

Interlanguage Dissimilarity Enhances the Decline of Thinking Ability During Foreign Language Processing

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This study tested a hypothesis that the “foreign language effect” is larger when similarity between a foreign language and a native language is less. Foreign language effect refers to a temporary decline of thinking ability during foreign language processing, a decline that is distinguished from foreign language processing difficulty per se. In the first of two divided-attention experiments, we compared 16 adult native speakers of German and 16 of Japanese given English as a common foreign language; in the second, we compared 16 adult native speakers of Korean and 16 of English given Japanese as a common foreign language. The participants performed a thinking task (addition) and a linguistic task (question-answering)

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in parallel. The thinking task contained *no* foreign language; the linguistic task was presented in either the native language or the foreign language. In accordance with the hypothesis, the foreign language effect (defined by lower performance in the thinking task when the linguistic task was in the foreign language) was larger in both cases for those whose native language was less similar to the common foreign language.

The present study tested a hypothesis that the magnitude of the "foreign language effect" (Takano & Noda, 1993; see below) is greater when a foreign language that is less similar to a native language is employed. The foreign language effect refers to a temporary decline in the thinking ability of people who are using a foreign language in which they are less proficient than in their own native language. The reason for this decline is as follows (see Takano & Noda, 1993, for more detailed explanation): When two demanding cognitive tasks are performed in parallel, they interfere with each other (e.g., Broadbent, 1958; Norman & Bobrow, 1975; Treisman, 1969). Ordinary linguistic activities (e.g., conversation and negotiation) consist of both linguistic processing and nonlinguistic information processing (i.e., thinking) that usually have to be performed in parallel. Therefore, performance of one or both should decline due to interference. Because completion of linguistic processing is a prerequisite for appropriate response in most cases, thinking is typically sacrificed. Meanwhile, extensive practice reduces the interference (e.g., LaBerge, 1981; Spelke, Hirst, & Neisser, 1976; Underwood, 1974). Because the amount of practice is smaller for a foreign language than for a native language, the interference with thinking is larger when a foreign language is employed. Hence, the temporary decline of thinking ability during foreign language processing (i.e., the foreign language effect).

The foreign language effect should be distinguished from foreign language processing difficulty per se. The latter is linguistic in nature; the foreign language effect is difficulty in nonlinguistic information processing (thinking) caused as a side effect of that

linguistic difficulty. The two difficulties are not incompatible; the foreign language effect may well act together with the linguistic difficulty additively. The foreign language effect does not mean any persisting damage to intelligence; it is a temporary decline of thinking ability, manifested only while a foreign language is actually in use. Therefore, it has to be distinguished from the long-debated issue of whether bilingualism obstructs cognitive development or not (see Diaz, 1983; Macnamara, 1966; Peal & Lambert, 1962).

In two divided-attention experiments, Takano and Noda (1993) verified the presence of the foreign language effect, distinguishing it from foreign language processing difficulty *per se*. English-Japanese and Japanese-English bilinguals performed two tasks in parallel: a thinking task in which no language was used at all, and a linguistic task in which either the foreign language or the native language was used. The thinking task was either addition of two-digit numbers or nonverbal problems to assess spatial reasoning ability in intelligence tests. The linguistic task was either question-answering or sentence verification. The results for the thinking task showed that performance was inferior when the concurrent linguistic task was in the foreign language (i.e., the foreign language effect) in either linguistic group. No foreign language at all was used in the thinking task, which means that the inferior performance cannot be attributed directly to the linguistic difficulty of processing foreign language sentences.

The present study investigated the relationship between this foreign language effect and native-language transfer. It has been claimed that skills to use a native language (L1) should transfer to a second language (L2). The status of this claim is still unsettled (see Hakuta, 1986; Hakuta & Cancino, 1977); negative findings (e.g., Dulay & Burt, 1972, 1973, 1974) have been presented as well as positive ones (e.g., Hakuta, 1976; Fathman, 1975, and Zehler, 1982, both cited in Hakuta, 1986). The notion of native-language transfer implies that acquisition of an L2 that is more similar to an L1 should be easier because positive transfer from the L1

should be greater and negative transfer should be smaller. We will refer to this implication as the "language transfer hypothesis" in the rest of this paper. If this hypothesis is valid, it leads to another hypothesis, the "linguistic similarity hypothesis," concerning the foreign language effect. The reason for the occurrence of the foreign language effect is explained in terms of the difference in proficiency between an L1 and a foreign language (see above). The same principle should apply to the case of two foreign languages as well. If the language transfer hypothesis holds true, proficiency in a foreign language less similar to an L1 should be lower than that in one more similar to it after both have been learned for an equal period. It follows that the magnitude of foreign language effect should be greater for the less similar foreign language. The primary concern of the present study was to test this linguistic similarity hypothesis, while testing the language transfer hypothesis at the same time.

