What is Universal in Event Perception? Comparing English & Indonesian Speakers

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Abstract

Does the language you speak shape the way you think about the world? Four studies investigate how English and Indonesian speakers encode and represent action events. Unlike English, Indonesian verbs do not include tense markers. Indonesian speakers are not required to indicate whether an event has already occurred, is happening now, or will occur in the future. Does needing to include tense to speak English grammatically change the way English speakers pay attention to, encode and remember events? We find cross-linguistic differences in memory and similarity judgments between English and Indonesian speakers, as well as between Indonesian-English bilinguals tested in English and Indonesian.

Introduction

Humans communicate with one another using a dazzling array of languages, and each language differs from the next in innumerable ways (from obvious differences in pronunciation and vocabulary to more subtle differences in grammar). For example, to say that "the elephant ate the peanuts" in English, we must include tense - the fact that the event happened in the past. In Mandarin and Indonesian, indicating when the event occurred would be optional and couldn't be included in the verb. In Russian, the verb would need to include tense and also whether the peanut-eater was male or female (though only in the past tense), and whether said peanut-eater ate all of the peanuts or just a portion of them. In Turkish, one would specify (as a suffix on the verb) whether the eating of the peanuts was witnessed or if it was hearsay. Speakers of different languages have to attend to and encode strikingly different aspects of the world in order to use their language properly (Sapir, 1921; Slobin, 1996). Do these quirks of languages affect the way their speakers think about the world? Do English, Mandarin, Russian, and Turkish speakers end up attending to, partitioning, and remembering their experiences differently simply because they speak different languages?

The relationship between language and thought is one of the most central questions in Cognitive Science. The universality of mental representations (whether or not speakers of different languages think differently about the world) has long been at the center of a controversy attracting thinkers from Plato to Chomsky, but despite much attention and debate, definitive answers have not been forthcoming. The idea that thought is shaped by language is most commonly associated with the writings of Benjamin Lee Whorf (Whorf, 1956). Whorf, impressed by linguistic diversity, proposed that the categories and distinctions of each language enshrine a way of perceiving, analyzing, and acting in the world. In so far as languages differ, their speakers too should differ in how they perceive and act in otherwise objectively similar situations. This strong Whorfian view—that thought and action are entirely determined by language—has long been abandoned in the field. However, definitively answering less deterministic versions of the "does language shape thought" question has proven a very difficult task. Some studies have claimed evidence to the affirmative (e.g., Boroditsky, 2001; Bowerman, 1996; Davidoff, Davies, & Roberson, 1999; Gentner & Imai, 1997; Levinson, 1996; Lucy, 1992; Dehaene, Spelke, Pinel, Stanescu, & Tsivkin, 1999; Hermer-Vasquez, Spelke, & Katsnelson, 1999; Spelke & Tsivkin, 2001), while others report evidence to the contrary (e.g., Heider, 1972; Malt, Sloman, Gennari, Shi, & Wang, 1999; Li & Gleitman, in press).

One possible resolution to this debate might be that some conceptual domains are more susceptible to linguistic influence than others. For example, Gentner and Boroditsky (2001) have argued that the effect of language should be most apparent in the conceptualization of relations (typically encoded by verbs and spatial prepositions). In general, the lexicalization of actions and relations varies much more cross-linguistically than does the lexicalization of object categories, and picking out the extent and generality of a relational concept requires considerable experience with language. Recent research has supported this view (Gillette, Gleitman, Gleitman, & Lederer, 1999). For example, in one study, adults watched silent films of mothers talking to their children and tried to guess what was being said. Given only the silent film, adult participants were able to correctly guess nouns three times more often

than verbs (45% and 15% correct respectively). Further, concrete activity verbs like 'push' were much more easily guessed from silent observation than from the syntactic frames in which they were used (50% and 15% respectively), whereas verbs that denote more abstract activities like 'think' were much more easily guessed from syntax than from observation (90% and 0% respectively). It appears that acquiring representations of actions, relations, and events requires experience with language. This suggests that the eventual form of these concepts may be importantly shaped by the language experience.

This paper examines a cross-linguistic difference in verb syntax between Indonesian and English, and its effects on people's representations of action events.

