

A Study Investigating the Understanding Of Counterfactual Statements

Lok Hin Au, Wei Wha Xu, Hui Nga Man, Jang Jin Sok, Shum Ho Ching

November 29th 2017
City University of Hong Kong
GE1132 Mind, Brain and Language
Instructed by Professor Paul S. Law

Introduction

The linguistic relativity hypothesis is the theory stating that the language we use to speak and communicate has an effect on the way we think and perceive the world around us. Also known as the Sapir-Whorf hypothesis, the magnitude of this effect is often debated and separated into two main variants. While the strong form of the linguistic relativity hypothesis, linguistic determinism, argues that all our thoughts and worldviews are completely based on the language we use, the *weak* form of linguistic relativity claims that it only shapes and influences the way we think.

Believing in the weak version of this linguistic relativity, Alfred H. Bloom conducted a scientific study in 1981 to compare native speakers of Mandarin Chinese to western speakers of English. Bloom believed that the fundamental structural differences in their respective languages would logically influence the two groups into having different ways of thinking and reasoning. Unlike English, a structure for expressing counterfactual statements in the Chinese language does not exist explicitly. As such, Bloom showed participants sentences in their language and questioned them for understanding. Finding a higher percentage of incorrect answers in the Chinese group, Bloom concluded that unlike English, Chinese speakers are mentally unable to undergo counterfactual reasoning (Bloom P. 2001).

However, Bloom's study soon came under controversy for its low reproducibility and was criticized by other researchers for poor experimental design and scientific method. For example, Au (1983) conducted a more extensive study and found that the difference between Chinese and English speakers essentially disappeared once the original text was translated into Chinese with higher and higher accuracy.

The aim of the current study is to investigate the effect of the linguistic relativity hypothesis on the understanding on conditional and counterfactual statements by conducting a modified replication of the original Alfred H. Bloom experiment to see if similar results can be replicated.

Experiment 1

The participants were each given questionnaires written in either English or Chinese, depending on the language they speak. They would be used to judge their understanding of conditional and counterfactual statements. They were asked to fill out the questionnaire, checking whichever selection box they felt most accurately answers the questions.

Each participant was given as much time as they felt needed, and the amount of time taken for each section is recorded by a researcher. Any noteworthy remarks during the experiment were also recorded, along with basic information of the participant such as initials and gender.

The participants' responses were then consolidated to give an overall picture of the responses of the respondents.

Materials

There were two versions of the form that we used in the experiment, depending on the spoken language of the participant

The Chinese speakers were given the Chinese version, which consisted of two sections. The second section contained pictures that depict hypothetical situations. This is included to help the participant realize that the conditional statements of the first section may in fact be counterfactual. The questions and statements in the Chinese form are also written in both simplified Mandarin and in traditional Cantonese so that participants can refer to whichever they prefer.

On the other hand, the English form consisted of two sections on counterfactual statements and one section on conditional statements.

Participants

The participants who took part in this experiment consisted of a group of ten English speakers and a group of ten Chinese speakers. The Chinese group included speakers of Mandarin and Cantonese Chinese. However, this should not make any difference as counterfactuals do not exist in either dialect. All of our participants are monolingual, native speakers of their language.

Of the participants, eight were male and twelve were female, split evenly between Chinese and English speakers. The Chinese speakers ranged from 16 to 33 years of age while the English speakers ranged from 16 to 23.