The basic experimental approach was to compare two groups of bilinguals who had different native language backgrounds, in the dual-task setting where a thinking task was performed in parallel with a linguistic task that was given in their respective L1 or in a common foreign language. The L1 of one group was more similar to the common foreign language whereas that of the other group was less similar; the experience in the common foreign language was comparable between the two groups. If the language transfer hypothesis is valid, performance in the linguistic task should be better for the "more similar" group. If the linguistic similarity hypothesis is valid, performance in the thinking task should also be better for that group.

Experiment 1

The first experiment compared native speakers of German and of Japanese, using English as the common foreign language. From a genealogical point of view, German is closer to English than Japanese. Both German and English belong to the Germanic branch of the Indo-European family. Although the exact genea-

logical identity of Japanese is still an issue, scholars agree that its closest family is Altaic (Miller, 1971, 1980); it is very different from the Indo-European languages. Therefore, the language transfer hypothesis predicts that proficiency in English should be higher for native speakers of German than for those of Japanese if their experiences with English are comparable. The linguistic similarity hypothesis predicts that the magnitude of foreign language effect should be greater for the native speakers of Japanese than for those of German.

The method of the divided-attention experiment was identical to that of Experiment 1 in Takano and Noda (1993): The thinking task and linguistic task were performed in parallel, and performance of the linguistic task provided a measure of the language transfer whereas that of the thinking task provided a measure of the foreign language effect. The latter provided an indirect measure of the language transfer as well. In addition, a group of experts who were familiar with these three languages rated linguistic similarity among them to confirm that intuitive judgment would coincide with the genealogical classification.

Method

Design. Three independent variables were included: (a) the Linguistic group, German or Japanese, was a between-group variable; (b) the presence or absence of the linguistic task was manipulated within group; and (c) the language in which the linguistic task was presented, L1 or foreign, was also manipulated within group. A combination of the within-group variables made up three types of trial to be performed by each linguistic group: (a) the single-task trial in which only the thinking task was imposed, (b) the L1 dual-task trial in which the thinking task was imposed with the linguistic task presented in the L1, and (c) the foreign language dual-task trial in which the thinking task was imposed with the linguistic task presented in the foreign language. The order of the single-task trial and the two dual-task trials and the order of the L1 and foreign language dual-task trials were coun-

terbalanced orthogonally to each other among participants within each linguistic group. The assignment of two lists of questions presented in the linguistic task to the two dual-task trials was also counterbalanced among participants.

Participants. We tested 18 native speakers of German in the German group. Two of them were excluded from the analysis because it was impossible to find Japanese counterparts with whom they could be pair-matched (see below); thus, 16 participants provided data. They comprised 9 graduate students at Japanese universities and 7 students at Japanese language schools: 8 men and 8 women, aged 20 to 31 years ($M=25.8$, $SD=3.5$). The average length of their formal education was 18.8 ($SD=3.1$) years. We tested 17 native speakers of Japanese in the Japanese group. One of them was excluded from the analysis because he failed to follow instructions; thus, 16 participants provided data. They were pair-matched with the German participants in terms of years of English learning, gender, age, and years of formal education. They comprised 5 undergraduates, 10 graduates, and 1 assistant at Japanese universities: 8 men and 8 women, aged 20 to 30 years ($M=25.1$, $SD=2.8$). The average length of their formal education was 18.3 ($SD=2.5$) years. Linguistic similarity among the three languages was rated by two groups of participants: all the 18 German participants and a separate group of 15 Japanese professors teaching and studying German language and literature at Waseda University and the University of Tokyo.

Materials. We employed the same materials as in Takano and Noda (1993) except that the lists of questions to be presented in the linguistic task were prepared in German as well, and a sheet of paper itemizing the contents of the instruction was prepared in German. The thinking task was addition of two-digit numbers. This task required a stop watch and seven addition sheets. On each of these sheets, random numbers between 10 and 40 were printed in a 13×13 matrix. We randomly chose three sheets to be assigned to the above three types of trial; the remaining sheets were used in practice trials and when the participant conducted more than 12×13 additions. We prepared

two tapes in German and Japanese, respectively, to present the directions, "Ready? Start," followed by 10 seconds of silence, and "Stop," in demonstration trials (see Procedures). The linguistic task was question-answering. For this task, we prepared two lists of questions in each of the languages. Each list contained 20 commonsense questions (e.g., "Is a lion an animal that lives in water?"). In the English and German lists, every question was phrased in a complex sentence containing two clauses combined by a relative pronoun so that linguistic processing would be demanding enough. In the Japanese lists, every question was put in a type of sentence grammatically corresponding to an English complex sentence (Teramura, 1982). The English lists were tape-recorded together with the directions by a male American graduate student from Ohio; the Japanese lists by a male Japanese graduate student from Tokyo; and the German lists by a male German graduate student from Bonn. The questions were read out at a rate of 1 question every 10 seconds. The total net time spent in presenting all the 20 questions was about 62 seconds in one list and 63 seconds in the other; it was made equal among the three languages for either list. We also tape-recorded a list of six similar questions in each of the three languages to be presented in the practice trials. We used two cassette tape recorders to present the lists and to record the participant's answers, respectively.

