

Bilingual cognition: How can English be acquired cognitively in Japan?

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In order to investigate the relationship between second language (L2) acquisition and cognition, we conducted a psychological experiment using an object-classifying task. The participants included 24 monolingual Japanese speakers and 20 bilingual speakers, whose first language (L1) is Japanese and L2 is English, living in Japan, and 25 monolingual English speakers living in the U.K. Through the analyses, we obtained the following two findings: first, monolingual Japanese and English speakers have different preference in choosing objects due to the nature of the two different languages; second, the bilingual speakers who have acquired English as an L2 are cognitively different from both English and Japanese monolingual speakers. Although their L1 is Japanese, the way they choose objects is different from that of monolingual Japanese speakers. Therefore, these results indicated that an L2 might have an effect upon cognition.

物を識別するタスクを使った心理実験を用い、第二言語習得と認知の関係を調べた。被験者は日本在住の日本語母語話者24人、母語が日本語で第二言語として英語を習得した日本人バイリンガル話者20人、英国在住のイギリス人英語母語話者25人である。実験結果から次の二点が明らかになった。まず、日本語母語話者と英語母語話者は、それぞれの言語構造の違いから異なる物の選択方法を保持する。そして、母語が日本語であっても第二言語として英語を習得した日本人バイリンガル話者は、



日本語母語話者とも英語母語話者とも認知的に異なる傾向があることもわかった。これらの結果は、第二言語習得が私達の認知に影響を及ぼすことを示唆する。

THE CURRENT study investigated whether English had an effect on the cognitive processing of Japanese second language (L2) learners of English. In Japan, English is taught as the L2 in most junior high schools. Test results such as TOEIC and TOEFL can reveal learners' achievement and proficiency in English. However, what is happening internally at the cognitive level is unknown. The question raised in this paper is whether learning English changes the way these learners think.

The basis of this research derives from the linguistic relativity hypothesis, also called the Sapir-Whorf Hypothesis. This hypothesis implies that humans are incapable of perceiving a cognitive category unless the language in which they communicate provides it. However, this hypothesis has been criticised by researchers such as Pinker (1994), who claims that the hypothesis does not sufficiently explain how language influences thought.

Recent research has revealed that there is a relationship between language and thought demonstrating different cognitive effects in monolingual speakers of languages with different concepts. The term concept can be seen as a way of thinking and perceiving things, or as one's preference in choosing things. For example, a study done by Imai and Gentner (1997) focused on preferences in choosing an object, and found that monolingual speakers of English and Japanese chose items differently on an item classifying task. In their experiment, there were sets of items which consisted of one target item and two alternates. One of the two alternates resembled the target item in shape; the other was composed of the same material. The participants were asked to choose the item which was similar to the target item (e.g. participants were shown a target item of a "pyramid made

of cork" and were asked to choose either a "pyramid made of plastic" or a "piece of cork" from the alternates as shown in Figure 1).

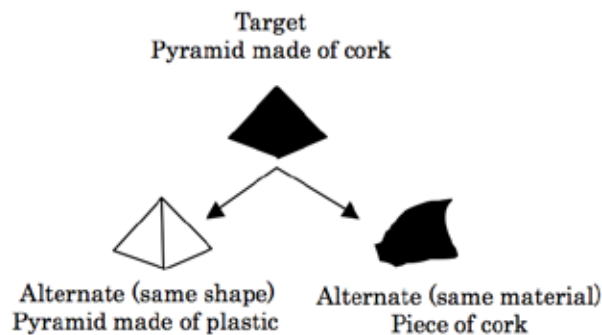


Figure 1. Example of the experimental set

The results showed that English monolinguals have shape preference (i.e. choosing a "pyramid made of plastic"), while Japanese monolinguals have material preference (i.e. choosing a "piece of cork"). Imai and Gentner (1997) and Imai (2003) argue that the difference between the two groups of monolinguals relates to syntactic differences. In the English language, mass nouns such as "water" cannot be directly modified by numerals (e.g. *a water), and have to be quantified through particular classifiers (e.g. a glass of water). On the other hand, count nouns such as "book" have no such restriction (e.g. a book). The Japanese language does not normally express quantity (e.g. *koko ni hon ga aru*, "here is book," *koko ni mizu ga aru*, "here is water"). When quantity is expressed, all nouns behave like mass nouns with the noun preceded by the numeral and a classifier (e.g. *koko ni issatsu no hon ga aru*, literally "here is one-classifier book"; *koko ni ippai no mizu ga aru*, "here is one-classifier water"). Hence

