The /s/-/ʃ/ confusion by Japanese ESL learners in grapheme-phoneme correspondence: bias towards [s] and <s>

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It is generally believed that Japanese English-as-a-second-language (ESL) learners tend to pronounce English /siʲ, sɪ/ as [ʃiʲ, ʃɪ], such as *see* and *sip* as *she* and *ship* respectively, and these errors are typically attributed to the Japanese phonotactic constraint *[si(:)]. However, Nogita (2010) reveals that such errors are due to their misinterpretation of the spellings of <s> and <sh>, not due to articulatory and perceptual difficulties. In this present study, I further reinforced Nogita's (2010) argument by conducting a reading task in which 42 Japanese ESL learners read nonsense words containing the graphemes <s> and <sh>, and a spelling task in which they spelled nonsense words containing the sounds [s] and [ʃ]. In the reading task, I found Japanese ESL learners' strong tendency of mispronouncing the grapheme <sh> as [s], presumably because they assumed that [s] sounded more English-like. In the spelling task, they misspelled the sound [ʃ] as <s> more frequently than [s] as <sh>, presumably due to *kunrei-shiki* Japanese romanization interference. Moreover, 29 participants' grapheme-to-phoneme and phoneme-to-grapheme conversion patterns were not consistent, indicating that they had not acquired the English grapheme-phoneme correspondences, <s>-/s/ and <sh>-/ʃ/.
Keywords: /s/-/ʃ/ confusion; <s>-<sh> confusion; second language grapheme-phoneme correspondence

1 Introduction

1.1 Background

It is generally believed that Japanese English-as-a-second-language (ESL) learners tend to pronounce English /siʲ, sɪ/ as [ʃiʲ, ʃɪ][1], such as *see* and *sip* mispronounced as *she* and *ship* respectively. Such errors are typically attributed to the Japanese phonotactic constraint in which [ʃ] is an allophone of /s/ before /i(:)/ (e.g., Avery & Ehrlich, 1992). However, some phonologists stated that in Japanese, [si(:)] and [ʃi(:)] are marginally phonologically contrastive (e.g. Vance,

[1] Slashes / / are used for phonemes or mental representations. Square brackets [ ] are used for phonetic realizations. In some cases these brackets can be interchangeable.

2008). Likewise, according to Matsuzaki (1993), not all linguists agree that Japanese [si(:)] and [ʃi(:)] are non-contrastive. My previous study, Nogita (2010), also proves that this phonological contrast does exist in Japanese at least in peripheral vocabulary, as in <水橋パルスィ>[2]-/midzuhaʃi parusi(:)/ (a name of a game character), as well as in a near minimal pair <らしい> /raʃii/ 'seem' and <ばらスィー> /barasi:/ 'Barasī (a pseudonym of a Japanese manga artist). Moreover, in Nogita (2010), I collected data from 93 monolingual standard Japanese speakers (aging from 17 to 89) to demonstrate that all the participants can distinguish [si] and [ʃi] in both production and perception if these sounds are in Japanese contexts, suggesting that Japanese ESL learners' /s/-/ʃ/ confusion in English cannot be an articulation or perception issue. In addition, Nogita (2010) also demonstrates that Japanese ESL learners' /s/-/ʃ/ confusion in English contexts can be easily corrected when learners are only taught the Grapheme-Phoneme Correspondence (GPC) rules (i.e. <see>-/siʲ/, <she>-/ʃiʲ/, <si>-/sɪ/, <shi>-/ʃɪ/ and so on) without any articulation training. Indeed, their /s/-/ʃ/ confusion may partially be a phonological issue, that is, since the functional load of the Japanese /si(:)/-/ʃi(:)/ contrast is very low, Japanese ESL learners may not pay much attention to this contrast in English. However, I assume that their English spelling knowledge plays a much bigger role. While my previous study, Nogita (2010), reveals that a training of spelling knowledge dramatically reduces their /s/-/ʃ/ production errors, I have not discovered how Japanese ESL learners read the spellings <s> and <sh> as well as how they spell /s/ and /ʃ/ when they encounter unfamiliar words. Therefore, this present study aims to fill in these gaps in order to further support Nogita's (2010) argument that Japanese ESL learners' /s/-/ʃ/ confusion is more of an orthographic issue, rather than a phonological issue.

