

A Preliminary Study on Second Language Acquisition of Logical Connectives with Negation

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1. Introduction

This study investigates the interpretations of negated logical connectives in English as a second language (L2) by Japanese (L1) learners. The interpretations of negated logical connectives have earlier been parameterized (Crain, 2012), nevertheless, the L2 acquisition processes are yet to be clarified. Grüter et al. (2010) found a delay of interpreting negated disjunctions in English among L1 Japanese learners and explained the process in terms of L1 transfer and learnability. In contrast, Goro (2011) suggests that Grüter et al.'s learnability account does not provide a comprehensive explanation to L2 learners' interpreting negated logical connectives, including disjunctions and conjunctions. In an attempt to settle this debate, the present study employs Goro's technique with a different method of data collection, the multiple-choice task, and compared the interpretation of negated disjunction with that of negated conjunction in English by L1 Japanese learners.

The rest of this paper is structured as follows: Section 2 explains the interpretive differences of negated logical connectives between English and Japanese. Section 3 reviews L1 and L2 acquisition studies of negated logical connectives, including Grüter et al. and Goro. Section 4 presents the research questions and predictions based on the L1 transfer and learnability account by Grüter et al. Sections 5 and 6 explain the methodology and present the results, showing that L1 Japanese learners have equal difficulties in interpreting negated disjunctions and conjunctions in English. Section 7

discusses implications of the findings, including the lack of sufficient L2 input for the learners. Section 8 concludes the paper, suggesting that this study supports Goro and fails to provide evidence for Grüter et al.'s learnability account.

2. Interpreting logical connectives in English and Japanese

The interpretation of logical connectives, namely, conjunctions (e.g., English *and*, Japanese *to*) and disjunctions (e.g., English *or*, Japanese *ka*) in downward entailing environments are known to display cross-linguistic variations (Szabolcsi, 2002; Goro & Akiba, 2004; Muromatsu 2007; Goro, 2011; Crain, 2012; Shimada, 2014). In English and German, the negated disjunction has a conjunctive interpretation. For example, the English sentence in (1a), “Mary didn’t eat the apple or the banana,” means “Mary didn’t eat the apple AND Mary didn’t eat the banana.” Thus, the meaning of the English sentence with the disjunction *or* in the scope of negation in (1a) can be paraphrased by the sentence that contains the conjunction *and* presiding over both disjuncts in (1b). Following Goro and Akiba, I will call this reading “conjunctive interpretation.” In contrast, in Japanese and Mandarin, the negated conjunction is interpreted differently. The Japanese sentence with the logical connective *ka* “or” and the negation yields a “disjunction interpretation.” For example, the Japanese sentence in (2a), “Mary-wa ringo ka banana-o tabe-naka-tta,” means “Mary did not eat the apple OR Mary did not eat the banana.” Thus, the disjunction and negation interact differently, depending on languages.

(1) English negated disjunction

a. Mary didn’t eat the apple or the banana.

b. ✓ Mary didn’t eat the apple AND Mary didn’t eat the banana. (Conjunctive interpretation)

(2) Japanese negated disjunction

a. Mary-wa ringo ka banana-o tabe-naka-tta.

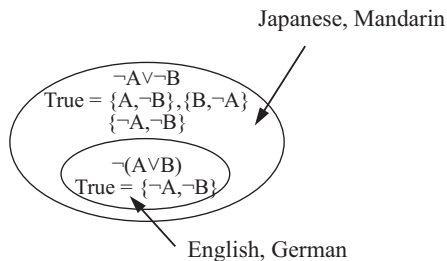
Mary-Top apple or banana-Acc eat-not-PAST

'*Lit.* Mary did not eat the apple or the banana.'

b. ✓ Mary didn't eat the apple OR Mary didn't eat the banana. (Disjunctive interpretation)

Goro and Akiba, and Crain further suggest that the interpretation of negated disjunctions in English (i.e., the conjunctive interpretation) corresponds to the formula of propositional logic, $\neg(A \vee B) = \neg A \wedge \neg B$, known as de Morgan's law. By contrast, the interpretation of negated disjunctions in Japanese (i.e., the disjunctive interpretation) is $\neg A \vee \neg B$, which allows three circumstances, namely, $\{A, \neg B\}$, $\{B, \neg A\}$, and $\{\neg A, \neg B\}$. Thus, the interpretation of English negated disjunctions is true in a subset of the circumstances that make the true interpretation generated by Japanese, as in (3). This cross-linguistic difference is attributed to the scope contrast among the disjunctions, namely, *or* in English is interpreted within the scope of negation, while *ka* in Japanese is not.