Procedures. We tested each participant individually in an experimental session of about 30 minutes, which consisted of the instruction, the above three types of trials, introspection reports, and inquiry concerning demographic data and English learning. For the Japanese group, the instruction was read out in Japanese. For the German group, it was read out in either Japanese or English according to the choice of each participant; in either case, the itemized instructions written in German were shown while the participant was listening to the oral instruction.

1. In the thinking task, the participant was asked to add every adjacent pair of numbers in a row of the matrix, and to write down the answer underneath the pair with a pencil as in Kräpelin's

(1895) test. Both accuracy and speed were equally stressed. In the linguistic task, we asked the participant to answer each question orally in any language that first came to mind, irrespective of the language in which the question was presented. The participant was to respond by saying, "I don't know," in any language, whenever he/she did not know the answer or failed to understand the question.

2. A dual-task trial consisted of a practice trial of 70 seconds followed by a test trial of 210 seconds; a single-task trial consisted only of a test trial of 210 seconds when it was given after the dual-task trials, but it was preceded by a demonstration trial (see below) when it was given before them. A dual-task test trial proceeded as follows: A tape-recorded direction, "Ready?" alerted the participant. Upon hearing the next direction, "Start," the participant initiated the addition. Ten seconds later, the first question was presented by the tape recorder. After responding, the participant could concentrate on the addition until the next question was presented. The participant terminated the addition with a direction, "Stop." We tape-recorded all the answers for later analyses. The participant was asked to continue the addition while listening to and answering the questions. Both tasks were equally stressed. In the single-task trial, those three directions alone were given in the same temporal organization by the experimenter with the stopwatch. The contents of the dual-task practice trial were identical to those of the dual-task test trial except for its duration and the number of questions presented. In the demonstration trial, the experimenter showed how to perform in the single-task trial by actually conducting the addition for 10 seconds following the tape-recorded directions.

3. In the inquiry, the participant provided orally information about age, years of formal education, and past experience with English—including years of English learning, months of staying in English-speaking countries, and age of starting English learning. The participant also rated his/her own ability of English on a 7-point rating scale ranging from *not fluent at all* (1) to *as fluent as native speakers* (7).

4. Only the German group answered the question, "What do you think the distance between English and German is if the distance between English and Japanese is assumed to be 10? Please answer with a whole number such as 3 and 15. A smaller number means shorter distance. Please take into consideration grammar, vocabulary, and sound altogether." The same question was printed on a sheet of paper and delivered to the professors of German language and literature.

Results

Thinking task. Mean numbers of correct additions and errors are shown in Table 1 along with their standard deviations. Either linguistic group performed a larger number of correct additions when the linguistic task was given in the L1 than when it was given in the foreign language (i.e., English). The difference was statistically reliable in the German group, pairwise $t(15)=3.524$, $p<.01$, as well as in the Japanese group, pairwise $t(15)=8.338$, $p<.001$. In other words, the foreign language effect was observed in both groups. Of primary interest was comparison between the two linguistic groups in terms of magnitude of the foreign language effect, the index of which was reduction rate (R) given by the following equation:

$$R=(N-F)/S \times 100 (\%) \quad (1)$$

where N denotes the number of correct additions in the L1 dual-task trial, F that in the foreign language dual-task trial, and S that in the single-task trial. This index represents the proportion of performance reduction because of the foreign language use in relation to the base performance in the single-task trial; it directly represents the magnitude of foreign language effect. The linguistic similarity hypothesis predicted that the reduction rate should be larger for the Japanese group than for the German group. Mean reduction rates are shown in Figure 1. The numerical pattern agreed with the prediction: The mean reduction rate was 16.40% ($SD=7.84\%$) for the Japanese group and 8.06% ($SD=8.83\%$)

Table 1
Experiment 1: Thinking Task
Mean Numbers of Correct Additions and Errors

Linguistic Task	Native Language			
	German		Japanese	
	Correct	Error	Correct	Error
None				
<i>M</i>	66.75	4.31	99.69	2.75
<i>SD</i>	17.14	3.58	15.67	2.86
Native				
<i>M</i>	53.38	2.69	76.38	2.38
<i>SD</i>	17.12	1.76	16.96	2.26
Foreign (English)				
<i>M</i>	47.63	3.00	60.00	1.44
<i>SD</i>	14.71	2.96	17.84	1.22