Results

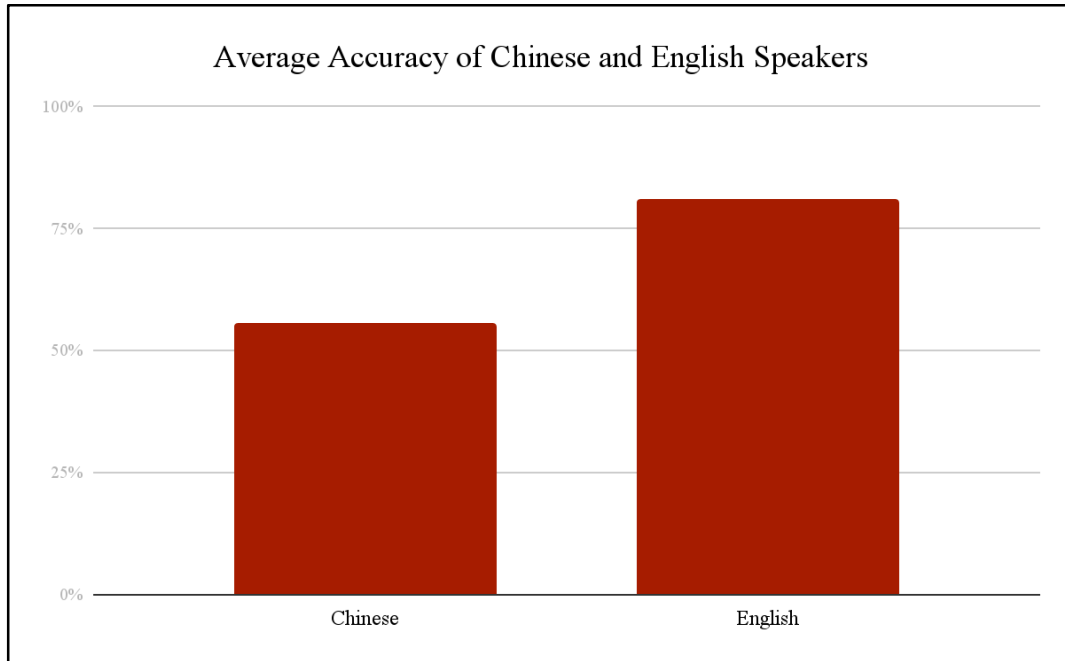
When we consolidated and processed the responses, we found that the English speakers on average answered the counterfactual statements with 80.00% accuracy and the conditional statements with 82.50% accuracy. Overall, the native speakers of English answered accurately 81.17% on average with a standard deviation of 6.97%.

For Chinese speakers, they answered with an average of 55.56% accuracy with a standard deviation of 14.24%. On average, monolingual Chinese speakers answered with an accuracy 25.61% lower than that of English speakers.

Table 1: Experiment 1 Results

	Average Accuracy (%)	Standard Deviation (%)
Chinese Speakers	55.56	14.24
English Speakers	81.17	6.97

Graph 1: Bar Chart of Experiment 1 Results



Experiment 2

After the first experiment, a second experiment was conducted to further investigate the linguistic relativity hypothesis on the understanding of conditional and counterfactual statements. In this experiment, the Cantonese questions were edited and refined to provide more intelligible translations, similar to Au's study in 1983.

Participants were sent a Cantonese questionnaire in the form of an online survey and were similarly asked to answer a set of questions that would test their understanding and ability to grasp conditional and counterfactual statements.

Materials

The online form consisted of ten questions in Cantonese along with some basic information of the participant, such as gender and level of education. The first six of these questions were similar to the ones used in the first experiment.

Questions 1 to 3, 8, and 10

English: If somebody had verb(past perfect), pronoun would have verb(past perfect).

English	Cantonese
Had + Verb(past perfect)	有 + Verb + 到/咗
Would have + Verb (past perfect)	就會 + Verb + 到/咗

Note that unlike English, verbs in Cantonese do not change the form according to the tense.

For example: If John **had studied** hard, he **would have passed** the exam.
如果佢**有比到**心機讀書，佢**就會合到格**

Questions 7 and 9

English: If somebody verb(past), pronoun would verb(bare infinitive).

