

Research article

Chinese JSL/JFL learners' online perception of Japanese verb conjugations: Evidence from a behavioral study

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ABSTRACT

Verb conjugation is essential in learning Japanese as a second or foreign language (JSL/JFL). Previous studies showed that Chinese JSL/JFL beginners behaved differently in acquiring Japanese verb conjugations, but the results were obtained from offline tests (e.g., writing examination without time limitation), hard to reflect the real perception. On this background, the current study adopted a time-controlled lexical decision task (real-time automatic processing) to explore how Chinese intermediate JSL/JFL learners processed four types of verb conjugations (i.e., *masu/tai* form, *te/ta* form, *nai* form and *yoo* form). Based on the error rates and RTs collected from 27 Chinese intermediate JSL/JFL learners, the results showed that the JSL/JFL learners processed better in *masu/tai* form and *te/ta* form, followed by *nai* form and *yoo* form. The discrepant processing of the four types of Japanese verb conjugations suggests that the JSL/JFL learners do have difficulties in Japanese acquisition. Finally, a general discussion is offered from the perspective of verb conjugations' frequency, JSL/JFL learners' learning strategy and Japanese teaching method.

1. Introduction

Due to the geographical proximity, China shares a long history of cross-culture communication with Japan, leading to the fever of Japanese learning in China. According to Lü et al. [1], mainland China had the most Japanese as a Second/Foreign Language (JSL/JFL) learners globally (1.046 million out of a total of 3.985 million), representing a rise of 26.5% from 2009 onward. Two reasons are likely to account for the increasing popularity of Japanese learning in mainland China: the practicability of Japanese for work and the cultural borrowing of Japanese culture (e.g., Japanese cartoon). With the upward Japanese learning trend, it is pivotal to access the perception of JSL/JFL learners in China [2,3].

The morphological dimension is an essential part for Japanese learning [4,5], for L2 learners have to conduct morphological changes with different tenses when forming sentences [6,7]. For example, Japanese adjectives and verbs must be conjugated with different tenses whereas nouns not [8–10]. Verb conjugations are the core in Japanese morphology and hence become the focus in grammar teaching for JSL/JFL learners [11,12].

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1.1. Japanese verb conjugations

Verb conjugation is a linguistic process that changes a verb from its principal parts to derived forms in order to convey different meanings. In Japanese textbooks in China, there are three basic verb conjugations (i.e., *masu*, *te*, *ta*) and they denote different tenses [13]. *Masu* form equals to two tenses in English, including the simple present tense and simple future tense [14]. *Te* form can represent the present progressive tense whereas *ta* form is equal to the simple past tense in English [15,16]. Importantly, the rules of verb conjugations with these three tenses are listed together with other three sentence forms, i.e., *tai* form (means “want to” in English), *nai* form (means “do not” in English) and *yoo* form (means “let’s” in English) in the textbooks [17]. Morphologically, all Japanese verbs are conjugated in a similar way under these conditions. Take the verb “manabu” for example. The conjugation rules consider it as three Japanese syllables (“ma”, “na” and “bu”) and changed the last syllable to other syllables according to different tenses or sentence forms (e.g., “manaboo” under *yoo* form) [18–20]. It should be noted that *masu* form has the identical verb conjugations with *tai* form, and so do *te* form and *ta* form [21]. Accordingly, this study adopts the four types of verb conjugations to make a comparison, including *masu/tai* form, *te/ta* form, *nai* form and *yoo* form.

1.2. Empirical studies on verb conjugations

Numerous empirical studies to date have adopted different verb conjugations as stimuli to explore whether JSL/JFL learners grasped the tenses. For example, Shirai et al. [22] found that Chinese JSL/JFL learners had difficulty in identifying imperfective tense with recourse to different conjugations of non-durative verbs (e.g., fall) as materials (non-durative verbs indeed have imperfective tense in Japanese). In contrast, this situation was reversed for German and Slavic JSL/JFL learners [23]. However, these studies just used verb conjugations as materials to test the perception of tense rather than to explore whether JSL/JFL learners acquire the verb conjugations in Japanese.