Unlike English, Indonesian verbs do not include tense (they do not indicate whether the event or action took place in the past, is taking place in the present or will take place in the future). While Indonesian speakers may use other temporal words (e.g., just now, or soon) to communicate this information, these temporal markers are optional, and the tense of an action is often left to be inferred from context.

For example, in order to describe the three pictures shown in Figure 1, an English speaker might say (from left to right) "John is about to kick the ball," "John is kicking the ball," and "John has kicked the ball." In Indonesian all three pictures would likely be described by the same sentence, roughly "John kick ball." Does this difference between how English and Indonesian speakers talk about action events lead to differences in how the two groups attend to, encode, and represent the events?

We report four studies aimed at uncovering differences and similarities between Indonesian and English speakers in terms of how they encode and represent actions and events.

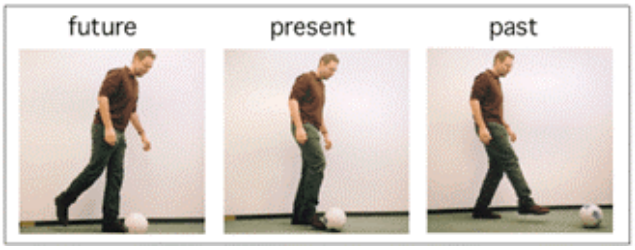

Figure 1: Example of action in three different tenses.

Experiment 1

Experiment 1 examined whether speaking a tensed language makes English speakers think of actions in different tenses as less similar, and actions in the same tense as more similar. English and monolingual Indonesian speakers were shown pairs of pictures that show either two different actors performing the same action in the same tense, or the same actor performing the same action in two different tenses (as shown in Figure 2). Subjects were asked to rate the similarity of a large set of such pairs (on a 9 point scale where 1=not similar and 9=very similar). The linguistic difference between the two languages predicts that English speakers will rate same-tense pairs more similar than will Indonesian speakers, but will rate different-tense pairs less similar than will Indonesian speakers.

Methods

Participants 14 native English and 12 monolingual Indonesian speakers participated in this study in exchange for payment. The English speakers were recruited and tested at MIT, and the Indonesian speakers were tested in Jakarta. None of the Indonesian speakers had learned English.

Materials A set of 90 pictures served as stimuli for this experiment. The pictures portrayed 10 different actions, each action performed by three different actors. For each actor performing a particular action there were 3 versions showing the actor about to perform the action, doing the action, and having done the action (as shown in Figure 1). The actions were: kicking a ball, throwing a frisbee, eating a banana, drinking orange juice, ripping a sheet of paper, cutting a rope, hula-hooping, lifting a very large ball, pouring dark liquid out of a clear container, and opening an umbrella. The actions were chosen to be sufficiently different from one another to ensure generality.

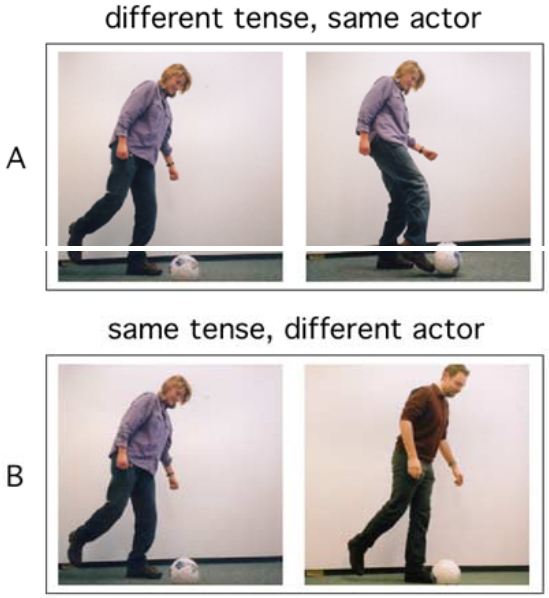

Figure 2: Examples of picture-pairs used.

Design A set of 180 picture pairs were created. Half of these showed the same actor performing the same action in different tenses (as shown in Figure 2A), and half showed two different actors performing the same action in the same tense (as shown in Figure 2B). All possible combinations of pictures that yielded such pairs were used (a total of 180 pairs).