In L2 learning, what must be avoided is that Japanese ESL learners' English /s/-/ʃ/ confusion is misdiagnosed as a phonological issue and an unnecessary pronunciation training is provided only to further confuse learners, just as misdiagnosis of illness and medication errors only make patients suffer from side effects. To avoid such misdiagnosis, there are good reasons to examine to what extent Japanese ESL learners understand L2 GPC rules.

1.2 Japanese romanization regarding /s/ and /ʃ/ and phonetics

If this is in fact an orthographic issue, learners' L1 spelling, more specifically *rōmaji* (Japanese romanization) spelling, may interfere in L2, so I will briefly discuss Japanese romanization. There are two major types of *rōmaji* regarding [ʃi]: [ʃi] is spelled as <si> in *cabinet-ordered rōmaji* (or *kunrei-shiki rōmaji,* implemented in 1937) while it is also spelled as <shi> in *Hepburn rōmaji* (or *Hebon-shiki rōmaji* adopted in 1908 by an American missionary James C. Hepburn) (Taylor & Taylor, 1995). A difference between these two types is seen in some coronal obstruents, which reflect inconsistencies in some spellings in the

[2] Angle brackets < > are used for graphemes or written forms.

Japanese *kana* script (one of the scripts in the Japanese writing system). In the *kana* chart (or the 50-sound chart), the moras /sa, ʃi, sɯ, se, so/, for example, are aligned in the same consonant column despite occurrence of two different consonants, /s, ʃ/. This inconsistency mirrors historical sound changes[3]. In *cabinet-ordered rōmaji*, /sa, ʃi, sɯ, se, so/ are spelled as <sa, si, su, se, so> to be consistent with the *kana* chart, whereas in *Hepburn rōmaji*, these moras are spelled as <sa, shi, su, se, so> to be consistent with sounds (Taylor & Taylor, 1995).

Typing the Japanese *kana* script with a computer is typically based on both types of Japanese romanization. For instance, pressing either "s-i" keys (*cabinet-ordered rōmaji*) or "s-h-i" keys (*Hepburn rōmaji*) makes the *kana* letter <し> corresponding to [ʃi]. This suggests that native Japanese speakers are likely to be familiar with both spellings of [ʃi]. As for the rōmaji spelling for [si], according to the Ministry of Education, Culture, Sports, Science and Technology-Japan (2009), there is no official rule, but according to the Department of English Language in The University of Tokyo (2009), the recommended rōmaji spelling for [si] is <si>. This means that the rōmaji spelling <si> corresponds to both [si] and [ʃi], and at the same time, the sound [ʃi] corresponds to both <si> and <shi>, as it is shown in Figure 1 below[4]. This complicated relationship might influence their L2.

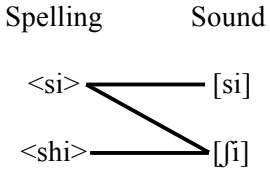

Figure 1. Japanese rōmaji spelling-sound correspondence

Incidentally, phonetic qualities of English /s/ and /ʃ/ and their Japanese counterparts are not the same. According to Pan, Utsugi, and Yamazaki (2004), compared to the English /ʃ/, the Japanese /ʃ/ is articulated further back and the front part of the tongue is higher. As well, the Japanese /ʃ/ does not have lip rounding and dorsum elevation, unlike the [ʃ] English counterpart (Pan et al, 2004). Therefore, the Japanese /ʃ/ is transcribed as /ɕ/ by some linguists (Pan et al, 2004). As for /s/, as indicated by Beckman, Edward, and Li (2009), the English /s/ is clearly alveolar while the Japanese /s/ is more laminal and possibly somewhat dentalized. Indeed, knowledge of these cross-linguistic phonetic differences would contribute to attainment of native-like accents, particularly for

[3] The original phonetic value of the consonant in the modern /s/ column in the *kana* chart is still under debate, but there is evidence that it was a coronal affricate rather than a fricative (Takayama, 2003).

[4] For *kana* typing, pressing "s-w-i" or "s-u-x-i" makes <すぃ> that corresponds to [si].

advanced level learners who can afford to deal with articulatory details. However, this present study does not discuss phonetic details.