There were two studies investigating the perception of verb conjugations by JSL/JFL learners. The first one was conducted by Klafehn [24], in which a judgment task was adopted to explore whether American JSL/JFL learners could grasp verb conjugations by virtue of pseudo verbs (comparing a correct and an incorrect conjugation of pseudo verbs). The results showed that American JSL/JFL learners outperformed Japanese natives in this task. The second study by Sugaya [25] utilized the same method to examine JSL/JFL learners from Inner Mongolia and Korea. In contrast with Klafehn [24], the results showed that all JSL/JFL learners had low accuracy in identifying the correct conjugations of pseudo verbs. However, Klafehn [24] did not compare the performances in verb conjugations by the learners from different backgrounds, just combining them for statistical analysis. Besides, the two studies tested verb conjugations with all tenses, and it remains unknown how JSL/JFL learners process verb conjugations in specified tenses, such as *masu* form, *te* form and *ta* form.

In China, only one study has been conducted to examine how Chinese JSL/JFL learners acquire the verb conjugations under the above four conditions. Chu [26] drew upon a writing examination (without time limitations) to test this question for Chinese JSL/JFL beginners. The results showed that the highest accuracy was observed in *masu/tai* form, but JSL/JFL learners had the lowest accuracy in *ta* form. However, the study only focused on the Japanese beginners, leaving the case of intermediate learners unknown. Most importantly, the online perception of Chinese JSL/JFL learners could not be reflected because the data of the experimental paradigm were achieved from the controlled processing (see 1.3 below) of participants. Therefore, the real perception of four types of verb conjugations for Chinese intermediate JSL/JFL learners is basically vacant, from an online behavioral study in particular.

1.3. Automatic processing v.s. controlled processing

Automatic processing and controlled processing are the two cognitive processing system proposed by Shiffrin et al. [27]. Automatic processing is a type of thinking or cognition that does not involve any effort or deliberation. It is also known as unconscious processing and often occurs almost like an automatic reflex [28,29]. Its typical example is a car driving: with enough practice, people can operate the car entirely without conscious awareness. By contrast, controlled processing is the process wherein people are consciously aware of what they are doing when involving in a task. In other words, people tend to think about situations, evaluate and make decisions. A good example of this type would be reading articles. Readers are required to pay attention and deliberately try pains in reading and understanding the concepts concerned with the articles; hence, controlled processing is thought to be slower [30].

Generally, controlled processing can be transformed into automatic processing through enough practice. At the early stage of second language learning, L2 learners have difficulty understanding each procedure of target language output, which is at the “controlled processing” stage. However, through a great deal of practice, the learners can internalize the language knowledge, moving to the “automatic processing” stage, so that they can speak the target language accurately without thinking in advance [30,31]. For example, when learners first started learning English, they will be confused about the specific constructions, such as the subject-verb agreement. However, after practicing a lot, English learners can fluently use this construction when speaking English [32].

In the area of SLA, controlled processing occurs in the time-unlimited task (e.g., writing examination) when scholars examine the acquisition of L2 learners [26]. During controlled processing, L2 learners spend plenty of time and attention in conjecturing specified procedures of specific constructions based on the instructions in class. However, this processing happens without time limitations, which cannot reflect the real acquisition of L2 learners. Compared with time-unlimited task, time-controlled lexical decision tasks can reflect automatic processing of JSL/JFL more accurately because these tasks require participants to make timely response to the given stimuli. Even though L2 learners have already acquired linguistic knowledge from textbooks, they are prone to errors due to time limitations [33]. Based on this advantage, this present study adopted time-controlled lexical decision task as the real-time paradigm to

investigate how Chinese JSL/JFL learners acquired Japanese verb conjugations so as to examine their corresponding real-time automatic processing.