one explanation for the Japanese material preference found by Imai and Gentner (1997) is that the Japanese speakers fall back on material responses as a default in the absence of a syntactic distinction between mass and count nouns, whereas the English speakers have to constantly decide whether something is an object or a substance in order to apply the correct mass/count noun distinction, so whenever something has a shape, albeit extremely simple, it is classified by English speakers as a count noun (i.e. an object).

If it is the case, as Imai and Gentner argue, that each language has its own effect on speakers, what would happen to bilinguals who operate two different languages? Would the nature of the L1 affect the way they think, would they be affected by a newly acquired L2 and start thinking like native speakers of the L2, or would they be affected by both the L1 and L2 and acquire a totally different concept? Cook, Bassetti, Kasai, Sasaki, and Takahashi (2006) focused on this issue and investigated how bilingual speakers who operate in English and Japanese responded to the same experiment based on the study of Imai and Gentner (1997). Cook et al. (2006) found that bilingual speakers (L1=Japanese, L2=English, living in the U.K.) showed totally different behavior which belonged to neither monolingual Japanese nor monolingual English. They argued that the L2 had somehow affected their way of thinking.

The current research also examines bilinguals whose L1 is Japanese and whose L2 is English, living in Japan. The reason for choosing such participants was to eliminate the cultural effect on the participants, which Cook et al. (2006) could not eliminate. Their participants lived in the U.K., and they may have been affected by the environment. Thus, in order to eliminate such a cultural effect and in order to examine whether an L2 acquired in Japan can affect speakers' cognition, bilinguals living in Japan were chosen. The definition of bilingual varies from one field to another, but in the current research, those who have high Eng-

lish proficiency were grouped as bilinguals, and those with low English proficiency were grouped as monolinguals. The details of the participants are presented in a later section. For comparison, monolingual English speakers were also examined. Table 1 summarises the previous research.

Table 1. Summary of previous research

		Monolingual English	Monolingual Japanese	Bilinguals L1=Japanese, L2=English
Imai & Gentner (1997)	Results	Shape preference	Material preference	
	Participants	Children and adults	Children and adults	
Cook et al. (2006)	Results			Non-preference
	Participants			Adults (living in the U.K.)

Materials

The objects used in the current research were replicas of the experimental objects used by Imai and Gentner (1997). There was one target item and two alternates in each set. The participants were shown the target item (e.g. a pyramid made of cork), and were asked to choose which of the two alternates were similar to the target item (e.g. a plastic pyramid or a piece of cork).

There were fifteen sets consisting of three types of objects. The first five sets were called simple objects, which were made of solid materials that did not have any function, for example a pyramid made of cork. The second sets were called substance objects and were made of non-solid materials such as hair gel. The last sets were made of solid materials with a specific func-

tion, for example a paper clip, and were called complex objects. The sets were randomly mixed so that the same type of sets were not shown consecutively. The details of the objects used are shown in Table 2.

Table 2. Experimental objects

Type	Target items	Same shape items	Same material items
Simple objects	Cork pyramid	Plastic pyramid	Piece of cork
	Plastic flying saucer shape	Wood flying saucer shape	Piece of plastic
	Red wax kidney shape	Purple plaster kidney shape	Pieces of red wax
	Red play-dough half egg	Plastic half egg	Pieces of red play-dough
	Cylinder made of paper	Cylinder made of plastic	Pieces of paper
Substance objects	Reverse C-shape in white cream	Reverse C-shape in transparent gel	Blobs of white cream
	S-shape in sand	S-shape in glass beads	Piles of sand
	Reverse Ω -shape in sawdust	Reverse Ω -shape in leather	Piles of sawdust
	Γ -shape in fresh cream	Γ -shape in clay	Piles of fresh cream
	Spiral made of black tea leaves	Spiral made of green tea powder	Piles of black tea leaves

