The Effect of Shadowing: Exploring the Speed Variety of Model Audio and Sound Recognition Ability in the Japanese as a Foreign Language Context

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Abstract

Shadowing has increasingly been recognized as an effective practice for developing listening skills in second language learning. The common claim is that the act of simultaneous listening and speaking activates sub-vocalization in the working memory, which helps improve bottom-up processing (Kadota, 2007). This helps improve morpheme perception that contributes to sound recognition skills leading to listening comprehension (Hamada, 2016). However, there is very little research focusing on the influence of speed variation in shadowing model audio. The aim of this study is to investigate the effect of shadowing in relation to gradual speed progression of the model audio and sound recognition ability. Participants in this study were 29 university students who were enrolled in the language courses, Advanced Spoken Japanese (experimental group) and Advanced Japanese (control group) at an Australian university. Shadowing practice was conducted for eight weeks during a 13-week semester. The pre- and post-tests used parts of standardized Japanese proficiency tests for listening comprehension (24 questions) and a dictation test (10 items) for sound recognition ability. The results indicated that the experimental group improved in both listening comprehension and dictation at slow and fast speed, whereas the control group showed improvement only in slow speed dictation.

1 Introduction

1.1 Shadowing

Listening skill is the only area of communication in which one cannot have control over the speed, unlike the other three language skills where one can adjust the speed (of speaking, writing and reading) at will. So once a listener is left behind or misses certain utterances during a conversa-tion, the listener must ask the speaker to repeat what they said in order to recover the missed infor-mation or, if watching a movie, rewind and play the part again. However, failing to hear information is problematic when it comes to examinations, academic or business conferences, or even when watching movies at the cinema, for example, where listeners are given only one attempt at listening. By the same token, if a learner is unable to keep up with the speed of communication at their profi-ciency level, their acquired linguistic competence would be of no use, as there is virtually no incom-ing information to process, to begin with. Despite the fact that listening skill is the most common area that learners of Japanese language wish to improve (Yang, 2008), there is no solid teaching method in L2 pedagogy to improve listening skills when communicating at a fast speed.

In the field of second language acquisition (SLA), shadowing has increasingly been recognized as an effective practice for developing listening skills in L2 learning in Japan (e.g. Hamada, 2016;

Kadota, 2012; Kondo, 2012; Nakayama, 2011). Shadowing refers to "a paced, auditory tracking task which involves the immediate vocalization of auditorily presented stimuli, that is, word-for-word repetition, in the same language, parrot-style, of a message presented through headphones" (Lambert, 1992, p. 266). It was originally used as a training method for simultaneous interpreters. This simultaneous task of listening and speaking has been suggested as an effective means of improving listening skills in L2 learning, as the learner is required to listen and speak at the same time (Kadota, 2007, 2012). However, Lambert's metaphor of "parrot-style" may give the impression that shadowing itself does not require much brain work, as parrots apparently repeat without linguistic processing, but simultaneous interpreters must perform a series of cognitive tasks while shadowing (Spiller-Bosatra, Darò, Fabbro, & Bosatra, 1990). Tamai (1997), the pioneer of shadowing research in Japan's English as a foreign language (EFL) context, re-defined Lambert's definition of shadowing as "an act or a task of listening in which the learner tracks the heard speech and repeats it as exactly as possible while listening attentively to the incoming information" (pp. 105–106). This definition of shadowing highlights the importance of active attention to incoming sound in terms of linguistic processing in the human brain; otherwise, without paying attention, the speech becomes as good as background noise. Furthermore, listening at fast speed means processing more information within the given time. For instance, L2 learners who are able to comprehend speech speed at 300 words per minute can process 1.5 times more information than L2 learners who can only comprehend at 200 words per minute. This study, therefore, puts a focus on speed progression to examine learners' sound recognition ability through shadowing practice.

1.2   Shadowing mechanisms

In listening, the information is in the auditory medium, which is transient and vanishes quickly, unlike written characters in reading where readers can control the pace and even repeatedly read parts for better comprehension. Therefore, listening comprehension must be considered from not only a linguistic processing point of view, but also in terms of the recognition of sound, especially the speed of the incoming information, because it has been suggested that listening comprehension drops significantly as speed increases over around 280 words per minute (Hausfeld, 1981).

The human brain is often explained using the metaphoric expression of a computer's memory system and the central processing unit. Baddeley (1992) proposes the term "working memory" (WM) of the human brain when discussing information processing of incoming visual and sound stimuli. He describes the WM in three components: the central executive operates as an attentional-control system; the visuospatial sketchpad processes visual images; and the phonological loop is for incoming sound storage. The central executive is solely an attentional system with no storage capacity of its own, and it functions as a processing device between the two "slave systems" with their own temporary short-term memory function (Baddeley, 1992, p. 556). To illustrate the process of listening comprehension, the heard speech is temporarily stored in the phonological loop, which is considered to last only one to two seconds (Baddeley, 1992). The central executive then runs a semantic analysis of the phonetic signals by referring to the long-term memory (LTM), after which comprehension is achieved after examining the pragmatic and contextual usage of the language. The crucial point in this listening comprehension process is that the capacity of the central executive is limited. Furthermore, if the central executive mobilizes a large portion of its resources to focus on visuospatial sketchpad or episodic buffer[1] linkage instead of on the phonological loop, listening comprehension may not occur as the link between the central executive and the phonological loop becomes very limited or even non-existent. In other words, people do not always comprehend what they hear even in their native language, especially when they are in an absent-minded or multi-tasking state, because the heard speech is not processed for comprehension.

One of the key functions is the phonological loop. With respect to the listening process, it is assumed to have two additional functions: phonological short-term storage and subvocal rehearsal. The former is the memory function of sound stimuli, and the latter is the mental repetition of the heard speech stored inside the phonological loop. This subvocalization is assumed to last for about

two seconds (Darro & Fabbro, 1994), but it is suggested that the length of subvocal rehearsal can be extended with active subvocalization (Kadota, 2007), and the memory capacity of WM can also be improved by training (Klingberg, Forssberg, & Westerberg, 2002). Namely, in order to retain the heard speech longer, the role of the central executive becomes crucial, because it will require larger processing power for more active subvocalization.