In summary, there have been two problems left unsolved as follows: (1) the paradigm based on controlled processing fails to reflect the learners' real perception of verb conjugations in Japanese. (2) it is to be investigated how the four types of verb conjugations (i.e., *masu/tai* form, *te/ta* form, *nai* form and *yoo* form) are processed by Chinese intermediate JSL/JFL learners.

For our study, since the four types of verb conjugations are particularly difficult for Chinese learners to acquire, there should be some cognitive causes to motivate the situation. Accordingly, it is important and significant to examine how JSL/JFL learners process the conjugations by on-line behavioral experiment, and to identify how the four types of conjugations are similar or different from the perspective of psychological processing.

Backgrounded by the above, the current study aimed to adopt a lexical decision task to explore the below questions:

- (1) How do Chinese intermediate JSL/JFL learners process four types of verb conjugations (i.e., *masu/tai* form, *te/ta* form, *nai* form and *yoo* form) in on-line behavioral experiment?
- (2) What is the difference of the acquisition of four types of verb conjugations?

2. Methods

2.1. Participants

27 Chinese JSL/JFL learners (20 females and 7 males) were recruited for this experiment, which were all individuals in a natural class. Meanwhile, our sample size also followed the study Fukuda [34], which recruited 20 participants to investigate the acquisition of *nai* form of Japanese. To compare effects across four basic verb conjugations, between-subject variables are observed. Therefore, in order to eliminate potential confounds, we carefully controlled the characteristics of the participants that can influence the performance in the task.

All participants were third-year undergraduate students, aged from 20 to 22, majoring in Japanese language and literature at a Chinese university. They had studied Japanese for three years on average and all had passed the N2 Japanese Language Proficiency Test (JLPT), indicating that they are at the intermediate level. According to their self-reports, none of them had been to Japan before. This study also referred to the experimental paradigm (i.e., time-controlled lexical decision task) by Kadota [35] and received approval from the Human Research Ethics Committee of the university. Besides, the informed consent was obtained from all the participants prior to the experiment. All the participants were paid (i.e., 10 RMB) after the experiment.

2.2. Materials

A lexical decision task was adopted in this study. Four basic verb conjugations were used as experimental materials, including *masu/tai* form, *te/ta* form, *nai* form and *yoo* form. To select appropriate stimuli, we manipulated important variables of the verbs (e.g., frequency of vocabulary) and control other irrelevant variables to reduce confounds (e.g., morphological similarities) rigorously as below. All the verbs were selected from the word list of Test Content Specifications of JLPT [36]. It should be noted that only two types of verbs (i.e., consonant-ending verbs and vowel-ending verbs) were applied in this study. In order to minimize the effect of the frequency of vocabulary [34], we used N2 or lower-level common words. Furthermore, words with similar morphological features across two types of verbs were excluded to avoid confusion. According to participants' self-reports after the experiment, we ensured that all the verbs of stimuli are known to the participants. Finally, 96 words were selected and transformed into the four conjugations respectively, including 48 correct and 48 incorrect verb conjugations. Specifically, we made 48 pseudo words, which were classified into three types in terms of verb conjugations. In light of Japanese morphology, the words were formed by observing the following procedures. First, we selected 36 frequently used Japanese verbs and replaced their consonant ending of stem with other consonants (e.g., "kubas-anai", the word should be "kubar-anai") to generate 36 pseudo words correspondingly. Second, we constructed 6 pseudo Japanese verbs by changing their conjugations of *te/ta* forms into corresponding unacceptable allophones (e.g., changing "anda" into "anta"). Third, another 6 pseudo verbs were constructed by changing one phoneme of verb stem's suffix (i.e., the initial phoneme of a suffix) into another phoneme corresponding to other forms (e.g., changing "mawar-anai" into "mawar-inai", where [a] from *nai* form is changed into [i] from *masu/tai* form). The reliability of this task was calculated using Cronbach alpha and the result ($\alpha = 0.886$) proved the validity of our task.