(3) The disjunction parameter (Crain 2012, p.182 with minor modifications by the author)



Not only negated disjunctions but also negated conjunctions show interpretive variations among languages. Negated conjunctions receive disjunctive interpretations in English and German while they receive conjunctive interpretations in Japanese and Mandarin. For example, the English sentence in (4a), “Mary didn’t eat (both) the apple and the banana” implies that “Mary did not eat the apple OR Mary did not eat the banana.” Conversely, the Japanese sentence in (5a), “Mary-wa ringo to banana-o tabe-naka-tta,” yields the conjunctive interpretation, “Mary did not eat the apple AND Mary did not eat the banana.”

(4) English negated conjunction

- a. Mary didn’t eat (both) the apple and the banana.
- b. ✓ Mary didn’t eat the apple OR Mary didn’t eat the banana. (Disjunctive interpretation)

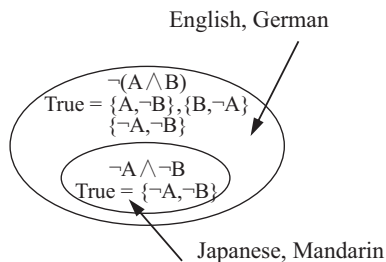
(5) Japanese negated conjunction

- a. Mary-wa ringo to banana-o tabe-naka-tta.
Mary-Top apple and banana-Acc eat-not-PAST
‘*Lit.* Mary did not eat the apple and the banana.’
- b. ✓ Mary didn’t eat the apple AND Mary didn’t eat the banana. (Conjunctive interpretation)

The conjunctive interpretation of Japanese in (5) corresponds the logical formula $\neg A \wedge \neg B$. As shown in (6), this interpretation of Japanese negated conjunction is true in a subset of the circumstances that make true the interpretation generated by English. This difference is attributable to the distinct property of the conjunction, namely, *to* in Japanese is interpreted within the scope of negation, while *and* in English is not. Thus,

Crain (2012) proposes that the interpretations of logical connectives with negation can be parameterized.

(6) The conjunction parameter (Crain 2012, p.181, with minor modification by the author)



3. Previous Studies

3.1. L1 study

As we have seen in Section 2, negated disjunctions have varied interpretations depending on the language: English and German receive conjunctive interpretations, while Japanese and Mandarin yield disjunctive interpretations. Goro and Akiba (2004) investigated the interpretation of *ka* in simple negative sentences in Japanese by native children (Age: 3;7 to 6;3) in a truth-value judgement task (Crain & Thornton, 1998). They found that the children initially assigned the conjunctive interpretation to the negated *ka*, unlike native Japanese adults, who assigned the disjunctive interpretation to it in the same experiment. Thus, Japanese children behaved more like English children, rather than Japanese adults, interpreting the negated *ka*. Goro and Akiba thus provide evidence for the conjunctive interpretation as default regarding children's reading of the word. In other words, as a part of Universal Grammar, children initially assume that disjunctions are cross-linguistically Boolean inclusive disjunctions

interpreted under the scope of negation, just like the English *or*: Then, they change their assumption of disjunctions from the English setting to their L1 setting, in line with L1 input. In the case of Japanese, for example, children initially assign the conjunctive interpretation to the negated *ka* (i.e., subset reading). They subsequently expand the interpretation and finally arrive at the correct one, that of the disjunctive (i.e., superset reading), just like native Japanese adults.

