect on Japanese EFL learners in terms of listening, syllables per

minute should have been standardized between each sentence length. Furthermore, since long-length sentences might have been more complex and more difficult to understand for Japanese EFL learners than short-length and medium-length sentences, not only the number of syllables but also factors such as vocabulary familiarity and syntactic complexity should be carefully considered in further research.

In conclusion, a variety of additional information relating to repeating tasks, which was overlooked in Morishita (2008), was uncovered in the present study, implying that research on speaking requires analyses from many different perspectives. The number of samples should be further increased in order to obtain sufficient data to decide in what conditions articulatory rehearsal has the most positive effect on utterances and helps retain short-term memory in order to realize the accurate reproduction. An experiment to examine the learning effect of repeating tasks based on the results of the present study (e.g., how repeated exposures can accelerate learning) should also be conducted in the future in order to obtain an effective speaking pedagogy for Japanese EFL learners.

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