As a result, four conditions of verb conjugations were made, 24 items for each (one half for correct and the other half for incorrect conjugations), i.e., (1) verbs with *masu/tai* form, (2) verbs with *te/ta* form, (3) verbs with *nai* form, and (4) verbs with *yoo* form. Table 1 shows examples of words used in the experiment.

Table 1
Examples of words used in the experiment.

	<i>masu/tai</i> form	<i>te/ta</i> form	<i>nai</i> form	<i>yoo</i> form
Correct example	Keshimasu	Hagemashite	Nobinai	Dekiyou
Incorrect example	Kubasatai	Kimette	Chijiranai	Nararou

2.3. Procedure

Participants were tested one by one in a quiet classroom. The lexical decision task consisted of a practice trial (5 trials in total), and a formal trial. We utilized SuperLab Pro to control the presentation of the stimuli and record RTs. Stimuli were presented sequentially on the screen of a Lenovo laptop in black MS Mincho font. In each trial, A fixation signal (***) was displayed in the middle of the screen for 3000 ms. Verb conjugations appeared in the middle of the screen after a 2000 ms blank period. After presenting the fixation point, the screen presented stimuli 5000 ms in the center until the participant made a reaction. We requested the participants to press the “F” key (✓) on the keyboard with the index finger of the right hand in response to a correct verb, and press “J” key (×) with the index finger of the left hand in response to an incorrect verb. The next trial was presented as soon as the key was pressed, and the system would automatically move to the next trial even if the participant didn’t make any reaction within 5000 ms. There was an intertrial interval of 1 s between each response and the presentation of the next stimulus. Participants were asked to react as quickly and precisely as possible. We measured RTs from the onset of the conjugated verb until the participant’s reaction. Different stimuli were presented in random sequences to each participant. The session lasted around 10 min. The procedure of the experiment is shown in Fig. 1.

2.4. Data collection

By referring to the parameters in Welford [37], our study selected reaction time (RT) (i.e., interval between onset of stimuli and responses from participants), which is regarded as a precise parameter to measure the real-time processing of humans’ brains, and error rates to conduct statistical analysis based on the responses of 27 Chinese intermediate JSL/JFL learners across four types of verb conjugations, including *masu/tai* form, *te/ta* form, *nai* form and *yoo* form.

2592 pieces of data were collected in total. To explore the online perception of four types of verb conjugations by Chinese intermediate JSL/JFL learners, we calculated error rates of participants. Afterward, we used all the RTs of correct responses of each participant. Accordingly, 347 pieces of RTs of incorrect responses were excluded.

Besides, additional 19 pieces of data were excluded from the analysis because the participants made no reactions or pressed other keys by mistake. Finally, a total of 2226 pieces of valid data were entered into the measurement analysis. All the data were analyzed using R [38]. A one-way analysis of variance (ANOVA) was made to compare error rates and RTs across four types of verb conjugations, using EMMEANS function in bruceR package. When a significant main effect was observed, multiple comparisons of means using Tukey method were employed for further analysis.

3. Results

Two analyses were conducted to explore the online perception of Chinese intermediate JSL/JFL learners by error rates and RTs on four types of verb conjugations, i.e., *masu/tai* form, *te/ta* form, *nai* form, and *yoo* forms. For one thing, descriptive statistics were conducted on the error rates across the four types of verb conjugations to investigate the accuracy of responses by Chinese intermediate JSL/JFL learners. For another, a further analysis using ANOVA was performed to RTs of correct responses across four types of verb conjugations.