Type	Target items	Same shape items	Same material items
Complex objects	Ceramic lemon squeezer	Wooden lemon squeezer	Pieces of ceramic
	Red plastic clip	Metal clip	Pieces of red plastic
	Copper T-shape junction	Plastic T-shape junction	Pieces of copper
	Wooden whisk	Plastic whisk	Pieces of wood
	Roll of brown packaging tape	Roll of clear packaging tape	Pieces of brown packaging tape

Methodology

Participants' background

The participants included 24 monolingual Japanese speakers living in Japan, 25 monolingual English speakers living in the U.K., and 20 bilingual speakers living in Japan whose L1 was Japanese and L2 was English. It is practically impossible to find monolingual Japanese speakers in Japan since English is taught as an L2 in junior and senior high schools. English vocabulary, grammar, and pronunciation are taught with a textbook mostly by native speakers of Japanese. Although new approaches, such as the Communicative Approach, have been introduced, the Grammar Translation Method remains as the main teaching method for large classes, and the language of instruction is typically Japanese. Therefore, although the terms “monolingual” and “bilingual” are used in this paper, they are used to distinguish those who have low and high English proficiency.

Levels of English proficiency in the monolingual group and

the bilingual groups were checked based on the scores from university entrance examinations and were found to be statistically different ($p=.00$). Also, the Minimal English Test (MET) was used to check proficiency on the day of the experiment. The MET is an English proficiency test that can be administered in 5 minutes; previous studies have shown that there are correlations between the MET and the English portion of university entrance examinations (Goto, Maki, & Kasai, 2010), and other English proficiency tests such as Nation's (2001) Vocabulary Levels Test (Kasai, Maki & Niinuma, 2005; Maki, Bai, Kasai, Goto & Hashimoto, 2007). The reason for using the MET instead of other proficiency tests was to minimise the time in measuring the participants' English proficiency. In a pilot experiment, Nation's Vocabulary Levels Test was used, and the participants often were unable to concentrate during the experiment since the proficiency test took a long time to complete and exhausted them. Given these problems, the MET was used in order to decrease the amount of participant fatigue. Those who received average scores of 37.83 on the MET were grouped as monolinguals, and those with average scores of 58.79 were grouped as bilinguals. As for the English monolinguals, most of them were company employees with a U.K. university education. None of the English monolinguals had studied Japanese, but they had learned other European languages. However, on a self-administered questionnaire done prior to the experiment, none of the participants marked themselves as bilingual speakers. Thus, they were considered to be monolingual English speakers. Although the male/female ratio appeared to be uneven, it did not affect the results of the experiment. A statistical analysis to find a difference between male and female showed $p=.89$ for monolingual English, $p=.91$ for monolingual Japanese, and $p=.86$ for bilinguals. All the p values are close to 1.00, meaning there is no statistically significant difference between males and females. Table 3 summarises these details.

Table 3. Participants

	Monolingual English	Monolingual Japanese	Bilinguals
Number of Participants	25	24	20
Sex (M/F)	17/8	8/16	13/7
Age Range	23-38	18-20	18-20
Average Age	27.87	18.64	18.89
English proficiency	NA	37.83/72	58.79/72

Procedure

The experiment was conducted in a classroom setting where 20 to 30 participants were accommodated. The participants took part in the experiment at the same time. First, the MET was administered to measure the participants' English proficiency. Second, an examiner explained the nature of the experiment showing example sets. On the first slide, a photo of an object (i.e. a target item) was shown. On the next slide, two photos of the objects, one which had the same shape as the target item and the other with the same material, were presented side by side, as shown in Figure 2. In order to avoid having the participants get used to a pattern of the alternates, for instance, shape alternates always being on the right side, the order of the alternates was varied. Three sets were shown as practice on a PowerPoint slide show for the participants to get used to the experiment. Each slide was shown at 3-second intervals. Third, after the participants understood how to participate in the experiment, an answer sheet was provided for the participants to mark the side

of the photo they chose (right or left), and the actual experiment started. Once the slide show started, the examiner remained silent in order to provide a consistent experimental environment.