Procedure Participants were tested individually in a quiet room. English speakers were given instructions in English, and Indonesian speakers were given instructions in Indonesian. The English instructions were: "You will see two pictures each time. Your task is to rate how similar those two pictures are. In rating them, use the numbers 1 through 9: 1 for NOT similar at all, 9 for VERY similar." The Indonesian instructions were: "Setiap kali, Anda akan melihat dua gambar. Kami minta agar Anda mengatakan seberapa mirip dua gambar itu. Gunakan angka 1 sampai dengan 9. 1 untuk SANGAT TIDAK MIRIP, 9 untuk MIRIP SEKALI."

The participants were also told that all of the pairs would be pretty similar, but they should still try to use the whole range of similarity ratings from 1 to 9.

A computer presented the 180 pairs in a new random order for each subject. Each pair stayed on the computer screen until the subject pressed a key (1 through 9) to indicate their similarity rating.

Results

Results are shown in Figure 3. As predicted, English speakers rated same-tense pictures (involving different actors) more similar than did Indonesian speakers (M=6.34 for English speakers, and M=4.82 for Indonesian speakers), $t=2.07$, $df=24$, $p<.05$. Further, as predicted, English speakers rated different-tense pictures less similar than did Indonesian speakers (M=5.56 for English speakers, and M=6.64 for Indonesian speakers), $t=1.71$, $df=24$, $p<.05$. The difference between the two language groups was confirmed as an interaction between comparison type (between-tense or within-tense) and language (English or Indonesian) in a 2x2 repeated measures ANOVA, $F(1,24)=4.41$, $p<.05$. This pattern of findings suggests that using the English tense system may change English speakers' representations of actions, making differently tensed actions appear more distinct and actions in the same tense appear more similar.

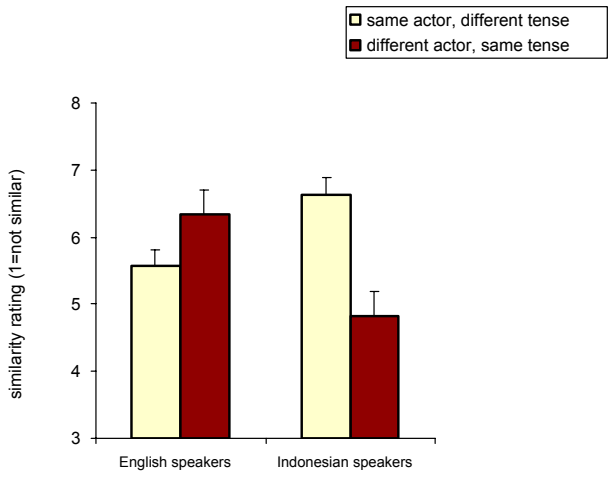

Figure 3: Results of Experiment 1.

Discussion

English and Indonesian speakers appeared to focus on different aspects of action scenes in making their similarity comparisons. English speakers seemed to hone in on tense, judging actions in the same tense but performed by different actors (as shown in Figure 2b) to be more similar than actions performed in different tenses but by the same actor (as shown in Figure 2a). The Indonesian speakers showed the opposite pattern, appearing to ignore similarity of tense in favor of similarity of actor.

This raises two further questions: (1) Do Indonesian speakers who learn the English tense system change the way they think about events? and (2) Do Indonesian-English bilinguals think differently when speaking Indonesian than when speaking English? Experiment 2 tested Indonesian-English bilinguals both in Indonesian and in English on the same task as described in Experiment 1.

Experiment 2

Methods

All of the materials, design and procedure were exactly as described for Experiment 1. Seventeen Indonesian-English bilinguals participated in this study. Seven were tested in English and ten were tested in Indonesian. All of the participants were native speakers of Indonesian and were matched on their amount of experience with English.

Results and Discussion

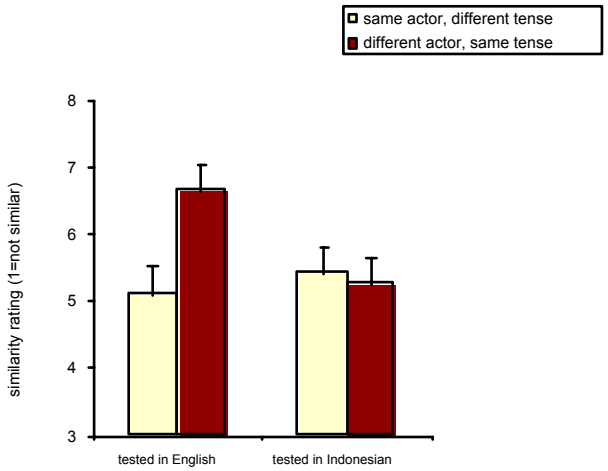

Figure 4: Results of Experiment 2.