3.2. L2 studies

Grüter et al. investigated the extent of L1 transfer in interpreting negated disjunctions in L2 English and L2 Japanese in a bidirectional study. As shown in (3), the interpretation of the negated disjunction in English is the subset of that in Japanese. Moreover, this interpretive difference between English and Japanese is not explicitly taught in language classes. Therefore, L1 Japanese learners may have a problem with negated disjunctions in English. In contrast, L1 English learners may not have a problem with negated disjunctions in Japanese because L2 input may help them expand their interpretation. To test these predictions, Grüter et al. compared L1 English learners' interpretation of the negated *ka* with L1 Japanese speakers' interpretation of the negated *or* in a truth-value judgement task. The results support their predictions, showing a delay of success among L1 Japanese learners' of L2 English. In fact, only a small majority (4 out of 32) of L1 Japanese speakers exhibited target-like interpretations of negated *or*, whereas the majority of (12 out of 20) L1 English learners had target-like interpretations of negated *ka*. Notably the results of the two experiments were comparable although they investigated different L2s. The two truth value judgement tasks were translation equivalents and administered to the two L2 groups in the same way. Moreover, the two L2 groups were statistically equivalents in terms of proficiency of L2 (intermediate) and the amount of time spent in L2 environment (1;9-2;7 years). The L2 English group had the potential advantage of

A Preliminary Study on Second Language Acquisition of Logical Connectives with Negation

proficiency over the L2 Japanese group, because they were exposed to the L2 significantly earlier (at age 12) than the L2 Japanese group (at age 18), and both groups were residents of Canada at the time of testing. Nevertheless, the results show the unexpected direction of the differential success, namely, L1 English speakers' advantage over the L1 Japanese speakers. Grüter et al. regard this result as evidence for L1 transfer of the semantic property on L2. L1 English speakers, who start with the subset interpretation as the L1 setting, can easily acquire the target interpretation because relevant input is sufficient for changing interpretive preference from subset to superset. In contrast, L1 Japanese learners, who start with the superset interpretation (L1 setting), suffer a prolonged problem because of the lack of evidence towards expunging interpretation in input. Thus, they found that acquiring the target interpretation in L2 English is more difficult than that in L2 Japanese that conforms to the L1 transfer and learnability account.

Grüter et al.'s L1 transfer and learnability account is quite attractive, nevertheless, Goro (2011) raises questions about its reliability through investigating interpretation of negated conjunctions. As we have seen in Section 2, English and Japanese negated conjunctions form an opposite superset-subset relationship, namely, English is the superset and Japanese is the subset, in terms of interpretation. Therefore, if the L1 transfer and learnability account is right, interpreting the English negated conjunction *and* must be easier than the English negated disjunction *or* for L1 Japanese learners. However, this prediction was not borne out. Goro conducted a truth-value judgment task and found that L1 Japanese learners performed badly in interpreting the negated conjunction (with only 3.6% of accuracy rate) than in the negated disjunction (with 20% of accuracy rate) in English, contrary to the learnability account. Moreover, Goro maintains that the learnability account may not be applicable to interpretation of Japanese negated conjunctions. He also investigated L2 interpretations of the Japanese negated disjunctions *ka* "or" and the negated conjunctions *mo* "and" by the same L1

English learners in a truth-value judgment task. He found that the L2 learners performed badly in the former (with 47.9% of accuracy rate) than the latter (with 92.96% of accuracy rate), contrary to the learnability account. Therefore, Goro concludes that the learnability account fails to provide a comprehensive explanation for the distinct degree of success among the same L2 learners in interpreting logical connectives with negation.

4. The Research Questions

To test the reliability of the L1 transfer and learnability account in Grüter et al., this study investigates the interpretation of negated disjunctions and conjunctions by L1 Japanese learners of L2 English. Specifically, this study addresses the following research questions in (7).

- (7) a. Do L1 Japanese learners of L2 English have more difficulty interpreting negated disjunctions than negated conjunctions in the multiple-choice task, as the learnability account in the study by Grüter et al. predicts?
- b. Do L1 Japanese learners of L2 English transfer their interpretations of negated disjunction and conjunction from L1 to L2?

As (7) shows, this study investigates the same properties as Grüter et al. and Goro , employing a different method of data collection, the multiple-choice task. If the L1 transfer and learnability account are accurate, L1 Japanese learners will have more difficulty interpreting negated disjunctions than negated conjunctions in English. To test this prediction, two experiments were conducted, as presented in the next section.