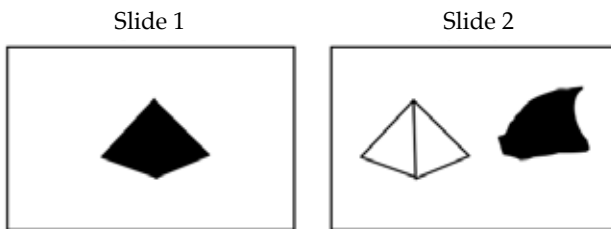


Figure 2. Example PowerPoint slides

Instructions

In the original experiment conducted by Imai and Gentner (1997), nonsense names such as *Nehia* and *Onlar* were used in presenting the target item. The examiner showed the actual target item saying, "This is called *Nehia*." Then the examiner showed the two alternates saying "Which plate has *Nehia*?" and asked the participants to choose one of the alternates. However, in our experiment, neither nonsense names nor verbal instructions were used since there was a concern that the participants might be affected by the instructions if they were given in Japanese (or in English). In Imai and Gentner (1997), the participants were monolinguals. Thus, the instructions had to be in their first language. The bilingual participants in the current research obtained high English proficiency, and even monolingual participants had experience learning English. In case the language of the instructions could affect the participants' responses, it was decided not to use any verbal instructions, but to investigate their reactions on the cognitive level.

Experimental objects

In a previous pilot experiment, we had problems using the actual objects. First, an experiment with real objects requires a large room since all the 15 sets need to be displayed. Second, the objects made of substances such as hair gel and whipped cream deteriorated as the experiment proceeded and lost the original textures. Third, we could only invite participants one by one into the setting. In order to help the participant concentrate on a set, the rest of the sets were covered with paper towels. One by one, the sets were revealed by lifting the paper towel. Thus, before every participant came into the setting, considerable preparation had to be done to re-create the substance objects and to cover the objects. Another pilot experiment invited several participants together into the setting to test whether it was possible to examine them together. It was difficult to control the participants' interaction with each other and at the same time, have them exchange their thoughts and responses about the experiment. These are the main reasons why a PowerPoint slide show was used instead of the real objects. The results from the experiment with the actual objects and the PowerPoint slide show were compared and were shown to be statistically similar. In short, the slide show provided the same image as the actual objects.

Results

This section introduces how bilinguals responded to the experiment, followed by the results of English and Japanese monolinguals, concluding with a comparison among all the participant groups. A *t* test and a Kolmogorov-Smirnov two-sample test were used for the analyses.

Results from bilinguals

Figure 3 shows the results from bilinguals. Table 4 shows the percentages of their answers on shape preference or material

preference. The data was analysed by a *t* test.

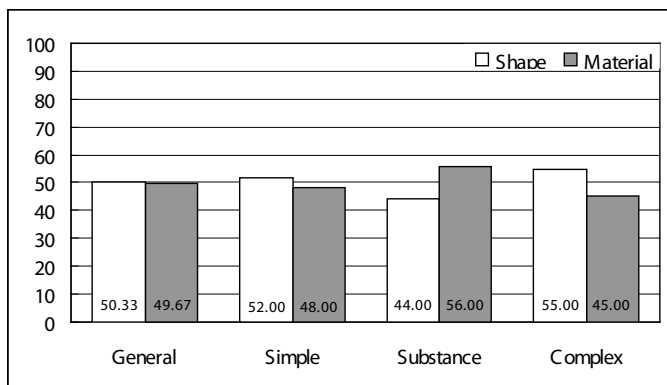


Figure 3. Results from bilinguals

For simple and complex object groups, the percentages choosing the shape alternates were slightly higher than those choosing the material alternates. Substance was the only group in which participants chose the material alternates more often than the shape alternates. However, none of the three groups showed a statistically significant difference.

Table 4. Results of the *t* test

	Percentage (%)		t Stat
	Shape	Material	
General	50.33	49.67	0.07
Simple	52.00	48.00	0.29
Substance	44.00	56.00	0.85
Complex	55.00	45.00	0.74

(n=20)

As for the general tendency, the percentage choosing the shape alternate was 50.33%, while the material alternate was 49.67%. The absolute value of *t* Stat (0.07) was less than that of *t* Critical two tail (2.09). Therefore, the tendency of the bilinguals was shown to be non-preference at a significant level.

