

## USEFULNESS AND USABILITY OF MOBILE DEVICES IN CHINESE-ENGLISH ELECTRONIC MEETINGS

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### ABSTRACT

*The business world is increasingly global generating a tremendous need for successful multilingual communication. Several prior studies have examined how multilingual groups can communicate effectively using networked computers, electronic meeting software, and machine translation. However, the current trend is increasingly shifting to the use of mobile devices such as smartphones. Some recent research has focused on how groups can use mobile devices such as smartphones for electronic meetings. In perhaps the first instance of truly multilingual groups using mobile devices, this study shows that participants find the technology easy to use and useful, and, the translation quality, while not perfect, is adequate. Thus, it is now realistic and feasible for groups to communicate nearly anywhere, anytime, in dozens of different languages.*

**Keywords:** Multilingual, Machine Translation, Electronic Meetings, Mobile Devices, Smartphones, Chinese

### INTRODUCTION

The adoption of mobile devices such as tablets and smartphones has grown tremendously over the past decade and, in certain areas of the world, a large proportion of the population currently uses the technology [20]. For example, in 2013, 56% of Americans owned a smartphone. Further analysis shows that the proportion is even higher for higher-income adults or for those under age thirty-five [22]. At the same time, automatic, machine translation of natural languages has increased in accuracy, and more people are using these systems to provide information when human interpreters are not available or are too expensive [13, 17].

Studies have been conducted on groups using mobile devices for electronic meetings, and other research has investigated how multilingual groups can use machine translation with desktop computers to support meetings. The purpose of this paper is to study how the choice of device (desktop computer or mobile device) can affect electronic meetings in which some group members speak Chinese and some speak English. First, we provide a literature review and a description of the multilingual electronic meeting software. This is followed by a discussion of the experiment and the results. Finally, we present a conclusion section with a summary, limitations and some suggestions for future research.

### LITERATURE REVIEW

The use of machine translation for the support of multilingual meetings began in the early 1990s [6], and in the subsequent interval, many studies have been conducted that show the feasibility of the technique for informal, idea gathering [23]. Although translation errors among languages are made, enough of the gist of comments can be ascertained to adequately inform all group members what is meant, and, at the same time, comments can be exchanged simultaneously and anonymously. Thus, except for small groups using only one or two languages, electronic meetings with automatic translation are more efficient, productive, and satisfying for the participants [19].

At least seven computer applications have been developed that provide automatic translation for instant messaging between pairs of individuals: Amikai, ChatTranslator, Free2IM, Hab.la Realtime Chat, IBM Lotus Sametime, MeGlobe, and WorldLingo Chat [8], and a few electronic meeting software packages have also been developed (e.g., *AmiChat* and *Annochat*) [12, 14, 18, 24]. However, until recently, no research has been conducted on multilingual groups using mobile devices.

Although many people now have tablets and smart phones which can be used for texting at any time from any place, typing is not as efficient as with using a large keyboard and less information can be displayed at a time on the screen [21]. Nevertheless, hundreds of different applications are now available for these devices, and many involve communication.

Several studies have investigated the feasibility of using mobile devices in electronic meetings (e.g. [11, 15, 25, 26, 27] ). However, to our knowledge, only two studies have used mobile devices (or simulated devices) to conduct a multilingual meeting with automatic translation.

In one of these studies [10], groups of students used desktop computers with either a full screen or a smart device emulator on the screen. To simulate a multilingual meeting, students copied and pasted previously prepared German and Spanish text into the discussion and evaluated the English translations afterward. Results showed that there was no difference between the desktop and smart device emulator groups in terms of comprehension, ease of use, or usability.

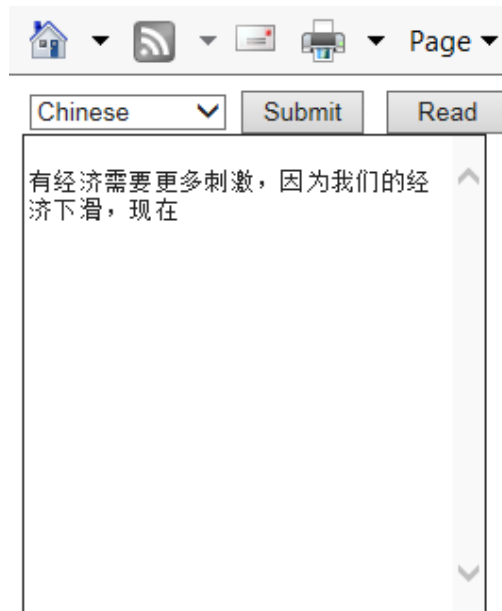
In another study [9], students used either desktop computers or actual mobile devices (typically Apple iPhones) in electronic meetings. Students typed comments in English while the facilitator entered previously prepared German and Spanish comments at random intervals into the discussion to simulate a true, multilingual meeting. Again, results showed that there was no difference between the desktop and smart device emulator groups in terms of comprehension, ease of use, or usability. Students in both studies were able to comprehend the comments well, and believed both types of meetings were easy to use and useful.

However, these two prior studies were not true multilingual meetings in that some foreign text was copied into the discussion, principally because of the lack of foreign-language speakers to adequately test the system. The previously prepared German and Spanish comments did not have errors, and only one German/Spanish speaker evaluated the comments typed in English and translated. In addition, the system was able to translate among these Western European languages well [3]. Translation among other language combinations might have resulted in better or worse translation accuracy, consequently affecting users' perceptions of the meetings. In particular, the greater the linguistic diversity among languages, the more difficult it is to translate among them. For example, Hindi, Chinese, and English differ radically in terms of linguistic features and structures at all morphologic, syntactic, and semantic levels. In addition, it could be more difficult to enter text in a language with a non-Roman alphabet on a standard QWERTY computer keyboard.