3.1. Error rate

This study used descriptive statistics to calculate the error rates under the conditions of four types of verb conjugations to investigate the accuracy of responses by Chinese intermediate JSL/JFL learners. The dependent variable in this analysis was “error rate” while the independent variable was “type” (i.e., four types of verb conjugations). Fig. 2 presented the mean values and standard

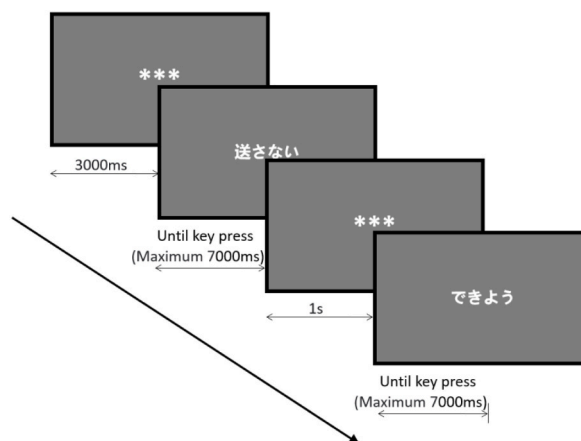


Fig. 1. Procedure of the lexical decision task.

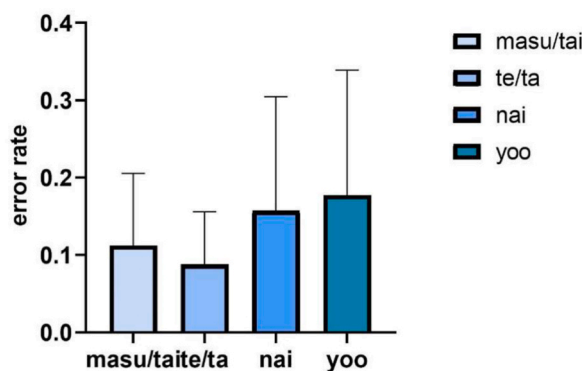


Fig. 2. Results of mean error rates.

deviations of error rates across four types of verb conjugations. As shown in Table 2, *te/ta* forms indicated the lowest error rate among the responses of 27 participants ($M = 8.8\%$, $S.D. = 0.068$), followed by *masu/tai* form ($M = 11.3\%$, $S.D. = 0.093$). By contrast, the highest error rate was observed in *yoo* form ($M = 17.7\%$, $S.D. = 0.162$). Close to *yoo* form, the mean values and standard deviations of *nai* form ranked third among the four forms ($M = 15.8\%$, $S.D. = 0.147$).

3.2. RTs of correct responses

One-way analysis of variance (ANOVA) was conducted to analyze RTs of correct responses under four types of verb conjugations. In this analysis, the independent variable was “type” (i.e., four types of verb conjugations) whereas the dependent variable was “RTs”. The main effect of “type” was significant on participants’ mean RTs of correct responses ($F(3,2222) = 11.946$, $p < 0.001$).

To further examine the perceptions of Chinese intermediate JSL/JFL learners on the four types of verb conjugations, we utilized multiple comparisons of means using Tukey method. As demonstrated in Table 3 and Fig. 3, the results revealed three findings. First, there was no difference between *masu/tai* form and *te/ta* form ($\beta(te/ta - masu/tai) = 114.900$, $t(2222) = 0.241$, $p = 1.000$, $Cohen's d = 0.014$), indicating that participants showed a similar perception on the *masu/tai* form and *te/ta* form.

Second, no difference was also found between *nai* form and *yoo* form ($\beta(yoo - nai) = 131.563$, $t(2222) = 2.044$, $p = 0.246$, $Cohen's d = 0.125$). This suggests that participants share similar performance on *nai* form and *yoo* form.

Third, *Masu/tai* form and *te/ta* form showed shorter mean correct RTs than *nai* form and *yoo* form ($\beta(nai - masu/tai) = 193.731$, $t(2222) = 3.076$, $p < 0.05$, $Cohen's d = 0.184$; $\beta(nai - te/ta) = 178.831$, $t(2222) = 2.862$, $p < 0.05$, $Cohen's d = 0.170$; $\beta(yoo - masu/tai) = 325.294$, $t(2222) = 5.112$, $p < 0.001$, $Cohen's d = 0.310$; $\beta(yoo - te/ta) = 310.394$, $t(2222) = 4.916$, $p < 0.001$, $Cohen's d = 0.295$). This implies that Chinese intermediate JSL/JFL learners had higher perception on *masu/tai* form and *te/ta* form than on *nai* form and *yoo* form.

