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THE AUDITORY PRIMING EFFECT IN JAPANESE LEARNERS OF ENGLISH: EFFECTS OF VOICE SPECIFICITY AND WORD STRESS PATTERNS

1. INTRODUCTION

Exposure to a linguistic stimulus during priming influences subsequent language processing (McDonough & Trofimovich 2009: 1). For instance, people tend to effectively process spoken words that they have previously encountered without noticing that they are doing so. Similarly, in an auditory repetition task, people are likely to repeat previously heard auditory input faster and more accurately than previously unheard words. This example of priming is called the auditory priming effect. This effect is thought to occur as people unconsciously encode and store phonetic and/or phonological information for encountered words in their memory. Thus, on encountering the same words again later, they can retrieve them efficiently using the stored information (Ohta 2008: 104). Since they do not recall episodic memory from the previous situation in which they encountered these words, priming is seemingly related to implicit memory (Murao & Sasaki 2008: 67).

1.1. AUDITORY PRIMING IN L1

Priming research has been conducted mainly in the context of first language (L1), in which several characteristics of the auditory priming effect have been studied (McDonough & Trofimovich 2009: 22). It has been reported that the auditory priming effect occurs not only in adults, but also in infants (Church & Fisher 1998; Church & Schacter 1994; Fisher, Hunt, Chambers & Church 2001; Schacter & Church 1992). According to an experiment by Church and Fisher (1998), the auditory priming effect showed no significant change from 2.5 years of age to college age. It has also been shown that infants can identify sounds unconsciously, after they encounter them many times (Ohta 2008). In fact, auditory priming is not thought to require knowledge of the meanings of the words. Therefore, it is hypothesized that even infants and young children can build phonological representations of words without understanding their meanings.

Furthermore, the type of processing that occurs when listeners first encounter spoken words is not believed to influence auditory priming (McDonough & Trofimovich 2009: 23). Church and Schacter (1994) asked one group of participants to rate the clarity of pronunciation of word stimuli, and another group to count the number of meanings for each of these words to manipulate the different encoding processes (semantic versus non-semantic), and found that it did not affect priming at all. In other words, the magnitude of the priming effect was not affected by whether the listeners' attentional orientation was directed toward the meaning or sound of the words.

In addition, auditory priming is seemingly dependent on specific features of the stimulus including such as the qualities and prosody of the voice. Listeners recognize repeated words faster and more accurately than unrepeated words, but they recognize repeated words spoken in the same voice even faster and more accurately than the same words spoken in a different voice (Craik & Kirsner 1974). Schacter and Church (1992) examined the influence of voice change between study and test phases on the auditory priming effect with L1 speakers. The participants listened to a series of words. Some of the words had a number of different meanings while others have only one. The participants were asked to count the number of meanings of each word or rate clarity of each pronunciation. In the test phase, they engaged in the stem-completion task (completing word stems with the first word that comes to mind) that included studied and unstudied words, which were read in either the same or a different voice between study and test phases. The results showed that significant priming occurred and the magnitude of priming effects were significantly higher in the same-voice condition than in the different-voice condition. When the voice reading the stimuli was the same between the study and test phases, the auditory priming effect was facilitated.

In addition to voice, listeners have been shown to be sensitive to other acoustic features such as intonation, pitch, and the phonetic context of L1 (McDonough & Trofimovich 2009: 22); however, the influence of stress has not been investigated well. Schiller, Fikkert, and Levelt (2004) examined whether lexical stress can be primed with bisyllabic target words having either the same or different stress in a picture-naming task in the L1 (Dutch) condition. They explained that the default stress in Dutch is placed on the first syllable of words, and words with the stress placed on the final syllable are regarded as irregular. They hypothesized that the final stress pattern can be primed when the patterns are irregular, based on the phonological encoding theory, which states that the metrical pattern of a word is stored in the mental lexicon, only when it differs from the default rule for stress assignment. Although target words with initial stress elicited faster responses than those with final stress, no stress priming effects were observed. They speculate that distributionally exceptional stress patterns are not stored in the mental lexicon.