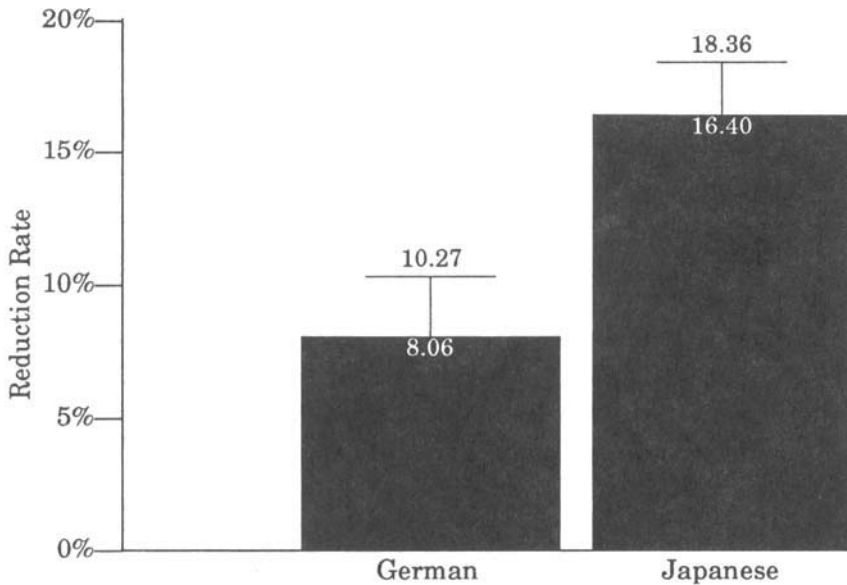


Figure 1. Experiment 1: Thinking Task. Magnitude of foreign language effect in terms of reduction rate for the native speakers of German and of Japanese when the foreign language was English. Standard errors are indicated by the vertical bars.

for the German group. A statistical test based on the arcsin-transformed data¹ confirmed that the difference was reliable, pairwise $t(15)=3.001$, $p<.01$.

Linguistic task. We classified the answers in the linguistic task into three categories: correct, error, and failure (which included both no response and "I don't know"). Their mean percentages are shown in Table 2 together with standard deviations. The language transfer hypothesis predicted that the German group should outperform the Japanese group only in the foreign language condition. The numerical pattern of the mean correct responses agreed with this prediction. We conducted a two-way ANOVA on the arcsin-transformed data with the group (German vs. Japanese) and the language (L1 vs. foreign) as two factors. The main effect of the language was significant, $F(1, 15)=28.528$, $p<.0005$, whereas that of the group was not, $F(1, 15)=3.470$. As the interaction was significant, $F(1, 15)=21.082$, $p<.001$, we conducted a separate analysis for each level of the language factor: In accordance with the prediction, the German group outperformed the Japanese in the foreign language condition, $F(1, 15)=12.112$, $p<.005$, and there was no numerical difference in the L1 condition. The percentage of failure was higher for the Japanese group in the foreign language condition, whereas there was no substantial

Table 2
Experiment 1: Linguistic Task
Mean Percentages of Correct Answers, Erroneous Answers, Failures

Language Employed	Native Language					
	German			Japanese		
	Correct	Error	Failure	Correct	Error	Failure
Native						
<i>M</i>	90.31	3.44	6.25	90.31	2.50	7.19
<i>SD</i>	6.49	3.84	6.50	9.76	3.06	8.65
Foreign (English)						
<i>M</i>	81.25	3.75	15.00	60.94	5.31	33.75
<i>SD</i>	10.68	4.84	10.00	23.33	7.39	22.33

difference in the native language condition. A two-way ANOVA based on the arcsin-transformed data showed that the main effect of the language was significant, $F(1, 15)=38.633, p<.0005$, whereas that of the group was not, $F(1, 15)=3.690$. As the interaction was significant, $F(1, 15)=13.897, p<.005$, we conducted a separate analysis for each language condition: the Japanese group committed more failures in the foreign language condition, $F(1, 15)=9.226, p<.01$, whereas there was no significant difference in the native language condition, $F(1, 15)=0.034$.

English learning. The data concerning English learning are shown in Table 3. The period of English learning was longer for the Japanese group on the average in spite of the pair-matching procedure; the difference was statistically reliable, pairwise $t(15)=5.015, p<.001$. There was no significant difference either in the age of starting English learning or in the length of staying in English-speaking countries. The self-rating of English ability was significantly higher for the German group, pairwise $t(15)=2.251, p<.05$.