Speaking in shadowing differs from that of ordinary conversation. According to Levelt's (1989) blueprint for the speaker model, speech production involves three stages in its production: 1) the message is generated in the Conceptualizer, 2) the message is processed through grammatical encoding and phonetic encoding in the Formulator, and 3) the phonetic plan (internal speech) is executed in the Articulator. This series of speech production flow is conducted in WM and requires the attention of the central executive (pp. 9–13). On the other hand, speech production in shadowing initiates at the latter stage of the Formulator of the blueprint model, since the heard speech is directly encoded into production in the phonological loop. In other words, it can be said that speech production in shadowing represents subvocalization to make visible unseen brain activity, which otherwise remains hidden in other listening practice methods.

From the SLA point of view, there are two opposite approaches that L2 learners typically take in the listening comprehension process: bottom-up processing and top-down processing (O'Malley, Chamot, & Kupper, 1989). The former refers to the processing that starts from a minimum element of speech, such as sound, which forms a morpheme, then a word, then a sentence and then finally the context and pragmatic use of the language, which leads to comprehension. On the contrary, top-down processing refers to processing that starts from the context and only recognized words to guess the meaning by compensating for missed words. This listening technique is naturally practiced by native and advanced L2 speakers, especially in daily conversations where incomplete sentence exchanges are likely to occur. For example, linguistically speaking, functional words, such as the English articles "a" and "the," are often pronounced much more weakly than other words (Nakayama, 2011), and Japanese particles are often omitted in spoken language (Maeda, 1998). However, for novice and intermediate L2 learners, it is of crucial importance to develop sound recognition skills for bottom-up processing in order to maximize the number of recognizable words in their limited lexicon (Vandergrift & Baker, 2015). Shadowing is considered especially effective in training this bottom-up processing by forcing active subvocalization in WM, and automatizing this process would enable the brain to utilize its limited resources for higher level linguistic processing, just like native and advanced L2 speakers (Kadota, 2007, 2012).

Cognitive load theory assumes that extraneous cognitive load is imposed when multiple sources are presented and the brain is required to mentally integrate the separate information (Chandler & Sweller, 1991). Extraneous cognitive load is caused by the limited capacity of WM to deal with repeated or unnecessary information, resulting in inefficient processing. Moussa-Inaty, Ayres and Sweller (2012) found simultaneous reading and listening was significantly less effective than reading only in learning new vocabulary and translating sentences among 38 university students in the EFL context. The participants were divided into the Read Only group and Read + Listen group, and the experiment consisted of six acquisition activities (word learning, word translation, sentence learning, sentence translation, cloze activity, and sentence creation). The former group received only the written materials, while the latter received both the written and auditory materials simultaneously. Their research supported the hypothesis that the auditory information was redundant and therefore imposed an extraneous cognitive load, resulting in lower achievement after instruction using multiple sources. Leahy and Sweller (2011) found the Audio/visual group performed significantly lower than the Visual only group in a PowerPoint learning environment for 24 Year-6 students. The investigators argued that instructions containing a considerable amount of information resulted in exceeding the WM limits of the Audio/visual group members, since the information had to be remembered after hearing the transient instruction once, while the Visual only group was able to read and process the instruction repeatedly. These findings suggest that extraneous cognitive load was imposed as the result of split attention caused by attempts to mobilize different channels of WM,

the visuospatial sketchpad and the phonological loop. During this process, comprehension was assumed to be hindered by the disparate processing, especially when these channels were processing the information at different speeds. Shadowing, on the other hand, requires learners to focus on the phonological loop and to synchronize incoming information into the phonetic representation of speech production. In this respect, shadowing may require a heavy cognitive load, as it requires simultaneous attention to the phonological loop and speech production, but it is different from a negative cognitive load like extraneous cognitive load caused by split attention.

1.3   Shadowing research

As the pioneer of the shadowing research in Japan's EFL context, Tamai (1992) examined the difference between shadowing and dictation among 94 high school students. He conducted a listening lesson once a week for 50 minutes (for 13 weeks). One session consisted of five parts: 1) listening, 2) parallel reading (reading while listening), 3) vocabulary check, 4) shadowing (for the experimental group) or dictation (for the control group), and 5) self-check of mistakes. Once the session was completed, the same process was repeated for different texts during the 50-minute lesson. Pre-post-test results in listening comprehension indicated with statistical significance that shadowing was more effective than dictation. Led by Tamai's study, there has been a rise in the popularity of shadowing practice as an L2 teaching technique in Japan.

Common shadowing practice adapted into language classrooms uses various types of shadowing model audio, including teaching materials such as textbook CDs (e.g. Hamada, 2011; Suzuki, 2007), standardized test audio such as TOEFL and TOEIC (e.g. Hamada, 2012; Kurata, 2007; Oki, 2010), and authentic audio materials such as movies and news clips (e.g. Shiki, Mori, Kadota, & Yoshida, 2010; Mochizuki, 2006; Nakayama, 2011; Saito, Nagasawa, & Ishikawa, 2011). All such audio materials are accompanied by written scripts for the purpose of reviewing shadowing accuracy. Table 1 shows the shadowing steps recommended by Kadota and Tamai (2004), and widely practiced by teachers and researchers (e.g. Hamada, 2012; Kyo, 2012; Saito, Nagasawa, & Ishikawa, 2011).

Table 1. Recommended six steps of shadowing training (Kadota & Tamai, 2004, p. 62)

Steps	Procedure	Details
1	Listening	Listening to the audio without the script, and trying to roughly grasp the content and the speech style.
2	Mumbling	Shadowing without the script focusing on the heard sound rather than reproducing pronunciation.
3	Synchronized reading (con-tent understanding)	Shadowing with the script focusing on the meaning of the script.
4	Prosody shadowing	Shadowing focusing on prosodic features, such as the stress, rhythm, intonation, speed, pauses, etc.
5	Synchronized reading (difficult points)	Shadowing with the script focusing on the parts listeners find difficult.
6	Content shadowing	Shadowing focusing on the content without reading the script.