4. Discussion

In this study, we conducted a time-controlled lexical decision task to investigate how Chinese intermediate JSL/JFL learners processed the four types of verb conjugations (eg., *masu/tai* form, *te/ta* form, *nai* form and *yoo* form) in Japanese. The results showed that Chinese intermediate JSL/JFL learners had significantly lower error rates and shorter RTs on *masu/tai* form and *te/ta* form than *nai* form and *yoo* form, suggesting that Chinese intermediate JSL/JFL learners acquired *masu/tai* form and *te/ta* form better, followed by *nai* form and *yoo* form. The following is to elaborate on analyzing the motivation concerned.

4.1. Learners’ better performance in *masu/tai* form

Unexpectedly, the results showed that Chinese intermediate JSL/JFL learners had a better mastery of *masu/tai* form reflected from the low error rates and the short RTs. There are two major reasons for this phenomenon.

First, *masu/tai* form is introduced early in the Japanese textbooks [39,40]. *Masu* form is a kind of polite form in Japanese, which is necessary to be used in conversations in order to express politeness to others [41,42]. For example, students are required to use polite

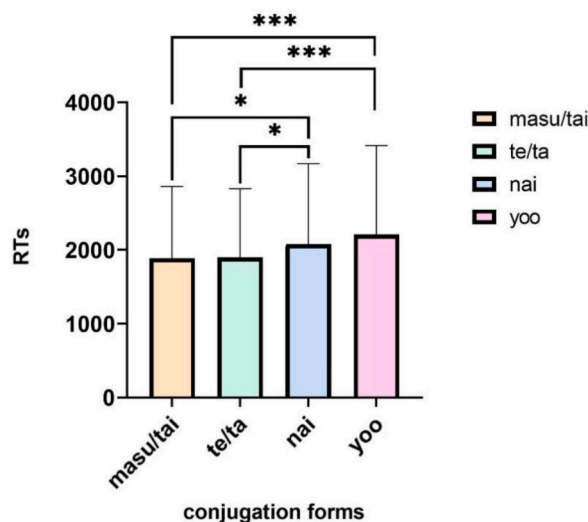
Table 2
Results of mean error rates and standard deviation.

	mean	S.D.
<i>masu/tai</i>	0.113	0.093
<i>te/ta</i>	0.088	0.068
<i>nai</i>	0.158	0.147
<i>yoo</i>	0.177	0.162

Table 3

Results of multiple comparisons of means using Tukey method of mean RTs of correct responses.

	β	S.E.	df	T	p	Cohen's d
<i>te/ta – masu/tai</i>	14.900	61.748	2222	0.241	1.000	0.014
<i>nai – masu/tai</i>	193.731	62.991	2222	3.076	0.013*	0.184
<i>nai – te/ta</i>	178.831	62.493	2222	2.862	0.026*	0.170
<i>yoo – masu/tai</i>	325.294	63.635	2222	5.112	< 0.001***	0.310
<i>yoo – te/ta</i>	310.394	63.142	2222	4.916	< 0.001***	0.295
<i>yoo – nai</i>	131.563	64.358	2222	2.044	0.246	0.125

**Fig. 3.** Results of mean RTs of correct responses.

forms when talking with their teachers [43,44]. Meanwhile, *tai* form is also the first desiderative expression [45], which means “want to” in English. Consequently, JSL/JFL learners are provided with a good foundation for the perception of *masu/tai* form.

Second, the high frequency of *masu/tai* form in daily life is also noteworthy. As known to Japanese learners, *masu* form is frequently used in sentences of formal style in Japanese as polite forms [46]. Similarly, *tai* form is widely used to express personal ideas in daily communications [47]. It is no wonder why Chinese JSL/JFL learners are so familiar with these forms and use them more fluently in practice.