2 Experiment 1: Reading task

2.1 Methodology and stimuli

42 Japanese ESL learners were recorded reading aloud unfamiliar words <sith>[5] and <shiff>, which are expected to be pronounced as [sɪθ] and [ʃɪf] based on the English GPC. I used nonsense words in order to observe the participants' pure GPC knowledge without loanword interference. I chose <i> as the following vowel letter rather than <ee> (corresponding to /iʲ/) since the potentially confusing Japanese romanization spellings are <si> and <shi> as shown in Figure 1. In addition, <ee> could be pronounced as [ɛ] or similar variations, rather than [iʲ], due to Japanese romanization interference. In such cases, [s, ʃ] before high front vowels cannot be observed. As for the coda consonants, I chose relatively difficult sounds for Japanese speakers (Japanese /f/ is bilabial [ɸ] rather than [f], and Japanese lacks /θ/) in order to draw their attention to the coda consonants. These stimuli were mixed with those for another study in which I examine Japanese ESL learners' knowledge of English vowel spellings, so the participants pronounced 50 nonsense words in total. In this present study, I analyzed only these two words. All the stimuli were printed on a sheet of paper.

2.2 Participants

In total, 42 Japanese ESL learners were recruited in Victoria, British Columbia in Canada. They were divided into two groups: 1) ESL learners who have been in Canada for 1 year or more, and 2) Japanese ESL learners who have been in Canada for less than 1 year. In the first (longer length of residence in Canada (LOR)) group, there were 26 participants (10 males and 16 females). Their mean LOR was 5.2 years (ranging from 1 year to 20 years). Their mean age was 33.9 years old (ranging from 19 to 71). In the second (shorter LOR) group, there were 16 participants (3 males and 13 females). Their mean LOR was 5.7 months (ranging from 3 weeks to 11 months). Their mean age was 25.1 years old (ranging from 19 to 32). As a control group, I also recruited 14 native speakers of Canadian English (8 males and 6 females) at the mean age of 31.9 (ranging from 20 to 56). No participants reported a hearing problem.

As limitations, I originally planned to compare English-as-a-foreign-language (EFL) learners, or inexperienced learners, and English-as-a-second-language learners, or experienced learners, but due to my physical presence in Canada and the time constraint, I collected data only from Japanese ESL learners. Thus, length of residence and their English proficiency could not be controlled.

[5] I intended to make nonsense words, but <sith> turned out to be an existing word, *Sith* (an organization in Star Wars).

2.3 Results of the reading task

Table 1 shows the results from Japanese ESL participants whose LOR is 1 year or more. Table 2 shows the results from those whose LOR is less than 1 year.

Written stimulus	Productions [s]	[ʃ]	[st]	Total
<sith>	25	1		26
<shiff>	8	18	1	26

Table 1: Results of the reading task from the longer LOR group

Written stimulus	Productions [s]	[ʃ]	[st]	Total
<sith>	16			16
<shiff>	12	3	1	16

Table 2: Results of the reading task from the shorter LOR group

Surprisingly, only 1 participant, whose LOR is 5 years, out of the total 42 participants, pronounced <s> as [ʃ]. She was first going to pronounce [s] and then changed it to [ʃ], suggesting that she had a dilemma but chose to pronounce [ʃ] over [s]. All the other participants correctly pronounced <s> before <i> as [s], although 4 in the longer LOR group and 3 in the shorter LOR group pronounced <i> as [aj], meaning that not all the participants pronounced [s] before a high vowel. All the other participants' vowels were in the high front region like [ɪ] or [i]. One participant of each group pronounced <sh> as [st], presumably because they mistook <shiff> for the real word <stiff>. Other than these 3 errors (<s>→[ʃ] × 1, <sh>→[st] × 2), all the other 20 errors were <sh> pronounced as [s]. These results turned out completely opposite to the popular assumption that Japanese ESL learners are unable to produce [s] before high front vowels and tend to substitute /s/ with [ʃ]. Rather, Japanese ESL learners are strongly biased towards [s]. As shown in Figure 1, the <shi>-[si] correspondence does not exist in Japanese romanization, so their <sh>→[s] errors cannot be L1 interference. Rather, they may have assumed that [ʃ] sounds more Japanese and hyper-corrected it to [s]. This pattern is consistent with Eckman and Iverson (2013), who found that Japanese ESL learners produced a preponderance of hypercorrection errors, that is, /ʃ/ before high front vowels as in *sheep* pronounced as [s]. As for LOR and error frequency, it is noteworthy that in the shorter LOR group, 12 out of 16 (75%) of the participants pronounced <sh> as [s], while in the longer LOR group, only 8 out of 26 (31%) pronounced <sh> as [s]. This implies that this hypercorrection becomes less frequent as they are exposed in English for longer time.