Results are shown in Figure 4. Indonesian-English bilinguals rated same-tense pictures (involving different actors) more similar when they were tested in English than when tested in Indonesian, (M=6.64 when tested in English, and M=5.27 when tested in Indonesian). Further, Indonesian-English bilinguals rated different-tense pictures less similar when they were tested in English than when

tested in Indonesian (M=5.11 when tested in English, and M=5.42 when tested in Indonesian). The difference between the two groups was confirmed as an interaction between comparison type (between-tense or within-tense) and language of testing (English or Indonesian) in a 2x2 repeated measures ANOVA, $F(1,15)=4.40$, $p<.05$.

This pattern of findings suggests two things. First, it appears that bilinguals do think differently when speaking different languages. Even though the task was conducted in pictures, setting a linguistic context by providing instructions either in English or in Indonesian changed the way Indonesian-English bilinguals reasoned about the action events in this study.

Second, it appears that learning a new language can change the way one thinks. The Indonesian-English bilinguals who were tested in Indonesian showed a pattern that was somewhere in-between the pattern shown by monolingual Indonesian speakers and the pattern shown by English speakers. Even though they were tested entirely in Indonesian it appears that having learned English may have changed the way they think about action events. Further studies will be necessary to explore this possibility in more detail.

Experiment 3

Although the findings of Experiments 1 & 2 are very suggestive, the similarity-ratings task used is subjective and may tell us more about the participants' cognitive preferences than about their cognitive performance. Could cross-linguistic differences lead to difference in cognitive performance and not just preference?

Experiment 3 was designed to test Indonesian and English speakers' ability to remember action events. Subjects were shown pictures of people performing actions (the same pictures were used as in Experiments 1 & 2). During the learning phase, each subject saw a person performing an action in one of three tenses (e.g., they may have seen only the middle panel of Figure 1). During the test phase, subjects were shown pictures of that person performing the action in all three tenses (as shown in Figure 1) and asked to choose which one they had seen previously. We predicted that English speakers should be better than Indonesian speakers at encoding and remembering the tense in which they witnessed an action.

Methods

Participants 13 native English and 18 monolingual Indonesian speakers participated in this study in exchange for payment. The English speakers were recruited and tested at MIT, and the Indonesian speakers were tested in Jakarta. None of the Indonesian speakers had learned English.

Materials and Design All of the same pictures as described for Experiment 1 were used. During the learning phase, subjects were shown 30 of the 90 pictures (1 picture of each person doing each action in only one of the possible 3 tenses). At test, subjects were shown all three pictures of a person performing an action in all 3 tenses (all three pictures were presented simultaneously) and asked to choose which one they had seen earlier.

Procedure Participants were tested individually in a quiet room. English speakers were given instructions in English, and Indonesian speakers were given instructions in Indonesian. Participants were told to simply look at the pictures and try to remember everything they saw. Participants were not instructed to encode the pictures linguistically.

A computer presented the pictures in a new random order for each subject (both for the learning and test sets). During the learning, each picture was shown only once and stayed on the screen for 3 seconds. During the test, the pictures stayed on the screen until the subject made a response (by pressing 1, 2, or 3 on the keyboard to correspond to which picture they thought they had seen previously).

Results

Results are shown in Figure 5. As predicted, English speakers were better able to remember which of the three tense versions of a picture they had seen before. English speakers were able to pick the correct answer 41% of the time, as compared to Indonesian speakers who only succeeded 31% of the time, $t=1.72$, $df=29$, $p<.05$. Indonesian speakers were not better than chance at recognizing the picture they had seen before (chance=33.3%).