5. Experiment 1 (English)

5.1. Participants

The first experiment aims to clarify which of the two properties, the negated disjunction or negated conjunction, is more difficult to acquire for L1 Japanese learners of L2 English. The participants consisted of 14 L1 Japanese students learning English as their L2 at a university in Japan. They were freshmen whose mean age was 19 (ranging from 18 to 19) and who had never been abroad for more than three months. They were first exposed to English at a junior high school in Japan at the age of 12 on average (ranging from 11 to 12). Their English proficiency level was intermediate, based on their score on the Test of English for International Communication (TOEIC) (635 out of 990 on average, ranging from 500 to 730, $SD=67.5$) which they had taken six months before the experiment.

5.2. Stimuli

In the experiment, the participants were asked to read English sentences which contained a negation along with a disjunction or conjunction in the object position. Then, they were instructed to choose the most appropriate interpretation from four options, (a) disjunctive interpretation, (b) conjunctive interpretation, (c) neither (a) or (b), or (d) I don't know. The example stimuli are given in (8) and (9). In (8), the test sentence "Yuri didn't drink the coffee or the tea," included a negated disjunction, accordingly, the sentence comprises a conjunctive interpretation and a native English speaker would choose (b). Contrastingly, the test sentence in (9) "Yuka didn't eat both the apple and the banana" included a negated conjunction, consequently, the sentence comprises a disjunctive interpretation and a native English speaker would choose (a). The stimuli consisted of five sentences with a negated disjunction in object positions and five sentences with a negated conjunction in object positions. Although this

experiment focuses on disjunction and conjunction in object positions, the stimuli also included two negated sentences with a disjunction or conjunction in subject positions, as shown in (10) and (11). In (10) and (11), the disjunction *or* and conjunction *and* are outside of the scope of negation, accordingly, (10) and (11) receive disjunctive and conjunctive interpretations, respectively. As a result, each participant judged 14 English sentences in total. The four types of sentences were randomized and presented with the participants.

(8) The example stimulus of the negated disjunction (object)

“Yuri didn’t drink the coffee or the tea.”

- a. Yuri didn’t drink the coffee OR Yuri didn’t drink the tea.
- b. Yuri didn’t drink the coffee AND Yuri didn’t drink the tea.
- c. Neither (a) nor (b)
- d. I don’t know

(9) The example stimulus of a negated conjunction (object)

“Yuka didn’t eat both the apple and the banana.”

- a. Yuka didn’t eat the apple OR Yuka didn’t eat the banana.
- b. Yuka didn’t eat the apple AND Yuka didn’t eat the banana.
- c. Neither (a) nor (b)
- d. I don’t know

(In (8) and (9), represents the target response)

(10) The example sentence of a negated disjunction (subject)

“Takumi or Yuki didn’t make the curry.”

(11) The example sentence of a negated conjunction (subject)

“Tom and Ken didn’t draw the picture.”

5.3. Group results

Table 1 shows the proportions of the target responses of each sentence type for the L2 learners. Table 1 shows that the L2 learners mostly had non-target-like interpretations of negated disjunctions and conjunctions in object positions. In fact, only 17% of the responses were target-like conjunctive interpretations for negated disjunctions in object positions. Similarly, only nine percent of the responses were target-like disjunctive interpretations for negated conjunctions in object positions. The difference between the proportions of negated disjunctions and conjunctions in object positions was not statistically significant ($t(13)=-0.085$, $p=0.467>0.05$), suggesting that the L2 learners were equally inaccurate in judging the two sentence types. Contrastingly, the L2 learners were accurate in interpreting negated disjunctions and conjunctions in subject positions. They correctly chose the disjunctive interpretations for negated disjunctions 82% of the time. Similarly, they correctly chose the conjunctive interpretations for negated conjunctions 100% of the time. The visualization of the results is displayed in Figure 1.