English	Cantonese
Verb(Past)	Verb (without 有/到/咗)
Would + Verb(Bare infinitive)	就會 + Verb (without 到/咗)

For example: If John **studied** hard, he **would pass** the exam.
如果佢**比**心機讀書，佢**就會合格**

Comparison:

Counterfactual Sentence: 如果佢**有比到**心機讀書，佢**就會合到格**
Not a Counterfactual Sentence: 如果佢**比**心機讀書，佢**就會合格**

Questions 4 and 5

E.g. Suppose all the circles are of rubber, and all the triangles are made of metal.

The circles and the triangles have the same volume.

If the triangle were a circle, would it be light?

個圓形係用膠做，三角形係用金屬做，而個圓形輕過個三角形；喺呢個情況下，如果三角形變咗做個圓形，咁佢係輕定重？

In Q5, interviewees had to consider both shape and material of the object.

In the translated Cantonese version, this sentence is semantically ambiguous, in which it can be comprehended in two ways. The first way is to think that the shape of the object changes from a triangle to a circle, but it is still metallic. Another way is to interpret that both the shape and material of the object changes.

However, in the original English version, this sentence only implies the latter. Therefore, the Cantonese translation may have caused misunderstandings.

Participants

A total of 115 fluent, native speakers of Cantonese participated in this experiment through the internet via the online form.

Of the participants, 48 were male and 67 were female. Education levels ranged from elementary to masters or above.

Results and Trends

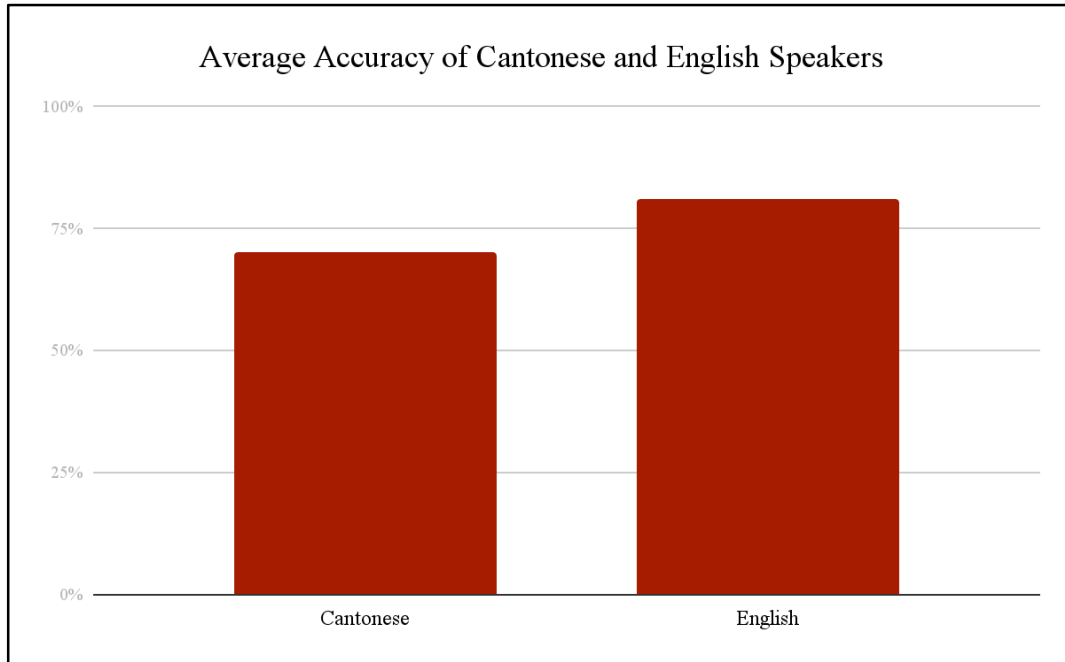
Overall, the Cantonese speaking participants of this experiment answered with an average accuracy of 70.03% and standard deviation of 14.62%.

Compared to the English speaking participants of the first experiment, the Cantonese speakers on average only scored 11.14% lower.