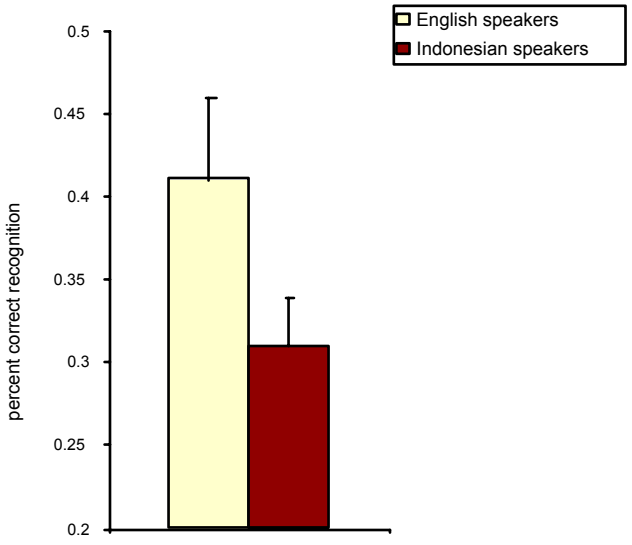

Figure 5: Results of Experiment 3.

Discussion

Results of Experiment 3 suggest that experience with particular languages may affect not only people's cognitive preferences, but also aspects of their performance on basic cognitive tasks (such as memory). However, it is possible that differences in memory performance between English and Indonesian speakers observed in this task are not due to linguistic differences, but rather to other differences in cultural upbringing or education. It is quite possible that the English speakers included in this sample (mostly MIT undergraduates) have received more training in memorization than the Indonesian speakers in our sample. In order to control for such differences, Experiment 4 tested Indonesian-English bilinguals (who were matched on educational and cultural background) either in English or in Indonesian in the same task as described for Experiment 3. By keeping constant educational and linguistic background and only varying the language of testing we can test whether speaking one language versus another can really affect aspects of one's cognitive performance.

Experiment 4

In Experiment 4, Indonesian-English bilinguals were tested either in Indonesian or in English in the same memory task as described for Experiment 3.

Methods

All of the materials, design and procedure were exactly as described for Experiment 3. Eighteen Indonesian-English bilinguals participated in this study. Seven were tested in English and eleven were tested in Indonesian. All of the participants were native speakers of Indonesian and were matched on their linguistic and educational background.

Results and Discussion

Results are shown in Figure 6. As predicted Indonesian-English bilinguals were better able to remember the tense of actions when they were tested in English (40% correct) than when they were tested in Indonesian (26% correct), $t=1.76$, $df=16$, $p<.05$. When they were tested in Indonesian, Indonesian-English bilinguals did not perform better than chance (in fact, slightly worse).

These results suggest that even something as subtle as linguistic context (whether instructions were given in English or Indonesian) can have an effect on how people encode and represent events. Even though subjects were not asked to encode the events linguistically (and the entire task was conducted in pictures), people's ability to remember the tense of events they had witnessed (whether they saw someone about to kick a ball or having already kicked a ball) depended on whether or not tense distinctions were required in the language in which they had been greeted and given instructions just prior to the task.

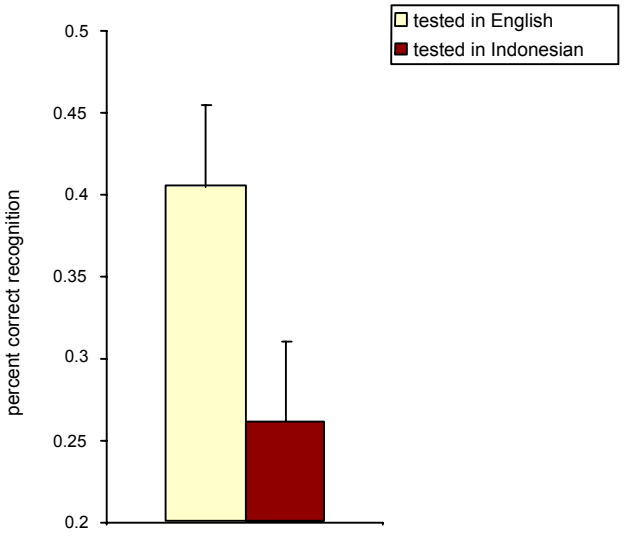

Figure 6: Results of Experiment 4.

Summary

Four studies investigated the effect of linguistic experience on how people attend to, encode, and represent action events. The results suggested that experience with the English tense system makes English speakers think of actions in the same tenses as more similar and action in different tenses as less similar. Unlike English speakers, Indonesian speakers did not appear to value tense in making their similarity judgments. Further, English speakers were better able to remember the tense of an action they had witnessed than were Indonesian speakers (who did not perform above chance on the memory task).