Since Kadota (2012) recommends that the shadowing scripts be easier than the learners' current language level, for example, using less than 3% of unknown vocabulary, Steps 3 and 5 (Synchronized reading) reasonably fit in the process of shadowing development, as they play the important role of eliminating the gap between unfamiliar pronunciation and identification of vocabulary in the script. However, Kondo (2012) points out the possibility of a negative effect of this reading process during the shadowing practice; that is, she questions whether the shadower neglects the phonological aspects by using recognized vocabulary from the LTM in the reading process. She also implies there is a positive effect of not showing the script during shadowing practice, arguing that it is closer to authentic listening in actual conversation in the target language. In fact, the timing of the use of a shadowing script has become controversial as some researchers have found it more effective for the

script to be shown after the shadowing (Hamada, 2014; Kondo, 2012). This study employs this post-shadowing script method not only for the above reasons, but also because based on cognitive load theory, synchronized reading is considered likely to trigger split-attention effect and impose unnecessary extraneous cognitive load, which would become problematic especially when attempting shadowing at faster speeds.

In terms of the shadowing skill of reproduction accuracy, Shiki et al. (2010) report that the reproduction rate likely hits the ceiling point after four to five shadowing trials. Although this finding was based on a one-day session involving 48 Japanese university students, and the implication may be limited to the conditions of their study, this ceiling phenomenon was observed in Tamai's (2002) studies as well. However, the shadowing materials were set at the average of the participants' L2 proficiency levels in these studies, and different materials (but the same difficulty level and speed) were used throughout the study period. Therefore, it is reasonable to assume that those at lower L2 proficiency show more improvement than those at a higher proficiency level, as they are assumed to have more room for improvement. Within the progressive speed range of this study's shadowing materials (see Section 2.2.1 for more details), it is reasonable to assume that most participants reached their ceiling speed for shadowing earlier than they would for a listening task by itself, since shadowing involves the act of speaking, which is cognitively more challenging than listening alone as no one usually listens and speaks at the same time (Kadota, 2007). Taking this into consideration, starting at a slower speed than necessary is a way to allow learners to practice shadowing. It is also assumed that learners' anxiety towards spoken language can be mitigated if the speed is manageable for shadowing (Gregersen & Horwitz, 2002). However, when the speed increases to the point where the shadower feels it is challenging to process the incoming sound, the learner needs to practice more in order to be able to perform the shadowing at a satisfactory level; such practice is considered vital for improvement.

As for listening skills, Onaha (2004) investigated the effect of shadowing in relation to listening comprehension, dictation and phonological memory among 62 university students for one semester. Students' shadowing recordings were also graded on reproduction ability and stress and intonation five times by the instructors (a native Japanese speaker and a native English speaker). The results indicated that post-test listening comprehension scores were strongly correlated to shadowing and moderately related to the dictation and digit span scores. With regard to the differences in linguistic processing, Hamada (2016) examined the effect of shadowing on listening comprehension and phoneme perception among 43 Japanese national university students. The author conducted 15–20 minutes of in-class shadowing practice twice a week for a month (nine times). Pre- and post-tests in listening comprehension and phoneme perception were conducted before and after the study period. Participants were divided into two proficiency groups (low and intermediate) for analysis. The results revealed that both groups improved in phoneme perception, but only the low-proficiency group improved at high-school level listening comprehension, and neither group improved at university level listening comprehension.

Since learners are likely to feel that the audio speed is the most difficult to follow in shadowing practice (Chang, 2008), it is of vital importance to consider the audio speed as one variable; however, most of the shadowing studies leave this out. In this respect, Nakayama's (2011) study in an EFL context in Japan presents a very important account addressing speed differences in shadowing material. The author conducted a short shadowing session among 26 university students to examine the relationship between the model audio speed and sound recognition of weak forms of function words in English. He divided the participants into two groups to conduct shadowing with three different model audio speeds (experimental group) and fast speeds only (control group). The experimental group was asked to shadow three recordings that were recorded at different speeds, each containing different numbers of weak forms of function words, while the control group was asked to shadow the same materials but all were recorded at a fast speed. The pre-post-test results revealed that only the experimental group showed statistically significant improvement in the recognition of weakly pronounced function words, while neither group showed any improvement in the content words. However, as Nakayama pointed out himself, these results may be limited to the study context, as

the same script was used for the recordings in which the weak forms of function words were expressed more clearly at a slower speed, and thus the experimental group may have developed better recognition of the script than the control group.

1.4   The aim and research questions

Previous shadowing research reveals that shadowing is effective for improving listening skills, particularly by contributing to bottom-up linguistic processing. However, there is still a lack of empirical data about which shadowing model audio speed is effective. Therefore, this study will attempt to investigate the effect of shadowing in relation to the speed of the model audio and sound recognition ability by employing gradual speed progression of the shadowing model audio and a short dictation test as a specific measurement for sound recognition ability. This study employs the post-shadowing script method in order to encourage attentive listening to incoming sound without reading scripts, and also to enable the researcher to monitor participants' shadowing performance for analysis.

The two research questions are as follows:

- RQ1. Is there any difference in the effect of shadowing on sound recognition ability between slow and fast model audio speeds?
- RQ2. What is the most effective speed range of shadowing model audio for improving sound recognition ability?

2   Methods

2.1   Participants

Participants in this study were recruited from Australian university students who were enrolled in the general language course of Advanced Japanese II, and its co-requisite (optional) course, Advanced Spoken Japanese, so that the participants were divided into the control (general course only: without shadowing) and experimental (both spoken and general courses: with shadowing) groups. It was necessary to recruit participants from two different courses in order to set up these groups within the university's ethical framework, which requires that the same teaching materials be used within one course. The Advanced Japanese course met twice a week, once for a lecture and once for a tutorial (for two hours each), and the Advanced Spoken Japanese course met once a week for two hours. It was considered that shadowing exercises would fit well in the speaking-focused course, as it inherently involves speaking practice. A total of 29 students agreed to participate in this study. Nine of those students were enrolled in the spoken course as the experimental group (n = 9), and the remaining students in the general course were considered as the control group (n = 20). Table 2 summarises the participants of this study.