Interestingly, the results of this present study (as well as Eckman and Iverson's (2013) study) contradict those in my previous study (Nogita, 2010). In Nogita's (2010) passage reading task by beginner to lower-intermediate Japanese ESL learners, <s> in real English words (*see, sea, sits, seat, CD*, and *sick*) was

pronounced as [ʃ] 21% of the time, and <sh> in real words (*washing*, *relationship*, *sheets*, and *she*) was pronounced as [s] 19% of the time, meaning that <s> and <sh> were almost equally frequently mispronounced. However, this discrepancy can be explained by error frequency differences among words in Nogita's (2010) experiment. Based on One-Way ANOVA, <s>(and <c>)-related error frequency significantly differs depending on words (from 0% for *see* to 33% for *CD/sits*, $F(5, 156) = 3.61$, $p < 0.005$), and <sh>-related error frequency marginally significantly differs (from 11% for *washing* to 37% for *sheets*, $F(3, 104) = 2.34$, $p = 0.078$). High error frequency in at least *CD* (33%) and *seat* (30%) can be analyzed as loanword interference (c.f. [ʃi:di:] 'CD' and [ʃi:to] 'seat' in Japanese), suggesting that Japanese ESL learners may be more likely to mispronounce <s> as [ʃ] in English words that have been already imported to the Japanese vocabulary. In contrast, in unfamiliar words, Japanese ESL learners are very unlikely to mispronounce <s> as [ʃ], even with short LOR.

Japanese ESL learners' <sh>→[s] error pattern may be analogous to English speaking people's <j>→[ʒ] pattern in the Chinese loanword *Bei*j*ing*, which is called "hyperforeignization" (Janda, Joseph, & Jacobs, 1994, 71). The original Chinese sound of <j> in *Bei*j*ing* is the alveo-palatal affricate [dʑ], which is more similar to the English [dʒ] than to [ʒ] (Janda at al., 1994, 80). In addition, based on the basic English GPC rule, the letter <j> commonly corresponds to /dʒ/. Moreover, English has the phonological /dʒ/-/ʒ/ contrast as in *J*ap*an* and *A*s*ia*, so this distinction should not be a problem for English speaking people. Despite all of these legitimate reasons for choosing [dʒ], English speaking people have selected [ʒ], since English speakers tend to treat palato-alveolar fricatives /ʒ, ʃ/ as generic foreign consonants (Janda at al., 1994). Likewise, in Japanese, [s] before high front vowels sounds foreign, so Japanese ESL learners may choose [s] for <sh> by prioritising foreignness over the L1 spelling rule and the original L2 sound.

Finally, as for the control group, unsurprisingly, all the 14 native English speakers pronounced <sith> as [sɪθ] and <shiff> as [ʃɪf] without hesitation.

3 Experiment 2: Spelling task

3.1 Methodology and stimuli

In the spelling task, the same participants were asked to listen to the audio stimuli [siʲv] and [ʃiʲʧ] and spell what they heard. They were allowed to listen to the stimuli as many times as they wanted. These audio stimuli were pronounced by a phonetically trained male native Canadian English speaker from British Columbia in his 40's. I selected the tense /iʲ/ as in *eat* as the following vowel, but not the lax /ɪ/ as in *it,* since the English lax /ɪ/ can be perceived as the Japanese /e/ by Japanese L1 speakers. In Japanese romanization, /se/ and /ʃe/ are clearly spelled differently, <se> and <she> (or <sye>) respectively, so the participants' <s>-<sh> confusion would not be expected if they perceive the English /ɪ/ as the Japanese /e/. Again, these two stimuli were mixed with those in the study of

vowel spelling, so the participants listened to many more stimuli other than [siʲv] and [ʃiʲɡ].

3.2 Results of the spelling task

Table 3 shows the results from Japanese ESL participants whose LOR is 1 year or more. Table 4 shows the results from those whose LOR is less than 1 year.