Studies that tested Indonesian-English bilinguals in either English or Indonesian provided further insights about how language may affect thinking. Both in memory and similarity ratings, the language that bilinguals were tested in had an effect on the subjects' performance in the task. Indonesian-English bilinguals looked just like English speakers when tested in English, and much more like Indonesian speakers when tested in Indonesian. Further, results of the similarity study suggested that learning a new language can change the way one thinks – Indonesian-English bilinguals tested in Indonesian showed a pattern of results that was somewhere in-between the English-speakers' pattern and that shown by monolingual Indonesian speakers.

Overall, it appears that representations of action events are not universal. Experience with the English tense system appears to segment actions into distinct temporal categories that are not basic or universal to human cognition. Further, even something as subtle as linguistic context (here, the language in which instructions are given for a non-linguistic task) appears to have a striking effect on how people encode and represent their experiences.

It appears that speakers of different languages do attend to, partition, and remember their experiences differently, simply due to the implementational differences of the languages they speak.

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References

Boroditsky, L. (2001). Does Language Shape Thought? Mandarin and English speakers conceptions of time. Cognitive Psychology, 43(1), 1-22.

Bowerman, M. (1996). The origins of children's spatial semantic categories: cognitive versus linguistic determinants. In J. Gumperz & S. Levinson (Eds.), Rethinking linguistic relativity. Cambridge, MA: Cambridge University Press, 145-176.

Davidoff, J., Davies, I., & Roberson, D. (1999). Colour categories in a stone-age tribe. Nature, 398, 203-204.

Dehaene, S., Spelke, E., Pinel, P., Stanescu, R., & Tsivkin, S. (1999). Sources of mathematical thinking: Behavioral and brain-imaging evidence. Science, 284, 970-974.

Gentner, D., & Boroditsky, L. (2001). Individuation, relational relativity and early word learning. In M. Bowerman & S. Levinson (Eds.), Language acquisition and conceptual development. Cambridge, England: Cambridge University Press.

Gentner, D. & Imai, M. (1997). A cross-linguistic study of early word meaning: Universal ontology and linguistic influence. Cognition 62, 2, 169-200.

Gillette, J., Gleitman, H., Gleitman, L., Lederer, A. (1999). Human simulations of vocabulary learning. Cognition, 73(2), 135-176.

Heider, E. (1972). Universals in color naming and memory. Journal of Experimental Psychology, 93, 10-20.

Hermer-Vasquez, L., Spelke, E. S. & Katsnelson, A. S. (1999). Sources of flexibility in human cognition: Dual-task studies of space and language. Cognitive Psychology, 39, 3-36.

Kay, P., & Kempton, W. (1984). What is the Sapir-Whorf hypothesis? American Anthropologist, 86, 65-79.

Levinson, S. (1996). Frames of reference and Molyneux's question: Crosslinguistic evidence. In P. Bloom & M. Peterson (Eds.), Language and Space. Cambridge, MA: MIT Press, 109-169.

Li, P. & Gleitman, L. (in press). Turning the tables. Cognition.

Lucy, J. (1992). Grammatical categories and cognition: a case study of the linguistic relativity hypothesis. Cambridge, England: Cambridge University Press.

Lucy, J., & Shweder, R. (1979). Whorf and his critics: Linguistic and nonlinguistic influences on color memory. American Anthropologist, 81, 581-618.

Malt, B., Sloman, S., Gennari, S., Shi, M., & Wang, Y. (1999). Knowing versus naming: Similarity and the linguistic categorization of artifacts. Journal of Memory and Language, 40, 230-262.

Sapir, E. (1921). Language, New York, NY: Harcourt, Brace, and World.

Slobin, D. (1996). From "thought and language" to "thinking for speaking." In J. Gumperz & S. Levinson (Eds.), Rethinking linguistic relativity. Cambridge, MA: Cambridge University Press, 70-96.

Spelke, E., & Tsivkin, S. (2001). Language and number: A bilingual training study. Cognition, 78(1), 45-88.

Whorf, B. (1956). Language, Thought, and Reality: selected writings of Benjamin Lee Whorf, ed. J.B. Carroll. Cambridge, MA: MIT Press.