Table 2. Summary of participants

		Experimental Group (*n* = 9)	Control Group (n = 20)	Total (n = 29)
Gender	Male	3 (33%)	7 (35%)	10 (34%)
	Female	6 (66%)	13 (65%)	19 (66%)
Native language	English	3 (33%)	9 (45%)	12 (41%)
	Chinese	4 (44%)	8 (40%)	12 (41%)
	Korean	1 (11%)	1 (5%)	2 (7%)
	Indonesian	1 (11%)	1 (5%)	2 (7%)
	Thai	0 (0%)	1 (5%)	1 (3%)
Born in Australia	Yes	5 (56%)	13 (65%)	18 (62%)
	No	4 (44%)	7 (35%)	11 (38%)

Japanese Major	Yes	7 (78%)	14 (70%)	21 (72%)
	No	2 (22%)	6 (30%)	8 (28%)

Overall, there were almost twice as many females (n = 19) as males (n = 10), and this was the same trend in the control and the experimental groups. All the participants spoke English as a required language in an Australian university; however, there were various native language speakers among the participants of this study (English: n = 12, Chinese: n = 12, Korean: n = 2, Indonesian: n = 2, Thai: n = 1), which is considered to be due to their family circumstances as immigrants. Eleven participants were born overseas and moved to Australia when they were two (n = 1), nine (n = 2), ten (n = 3), twelve (n = 3), sixteen (n = 1), and nineteen years old (n = 1). The majority of the participants were majoring in Japanese (n = 21), while the majors of the remaining participants were International Studies (n = 1), Marketing (n = 1), or undecided (n = 6). All the participants were continuing students from a course in the previous semester, Advanced Japanese I, and had experience of shadowing in that course.

2.2   Materials

This study consisted of three phases: a pre-test, eight weekly shadowing exercises, and a post-test. Small dictation quizzes were also administered in order to measure the participants' sound recognition ability, because the pre-post tests were considered to measure overall listening comprehension skills.

2.2.1   Shadowing materials

For shadowing model audio, monologic narrative recordings were used, because they are read at a stable pace with appropriate pauses, which is considered ideal for the purposes of this study to measure the effect of shadowing in relation to the gradual speed progression of the model audio and sound recognition ability. Descriptors of linguistic competence for the five levels of the standardized language test, the Japanese Language Proficiency Test (JLPT), refer to the speed of listening comprehension skills for L2 Japanese learners as follows: novice learners (levels N4 & N5) can comprehend Japanese which is spoken "slowly," and more advanced learners can comprehend at "at near-natural speed" (level N3), "at nearly natural speed" (level N2) and "at natural speed" (level N1) (Japan Foundation, 2017). It is fair to assume the "natural" speed in this description is of native equivalent. Therefore, audio recordings were selected from a reading aloud textbook (Matsuura, Fukuike, Kohno, & Yoshida, 2014) for "near-natural" speed materials, and from NHK online news (NHK, 2016) for "natural" speed materials. The former is a textbook for intermediate level Japanese learners, while the latter is broadcast for native audiences. The NHK news material was selected during the month prior to the study period so that the news content was reasonably up-to-date. The speeds of the audio materials were then calculated by dividing the total number of mora[2] in the script by the running time. Pauses were not excluded from this calculation, since it is considered that appropriate pausing is naturally required in proportion to the speech speed. The investigator then selected materials at various speeds in order to provide gradual speed progression of the shadowing materials (see Table 3). Each audio recording was approximately one minute long. Kadota (2007) recommends that shadowing materials contain no more than 3% of unfamiliar vocabulary; however, this recommendation is based on the requirements for content shadowing, where the aim is to understand the content while shadowing. This study, on the other hand, put a focus on sound recognition, not comprehension, so NHK news audio was considered suitable for providing a wider range of speed variation up to the native speed in the shadowing materials. Therefore, in order to prepare students for the progressive speed increase of the shadowing materials, in the first week of semester, the investigator explained the shadowing mechanism, various shadowing purposes at multiple steps (see Table 1), and the aim of adapting the shadowing method for this particular study in order to focus on speed progression and accuracy. Table 3 summarises the shadowing speed for each week.

Table 3. Progression of weekly shadowing model audio speed

Materials	Read Aloud Textbook				NHK Web News			
	W02	W03	W04	W05	W07	W09	W10	W11
Mora per minute (m/m)	315	340	350	370	400	410	430	440
Number of mora	331	332	333	329	409	391	352	437
Gender of speaker	F	M	F	M	F	M	M	M

The adjustable speed of shadowing materials is particularly unique in this field of shadowing research. The greatest advantage of increasing the speed of the shadowing audio is assumed to be the scaffolding effect for almost all the participants, since the material started at 315 mora per minute (m/m), increased by 10–30 mora every week, and eventually reached 440 m/m by the end of the study period. These model audio speeds were selected in reference to data obtained in the previous semester, where all the participants in the experimental group had experienced shadowing, as mentioned in the previous section. The model audio speeds of the previous semester ranged between 300 and 400 m/m, which were the reference points for selecting the audio speeds between W02 (Week 02) and W07 for this study. The W09 to W11 speeds were added in order to explore the possible speed range, in line with the objective of this study to investigate the effect of variation in the speed of the shadowing model audio.

2.2.2 *Pre-post listening comprehension tests*

Since the Advanced Japanese course encourages students to sit for the JLPT N2 level, the pre-post-tests used N2 equivalent tests that were sourced from a mock examination book for JLPT preparation (Tanahashi, Sugiyama, & Nohara, 2011). The content of these tests is designed to measure students' overall listening skills, which are based on comprehensive linguistic competence to use the knowledge in actual communication (Japan Foundation, 2017). Twenty-four questions were used from the original 32 questions due to the time constraints of the class, and different sets of tests were used in order to avoid test-retest effect of memorization.

2.2.3 *Pinpoint dictation*

As a counterpart to the pre-post-shadowing tests, the author devised a dictation quiz called pinpoint dictation (PD), where students were asked to write down only certain information from a short sentence. The quiz aimed to measure listening skill by focusing as much as possible on sound recognition, and was inspired by the cloze test and the digit span test format. In the quiz, 10 short Japanese sentences were read aloud, followed by a question in English after each sentence. The sentence included one or two pieces of information containing either random numbers or names that L2 learners are likely unfamiliar with (e.g. celebrities and popular travel destinations were not used in this test).