Table 3
Experiment 1: English Learning

	Native Language	
	German	Japanese
Years of Learning English		
<i>M</i>	8.94	11.56
<i>SD</i>	2.25	1.73
Starting Age		
<i>M</i>	11.38	11.88
<i>SD</i>	1.22	0.48
Years in English-Speaking Countries		
<i>M</i>	0.09	0.38
<i>SD</i>	0.20	0.60
Self-Rating of Proficiency		
<i>M</i>	4.50	3.63
<i>SD</i>	0.73	1.11

Linguistic similarity. In the distance judgment, all the participants considered German to be more similar to English than Japanese. The distance between German and English estimated by the 18 German participants ranged from 2 to 6 ($M=3.6$, $SD=1.1$); it was significantly smaller than 10, the assumed distance between Japanese and English, $t(17)=24.577$, $p<.0001$. The distance estimated by the professors of German language and literature ranged from 0 to 5 ($M=1.9$, $SD=1.5$); it was also significantly smaller than 10, $t(14)=20.924$, $p<.0001$.

Discussion

There was no discrepancy between the provided intuitive judgment about linguistic similarity and the genealogical classification that German is more similar to English than Japanese. Although the Japanese group had on average been learning English significantly longer than the German group, this difference must have acted against the hypotheses. There was no difference either in the age of starting English learning or in the period of staying in English-speaking countries. Therefore, the prerequisites to test the hypotheses had been satisfied.

As to the language transfer hypothesis, all the indices attested that the German group was more fluent in English than the Japanese group. When the linguistic task was presented in English, the percentage of correct answers was higher for the German group. That there was no difference in the L1 condition suggests that the higher performance of the German group was not due to their more accurate general knowledge. The percentage of failures was higher for the Japanese group only in the foreign language condition, whereas there was no substantial difference in the percentage of errors. This suggests that the primary reason for the fewer correct answers of the Japanese group in the foreign language condition was their greater difficulty in understanding the questions presented in English. Although the above two indices are related only to listening comprehension, the self-rating of overall English ability was also

higher for the German group. It seems that the longer experience in English on the part of the Japanese group was overridden by the language transfer effect. The aforementioned results supporting the linguistic similarity hypothesis lend indirect support to the language transfer hypothesis as well.

That the performance in the thinking task was lower in the foreign language condition can be taken as evidence of the foreign language effect in either linguistic group. This lower performance cannot be attributed directly to the well-known difficulty of foreign language processing because no foreign language was used in the thinking task. As predicted by the linguistic similarity hypothesis, the magnitude of foreign language effect was greater for the Japanese group whose native language is less similar to English. Incidentally, the magnitude of foreign language effect should not be underestimated on the basis of the obtained reduction rates, 8.06% for the German group and 16.40% for the Japanese group, because it was only for less than half of the total time of the dual-task trial that both thinking and linguistic tasks were actually performed in parallel (see Takano & Noda, 1993).

Although the results were in perfect agreement with the predictions, they have to be interpreted with caution because the present experiment was a quasi-experiment in which random assignment of participants was not conducted regarding the principal independent variable, linguistic group. Accordingly, these results are also compatible with other interpretations that peculiarity of the combination of particular languages or particular linguistic groups employed in this experiment might be responsible for them. It may be argued, for example, that the present German participants happened to be better, on average, at dividing attention between two tasks than the Japanese participants. To exclude such alternative interpretations, it is necessary to replicate the experiment with a different combination of languages and linguistic groups to see if the same results can be obtained. The next experiment was conducted for this purpose.

Experiment 2

This experiment compared native speakers of Korean and of English, using Japanese as a common foreign language. Linguistically, Korean is considered to be more similar to Japanese than English. English is Indo-European. Although the exact genealogical relationship between Korean and Japanese has not been identified, both are considered close to the Altaic family and similar to each other (Miller, 1971, 1980). If the language transfer hypothesis is valid, therefore, native speakers of Korean would be more fluent in Japanese than those of English after an equal period of Japanese learning. If the linguistic similarity hypothesis is valid, the magnitude of foreign language effect would be greater for native speakers of English than for those of Korean. The basic method of this experiment was identical to that of the preceding experiment and to that of Experiment 1 in Takano and Noda (1993)².

Method

Design. The experimental design was identical to that of Experiment 1 except that one of the independent variables, linguistic group, was changed to Korean and English.

Participants. We tested 16 native speakers of Korean from the Republic of Korea in the Korean group. They comprised 7 undergraduates and 9 graduates at Japanese universities; 12 men and 4 women, aged 24 to 31 years ($M=27.6$, $SD=2.1$). The average length of their formal education was 16.9 ($SD=1.7$) years. Sixteen native speakers of English from the United States, the United Kingdom, and Canada formed the English group. They comprised 7 undergraduates and 3 graduates at a Japanese university, 2 students at a Japanese language school, and 4 businessmen; 9 men and 7 women, aged 20 to 31 years ($M=23.4$, $SD=3.6$). The average length of their formal education was 15.7 ($SD=1.3$) years. We could not pair-match them because there were insufficient compatible participants.

Materials. We used the same materials as in Experiment 1 except that a Korean undergraduate from Seoul tape-recorded in Korean the two lists of questions and the itemized instructions were prepared in both Korean and English.