Auditory priming effects were also reported to last from several minutes to days or even weeks (Goldinger 1996). These automatic, long-lasting, non-semantic, stimulus-specific, developmentally constant characteristics of auditory priming appear to play a role in speech processing (McDonough & Trofimovich 2009: 24). Church and Fisher (1998) argued that auditory priming may be related to perceptual learning mechanisms, and played a role in the initial acquisition of an auditory lexicon. If auditory priming is related to the perceptual learning mechanisms of L1, it is also possible that auditory priming is involved in L2 acquisition.

1.2. AUDITORY PRIMING IN L2

The priming paradigm has been used not only for L1 but also for bilingual and L2 research, especially using visual priming; however, only a few studies concerning L2 auditory priming have been conducted (McDonough & Trofimovich 2009: 26). Some researchers found that L2 learners, like L1 learners, exhibit the auditory priming effects. Ju and Church (2001), for example, showed that their participants demonstrated the same degree of the priming effect in both L1 and L2 conditions. Sugiura and Hori (2012) investigated whether Japanese learners of English benefited from repeated experiences of spoken input, and observed the priming effect when L1 was Japanese and L2 was English.

Priming effects are sometimes reduced, eliminated, or facilitated according to various factors, such as type of processing (attentional orientation while processing speech) and specific acoustic features of the stimulus.

As mentioned in section 1.1 on auditory priming in L1, insensitivity to the level of processing is considered a characteristic of auditory priming in L1, and the magnitude of the auditory priming effect is not affected by whether listeners' attentional orientation is directed toward the meaning or sound of the words. In L2, on the other hand, whether learners pay attention to the meaning or sound of words seems to influence the magnitude of the auditory priming effect.

Trofimovich and Gatbonton (2006) conducted an experiment to determine whether the participants, who were assigned to two groups based on their L2 pronunciation accuracy, are sensitive to types of processing, in particular those focusing on form (acoustic features) and meaning properties of L2 stimuli. The auditory priming effect was observed for all participants in both L1 and L2, but when low-accuracy participants' attentional orientation was directed toward L2 meaning, the priming effect was eliminated. This may be because L2 learners' speech processing is often not automatized, and may consume the learners' mental resources. When L2 learners are required to process meanings of stimuli, they may end up using the majority of their mental resources, not leaving enough resources for storing phonological/phonetic information.

Similar to the L1 auditory priming study, in L2, specific acoustic features of the stimulus, such as voice qualities also influenced the degree of the auditory priming effect. Trofimovich (2005) examined the influence of the voice used for stimuli in the study and test sessions with low-intermediate learners of Spanish, who are native speakers of English. In L1 conditions, the participants demonstrated the priming effect irrespective of whether the priming and test words were read with the same or different voices, while in L2 conditions, the priming effect was observed only when the priming and test words were read with the same voice.

Later, Trofimovich (2008) examined the effect of the length of residence in an L2 country (long vs. short), specific acoustic features of the stimulus (same vs. different voices), and attentional orientation while processing speech (semantic vs. non-semantic) on the degree of priming. The participants (Chinese native speakers) were assigned to two groups based on their length of residence in Canada. One group consists of people with a mean length of residence of 1.3 years while the other with a mean length of residence of 3.5 years. As a result, only the participants with a longer length of residence exhibited the auditory priming effect for the repeated words in both the same- and different-voice conditions when their attentional orientation was not directed toward the meaning of the words. In other words, when the participants of a longer length of residence directed their attention to the meaning of the words, the voice changes between the study and test phases eliminated the facilitation effect. The participants with a shorter length of residence did not show any significant priming effect regardless of voice conditions or types of attentional orientation.

These studies suggest that L2 learners seem to be sensitive to voice changes between the study and test phases. To put it differently, the L2 learners may be less sensitive to the abstract phonological information of L2 words, and fail to generalize across various, context-specific occurrences of the same word. L2 learners' insensitivity to abstract phonological information may be due to the developmental stage of L2 language proficiency (McDonough & Trofimovich 2009: 32). In fact, in the study of Trofimovich (2005), all participants were at an approximately low-intermediate level of proficiency in L2 (Spanish). It is hypothesized that learners with high L2 proficiency may be able to encode abstract phonological information of spoken words similar to L1 speakers.