Sound stimulus	Spellings <s>	<sh>	<c>	<th>	<ch>	Total
[siʲv]	14	3	3	6		26
[ʃiʲɡ]	8	16		1	1	26

Table 3: Results of the spelling task from the longer LOR group

Sound stimulus	Spellings <s>	<sh>	<c>	<th>	<sch>	Total
[siʲv]	10	3	2	1		16
[ʃiʲɡ]	6	8		1	1	16

Table 4: Results of the spelling task from the shorter LOR group

In the spelling task, Japanese ESL participants in both LOR groups more frequently spelled [ʃ] as <s> (14/42, 33%) than [s] as <sh> (6/42, 14%), suggesting that they were more biased towards <s> than towards <sh>. As shown in Figure 1, in Japanese romanization, the sound [ʃi] can be spelled as <si>, so their English [ʃ]→<s> pattern is likely L1 interference. It should be noted that as shown in Appendix A, many participants spelled the following vowel [iʲ] as <ee>, <ea> and other variations involving <e>, rather than Japanese romanization-like <ii>, <ih> or others starting with <i>. This suggests that many of the participants had acquired the English vowel phoneme-to-grapheme conversion /iʲ/→<ee, ea> to some extent, but had not acquired the consonant phoneme-to-grapheme conversion /ʃ/→<sh> before /iʲ/. In other words, their [ʃiʲ]→<see, sea> conversion patterns are partial L1 transfer. As for the opposite type of errors, specifically [s] spelled as <sh>, the [si]-<shi> correspondence does not exist in Japanese romanization as shown in Figure 1, so this pattern should not be L1 interference. This may be another type of hypercorrection. As for the frequency of the L1-influence-type errors ([ʃ] spelled as <s>), it was 6 out of 16 (38%) in the shorter LOR group, whereas it was 8 out of 26 (31%) in the longer LOR group, meaning that L1 influence slightly reduces but not dramatically. The frequency of the hypercorrection-type errors ([s] spelled as <sh>) was 3 out of 16 (19%) in the shorter LOR group, whereas it was 3 out of 26 (12%) in the longer LOR group, meaning that hypercorrection also slightly reduces but not dramatically. About individual patterns, only one participant in the shorter LOR group (11 months) exactly oppositely spelled [s] as <sh> and [ʃ] as <s>, but all the other participants' error patterns were biased towards either <s> or <sh>.

Notice that there were more variations of the participants' responses in the spelling task than in the reading task. The sound [s] spelled as <c> is regarded as correct as long as <c> precedes <e> or <i>. The [s]-<c> correspondence does not exist in Japanese romanization, indicating that those participants seem to have acquired the English so-called Soft-C ([s]-<c>) rule at least to some extent. Other patterns are [ʃ] spelled as <sch> or <ch>. These correspondences do not exist in Japanese romanization, so these should not be L1 transfer. Indeed, these patterns exist in English words, as in *chef* [ʃɛf] and *schedule* [ʃɛʤu^{w}l] in some dialects, so <sch, ch> for [ʃ] can be regarded as acquisition of less common L2 GPC patterns rather than acquisition of the default GPC patterns.

Finally, L1-L2 phonology-related errors are [s] or [ʃ] spelled as <th>. Although they did not hear [θ], they were biased towards <th>, which is another type of hypercorrection. Under the assumption that they know the English /θ/-<th> GPC rule, the fact that even by participants in the longer LOR group, [s] was spelled as <th> by 6 participants and [ʃ] was spelled as <th> by 1 participant implies difficulty in acquisition of non-L1 phoneme /θ/ by Japanese ESL learners.

As for the control group, unsurprisingly, all the 14 native English speakers spelled /s/ as <s> and /ʃ/ as <sh> although spellings of the rhyme parts showed a few variations.

4 Comparison between reading and spelling tasks

What is interesting is that not all the participants who made an error in the reading task also made an error in the spelling task, and vice versa. For example, those who read the grapheme <sh> as [s] did not necessarily spell the sound [s] as <sh>, and those who spelled [s] as <sh> did not necessarily read <sh> as [s]. Table 5 shows their error patterns. "Wrong in reading" indicates the number of participants who made an <s>-<sh>-related error in the reading task; note that other errors (e.g. <sh>→[st]) are not included. "Wrong in spelling" indicates the number of participants who made a [s]-[ʃ]-related error in the reading task; other errors (e.g. [s]→<th>) are not included. "Wrong in one task" indicates that the number of participants who made a [s]/<s>-[ʃ]/<sh>-related error in one task but did not in the other task. "Wrong in both tasks" indicates the number of participants who made a [s]/<s>-[ʃ]/<sh>-related error in both tasks. "Correct in both tasks" indicates the number of participants who did not make any [s]/<s>-[ʃ]/<sh>-related errors, and bracketed numbers show the number of those who did not make any other type of errors as well, such as [s, ʃ]→<th>. "1+ year" indicates the group with a 1 year or more of LOR and "< 1 year" indicates the group with a less than 1 year of LOR. The numbers "9/26", for example, indicates 9 out of 26.