Procedures. We followed the same procedures as in Experiment 1 except that the inquiry did not contain the self-rating of foreign language ability. Only the Korean group answered the question, "What do you think the distance between Japanese and Korean is if the distance between Japanese and English is assumed to be 10?" The rest of the question was identical to that in Experiment 1.

Results

Thinking task. The linguistic similarity hypothesis predicted that the reduction rate (see the above equation) should be higher for the English group. Mean reduction rates are shown in Figure 2. The numerical pattern supported the prediction: The reduction rate was 3.05% ($SD=9.46\%$) for the Korean group, whereas it was 17.90% ($SD=9.67\%$) for the English group. A statistical test based on the arcsin-transformed data revealed that the difference was reliable, $t(30)=4.615$, $p<.0005$. Mean numbers of correct additions and errors are shown in Table 4 together with standard deviations. The difference in the number of correct additions between the L1 and foreign language conditions provides a measure of the foreign language effect. For the English group, the difference was in the direction of the foreign language effect and statistically reliable, pairwise $t(15)=6.947$, $p<.001$. For the Korean group, it was in the same direction but not reliable, pairwise $t(15)=1.432$.

Linguistic task. Mean percentages of correct answers, errors, and failures are shown in Table 5. The language transfer hypothesis predicted that the Korean group should outperform the English group only in the foreign language condition. The numerical pattern of the percentages of correct answers supported this prediction. A two-way ANOVA based on the

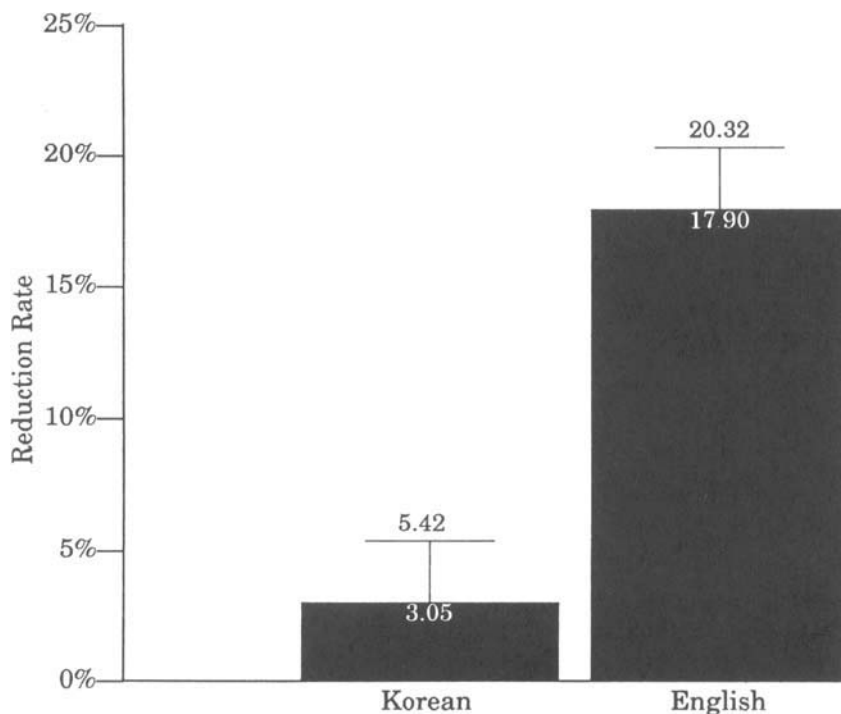


Figure 2. Experiment 2: Thinking Task. Magnitude of foreign language effect in terms of reduction rate for the native speakers of Korean and of English when the foreign language was Japanese. Standard errors are indicated by the vertical bars. Note: The data for the English group are from "A temporary decline of thinking ability during foreign language processing," by Y. Takano and A. Noda, 1993, *Journal of Cross-Cultural Psychology*, 24, p.451. Copyright 1993 by Sage Publications, Inc. Adapted with permission.

arcsin-transformed data revealed that both main effects were significant, $F(1, 30)=4.157, p<.05$ for the group, and $F(1, 30)=140.227, p<.0001$ for the language. As the interaction was significant, $F(1, 30)=47.590, p<.0001$, we conducted a separate analysis for each language condition: The Korean group significantly outperformed the English group in the foreign language condition, $F(1, 30)=32.857, p<.0001$, whereas no significant difference was found in the L1 condition, $F(1, 30)=1.648$. The percentage

Table 4
 Experiment 2: Thinking Task
 Mean Numbers of Correct Additions and Errors

Linguistic Task	Native Language			
	Korean		English	
	Correct	Error	Correct	Error
None				
<i>M</i>	89.69	4.56	77.56	3.13
<i>SD</i>	14.29	3.16	17.88	3.74
Native				
<i>M</i>	69.44	2.94	62.56	2.00
<i>SD</i>	14.52	2.67	16.00	2.53
Foreign (Japanese)				
<i>M</i>	66.44	2.94	49.00	2.13
<i>SD</i>	13.51	3.68	16.77	1.67

Note. The data for the English group are from "A temporary decline of thinking ability during foreign language processing," by Y. Takano and A. Noda, 1993, *Journal of Cross-Cultural Psychology*, 24, p.451. Copyright 1993 by Sage Publications, Inc. Adapted with permission.