Not much research has been done on the influence of stress patterns on auditory priming in L1 and L2. In L1, as mentioned in the previous section, Schiller, Fikkert, and Levelt (2004) examined the influence of stress patterns on auditory priming with bisyllabic words in Dutch and found no stress related priming effect. Although they hypothesized that the final stress pattern can be primed based on the phonological encoding theory, the results were not consistent with the theory.

The findings mentioned above indicate a close relationship between auditory priming and speech processing. Thus, L2 auditory priming research will further our understanding of L2 spoken word processing and learning. Furthermore, examining factors that reduce, eliminate, or facilitate the priming effect can not only unravel the speech processing mechanisms, but also lead to effective pedagogical applications for L2.

1.3. THE CURRENT STUDY

This study aims to investigate how voice and stress patterns influence auditory priming in L2 processing with Japanese learners of English. In terms of voice factors, since Trofimovich (2005) investigated the priming effect with participants with low-intermediate L2 proficiency (as determined by the self-ratings and degree of foreign accent), this study examined the priming effect with participants, including advanced level speakers (based on the scores of TOEIC, Test of English for International Communication). It is hypothesized that participants with high English proficiency will be primed irrespective of whether the priming and test words were read in the same or different voices.

As for stress patterns, this study examines whether lexical stress can be primed in L2 (English). If L2 learners are sensitive to lexical stress, and the stress pattern of a word is stored in the mental lexicon only when it differs from the default rule for stress assignment, words with initial stress cannot be primed.

Since Schiller, Fikkert, and Levelt (2004) examined the auditory priming effect of stress patterns in bisyllabic Dutch words (L1) and obtained no priming effect, this study uses two-syllable target English words (L2) with two different stress patterns (strong–weak and weak–strong) and three-syllable English words with strong–weak–weak and weak–strong–weak stress patterns. Two- and three-syllable English words are more likely to have primary stress on the first syllable (Clopper 2002: 8). This means that the default stress pattern in English is initial stress, and other stress patterns are considered as irregular.

Japanese, the L1 of the participants, is considered a pitch accent language, while English is considered a stress accent language. Beckman (1986) demonstrates that the contrast between falling and rising intonation contours in Japanese (e.g., initial vs. final accented words as in *kata* "shoulder" [High-Low] vs. *kata* "form" [Low-High]) are very similar to the contrast in English (initial vs. final stressed words as in English "CONtrast" vs. "conTRAST"). The pitch factor in both the languages corresponds to each other, and the type of pitch accent tone is limited to high and low (Akita 2001). For instance, more than 90% of Japanese nouns (3 moras) that originated from foreign words have a falling accent pattern (Kubozono 2006: 64). Therefore, it can be assumed that the default stress pattern for Japanese learners of English, when speaking English, is initial stress.

2. EXPERIMENT

2.1. RESEARCH QUESTIONS

(1) How does a speaker's voice (same, different) influence the auditory priming effect in the processing of English for Japanese learners? Does the auditory priming effect differ according to English proficiency level?

(2) How do the stress patterns (strong–weak, weak–strong) of spoken words influence the auditory priming effect in the processing of English for Japanese learners? Does the auditory priming effect differ according to English proficiency level?

2.2. PARTICIPANTS

The participants in the present study were 20 Japanese learners of English (13 females and 7 males), aged between 19 and 22 years. Based on their TOEIC scores, they were divided into two groups: "advanced" (nine students with TOEIC score of 600 or above) and "pre-intermediate" (11 students with TOEIC score of 550 or less) groups. The scores of these groups were found to be significantly different ($t(18) = 6.61$, $p < .001$). The participants were paid to participate in this experiment.

2.3. LINGUISTIC STIMULI

The linguistic stimuli (see Appendix) consisted of two sets of 40 words (a two-syllable set and a three-syllable set). The two-syllable word set included two different stress patterns (strong–weak [SW] and weak–strong [WS]), while the three-syllable word set included strong–weak–weak (SW) and weak–strong–weak (WS) patterns. In order to minimize semantic influence from the stimuli, words were chosen that were unfamiliar to the participants, from the MRC Psycholinguistic Database hosted by the University of Western Australia.

