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Do cross-linguistic differences in writing directions affect spacial construals to represent time?

Munehiko Miyata

Abstract

Do speakers of different languages develop distinct concepts of time? Do linguistic differences have nonlinguistic consequences? Reporting results from an experiment employing non-linguistic tasks, this study illuminates an aspect of the psychological status potentially influenced by a cross-linguistic difference between English and Japanese—different use of writing directions. Three groups of subjects, 8 monolingual English speakers, 12 monolingual Japanese speakers, and 11 Japanese second language speakers of English were recruited based on subjects’ linguistic backgrounds. All subjects were asked to create a story and arrange a series of pictures in sequence from the earliest to the latest. Results showed that all English monolingual speakers arranged the pictures from left-to-right pattern. On the other hand, Japanese monolingual speakers displayed a strong tendency for top-to-bottom sequence orientation. The Japanese English bilinguals’ performance showed both left-to-right and top-to-bottom patterns. Pair-wise chi-square tests showed statistically significant differences among the groups’ performances in the picture arranging task and suggested that the cross-linguistic differences in writing directions are likely to affect describing event sequences, supporting the notion that idiosyncratic linguistic characteristics influence spatial cognition.

Introduction

Whorf (1939/2000) proposed the idea that cross-linguistic differences influence the way we view the world around us, widely known as the Sapir-Whorf hypothesis. The Sapir-Whorf hypothesis has been heavily criticized by the majority in the Chomskian universal grammar camp. Pinker (1994) for example represents the long-standing criticism on linguistic relativism in his book “Language Instinct” in which he dismisses the whole hypothesis as completely wrong. Nevertheless, studies in cognitive linguistics have reopened the debate about the extent to which language influences nonlinguistic general cognition, particularly in the domain of space and time (e.g., Boroditsky, 2001; Casasanto, Boroditsky, Phillips, Greene, Goswami, & Bocanegra-Thiel, 2004; Chan & Bergen, 2005; Maass & Russo, 2003; Nunez & Sweetser, 2006). Most importantly,
recent research offers further evidence that cross-linguistic differences in spatial cognition for time may conceivably result in different mental representations, which in turn may lead to different nonlinguistic behaviors.

Do speakers of different languages develop distinct concepts of time? Do linguistic differences have nonlinguistic consequences? By illustrating empirical studies focusing on the relationship between cross-linguistic differences in spatial metaphors and corresponding behavioral differences in general cognition of time, this study reports the results of a psycholinguistic experiment, illuminating an aspect of the psychological status potentially influenced by a cross-linguistic difference—different use of writing directions between English and Japanese.

Time in different languages

Boroditsky (2001) and Nunez & Sweetser (2006) give details on how people talk about time using spatial metaphors. Using spatial metaphors is very common among languages, but semantic parings from space to time greatly vary depending on the language we speak. For example, English speakers use spatial metaphors such as long as in a long vacation and forward as in moving a meeting forward. Boroditsky (2001) suggests that it is natural for English speakers to talk about the future as if it lies ahead of us while it is natural for Mandarin Chinese speakers talk about the future as if it lies below us. By demonstrating the relationships between spatial and temporal thinking that were consistent with linguistic metaphors, Boroditsky (2001) and Nunez & Sweetser (2006) found empirical evidence supporting the Whorfian notion that the speakers of languages using different spatiotemporal metaphors think about time differently.

Based on findings by Boroditsky (2001) and Nunez & Sweetser (2006), Casasanto, Boroditsky, Phillips, Greene, Goswami, and Bocanegra-Thiel (2004) developed non-linguistic tasks to evaluate how speakers of different languages perceive their experiences of time. Casasantos, et al. (2004) argue that non-linguistic tasks are more appropriate to validate the relationships between spatial and temporal thinking than linguistic tasks and designed a psychophysical task to examine whether spatial metaphors influence perceptuo-motor representations of time. Results showed that cross-linguistic differences in metaphors for time duration in English and Greek were significantly correlated with differences in English and Greek speakers’ performance on nonlinguistic duration estimation tasks, indicating that speakers of languages that use different spatiotemporal metaphors have distinct mental representation of time influenced by their language use.