Table 1. Proportions of the target responses by the L2 learners (%)

Sentence type		Target interpretation	Accuracy (%)	
			Mean	SD
Object position	Negated disjunction	conjunctive	17	31.0
	Negated conjunction	disjunctive	9	25.9
Subject position	Negated disjunction	disjunctive	82	35.9
	Negated conjunction	conjunctive	100	0.0

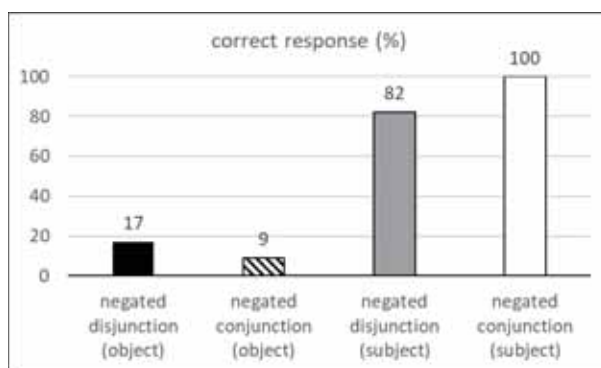


Figure 1 presents the results of L1 Japanese learners of English.

5.4. Individual results

To see the performance of each participant, Figures 2 and 3 present individual L2 learners' accuracy regarding negated disjunctions and conjunctions. In these figures, the L2 learners were arranged in the order of their English proficiency (TOEIC scores) from L1 (the most proficient) to L14 (the least proficient) on the horizontal line. Figure 2 shows that the L2 learners' performance does not relate to their English proficiency. In fact, a statistical analysis found little correlation between their TOEIC score and their accuracy regarding the negated disjunction ($r=0.17$). Similarly, no

positive correlation was found between their TOEIC score and their accuracy regarding the negated conjunction. Thus, most L2 learners were inaccurate in interpreting negated disjunctions and conjunctions in object positions, irrespective of their English proficiency. Notably, six L2 learners, L2, L3, L9, L10, L12, and L14, show correct responses regarding negated disjunctions and conjunctions in object positions, as shown in Figure 2. Nevertheless, only three of them, L9, L12, and L14, were accurate in judging negated disjunctions and conjunctions in subject positions, suggesting that they acquired the interpretive difference between subject and object positions. Furthermore, the L2 learners rarely chose the options of “(c) neither (a) nor (b)” or “(d) I don’t know” in judging sentences in the experiment. In other words, the L2 learners appeared to be quite confident in judging sentences and their non-target-like responses were the opposite interpretation of the target interpretation. In contrast to the inaccurate performance regarding object positions given in Figure 2, all L2 learners except L2, L3, and L10, accurately interpreted negated disjunctions and conjunctions in subject positions, as shown in Figure 3. These contrasts between the subject and object positions by individual L2 learners as shown in Figures 2 and 3 are compatible with the group results in Figure 1.