Results from monolinguals

English monolinguals

Figure 4 shows results from English monolinguals. In every group the percentages choosing the shape alternates were higher than choosing the material alternates, and were statistically significant.

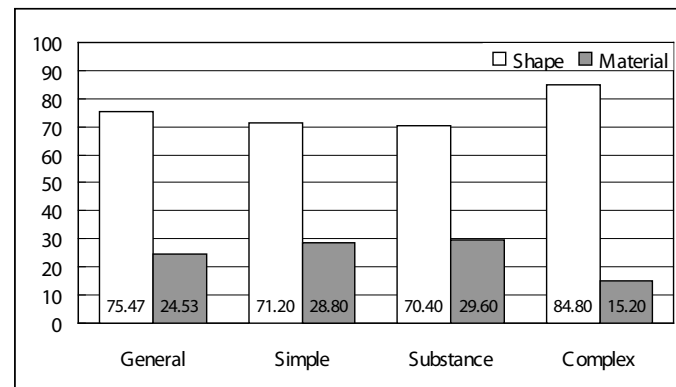


Figure 4. Results from English monolinguals

As for the general tendency, the percentage choosing the shape alternate was 75.47%, while the material alternate was 24.53%, as seen in Table 5. The absolute value of *t* Stat (3.87) was larger than that of *t* Critical two tail (2.06). Therefore, the tendency was shown to be shape preference at a significant level.

Table 5. Results of the t-test

	Percentage (%)		t Stat
	Shape	Material	
General	75.47	24.53	3.87
Simple	71.20	28.80	2.86
Substance	70.40	29.60	2.72
Complex	84.80	15.20	5.67

(n=25)

Japanese monolinguals

Unlike the English monolinguals, the percentages of Japanese monolinguals choosing the material alternates was higher than the shape alternates in every object groups, as seen in Figure 5. A statistical analysis showed that in all three types of objects, the tendency was for material preference at a statistically significant level.

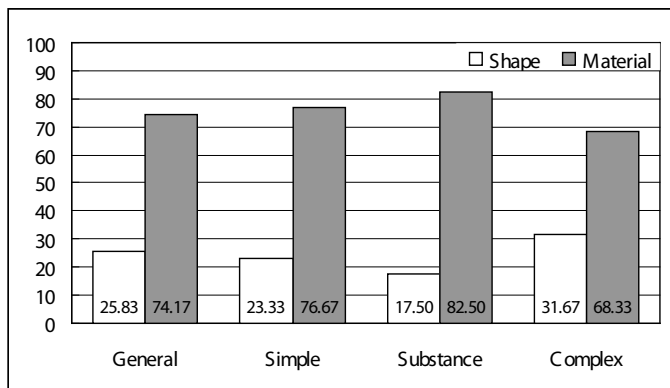
**Figure 5. Results from Japanese monolinguals**

Table 6 shows results of the *t* test. As for the general tendency, the percentage choosing the shape alternate was 25.83%, while the material alternate was 74.17%. The absolute value of *t* Stat (4.09) was larger than that of *t* Critical two tail (2.07). Therefore, the tendency was shown to be significantly material preference.

Table 6. Results of the t-test

	Percentage (%)		t Stat
	Shape	Material	
General	25.83	74.17	4.09
Simple	23.33	76.67	4.37
Substance	17.50	82.50	6.68
Complex	31.67	68.33	2.44

(n=24)

Comparing the results between monolinguals and bilinguals

Table 7 summarises the results from the current research in comparison to the related previous research. The results between the two monolingual groups in the current research were the same as those of Imai and Gentner (1997). Also, the results from the bilingual group were the same as those of Cook et al. (2006), confirming that they were cognitively affected by the L2 they had acquired, not by their living environment. There were some confounding variables among the participants such as sex and age differences. However, these variables were statistically checked to show that they were not affecting the results. This means the only difference, namely language, seems to be causing the difference.