4.2. Learners' better performance in *te/ta* form

In addition to *masu/tai* form, Chinese intermediate JSL/JFL learners also showed a high level of fluency in *te/ta* form. This result is contradictory to Chu [26], which reported low accuracy in *te/ta* form by Chinese JSL/JFL beginners. These discrepant findings may result from different learning strategies adopted by the two populations.

The learning strategy of rule-based learning, in which L2 learners process and generate language based on linguistic rules [48,49], was employed by Chinese JSL/JFL beginners in Chu [26], because the current Japanese teaching methodologies in China focused on rule-based learning strategy at the early stage [50,51]. For example, Japanese teachers will introduce the grammatical or lexical rules before practicing [52]. According to Larsen [53], rule-based learning strategy is detrimental to L2 morpheme acquisition when the morphological rules are intricate. In our study, *te/ta* form has complex rules, containing five types of euphonic changes [54]; thus rule-based learning is inapplicable to processing *te/ta* form. Also, Skehan [55] stated that L2 learners have limited attention resources. If the morphological rules are too complex, they need to spend more attention resources to process these rules, leading to low accuracy and fluency. That's why Chinese JSL/JFL beginners had low accuracy in *te/ta* form [26].

In contrast, the item-based learning strategy, in which L2 learners memorize and produce words as a whole chunk, was adopted by Chinese intermediate JSL/JFL learners in our study [49,52]. It is because when L2 learners have more exposure to verb conjugations, the strategy they adopt may shift from rule-based learning to item-based learning [56], indicating that frequency is correlated with item-based learning. *Te/ta* form in our study has high fluency in the way of Japanese learning. For instance, *ta* form is always used as past tense [57] whereas *te* form always serves as a conjunction in sentences [58]. Besides, *te/ta* form always occurs in basic sentence patterns in Japanese teaching [59]. Therefore, Chinese intermediate JSL/JFL learners tend to memorize *te/ta* form as a whole rather than remember any rules, resulting in high level of fluency in this form.

4.3. Learners' poor performance in *nai* form

The results indicated that the perception of *nai* form by Chinese intermediate JSL/JFL learners was significantly lower than *masu/tai* form and *te/ta* form.

The potential reason is the lower frequency of this form. *Nai* form is a kind of negative form used in daily communication [19]. According to Clancy [60] and Maftoon et al. [61], Japanese showed a tendency to adopt positive words rather than negative ones during daily communications due to indirectness in Japanese culture. For instance, Japanese newspapers were found to use more positive words than negative words even when reporting disaster events [62].

Another reason is that JSL/JFL learners are easily confused with *nai* form (negative form of verbs) and *kunai* form (negative form of adjectives), for these two forms share the similar procedures of conjugations. For example, the verb “ma-na-bu” under *nai* form must be changed into “ma-na-ba-nai” with the last syllable “bu” changed to “ba” and added with “nai”. But for the adjective “yoi” under *kunai* form, the last syllable “i” must be changed to “ku” and added with “nai” [19]. Therefore, JSL/JFL learners may misuse the rules of *kunai* form when doing the conjugation of *nai* form. The evidence was found in Fukuda [63], which reported that JSL/JFL learners misused the rules of *kunai* form when the verb “naku” was required to conjugate under *nai* form.

4.4. Learners' poor performance in *yoo* form

The results showed that Chinese intermediate JSL/JFL learners had high error rates and long RTs on *yoo* form, suggesting that Chinese intermediate JSL/JFL learners had a low fluency in *yoo* form. There are mainly two explanations accounting for the results.