Consider the following example:

Sentence: このねぎとろ丼は 560 円だ。
    [*kono negitorodon wa gohyakurokujū en da.*]
    (This spring onion and raw tuna mince on rice costs 560 yen.)

Pattern 1. Q: How much is the dish?
    A: 560 yen.

Pattern 2. Q: What is the name of the dish?
    A: ねぎとろどん [*negitorodon*].

In order to measure participants' sound recognition ability at different speeds, the PD was divided into two parts: the first five sentences were read at relatively slow speed and the latter five at fast speed. The instructor, who is a native Japanese speaker and also the investigator of this study, recorded the PD audio after careful revision of the first week's slow and fast speeds in order to

maintain consistency throughout the semester. The slow speed sentences were read at 5.75 mora per second, and the fast speed sentences at 7.61 mora per second on average[3]. The total numbers of mora for the slow and fast speed sentences were made equal each week in order to avoid differences in the difficulty level caused by the length of the answers.

2.3 Procedure

Out of the 13-week semester period, shadowing practice was conducted as a homework assignment for eight weeks between W02 and W11 in the Advanced Spoken Japanese class only. There was no shadowing in W06 and W08 as there were speaking and written tests. The theoretical background of shadowing was explained to the students during the W02 class before the commencement of weekly shadowing assessments, as it is considered crucial to share such information in order to help students better understand the objectives (Mochizuki, 2006). Also, it was explained that the shadowing script would not be made available in the one week period between one lesson and the next, because the purpose of the exercise was to train their sound recognition ability. The gradual increase of the shadowing model audio speed was also mentioned, in order to raise students' awareness of the challenges that lay ahead in the following weeks.

The shadowing model audio was made available via the course module in the university online learning system on the day of the class, and the submission date was set four days later in order to maintain the weekly cycle. Each shadowing week, the instructor listened to the submitted shadowing audio and marked it for accuracy against the model audio script. The mistaken parts were highlighted on a printout of the audio script typed in kana scripts. Each mistake was manually spelt out above the highlighted kana script, and the total accuracy was calculated on a 100% scale. This marking process took approximately two hours for 25 shadowing submissions. Feedback and a marked script sheet were returned to each student in the following week's class. During the class, shadowing feedback involved the following steps: 1) the instructor played the model audio once while everyone shadowed altogether, 2) the instructor briefly pointed out the common mistakes and provided general comments on that week's shadowing performance, 3) a marked feedback sheet was returned as a printed script with mistakes highlighted in red and the correct spelling of pronunciation errors provided above the highlighted part, and 4) the average score of the class was shown. This in-class shadowing feedback normally took approximately 10 minutes each week.

Pre-post-listening comprehension tests and PD were conducted in the general Japanese course only: the pre-test in W01 and the post-test in W11, and PD six times in W02, W03, W05, W07, W09 and W11. Each PD test took about three minutes, and the audio was played only once as it was designed to measure students' sound recognition ability with a one-off attempt at listening to the audio sentence. Out of 10 items, the answers for the first five (slow) and the latter five (fast) contained the same number of mora (40 each), and each answer was marked on the number of correct phonetic representations so that the test score represented detailed accuracy as opposed to an all-or-nothing scoring method. The W02 PD was considered as an introduction, because most students were not familiar with the dictation format. Therefore, in order to ensure that any improvements in performance resulting from the participants becoming accustomed to the test format did not lead to misleading results, the W03 PD was considered as the pre-test for sound recognition, and W11 as the post-test. In order to test the reliability of the PD scores due to the possible differences in difficulty between W03 and W11, W03 items were included in the W11 PD for the purpose of correlation analysis. As a result, the W11 PD contained 20 items: 10 slow and 10 fast items with W03 PD items included alternately. It is reasonable to assume that there was very little chance that participants remembered the W03 PD answers given the nature of the content, such as sequences of random numbers, and that there was a nine-week interval between W03 and W11 (including the two-week mid-semester recess).

2.4 Data analysis

Descriptive statistics were used to present the overall features of the collected data. The raw test scores were converted into percentages (%) for consistent presentation. The effect sizes (Cohen's d) were calculated based on the standard deviation scores from a paired-sample t-test for each test. Line graphs were produced for clearer data presentation. For statistical analysis using the SPSS program, a mixed-design two-way analysis of variance (ANOVA) was performed to compare the improvements of each group for pre-post-listening comprehension and PD tests. The treatment (experimental-control group) was the between-participants factor, and time (pre-post) the within-participants factor.

Regarding the pre-post-listening comprehension tests, the number of participants was smaller than other tests due to the late enrollment of participants in the course, and as a result of filtering for genuine group scores for the same individuals who took both tests for valid comparison of the mean scores (experimental: $n = 6$, control: $n = 17$).

3   Results

In this section, firstly, pre-post-test results and PD results will be presented, where PD scores were analyzed separately between Slow and Fast in order to compare the speed differences. Secondly, overall shadowing performance scores will be presented followed by the results for the five PD tests in Slow and Fast in order to make detailed comparison based on the time elapsed.

In the pre-post-listening comprehension tests (24-item JLPT proficiency test), both groups showed improvement in the mean scores: by 23.4 from 36.3 to 59.7 in the experimental group, and by 12.1 from 41.0 to 53.1 in the control group (see Fig. 1 and Tables 4 and 5).
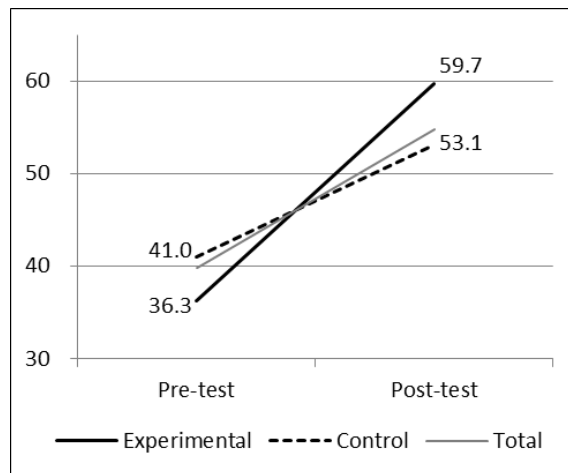

Fig. 1. Test results of pre-post-listening comprehension tests

A mixed-design of two-way ANOVA showed a statistically significant difference for *time* [F (1, 21) = 21.662, p =< .01, η^2 = .508]; however, no significant difference was observed for *treatment* [F (1, 21) = 0.019, p = .893, η^2 = .001] or *interaction* [F (1, 21) = 2.17, p = .156, η^2 = .094] (Table 4). The large effect size for the experimental group (d = 2.57) and the medium effect size for the control group (d = 0.69) along with these results indicate that the experimental group showed stronger improvement than the control group (see Table 4).