Table 7. Summary of the results

		Monolingual English	Monolingual Japanese	Bilinguals
Current Research	Results	Shape preference	Material preference	Non-preference
	Participants	Adults	Adults	Adults (living in Japan)
Imai & Gentner (1997)	Results	Shape preference	Material preference	
	Participants	Children and Adults	Children and Adults	
Cook et al. (2006)	Results			Non-preference
	Participants			Adults (living in the U.K.)

The difference among the three groups is striking. In order to confirm the significance of these findings, a Kolmogorov-Smirnov two-sample test was conducted. Figure 6 shows the results on shape preference, while Table 8 shows the results of the analysis.

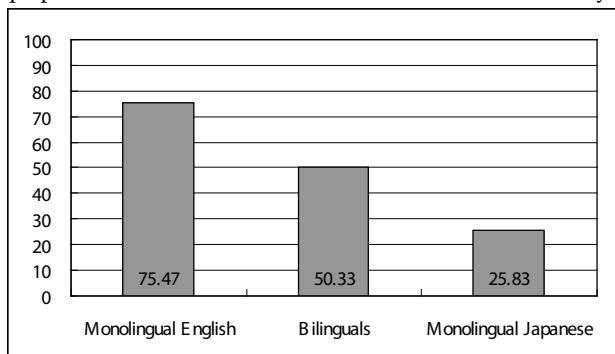


Figure 6. General tendencies of the three groups of speakers (shape preference)

As Table 8 indicates, the three groups were shown to be significantly different. To restate the tendency, monolingual English had shape preference, bilinguals had non-preference, and monolingual Japanese had material preference.

The findings indicate that monolingual English and Japanese speakers have different tendencies when classifying objects. The findings also indicate that once an L2 is acquired, the way of thinking becomes different compared to that of monolinguals. Therefore, we assume that there is a relationship between L2 acquisition and cognition.

Table 8. Results of the Kolmogorov-Smirnov two sample test

	Percentage (%)			P-Value	Significance ($\alpha=.05$)
	Monolingual English	Bilinguals	Monolingual Japanese		
Between Monolingual English and Bilinguals	75.47	50.33		0.021	*
Between Monolingual English and Monolingual Japanese	75.47		25.83	0.008	*
Between Bilinguals and Monolingual Japanese		50.33	25.83	0.038	*

Conclusion

The current research used an item classifying task to investigate participants' preferences when given two items with the

same shape and made from the same material. The participants were shown a target item, and were asked to choose which of the two alternates were similar to the target item. From the experiment, the following five findings were confirmed: First, the bilingual speakers whose L1 is Japanese and L2 is English showed non-preference. While having two choices of “shape” or “material”, the ratio of choosing them was about the same. A statistical analysis showed that there was no difference between the two choices. Thus the preference of the bilingual speakers was non-preference. Second, monolingual English speakers showed shape preference. Unlike the case of the bilinguals, there were more shape responses than material responses at a statistically significant level. Third, contrary to the monolingual English speakers, monolingual Japanese speakers had a significant material preference than shape preference. Fourth, statistically, monolingual English and monolingual Japanese speakers showed different preference, Japanese monolinguals for material, and English monolinguals for shape, thus showing that they focused on different factors when classifying objects. Finally, bilingual speakers showed totally different behavior which belonged to neither monolingual English nor monolingual Japanese speakers. While both Japanese and English monolinguals showed straight-forward preference, the bilinguals did not show such preference. Thus, they were shown to be an independent group affected by the L2 they had acquired. Most importantly, since the L2 (English) was acquired in Japan, none of the participants had experience studying abroad, but were taught through the Japanese English educational system. As mentioned in the introduction, TOEFL and TOEIC can reveal learners’ achievement by their scores. However, there is a possibility that even if two different learners have the same scores, what is happening at the cognitive level is different. Moreover, even if the learner’s score is low, they may have acquired the L2 at the cognitive level, and the acquisition is not revealed by these proficiency tests. On the whole, these results provide

empirical evidence that L2 does affect learners’ cognitive states. The findings can be seen as a starting point for a new line of investigation of the linguistic relativity hypothesis in relation to bilingualism.

Bio data

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