The 80 English words chosen were read in two different US accent voices (one female and one male), and recorded using the text-to-speech software, Natural Reader. They were then divided into two sets of 40 words, for which 20 words were randomly chosen from each speaker. The two sets were then used to construct four study list and test list pairs with each pair containing a 40-word study list and an 80-word test list. The test list included the entire list of study words (repeated 40 words, which the participants encountered both in study and test sessions) and a list of test words (40 unrepeated words, which the participants encountered only in test session). Of the 40 study words included in the test list, half were spoken by the same speaker (i.e., in the same voice) and half by a different speaker (i.e., in a different voice). Each word spoken by a male speaker in the study list was spoken by a female speaker in the test list, and vice versa. Each word appeared the same number of times across the study and test lists.

2.4. PROCEDURE

The experiment consisted of study and test phases. The whole experiment lasted approximately 30 minutes, and was conducted in a quiet room. During the study phase, the participants listened to 40 spoken words, individually presented at five-second intervals using the speech presentation software, Superlab 4.0. In order to ensure that all participants paid attention to all the stimuli, they were asked to answer whether the words in question included the /t/ sound in the stimuli. After the study phase, participants performed simple calculations for about five minutes to clear the working memory of the words from the study phase. For the test phase, participants listened to 80 spoken words presented in the same manner as those in the study phase. Upon hearing each word, the participants were asked to repeat it aloud as accurately and quickly as possible. Their repetitions were recorded using the audio processing software, Audacity (1.3.12), with a sampling rate of 44 kHz.

2.5. ANALYSIS

Only the words repeated correctly by the participants were used, and those with incorrect repetitions (4.6%) were excluded from the final data analyses. The length of time (in milliseconds) between the offset of the stimulus and the onset of the repetition was measured as the response latency. Since response latency is assumed to provide a measure of processing time, if the latency for certain words is shorter, it means that they are being processed faster (Trofimovich 2005). Measurements of response latency were made on the spectrogram of the speech analysis software, Praat 5.2.23. The magnitude of priming effect was obtained by subtracting mean response latency for repeated target words from mean response latency for unrepeated target words.

3. RESULTS

3.1. RESPONSE LATENCY

To confirm the auditory priming effect in this experiment, the response latency data was subjected to the one-way ANOVA, with repetition (unrepeated words, repeated words in same voice and different voice) as the within-subject factor. This analysis yielded the main effect of test words, $F(2,60) = 12.72$, $p < .05$, and a Tukey's post-hoc test revealed significant auditory word-priming effect for repeated words spoken in the same voice as compared to unrepeated words ($p < .001$), but not for between repeated words spoken in a different voice as compared to unrepeated words ($p > .05$, *ns*). Mean response latencies are presented in Table 1.

TABLE 1. Mean Response Latencies (ms) as a Function of Repetition

Words	Mean
Unrepeated	482(6)
Repeated	
Same voice	448(6)
Different voice	490(6)

Note. Values in the parenthesis indicate S.E.

3.2. PRIMING EFFECT

The priming effect data (the mean response latency for repeated words subtracted from the mean response latency for unrepeated words, which represents the amount of processing facilitation obtained, was calculated) was subjected to the MANOVA, with proficiency (high, low) as the between-subject factor, and voice (same, different) and stress (strong–weak, weak–strong) as the within-subject factors. The analysis revealed a significant main effect for voice, $F(1,72) = 7.24$, $p < .01$, but not for proficiency, $F(1,72) = .016$, $p > .05$, *ns*, and stress, $F(1,72) = .023$, $p > .05$, *ns*. In addition, no significant interaction effect for proficiency × voice, $F(1,72) = 1.98$, $p > .05$, *ns*, and proficiency × stress $F(1,38) = 1.29$, $p > .05$, *ns*, was found. The mean priming effect, as a function of proficiency, voice, and stress pattern is presented in Table 2.