Chan and Bergen (2005) investigated how cross-linguistic differences in writing directions may have an impact on the spatial organization of general cognitive functions, such as image recall
and expectations about the arrangement of sequential events. In their experiments, subjects were exposed to a series of pictures on a computer screen and were asked to remember what they saw. The task was designed to test how image recall is influenced by the writing direction of their native language. The corresponding hypothesis was that the way we look for information at locations is associated with how we process information. If the subjects are used to process information from left to right as in Chinese standard Mandarin and English, they may tend to look at things on the left side first. On the other hand, if the subjects are used to process information from top to bottom and right to left as in Taiwanese Mandarin, they may attend things on the right side first. If the direction of attention helps better image recall, the Taiwanese subjects will be most likely to recall pictures in the upper, right-hand corner of the screen, on the other hand the English speaking subjects will recall more pictures in the upper, left-hand corner of the screen. The results showed that English and the Chinese subjects remembered an image that appeared in the top, left-hand side of the screen better than Taiwanese subjects, and Taiwanese subjects remembered an image in the upper right-hand side of the computer screen better than the Chinese and English subjects, confirming to the hypothesis that the writing directions affect image recall.

Chan and Bergen further investigated the effect of cross-linguistic differences in writing directions on higher-level cognitive processes. In a following experiment, they asked the subjects to arrange pictures describing a sequence of natural events, and they examined whether they arrange the sequence in different directions. The related hypothesis was that writing directions would affect the orientation of sequential information. Thus, Taiwanese speakers may arrange pictures from right to left or top to bottom while English and Chinese speakers may tend to arrange them from left to right. The results showed that English speakers’ spatial representations for sequences were left to right with no exceptions. For Chinese subjects, this tendency was less strong but consistent with their left to right writing and reading direction. For Taiwanese subjects, however, there was much variability in their responses. Post hoc interviews with the Taiwanese subjects revealed that the broad range of responses might be due to the fact that Taiwanese Mandarin can be written in all left to right, top to bottom, and right to left directions, suggesting that this unexpected variability was due to the flexibility in Taiwanese Mandarin writing system to some extent.

This qualitative analysis provides a rational explanation, however, there seems to be a possible source of variation that was not examined by the study. In the experiments, the Chinese and Taiwanese subjects were all university students and second language English speakers who had been exposed to left to right English writing system extensively through their academic life in the U.S., while most English speaking subjects were monolingual speakers who did not have exposure to right to left and top to down writing system such as Taiwanese Mandarin. Chinese Mandarin and English share the same left to right writing direction. Therefore, one can imagine that the Chinese
group did not have to adjust their writing direction. On the other hand, Taiwanese Mandarin and English do not share the same writing direction. Therefore, one can expect that the Taiwanese group experienced a change in their writing direction thorough their English learning processes. It can be hypothesized that the Taiwanese subjects’ lack of consistency in their responses may be confounded with the effect of their extensive exposure to English. Since people learn and change their habits though exposure and practice, the variation could be an effect of their English learning processes.

The study

In order to investigate the question mentioned above, the study designed by Chan and Bergen (2005) was partially replicated to scrutinize a possible source of the variation in subjects’ responses. This research conducted a picture arrangement task with three groups of subjects. The first group was monolingual language speakers whose language only has left to right writing direction. The first group was a group of monolingual English speakers. The second group was monolingual language speakers whose language has top to bottom and right to left right writing directions. This group was a group of monolingual Japanese speakers. The last group was second language learners whose writing direction in the first language is different from the second language, and this was a group of Japanese second language learners of English. The followings are the research questions and corresponding hypotheses for this study:

Research Question 1: Does writing direction in English affect the orientation of sequential information by English monolinguals?

Hypothesis 1: Since conventional writing orientation will affect the orientation of sequential information, English speakers tend to arrange the event sequences from left to right.

Research Question 2: Does writing direction in Japanese affect the orientation of sequential information by Japanese monolinguals?

Hypothesis 2: Since conventional writing orientation will affect the orientation of sequential information, Japanese monolinguals tend to arrange the event sequences from top to bottom and right to left.
Research Question 3: Does writing direction in Japanese affect the orientation of sequential 
information by Japanese second language learners of English?

Hypothesis 3: Since both conventional writing orientation in their first language and learned 
writing orientation in their second language will affect the orientation of sequential 
information, Japanese bilinguals will show a several ways of sequential orientations 
such as left to right, right to left, and top to bottom.

Method

Subjects

Three groups of subjects were recruited based on the subjects’ linguistic backgrounds. The 
first group was 8 monolingual English speakers. They were all American college students learning 
at an American university, aged between 21 to 28 years. The second group was 12 monolingual 
Japanese speakers, aged between 16 to 17 years. They were all Japanese high school students in 
Japan. The last group was 11 Japanese second language speakers of English, aged between 26 to 
34 years. They were university graduate students learning at an American university. All English 
monolinguals were born in the U. S. and were native speakers of English. All Japanese monolinguals 
and Japanese second language speakers of English were born in Japan and were native speakers of 
Japanese. All subjects had received or currently being taking high school education. The English 
monolingual subjects were all literate in English. The Japanese monolingual subjects were all 
literate in Japanese. The Japanese second language speakers of English were literate in both English 
and Japanese. All subjects were tested individually by the researcher.