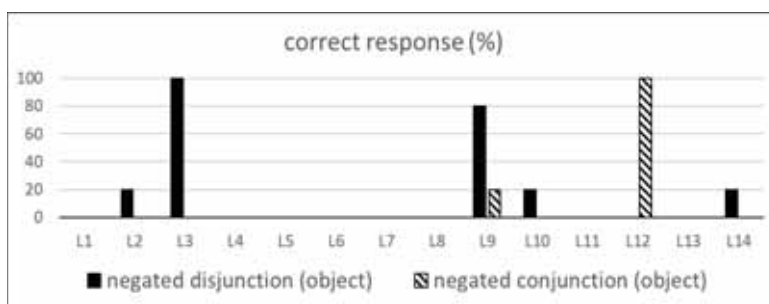


Figure 2. The percentage of correct responses by individual L2 learners

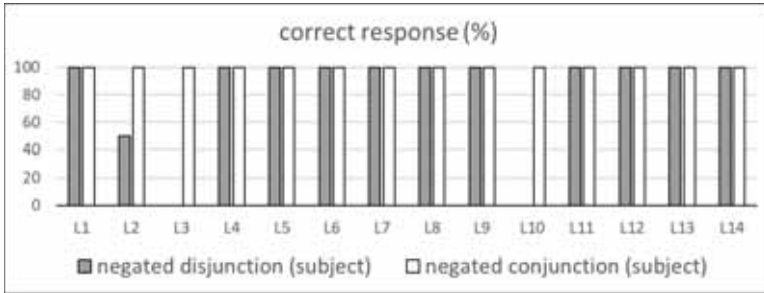


Figure 3. The percentage of correct responses by individual L2 learners

6. Experiment 2 (Japanese)

6.1. Participants

The second experiment aims to examine native Japanese speakers' interpretation of Japanese logical connectives to clarify whether the L1 interpretation is transferred to the L2. The participants were 22 native Japanese speakers who had never been abroad for more than three months. Their mean age was 19, ranging from 18 to 20. They did not participate in Experiment 1 although they were students at the same university as the participants in Experiment 1.

6.2. Stimuli

The stimuli were Japanese equivalents to the English stimuli in Experiment 1. The participants were asked to choose the most appropriate interpretation of the test sentence from four options: (a) disjunctive interpretation, (b) conjunctive interpretation, (c) neither (a) nor (b), and (d) "I don't know." The stimuli were divided into six types, by the combination of three logical connectives (disjunction *ka* 'or', conjunction *to*

‘and’, or conjunction *mo* “too”) and two positions (object or subject positions). (12), (13), and (14) show the examples of object positions. In (12), the test sentence includes the negated disjunction *ka* “or,” which receives the disjunctive interpretation. Contrastingly, the test sentence with the negated conjunction *to* “and” in (13) receives the conjunctive interpretation. (14) shows another type of negated conjunction that contains *mo* “too” in place of *to* “and.” The sentence in (14) also yields the conjunctive interpretation. The three types of object positions contained five stimuli and those of subject positions contained one or two stimuli. Consequently, each participant judged 20 sentences in total. They were randomized and presented to the participants.

(12) The example stimulus of a negated disjunction (object)

“Yuri-wa koohii ka kootya-o noma-naka-tta.”

Yuri-Top coffee or tea-Acc drink-Neg-Past

‘Lit. Yuri didn’t drink coffee or tea.’

a. Yuri-wa koohii-o noma-naka-tta’ mataha Yuri-wa kootya-o noma-naka-tta

Yuri-Top coffee-Acc drink-Neg-Past or Yuri-Top tea-Acc drink-Neg-Past

no dochiraka.

of which one

‘Either Yuri didn’t drink the coffee or Yuri didn’t drink the tea.’

b. Yuri-wa koohii-o noma-naka-tta si sarani Yuri-wa kootya-mo

Yuri-Top coffee-Acc drink-Neg-Past and in addition Yuri-Top tea-Mo

noma-naka-tta.

drink-Neg-Past

‘Yuri didn’t drink the coffee, in addition, Yuri didn’t drink the tea.’

c. (a) to (b) no dotirademo nai

‘Neither (a) nor (b).’

d. wakaranai

‘I don’t know.’

(13) The example stimuli of a negated conjunction (object)

“Yuka-wa ringo to banana-o tabe-naka-tta.”

Yuka-Top apple and banana-Acc eat-Neg-Pst

‘*Lit.* Yuka didn’t eat the apple and the banana.’

a. Yuka-wa ringo-o tabe-naka-tta’ mataha ‘Yuka-wa banana-o tabe-naka-tta
Yuka-Top apple-Acc eat-Neg-Past or Yuka-Top banana-Acc eat-Neg-Past
no dochiraka.

of which one

‘Either Yuka didn’t eat the apple or Yuka didn’t eat the banana.’

b. Yuka-wa ringo-o tabe-naka-tta si sarani Yuka-wa banana-mo

Yuka-Top apple-Acc eat-Neg-Past and in addition Yuka-Top banana-too
tabe-naka-tta.

eat-Neg-Past

‘Yuka didn’t eat the apple, in addition, Yuka didn’t eat the banana.’

c. (a) to (b) no dotirademo nai

‘Neither (a) nor (b)’

d. wakaranai

‘I don’t know.’

(In (12) and (13), represents the target response)

(14) The example stimuli of a negated conjunction *-mo* (object)

Yuka-wa ringo mo banana-mo tabe-naka-tta.

Yuka-Top apple and banana-too eat-Neg-Pst

‘Yuka didn’t eat the apple, in addition, Yuka didn’t eat the banana.’