TABLE 2. Mean Magnitude of Priming Effect (ms) as a Function of Proficiency, Voice, and Stress

Words	High Proficiency	Low Proficiency
Repeated		
Same voice		
SW	55(20)	23(18)
WS	30(20)	27(18)
Different voice		
SW	–8(20)	–4(18)
WS	–19(20)	19(18)

Note. S = strong; W = weak. Values in the parenthesis indicates S.E.

4. DISCUSSION

This study aimed to investigate how voice and stress patterns influence auditory priming in L2 processing. We studied how speaker's voice (same, different) and stress patterns (SW, WS) influenced the auditory priming effect in the processing of English among Japanese learners, and whether this effect differed as per their English proficiency levels.

Before examining the degree of the priming effect in voice and stress factors, the involvement of auditory word-priming was examined. As demonstrated in the statistical analysis, all participants (with high and low proficiencies) were overall significantly faster at initiating production of repeated words than unrepeated words, only when the repeated words were spoken in the same voice. This significant difference demonstrates the occurrence of the auditory priming effect.

Regarding the degree of priming in the voice (same, different) factor, significant differences in the response latency for repeated words spoken in the same voice and in a different voice demonstrated that all learners processed repeated words spoken in the same voice faster than repeated words in a different voice. In addition, no significant interactions between voice and proficiency revealed that the sensitivity to the voice change of spoken words was comparable in learners with high and low proficiencies.

It was hypothesized that participants with high English proficiency will have a statistically significant greater priming effect even in a different voice condition than participants with low proficiency, since the former's phonological representation system is presumed to be more developed than that of the latter. However, the results did not support this hypothesis. Even the participants with high proficiency seemed to be very sensitive to the voice changes of spoken words and failed to encode phonological information of spoken words correctly. In other words, the high proficiency group did not appear to be able to control the perceptual processing of spoken words sufficiently enough to generalize across various occurrences of the same word. In Trofimovich's experiment (2008), since participants with longer lengths of residence exhibited the auditory effect in both the same- and different-voice conditions, the differences between these groups may be worth examining. The participants inTrofimovich's experiment had much more ample opportunities to be exposed to L2 input spoken with a wide variety of acoustic features such as voices, intonations, and dialects since the participants live in an L2 speaking country.

Another objective of this experiment was to examine whether the stress pattern of a stimulus word influences the auditory priming effect under the same and different voice conditions. The statistical analysis examined the participants' sensitivity to the phonological information of the stress pattern in spoken L2 words. The results showed that there was no difference between SW and WS stress patterns in the degree of auditory word priming. In other words, the participants appeared to respond to both stress patterns of words similarly. The participants were expected to exhibit a greater priming effect with words of the WS pattern, since WS is considered irregular. However, this was not the case for the participants in our experiment. In addition, the interaction of stress and proficiency was not statistically significant, showing that high- and low-proficiency learners did not demonstrate differential sensitivity to repeated acoustic information across stress patterns.

This result is consistent with the results of Schiller, Fikkert, and Levelt (2004), where they did not observe any stress-related priming in L1. There are a few possible explanations for these findings. First, stress patterns for each spoken word may not be stored in the mental lexicon, regardless of their patterns when processing auditory stimuli. Another possibility is that listeners may need some exposure to stress patterns before they are stored. In the present study, the exposure to stress patterns was limited to once. In contrast, Trofimovich (2013) conducted a study on auditory priming of word stress patterns as part of classroom-based tasks. The participants engaged in the tasks over a 13-week semester, and the priming effect was observed in the tasks. Since research on auditory priming, in particular on stress patterns, is scarce, future research is needed to explore these possibilities.

5. CONCLUSION

The present study demonstrated the auditory priming effect in L2 subjects after being exposed to a spoken word in L2 only once. However, the effect is observed only for words repeated in the same voice, showing that they are sensitive to detailed context-specific information, but not to abstract systematic information, such as phonological information expressed in L2 words. In addition, factors such as English proficiency and the stress-patterns of words did not influence the magnitude of the auditory priming effect.