	Wrong in reading	Wrong in spelling	Wrong in one task	Wrong in both tasks	Correct in both tasks
1+ years	9/26	11/26	12/26	4/26	10(7)/26
< 1 year	12/16	8/16	6/16	7/16	3(1)/16
Total	21/42	19/42	18/42	11/42	13(8)/42

Table 5: Error patterns in both tasks

Interestingly, in total, 18 out of 42 (43%) participants made at least one error in one of the reading or spelling tasks but not in the other task, meaning that their reading patterns and spelling patterns were inconsistent. Among the 11 (26%) participants who made errors in both tasks, 1 in the longer LOR group and 2 in the shorter LOR group pronounced [s] for both <s> and <sh> in the reading task, but spelled <sh> for both [s] and [ʃ] in the spelling task. The other 8 pronounced [s] for both <s> and <sh> in the reading task and spelled <s> for both [s] and [ʃ] in the spelling task.

All this indicates that these 29 out of 42 (69%) participants' grapheme-to-phoneme conversion and phoneme-to-grapheme conversion patterns were inconsistent. There is a possibility that at least some of these 29 participants' error patterns were random or at the pre-systematic stage. Only 8 out of 42 (19%) participants did not make any errors, including errors like [s] spelled as <th>. Interestingly, while the one whose LOR was only 5 months did both tasks correctly, the one whose LOR was the second longest (14 years) made an error in both tasks, suggesting that although there is a tendency that those in the longer LOR group performed better, LOR does not guarantee their acquisition of <s>-/s/ and <sh>-/ʃ/ correspondence. Finally, reportedly, 4 were or had been majoring in linguistics, but only 1 of them did both tasks correctly, implying that phonetics and IPA knowledge does not guarantee their acquisition of <s>-/s/ and <sh>-/ʃ/ correspondence, although there needs to be more careful research about the relationship between English GPC knowledge and phonetic knowledge to make a conclusion.

5 Discussion

5.1 Teaching implication

According to my impression, quite a few Japanese ESL learners feel that they have difficulty in the English /s/-/ʃ/ contrast. However, Nogita (2010) already proved that Japanese does have the /si/ and /ʃi/ contrast and that even monolingual Japanese speakers can easily distinguish /si/ and /ʃi/ if these are in Japanese contexts. To help those Japanese ESL learners, first, it is very important to let them aware that both /si(:)/ and /ʃi(:)/ do exist in Japanese contrastively, as in しいたけ /ʃi:take/ 'shiitake mushroom' and まつばらスィー /matsubarasi:/ (a

handle of a Japanese person) (retrieved on Jan. 31, 2016 from https://www.youtube.com/watch?v=jE2UzFRAADc). Then, have them aware that the English /s/-/ʃ/ confusion is only a spelling issue, that is, most of the time <s> corresponds to /s/ and <sh> corresponds to /ʃ/. It would also be helpful to let them know the potentially confusing L1 spelling rule (both *cabinet-ordered rōmaji* <si> and *Hepburn rōmaji* <shi> corresponding to /ʃi/) and the common hypercorrection (the English <shi> pronounced as [sɪ] as in *friendship*). After they fully acquire these spelling rules and reach the level at which they can afford to deal with articulatory details without being confused, articulation training regarding cross-linguistic phonetic differences in /s/ and /ʃ/ can be given if necessary.

5.2 Limitation

Since this study was done only with ESL learners, it is unknown whether my conclusion can be generalized for Japanese EFL learners. In addition, the number of stimuli was few. This is because this experiment was done together with a vowel study as mentioned above, and I avoided making too many stimuli in order to reduce participants' loads. There is also a possibility that at least a few of the spelling errors may have been due to mishearing. For example, [ʃ] spelled as <ch> may have been mishearing of [ʃ] as /ʧ/ (although Japanese does have the /ʃ/-/ʧ/ contrast). This experiment could not distinguish pure spelling errors and potential mishearing.