Table 5
 Experiment 2: Linguistic Task
 Mean Percentages of Correct Answers, Erroneous Answers, Failures

Language Employed	Native Language					
	Korean			English		
	Correct	Error	Failure	Correct	Error	Failure
Native						
<i>M</i>	85.63	6.88	7.50	91.88	2.50	5.63
<i>SD</i>	14.24	8.54	8.37	8.92	3.65	6.80
Foreign (Japanese)						
<i>M</i>	76.88	7.19	15.94	44.69	5.94	49.38
<i>SD</i>	13.15	5.47	12.55	18.12	5.84	17.21

Note. The data for the English group are from "A temporary decline of thinking ability during foreign language processing," by Y. Takano and A. Noda, 1993, *Journal of Cross-Cultural Psychology*, 24, p.451. Copyright 1993 by Sage Publications, Inc. Adapted with permission.

Table 6
Experiment 2: Japanese Learning

	Native Language	
	Korean	English
Years of Learning English		
<i>M</i>	4.50	4.78
<i>SD</i>	2.98	3.57
Starting Age		
<i>M</i>	22.75	17.94
<i>SD</i>	3.96	5.20
Years in English-Speaking Countries		
<i>M</i>	2.95	1.95
<i>SD</i>	1.32	1.79

of failures was higher for the English group in the foreign language condition, whereas there was no substantial difference in the L1 condition. A two-way ANOVA based on the arcsin-transformed data showed that both main effects were significant, $F(1, 30)=10.044$, $p<.005$ for the group, and $F(1, 30)=135.673$, $p<.0001$ for the language. As the interaction was significant, $F(1, 30)=44.177$, $p<.0001$, a separate analysis was conducted for each language condition: The English group committed more failures in the foreign language condition, $F(1, 30)=37.010$, $p<.0001$, whereas there was no significant difference in the L1 condition, $F(1, 30)=0.319$.

Japanese learning. The data concerning Japanese learning are shown in Table 6. Although the English group had been learning Japanese longer, this difference was in the direction against the prediction and not significant, $t(30)=0.239$. There was no significant difference in the length of staying in Japan, $t(30)=1.742$. The age of starting Japanese learning was significantly earlier for the English group, $t(30)=2.850$, $p<.01$.

Linguistic similarity. All the participants in the Korean group considered Korean more similar to Japanese than English.

The estimated distance between Korean and Japanese ranged from 2 to 8 ($M=4.00$, $SD=1.58$); it was significantly smaller than 10, the assumed distance between Japanese and English, $t(15)=14.708$, $p<.0001$.

Discussion

The overall pattern of results in Experiment 1 was replicated in this experiment. In accordance with the initial assumption about linguistic similarity, the Korean group judged that Korean is more similar to Japanese than English. There was no significant difference between the two linguistic groups either in the length of Japanese learning or in the period of staying in Japan. Although the English group started Japanese learning significantly earlier than the Korean group, and although it is advantageous to start learning a foreign language earlier (e.g., Johnson & Newport, 1989), this difference must have acted against the hypotheses. Therefore, the prerequisites to test the hypotheses were satisfied in this experiment as well.

The reduction rates in the thinking task revealed that the magnitude of foreign language effect was greater for the English group whose L1 was less similar to the common foreign language, Japanese. This result supports the linguistic similarity hypothesis and replicated the corresponding result in Experiment 1.

As to the language transfer hypothesis, the results in the linguistic task showed that the Korean group was more proficient in Japanese than the English group. When the linguistic task was presented in the foreign language, the percentage of correct answers was higher for the Korean group. That there was no difference in the L1 condition again suggests that the higher performance of the Korean group cannot be attributed to their more accurate general knowledge. The percentage of failures was higher for the English group only in the foreign language condition; there was no substantial difference in the percentage of errors. This again suggests that the primary reason for the fewer correct answers of the English group in the foreign language

condition was its greater difficulty in understanding the questions in Japanese. The language transfer effect was manifested in spite of somewhat longer experience in Japanese on the part of the English group.

The foreign language effect was not statistically significant for the Korean group, though the numerical pattern suggested its presence. Nevertheless, we cannot conclude that Koreans who have learned Japanese for more than 4½ years are free from the foreign language effect. Both the thinking and the linguistic tasks were not especially demanding: The thinking task merely required execution of overlearned procedures of addition, and the linguistic task merely repeated the same grammatical structure without requiring production of foreign language sentences. When concurrent tasks are not demanding, little interference is expected between them (e.g., Norman & Bobrow, 1975). That is, the experimental setting was not favorable for the foreign language effect to be manifested. The same Korean participants might have revealed substantial foreign language effect in a more demanding setting like ordinary linguistic activities (e.g., negotiation and debate).