In future research, the influence of English proficiency, individual voice factors, or stress patterns on the auditory priming effect may be studied by exposing listeners to priming words several times. Through greater exposure to L2 input, they might be able to preserve more phonetic/phonological information in the study phase, and make use of it at a later processing stage.

The findings in this study are important for research in L2 processing and learning from the perspective of implicit perceptual learning. This research framework might also be applied to examine the effect of phonetic and phonological learning in L2, for example to see whether listeners can improve their pronunciation or word recognition skills by changing the quality and quantity of spoken input and by exposure to different methods of sound input (e.g., listening, shadowing). This type of research will provide concrete implications for L2 acquisitions

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APPENDIX

Lists of stimulus words

two-syllable words	two-syllable words	three-syllable words	three-syllable words
BANTER	PAMPAS	PIVOTAL	DENIZEN
BOLTER	PANFUL	PALADIN	DESOLATE
BELGIC	PELVIS	PAGANIZE	DIVAGATE
BALSAM	PUNDIT	PALATINE	DEMAGOGUE
BESPOKE	PARTOOK	PAROTID	DECORUM
BEGRUDGE	PURVEY	PALATIAL	DEMONIC
BETOOK	PONTOON	POLEMIC	DORADO
BECLOUD	PASTICHE	PETITION	DELIMIT
DAMSEL	SAWDER	BENISON	CONICAL
DICTUM	SEPSIS	BAILIWICK	CALIPER
DOWLAS	SILVAN	BARONAGE	CABOTAGE
DUPLEX	SYNDIC	BAYONET	CALYCES
DISDAIN	SEPTET	BUCOLIC	CADAVER
DEFRAY	SUBVERT	BUBONIC	CAJOLER
DISBARK	SUBLIME	BYRONIC	CORONIS
DISTIL	SUPERB	BETAKEN	KORANIC
KAMIC	CONCEIT	SUFFOCATE	SATANIC
CANKER	CONFIDE	SELENITE	SOLAMEN
CARVER	CONGEAL	SATRIST	SIROCCO
KERSEY	CANTEEN	SILICATE	SOROSIS

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Summary

This study investigated whether and to what extent stimulus characteristics such as voices (same vs. different) and stress patterns (strong–weak vs. weak–strong) influence the auditory priming effect. The experiment involved 20 Japanese participants learning the English language, who were asked to listen to English words (half of them in the same voice or stress pattern as in a prior study session) and repeat them as quickly and accurately as possible. The participants were significantly faster at initiating word production, when the word was spoken in the same voice in the study and test phase. Our results also revealed that neither English proficiency nor stress patterns had any influence on the priming effect.

Key words: auditory priming, phonological representation, voice, stress patterns

EFEKTY TOROWANIA SŁUCHOWEGO U JAPOŃCZYKÓW UCZĄCYCH SIĘ JĘZYKA ANGIELSKIEGO JAKO OBCEGO: WPŁYWY SPECYFIKI GŁOSU I SCHEMATÓW AKCENTOWYCH

Streszczenie

Celem artykułu jest wyjaśnienie, czy – a jeśli tak, to w jakim stopniu – dwie cechy bodźca, mianowicie głos (ten sam / inny) i schemat akcentowania (mocny – słaby / słaby – mocny), wpływają na rezultaty torowania słuchowego. W eksperymencie badawczym uczestniczyło 20 Japończyków uczących się języka angielskiego jako obcego, którzy byli proszeni o wysłuchanie i powtórzenie angielskich wyrazów jak najszybciej i najdokładniej (połowa z nich była wypowiedziana tym samym głosem lub miała taki sam schemat akcentowy jak w poprzedniej sesji). Uczestnicy badania zaczynali wypowiadać słowa znacznie szybciej, kiedy wyraz był wypowiadany tym samym głosem. Przeprowadzone badanie wykazało również, że ani biegła znajomość języka angielskiego, ani schematy akcentowe nie miały wpływu na efekt torowania.

Słowa kluczowe: torowanie słuchowe, reprezentacja fonologiczna, głos, schematy akcentowe