6 Conclusion

The present study supports the argument that Japanese ESL learners confuse /s/ and /ʃ/ before high front vowels in English because of their lack of knowledge of the English grapheme-phoneme correspondence rules, not because of difficulty in articulation. It is likely that their confusion originates from the complex Japanese romanization spelling patterns as shown in Figure 1. In the reading task, contrary to the popular assumption that Japanese ESL learners tend to substitute [ʃ] for /s/ due to the L1 phonotactic constraint, the results showed their strong tendency of pronouncing <sh> as [s], and only 1 out of 42 participants pronounced <s> as [ʃ]. In the spelling task, although the tendency was not as clear as the reading task, they tended to spell [ʃ] as <s> more frequently than [s] as <sh>, presumably due to L1 Japanese romanization interference. Most importantly, 29 out of 42 (69%) participants' grapheme-to-phoneme conversion and phoneme-to-grapheme conversion patterns were not consistent, suggesting that they had not acquired the English default GPC rules, <s>-/s/ and <sh>-[ʃ].

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Appendix A (Japanese ESL participants' raw data)

The table below shows each Japanese ESL participant's responses in both reading task and spelling task in both groups along with reported Length Of Residence in Canada (LOR). Capitalizations are based on their original spellings.

Shorter LOR ESL group					Longer LOR ESL group				
LOR	Stimuli				LOR	Stimuli			
	Reading task		Spelling task			Reading task		Spelling task	
month	<sith>	<shiff>	[siʲv]	[ʃiʲʧ]	year	<sith>	<shiff>	[siʲv]	[ʃiʲʧ]
0.7	[s]	[ʃ]	seeb	thezu	1	[s]	[ʃ]	seeph	sheech
2	[s]	[s]	ceeb	seeche	1	[s]	[ʃ]	thiegh	sitch
2	[s]	[s]	seeve	shiech	1.3	[s(aj)]	[s]	seave	sechu
3	[s]	[st]	seve	schitch	1.5	[s]	[ʃ]	Thieve	Seech
3	[s(aj)]	[s]	sheeb	sheach	1.5	[s]	[s]	ceive	seazue
3	[s]	[ʃ]	sheeb	shirtch	1.7	[s]	[ʃ]	seave	chuich
4	[s]	[s]	seave	seach	2	[s]	[ʃ]	seeb	seech
5	[s]	[ʃ]	seaf	sheech	2	[s(aj)]	[ʃ]	theeve	shesh
5	[s]	[s]	ceive	seech	2.9	[s]	[st]	theaf	siechi
5	[s]	[s]	seave	sheech	2.9	[s]	[ʃ]	seaf	seatue
8	[s]	[s]	theef	sheech	3	[s]	[s]	seeve	shech
9	[s]	[s]	seef	seatch	3	[s(aj)]	[ʃ]	seeve	sheech
10	[s]	[s]	seab	sheech	4.5	[s]	[s]	seeve	shityu
10	[s]	[s]	seeb	seech	5	[s]	[ʃ]	shif	shich
11	[s]	[s]	seeve	shitu	5	[ʃ]	[ʃ]	Seev	Shisu
11	[s]	[s]	shive	sitw	5.3	[s]	[s]	seef	seech
					6	[s]	[s]	thieve	thiech
					6	[s]	[ʃ]	seef	sheech
					7	[s]	[ʃ]	sheeve	shetch
					7	[s]	[ʃ]	seeve	sheech
					8	[s]	[ʃ]	seave	shich
					8	[s(aj)]	[ʃ]	theib	shich
					10	[s]	[ʃ]	cib	sheech
					10	[s]	[s]	seeb	sheich
					14	[s]	[s]	sheev	sheech
					20	[s]	[ʃ]	ceive	sheich

Appendix B (Canadian English participants' raw data)

The table below shows native Canadian English speakers responses in the spelling task. Capitalizations are based on their original spellings.

Stimuli	
[siʲv]	[ʃiʲʧ]
seeve	sheech
seeve	sheech
Seev	shech
Sieve	Sheech
seeve	sheech
seeve	sheech
Seeve	Sheech
seeve	sheech
SEEV	SHEECH
seeve	sheetch
seeve	sheech
seeve	sheech
seethe	sheech
seeve	sheech