Table 4. Test results of listening comprehension and PD scores (%)

Tests		Group	Pre Mean	*SD*	Post Mean	*SD*	Effect Size (*d*)
Listening Comprehension		Experimental	36.33	18.52	59.67	21.18	2.57 (L)
		Control	41.00	17.79	53.12	12.67	0.69 (M)
PD	Slow	Experimental	77.21	22.63	88.89	11.53	0.82 (L)
		Control	72.56	19.81	81.88	15.15	0.73 (M)
	Fast	Experimental	75.50	22.02	81.11	13.87	0.60 (M)
		Control	77.18	16.51	75.13	14.06	0.16 (S)

Table 5. Summary of the ANOVA results

Factor	Measurement		
	Listening Comprehension	PD	
		Slow	Fast
Time	$F(1, 21) = 21.662^*$, $p = .000$, η2 = .508	$F(1, 27) = 15.684^*$, $p = .000$, η2 = .367	$F(1, 27) = 0.524$, $p = .475$, η2 = .019
Treatment	$F(1, 21) = 0.019$, $p = .893$, η2 = .001	$F(1, 27) = 0.779$, $p = .385$, η2 = .028	$F(1, 27) = 0.126$, $p = .725$, η2 = .005
Interaction	$F(1, 21) = 2.17$, $p = .156$, η2 = .094	$F(1, 27) = 0.200$, $p = .658$, η2 = .007	$F(1, 27) = 2.435$, $p = .130$, η2 = .083

Note: *p < .05.

As for the PD (10-item dictation test), there was strong positive correlation between the afore-mentioned W03 repeat and W11 scores ($r = 0.932$, $p = 0.000$), which indicates that the W11 PD is reliable for comparative analysis.

In the PD Slow, both groups showed improvement. The experimental group improved by 11.7 from 77.2 to 88.9, while the control group improved by 9.3 from 72.6 to 81.9 (see Fig. 2 and Table 4). A mixed-design of two-way ANOVA showed a statistically significant difference for *time* [$F(1, 27) = 15.684$, =< .01, $\eta^2 = .367$] but no significant difference was observed for *treatment* [$F(1, 27) = 0.779$, $p = .385$, $\eta^2 = .028$], or *interaction* [$F(1, 27) = 0.200$, $p = .658$, $\eta^2 = .007$] (see Table 5). The large effect size for the experimental group ($d = 0.82$) and the medium effect size for the control group ($d = 0.73$) along with these results suggest that both groups improved in the PD Slow to a similar degree (see Table 4).
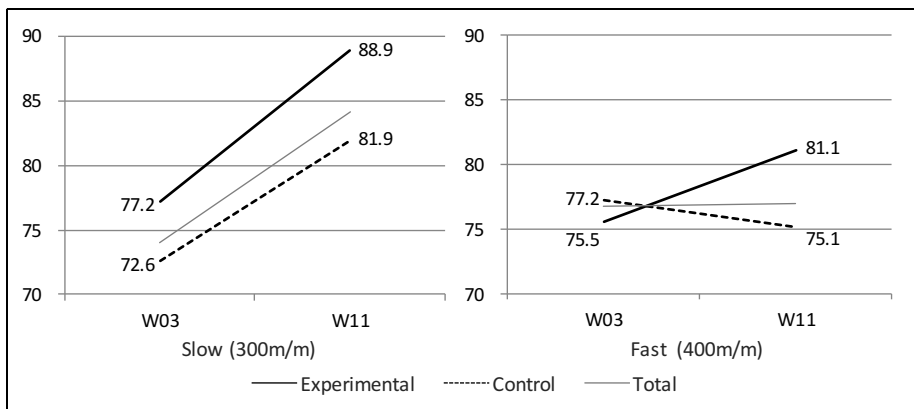

Fig. 2. Test results of PD in W03 and W11 at slow and fast speed

With regard to the PD Fast, the experimental and control groups showed a different trend. The experimental group improved by 5.6 from 75.5 to 81.1, but on the contrary, the control group decreased by 2.1 from 77.2 to 75.1 (see Fig. 2 and Table 4). A mixed-design of two-way ANOVA showed no significant difference in *time* [$F(1, 27) = 0.524$, $p = .475$, $\eta^2 = .019$], *treatment* [$F(1, 27) = 0.126$, $p = .725$, $\eta^2 = .005$], or *interaction* [$F(1, 27) = 2.435$, $p = .130$, $\eta^2 = .083$] (see Table 5). The medium effect size for the experimental group ($d = 0.60$) and the small effect size for the control group ($d = 0.16$) along with these results indicate that the experimental group improved in the PD Fast more strongly than the control group (see Table 4).