6.3. Results

Table 2 presents the proportions of target responses by the native Japanese speakers. It shows that the native Japanese speakers consistently behaved as we predicted. They chose disjunctive interpretations for negated disjunctions, regardless of the positions. They also chose conjunctive interpretations for negated conjunctions, regardless of the positions. For negated conjunctions with *mo* “too,” they chose conjunctive interpretations. The standard deviations (SDs) were low, suggesting that their judgements had few variations.

Table 2. Accuracy of each condition by the native Japanese speakers (%)

Sentence type		Target interpretation	Accuracy (%)	
			Mean	SD
Object position	Negated disjunction	disjunctive	93	20.5
	Negated conjunction	conjunctive	100	0.0
	Negated conjunction <i>-mo</i>	conjunctive	98	5.7
Subject position	Negated disjunction	disjunctive	100	0.0
	Negated conjunction	conjunctive	95	14.4
	Negated conjunction <i>-mo</i>	conjunctive	100	0.0

7. Discussion

In Section 4, two research questions, which are repeated as (15), were formulated.

- (15) a. Do L1 Japanese learners of L2 English have more difficulty interpreting negated disjunctions than negated conjunctions in the multiple-choice task, as the learnability account in the study by Grüter et al. predicts?

- b. Do L1 Japanese learners of L2 English transfer their interpretations of negated disjunctions and conjunctions from L1 to L2?

Regarding (15a), the L2 learners had difficulty interpreting negated disjunctions and conjunctions in object positions to the same extent. The accuracy rates were 17% for disjunctions and 9% for conjunctions, and no statistical difference was found between them. The similar difficulty with disjunctions and conjunctions is unexpected from the learnability account by Grüter et al. The learnability account predicts that the L2 learners will face more difficulty interpreting negated disjunctions than conjunctions. Instead, the result of this study conforms with Goro, who found that L1 Japanese learners had more difficulty with negated conjunctions than disjunctions in the truth-value judgment task and consequently, questions the reliability of the learnability account.

Regarding the L1 transfer issue in (15b), this study found that the L2 learners interpreted English negated conjunctions and disjunctions just like in the Japanese language. It follows that they transferred their interpretations of negated disjunctions and conjunctions from the L1 to L2, and adhered to it. The persistent L1 transfer occurred although they were not beginners but intermediate level learners, who had been studying English for more than six years. This shows that they did not have enough L2 input that provides negative or positive evidence to trigger the resetting of the parameter while they were studying English as a foreign language, rather than a second language, in Japan. In the interview after the experiment, some L2 learners told that they had never learned the interpretive differences of logical connectives between English and Japanese in English language classes.

In conclusion, this study found that native Japanese students, who had been studying English for several years, did not have target-like interpretations of English logical connectives with negation. Unlike the results in the study by Grüter et al., little

A Preliminary Study on Second Language Acquisition of Logical Connectives with Negation

trace of resetting the parameter has been found. More advanced L2 learners, who have got naturalistic L2 input, need to be investigated in future research. Moreover, L2 learners with different L1s need to be tested to clarify how far the L1 interpretation is transferred to L2.

8. Conclusion

This study attempted to clarify whether L2 learners correctly interpret negated logical connectives in L2, overcoming the interpretive differences between the L1 and L2. Grüter et al.'s study focused on negated disjunctions in English and Japanese, and found that L1 Japanese learners have difficulty interpreting English negated disjunctions due to the L1 transfer and learnability problem. In contrast, Goro investigated the interpretation of negated conjunctions and disjunctions, and suggested that Grüter et al.'s learnability account does not give a comprehensive explanation for the L2 learners' difficulty. This study extends these studies, investigating interpretation of English negated disjunctions and conjunctions by L1 Japanese learners in the multiple-choice task, which the previous studies did not employ. The results confirm more to Goro than Grüter et al., showing that interpretation of English negated disjunctions and conjunctions were equally challenging for L1 Japanese learners who had been studying English as a foreign language. The result also shows persistent L1 transfer, suggesting that the L2 learners had little relevant L2 input, which can cause parameter resetting.

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