Table 2: Experiment 2 Results

	Average Accuracy (%)	Standard Deviation (%)
Cantonese Speakers	70.03	14.62
English Speakers	81.17	6.97

Graph 2: Bar Chart of Experiment 2 Results



By Gender

On average, female interviewees performed better than males. Males only performed better than females in Q6, 7a, 9a, 9b only, and both had the same performance in Q7b.

In Q6, 87.5% of male respondents answered correctly, which is 21.4% more than those of female respondents (72.1%). One possible reason is that Q.6 is an arithmetic question, which means that this question may dependent more on the respondents' ability in maths rather than in language comprehension.

In Q7a, 9a and 9b, 14.3%, 16.6% and 15.9% of male respondents performed better than female respondents respectively. Also, male and female respondents have similar performance in Q7b. Both Q.7 and Q.9 are regular conditional sentences, which do not imply whether the mentioned events have actually happened or not, but only indicate that the events have a certain possibility to happen.

By Level of Study

The overall performance declines as the academic qualification of respondents ascends in most of the questions.

By Question

Q1, which is a counterfactual sentence, is repeated in Q8, but Q7 is asked, which is not a counterfactual sentence, before Q8. All respondents performed equally or better in Q8 when compared to Q1. And all respondents had a better performance in Q8 than in Q7.

Q9 is nearly identical to Q10, the only difference is that former is not a counterfactual sentence whereas the latter is. All respondents performed better in Q10a than in Q9a. But some of respondents performed worse in Q10b than in both Q9b and Q10a. This may account for the grammatical use of Cantonese word '感覺' (Feel) in Q10b. This word is also used in Q3b, and the

overall performance in Q3b is worse than in Q3a thus suggesting a correlation between the grammatical ambiguity of the word ‘感覺’ and the poorer performance of the respondents.

In Q10b, the percentage of respondents who answered ‘cannot tell’ is quite close to those who answered the correct answer ‘No’. This may be an indicator of respondents being misled by the wording of the question.

Conclusion

In both experiments, the results were in line with those found by Bloom in the original experiment, with the monolingual speakers of Chinese having greater difficulty answering questions when asked about counterfactual statements. In the first experiment, there is a large 25.61% decrease in accuracy for Chinese speakers. In the second, there was a smaller 11.14% reduction in accuracy.

With these results, it would be easy to conclude that the Chinese are unable to comprehend the logic and reasoning needed to understand counterfactual statements due to the linguistic relativity hypothesis, similarly to Bloom.

However, the more precise translations catered to Cantonese speakers that were given in the second experiment provided a sizable 14.47% improvement in accuracy. This is similar to the results found by the extensive follow up study by Au in 1983.

With these results, we argue that although the linguistic relativity hypothesis may certainly still have an effect over how we view the world, its effect may not be as strong as linguistic determinism. Our second experiment showed that more precise translations can improve the speaker’s ability to understand the described scenario, meaning that speakers of Chinese are certainly not doomed to never be able to understand the reason and logic of counterfactual statements.

Nevertheless, Chinese speakers do certainly seem to have more trouble grasping the concept of counterfactuals, as evidenced by the lower accuracy in both experiments. But this is likely due to fact that the Chinese do not commonly express thoughts in this particular structure, and instead have other forms of communicating logically similar ideas, as shown in the second experiment.

As such, the linguistic relativity hypothesis is very likely to be true, specifically the weak version with the language we speak affecting the way we shape our thoughts. On the other hand, the strong argument of the linguistic relativity hypothesis seems to be rather far fetched, as the Chinese speakers are certainly still able to understand counterfactuals, albeit with slightly more effort.

Works Cited

Au, T. K. (1983). Chinese and English counterfactuals: The Sapir-Whorf hypothesis revisited

[Abstract]. *Cognition*, 15(1-3), 155-187. doi:10.1016/0010-0277(83)90038-0

Bloom, P., & Keil, F. C. (2001). Thinking Through Language. *Mind & Language*, 16(4), 351-367.

doi:10.1111/1468-0017.00175