As for the overall shadowing performance, Figure 3 shows the mean scores between W02 and W11 for the experimental group. Out of the eight-week shadowing period, six weeks show a gradual shift in the mean scores, but there were sharp declines in W07 and W11, by 7.3 from 95.6 to 88.3 and by 8.1 from 91.5 to 83.4 respectively.
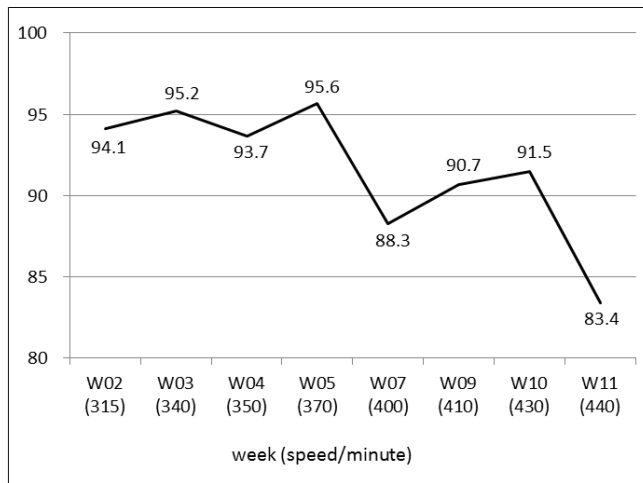

Fig. 3. Mean of shadowing performance scores

In order to present the overall PD score shifts from W03 to W11, the raw scores were converted into relative standard deviation values where the mean score was 50 in order to highlight the between-group comparison without fluctuations of test mean scores (see Fig. 4).
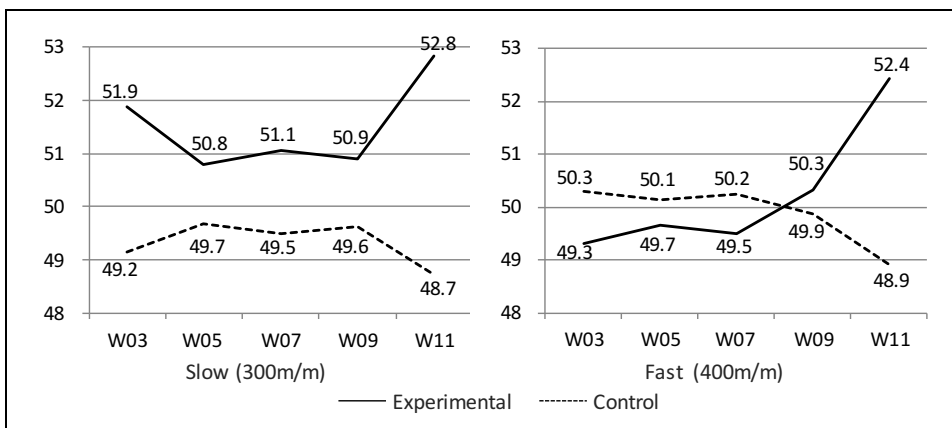

Fig. 4. Test results of PD in standard deviation value from W03 to W11

Regarding the PD Slow, the experimental group scored higher than the control group in W03 by 2.7, then the gap between the groups narrowed in W05 to 1.1 and remained small until W09, then the gap widened to 4.1 in W11. On the contrary, PD Fast traces a different pattern, where the control group commenced at a higher score than the experimental group with a gap of 1.0, then the groups remained parallel until W07 at a gap of 0.7, then the experimental group overtook the control group in W09 by 0.4, and widened the gap to 3.0 in W11.

In summary, both groups improved general listening comprehension skills and PD at a slow speed, while only the experimental group showed improvement in PD at a fast speed. The five-week PD test results show that the experimental group improved at a slow speed more strongly than the control group in W11, and at a fast speed after W07.

4   Discussion

The pre-post-listening comprehension tests revealed significant improvements in both the experimental and control groups, and the PD Slow indicated that both groups improved sound recognition skills at a slow speed to a very similar degree (see Fig. 1 and 2 and Tables 4 and 5). This commonality in improvements indicates the linkage between sound recognition ability and comprehension skills; namely, sound recognition ability at a slow speed is the fundamental step of bottom-up processing. This point echoes Nakayama's (2011) finding that slow speed shadowing material contributed to improvement in recognition of weakly pronounced function words in English. In addition, the results suggest another link between sound recognition and comprehension skills, in that the experimental group surpassed the control group in the post-listening comprehension tests and in the fast speed PD scores. One possible explanation for the experimental group improving more strongly in the listening comprehension test is that their newly developed sound recognition skills at a fast speed enabled more elaborated bottom-up processing. In fact, both groups improved their sound recognition skills at a slow speed, which alone could lead to improvements in the post-listening comprehension test, but the additional degree of improvement by the experimental group could be due to improvement in fast speed sound recognition ability.

After obtaining the results of the eight weeks of shadowing, which showed a sharp drop in the mean scores in W07 and W11 (see Figure 3), the investigator further examined the content of the shadowing scripts. A Japanese text readability measurement system called "jReadability" (Hasebe & Lee, 2015) was used to assess the difficulty level of the shadowing materials. The system operates online, and assesses the readability of a text regardless of the use of kana scripts or kanji, with a highly reliable outcome. Readability is evaluated between 6.4 (Lower-Elementary = very easy) and 0.5 (Upper-Advanced = very difficult). Table 6 summarises the content of the shadowing scripts.

Table 6. Readability and difficulty level of the shadowing material

Materials	Read Aloud Textbook				NHK Web News			
	W02	W03	W04	W05	W07	W09	W10	W11
Mora per minute (m/m)	315	340	350	370	400	410	430	440
Readability	3.63	4.32	2.93	3.81	2.45	1.93	1.70	1.18
(Difficulty Level)	(I-)	(I-)	(I+)	(I-)	(A-)	(A-)	(A-)	(A+)
Number of sentences	9	8	7	9	5	4	4	5
Words per sentence	21.3	22.0	25.6	18.9	40.2	47.5	48.3	41.8

Note: For Difficulty level, I = Intermediate, A = Advanced; - = Lower, + = Upper

There is a large gap between W05 and W07 in a number of aspects. Firstly, the speed increase from W05 to W07 was 30m/m, which was larger than that of previous weeks. Secondly, the audio materials for the first four weeks were taken from a textbook which was developed for L2 Japanese learners, while the materials for the latter four weeks were taken from NHK news, which was broad-cast for a native Japanese audience. Thirdly, a gap in the readability and difficulty levels of the materials used in the two four-week periods is to be expected, given the difference in the target

audiences. The materials of the first four-week period were all at the Intermediate level with an average readability of 3.7; on the other hand, the materials used in the latter period were all at the Advanced level with an average readability of 1.8. And finally, the number of sentences in the scripts is different between the two periods: in the former period it ranges between seven and nine sentences, while in the latter it ranges between four and five sentences, resulting in substantial differences in the words per sentence; an average of 22.0 and 44.5 words per sentence respectively.