The first reason may result from the phonographic presentation of morphological inflections in Japanese. Japanese has a phonographic writing system in addition to a logographic system [18,64]. In the phonographic system, each grapheme represents a sound unit and its morphological inflections must be identified from the sound unit rather than the orthography [65]. Taking the verb “まなぶ” (ma-na-bu) for example, its correct conjugation under *yoo* form is “まなぼう” (ma-na-bo-o). Our incorrect stimuli changed it into “まなもう” (ma-na-mo-o). When comparing the orthography of the correct and incorrect conjugations (i.e., “まなぼう” and “まなもう”), it can be found that the last grapheme is replaced clearly. However, these graphemes actually should be identified through their sound units (i.e., ma-na-bo-o and ma-na-mo-o). We can see that the verb stem's suffix (i.e., the initial phoneme of the suffix) “b” in “ma-na-bo-o” and “m” in “ma-na-mo-o” are bilabial vowels [66], which share the similar pronunciations, easily leads to the confusion when doing a time-controlled task. That's why Chinese intermediate JSL/JFL learners made the lowest accuracy on *yoo* form.

The second reason may be due to its lowest frequency compared to the other forms. To illustrate, *yoo* form is acquired later than the other conjugations, which causes less exposure of *yoo* form to JSL/JFL learners. Besides, *yoo* form serves to express wish and will, and this function actually overlaps with the aforementioned *tai* form, which is acquired earlier than *yoo* form. Consequently, Chinese intermediate JSL/JFL learners had low fluency in *yoo* form.

5. Limitations and recommendations for future research

There are three limitations in current study. First, the sample size is relatively small even though all individuals in a class were recruited, which may reduce the validity of the study. Therefore, further research should enlarge the sample size and compare more groups on their acquisition of Japanese verb conjugations, such as advanced JSL/JFL learners.

Second, we did not collect the geographics of participants, such as hometown. Since different hometowns lead to different dialects, it is to be investigated whether dialects can influence the acquisition of Japanese verb conjugations by JSL/JFL learners. Consequently, it is necessary to consider more geographic factors from participants in future studies.

Third, our experiment only focused on the acquisition of four types of verb conjugations, ignoring the factor of verb types. In fact, verbs can be divided into two types, i.e., consonant-ending verbs and vowel-ending verbs. Accordingly, further research can take the variable of verb types into consideration.

6. Conclusion

This study used a time-controlled lexical decision task to investigate the online perception of Chinese intermediate JSL/JFL learners across four types of verb conjugations (*masu/tai* form, *te/ta* form, *nai* form and *yoo* form). The results showed that Chinese intermediate JSL/JFL learners had the lower error rates and shorter RTs in processing *masu/tai* form and *te/ta* form than in processing *nai* form and *yoo* form. It indicates that Chinese intermediate JSL/JFL learners have the high fluency in *masu/tai* form and *te/ta* form, followed by *nai* form and *yoo* form.

Our experiment reveal three new findings when compared with previous studies in this area. First, compared with Chinese JSL/JFL beginners, which showed the lowest fluency in *te/ta* form, Chinese intermediate JSL/JFL learners make huge progress in acquiring *te/ta* form, which may result from the effect of item-based learning. Second, the frequency plays an essential role in learning conjugations, so JSL/JFL learners should practice more in Japanese morphology learning. It also provides a guideline for Japanese teaching on verb conjugations, like having more exposure on less-acquired verb conjugations. Third, the learning strategy (e.g., item-based learning) may have different effects when acquiring conjugations in different languages, such as European languages. For example, the item-based learning may not make sense in improving the fluency of English morphology.

Author contribution statement

Xia Yi: Conceived and designed the experiments; Performed the experiments; Analyzed and interpreted the data; Contributed reagents, materials, analysis tools or data; Wrote the paper.

Xiao Han, Wei Wei Wu: Conceived and designed the experiments.

Siyi Cao, Tongquan Zhou: Analyzed and interpreted the data; Contributed reagents, materials, analysis tools or data; Wrote the paper.

Data availability statement

The authors do not have permission to share data.

Declaration of interest's statement

The authors declare no conflict of interest.

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