General Discussion

Two divided-attention experiments tested two hypotheses that compared a foreign language more similar to an L1 and a foreign language less similar to it when both foreign languages have been learned for an equal period: the language transfer hypothesis that a learner should be more proficient in the more similar foreign language, and the linguistic similarity hypothesis that the foreign language effect (a temporary decline of thinking ability during foreign language processing) should be greater for the less similar foreign language.

In each experiment, the experience in the common foreign language was roughly comparable between one group whose L1 was more similar to that foreign language and the other group whose L1 was less similar to it. Although one of the three

measures in each experiment suggested that the less similar group had longer experience of the foreign language, this difference was in the direction to cancel out the effects predicted by the hypotheses. In the linguistic task, nonetheless, the more similar group proved itself to be more proficient in the common foreign language, just as predicted by the language transfer hypothesis. In the thinking task, the magnitude of foreign language effect was smaller for the more similar group, as predicted by the linguistic similarity hypothesis. Both experiments gave the same results in these respects.

As for the hypothesis of native-language transfer, the results provided new empirical support. The investigation of this issue has concentrated primarily on 'micro' analyses regarding certain linguistic elements; for example, comparing the orders of acquisition of particular morphemes in a second language between linguistic groups with different native language backgrounds (e.g., Dulay & Burt, 1974). Both positive and negative results have been obtained at this level. The present study has found that the native-language transfer is present at a 'macro' level as far as concerns the ease with which a foreign language is acquired. Furthermore, the results endorsing the linguistic similarity hypothesis constitute an indirect but totally novel type of supportive evidence for native-language transfer.

As for the linguistic similarity effect, the generality of the present findings may be questioned because the foreign language effect was shown only through performance in simple addition. However, Takano and Noda (1993) have confirmed that it is also observed when intelligence-test problems to assess spatial reasoning ability are used as the thinking task. There seems no reasonable basis to suspect that the present findings cannot be replicated with other thinking tasks. As stated in the Discussion section of Experiment 2, furthermore, the addition task does not favor manifestation of the foreign language effect because it has been overlearned. If different thinking tasks more difficult than addition of two-digit numbers are employed, the outcome will be magnification of the foreign language effect in every experimental

condition. In this case, the overall pattern endorsing the linguistic similarity effect will remain unchanged. Again, there seems no reasonable basis to suspect that the overall pattern would be altered when different thinking tasks are employed.

The results in Experiment 1 concerning the relationship between linguistic dissimilarity and the magnitude of foreign language effect were replicated in Experiment 2. Given that essentially the same results were obtained with different combinations of languages and linguistic groups, it is unlikely that they can be attributed to irrelevant factors peculiar to particular languages or particular participants.

Although experience in the foreign language was balanced between the compared groups, all the indices were based on retrospective self-reports. This leaves some ambiguity as to the validity of the linguistic similarity hypothesis, because self-reports may not be reliable enough. Although it is clear that the magnitude of foreign language effect is related to proficiency difference, the source of that proficiency difference remains ambiguous. However, the following considerations strongly suggest that the most likely source was the degree of similarity between the L1s and the common foreign languages, as assumed in the linguistic similarity hypothesis. First, in the two experiments we employed the same indices to control for learning experience to see the hypothesized relation between the similarity difference and the proficiency difference. The same results were obtained in both experiments. This adds confidence that the source of the proficiency difference was actually the similarity difference. Second, it is virtually impossible to control strictly for past learning experience. Given that the three indices agreed in indicating that the compared groups were roughly comparable in their experience in the common foreign languages, the present data provide fairly strong support for the linguistic similarity hypothesis as the evidence that can be obtained empirically. Finally, there are no firm bases to suspect that the linguistic groups with more similar L1s had more intensive experience in the employed foreign languages during the comparable period of learning. For instance,

the contents of formal education in English do not differ substantially between Japan and Germany; people in Korea seem to have fewer opportunities to be exposed to Japanese than people in English-speaking countries, because the Korean government severely restricts influx of Japanese culture in reaction to past colonization by Japan.

Therefore, we can conclude tentatively that the foreign language effect is greater for those whose L1 is less similar to the employed foreign language than for those whose L1 is more similar to it, because L1 transfer is smaller for the former provided that experience in that foreign language is comparable.

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Notes

¹All the statistical tests based on the nontransformed data gave essentially the same results in both experiments.

²The data for the English group were reproduced from Takano and Noda (1993) with permission. Although they were reported earlier, both English and Korean groups had been tested in the same experimental design for the purpose declared in the text.

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