Materials

The materials were of 3 sets of simple images. Each set had 4 pictures depicting people’s 
normal, everyday life such as a two people talking on the phone, a man is driving a car on the street, 
a person is working in an office, shopping at a supermarket, and so on. There were no English or 
Japanese letters on the picture. Each picture was drawn on 15 centimeters long square piece of 
paper.

Instructions

All subjects were asked to create a story using the pictures provided by the researcher. When
they were telling their stories they were asked to arrange the pictures in sequence. Depending on
the story each participant created, the events in his/her story were arranged from the earliest to the
latest. They arranged the pictures on a flat surface of a school desk normally found in high school
or college classrooms in Japan and in the U. S. No letters were written in the pictures. No additional
written materials were provided during the task.

Procedure

Instructions were given in subjects’ first language. After receiving instructions, subjects sat
in front of a school desk. The 3 sets of pictures were randomized for each set of pictures for each
subject. When subjects were handed the pictures, they looked over all pictures and then started
arranging them while they tell a story. There were no time constraints to complete the task.

Results

There were three observed patterns in the subjects’ responses during the task (See Table 1). They were left to tight, top to bottom, and right to left sequential orientations. There was one
exceptional response. One of the Japanese monolingual subjects showed each picture facing to the
researcher at one at a time and hid it under the desk during the task. This exceptional response made
the researcher impossible to determine the sequential orientation of the pictures. Therefore, it was
excluded from the analysis.

<table>
<thead>
<tr>
<th>Orientation</th>
<th>English Monolingual</th>
<th>Japanese Monolingual</th>
<th>Japanese English Bilingual</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>Left-Right</td>
<td>8</td>
<td>2</td>
<td>4</td>
<td>14</td>
</tr>
<tr>
<td>Top-Bottom</td>
<td>0</td>
<td>6</td>
<td>5</td>
<td>11</td>
</tr>
<tr>
<td>Right-Left</td>
<td>0</td>
<td>3</td>
<td>2</td>
<td>5</td>
</tr>
<tr>
<td>Total</td>
<td>8</td>
<td>11</td>
<td>11</td>
<td>30</td>
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All English monolingual speakers arranged from left to right pattern. Japanese monolingual speakers
displayed a strong tendency for top to bottom sequence orientation. Six used the dominant top to
bottom orientation and 3 used right to left orientation. Two subjects used left to right orientation.
The Japanese English bilinguals’ results were mixed. Four used left to right, 5 used top to bottom,
and 2 used right to left orientations.

Pair-wise chi-square tests comparing these three groups showed a significant relationship
between linguistic backgrounds and the direction of arrangement of the pictures. The comparison between English monolingual group and Japanese monolingual group was statistically significant, $\chi^2 = 9.37$ with Yates’ correction, $p < 0.002$. The comparison between English monolingual group and Japanese English bilingual group was also statistically significant, $\chi^2 = 3.91$ with Yates’ correction, $p = 0.048$. The comparison between Japanese monolingual group and Japanese English bilingual group was not statistically significant, $\chi^2 = 0.25$ with Yates’ correction, $p = 0.62$.

**Conclusion**

English monolingual speakers, as hypothesized, showed left to right pattern, consistent with their writing and reading direction with no exceptions. Japanese monolingual speakers displayed a dominant top to bottom and right to left patterns, and they were consistent with their writing and reading direction.

The overall results for Japanese monolingual speakers support a relationship between writing system orientation and spatial representations of sequences, and they were consistent with the hypothesis by Chan and Bergen (2005). The results from the Japanese English bilinguals responses showed variability, and that was very similar to the Taiwanese subjects’ responses that Chan and Bergen found in the original experiments.

Combining the result of Chan and Bergen (2005) and the current study, controlling for bilingual subjects’ linguistic backgrounds seems important since it appears that both conventional writing orientation in their first language and learned writing orientation in their second language affect the orientation of sequential information, thus losing consistency in their second language performances.

The results support the notion that cross-linguistic differences in writing directions affect the way we arrange the event sequences in space, showing that idiosyncratic linguistic characteristic is likely to influence our mental representation of spatial cognition. The results support the Whorfian notion that cross-linguistic differences in turn are likely to influence how we understand time and space.

**References**