As for the other sharp drop of the mean scores in W11, it is reasonable to assume that this is due to both the speed (440m/m) and the difficulty of the script (readability = 1.18) being at their highest levels, which may well have exceeded the capacity of the shadowing skills of the participants. However, the increase in the mean scores in W09 ($M = 90.7$) and W10 ($M = 91.5$), despite the faster speed and the greater difficulty of the scripts compared to W07 ($M = 88.3$), indicates that the shadowing skills of the participants improved during this period. Furthermore, a comparison between the W02 and W10 results corroborates this observation, in that there is a huge gap in the speed (from 315m/m to 430m/m) and difficulty (from 3.63 to 1.70), but a very small decrease in the mean scores by only 2.6 from 94.1 in W02 to 91.5 in W10.

Considering that the drop in the shadowing performance scores and the improvements in PD Fast coincided after W07, it is reasonable to assume that these outcomes resulted from resistance to the shadowing practice, a consequence of the participants being pushed beyond their comfort zones by the faster, more difficult materials. These different trends before and after W07 indicate that the Read Aloud textbook materials (used between W02 and W05) had little or no effect on Slow or Fast PD scores, but the NHK Web News materials (used between W07 and W11) had a substantial effect, especially on Fast speed scores. These results suggest that shadowing materials at a slow speed (up to 370m/m) did not have much effect on sound recognition ability, but shadowing materials at a fast speed (faster than 400m/m) improved sound recognition ability, especially for fast speed dictation materials. These findings echo Onaha's (2004) finding of a correlation between shadowing performance and listening comprehension, in that improvement in shadowing ability leads to more elaborated listening skills. However, it remains uncertain if a speed of 440m/m was suitable for the participants in this study.

5   Conclusion

5.1   Summary

The ANOVA results, based on the comparison between W02 and W10 scores, did not show statistical significance in the Interaction between Treatment (shadowing) and Time (pre and post); however, the analysis of eight-week shadowing performance and five-week PD scores revealed a possible effect of shadowing for improving sound recognition ability. The results indicated that shadowing can be effective when the model audio speed is 400m/m or faster, but not at 370m/m or slower for L2 Japanese learners at proficiency equivalent to JLPT N2 level. It is also suggested that the improvement in sound recognition ability contributes to improving general listening comprehension skills, as it is assumed to elaborate bottom-up processing. This study used shadowing materials at a slow speed with intermediate difficulty level and a fast speed with advanced difficulty level, but the relationship between the difficulty level and comprehension skills remains uninvestigated. Further research needs to be conducted to explore the effect of shadowing in relation to these two variables of speed difference and difficulty level.

The implementation of shadowing in the L2 teaching context can be applied to any target language, since it aims to activate the phonological loop of WM, which is universal to second language acquisition. The selection of the model audio can be relatively flexible and a wide range of audio materials can be used; however a written script is indispensable in conducting shadowing practice in order to enable learners to check the accuracy of their performance. The genre of the model audio may be determined depending on the target learning outcomes; for instance, monologic narrative may be appropriate for training accurate sound recognition and constant speech pace, and fictional

materials such as movie excerpts may be most suitable for enhancing emotional expression through performing language (Bryce, Suzuki, Mori, Sumiyoshi, & Barber, 2013).

The instructor should monitor the learners' shadowing performance so as to grasp the discrepancy between the model audio and the learners' proficiency levels. The results of this study suggest that the effective range of learners' shadowing performance accuracy falls between 90% and 95% (see Fig. 3), where the discrepancy between the model audio and the learners' proficiency levels is considered to provide appropriate resistance for learners to improve sound recognition ability. As for the model audio speed, it is the author's recommendation that when introducing shadowing at any level, it is important to begin at a relatively slow speed, in order to avoid possible anxiety among the learners, since shadowing requires the unusual behaviour of simultaneous listening and speaking, and, more importantly, to encourage motivation towards shadowing practice, as learners may feel frustrated when the shadowing speed is too fast to comprehend the content (Sumiyoshi & Svetanant, 2017). The author hopes that the findings of this study will trigger interest among language instructors in incorporating shadowing into their pedagogy, since shadowing can potentially contribute to improvement in listening at fast speeds.

5.2 *Limitation of the study*

This study employed quasi-experimental design by recruiting participants for the experimental group from a spoken Japanese course that was a co-requisite to the general Japanese language course, and participants for the control group from the general course. This recruitment method was necessary in order to set up the control group within the university's ethics guidelines, but resulted in a different number of participants in the experimental (n = 9) and the control (n = 20) groups, since enrollment in the co-requisite course was optional. This also resulted in a small number of participants, which may not have been sufficient to perform statistical analyses to validate the results for more appropriate interpretation, as p-values are likely to become non-significant when the sample size is small (Demidenko, 2015).

This recruitment method also involved another between-group difference in terms of the required study hours. The experimental group had two extra class hours per week, which may have contributed to stronger improvement in their general listening comprehension skills. In addition, the fact that the experimental group participants chose to enroll in two Japanese courses out of the four courses available to them in the semester implies a high level of interest, motivation and/or engagement in Japanese study, which may have resulted in the higher degree of development in language competence.

Notes

[1] The episodic buffer is assumed to be a temporary store controlled by the central executive, which feeds and retrieves information from LTM through the medium of conscious awareness (Baddeley, 2000). The buffer is episodic and can be associated with incoming information via visuospatial sketchpad and/or phonological loop

[2] Japanese is a mora-timed language in which each mora is spoken at a roughly constant rate, while English is a stress-timed language with syllables (Ishihara, Tsurutani, & Tsukada, 2011).

[3] These speeds were calculated based on the length of the sentence utterances which only lasts for a few seconds. The speeds of 5.75 mora per second and 7.61 mora per second are equivalent to 340 m/m and 450 m/m respectively, but somewhat slower than these speeds as this recalculation does not include pauses between sentences.

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