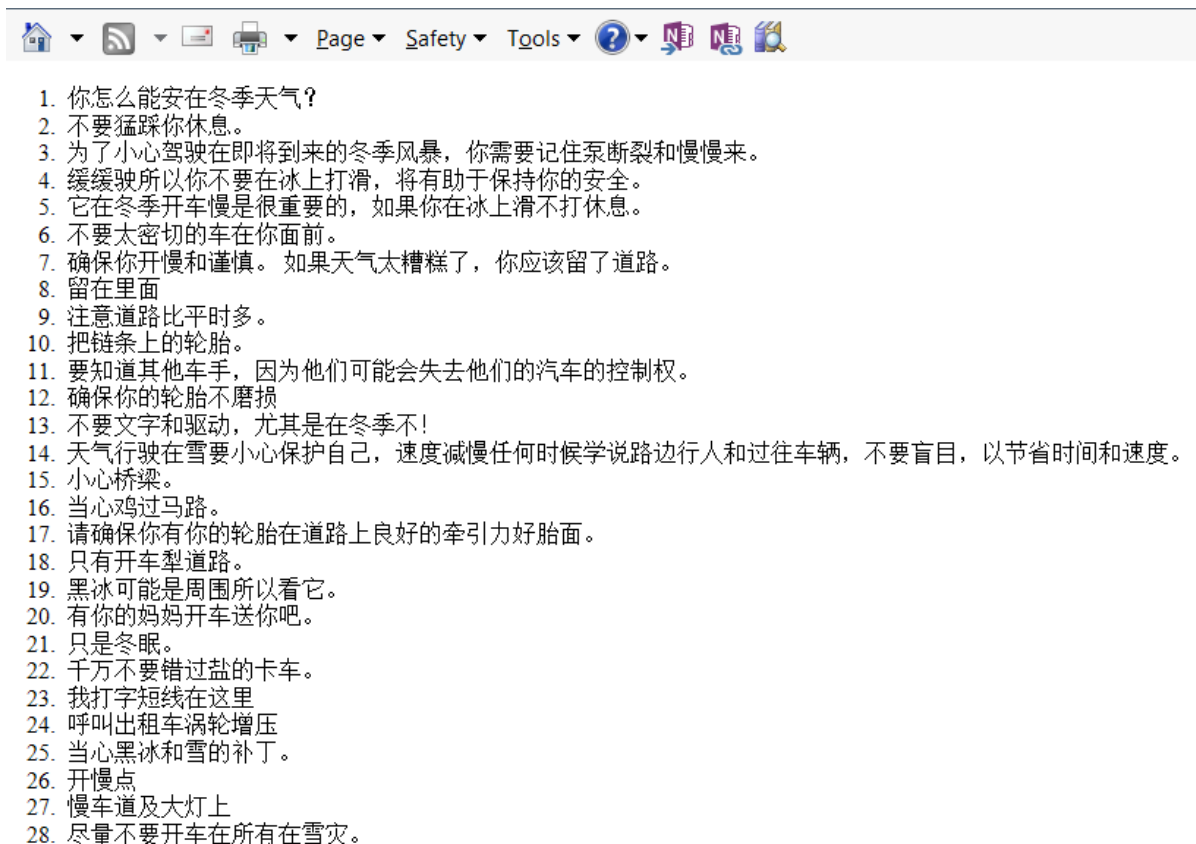
### **MULTILINGUAL MEETING SOFTWARE**

Although there are several multilingual electronic meeting software packages, all are proprietary and support a relatively small number of languages. As an alternative, we have developed our own Web-based electronic meeting software integrated with *Google Translate* that provides automatic translation among 90 different languages in 8,010 combinations [9, 4]. Since the software is Web based, it can run in any browser on any type of device, the only difference being the viewable screen size and the method of text entry. Group members using languages with other character sets, such as Hindi or Russian, can use specialized apps for conversion from a Roman character keyboard. Figure 1 shows how a Chinese group member might use the multilingual meeting software on a smartphone to enter a new comment into a discussion.

The meeting software is very easy to use. A group member simply types a comment into a textbox and presses the 'submit' button to add it to the transcript. It is automatically translated within a second to all other languages being used in the meeting. If the participant wishes to only read what others' wrote and not submit a new comment, he or she just presses the 'read' button, as shown in Figure 2.



**Figure 1.** A Chinese Comment Entered into Web Browser on Smartphone



**Figure 2.** Chinese Comments Being Read in Web Browser on Desktop Computer

## EXPERIMENT

### Purpose

The purpose of this study is to investigate how groups use mobile devices (specifically, smartphones) for multilingual electronic meetings as compared to traditional, networked, desktop computers. To address the limitations of the two prior multilingual/mobile-device studies, we chose to use Chinese and English instead of only Western European languages, and we recruited native speakers to participate in the discussions. Thus, artificial, pre-written text was not simply added. Instead all group members were able to contribute comments with typing mistakes, slang, idioms, and other text that might cause translation errors. Additionally, it was expected that it was more likely to have a larger number of translation errors between Chinese and English than among European languages [3].

### Subjects and Task Description

We recruited a sample of 88 undergraduate business students from a public university in the northeastern region of the United States. The experiment consisted of about 10 meetings of 8 or 9 students each, with 38 students in mobile-device meetings and 50 in desktop PC meetings. A total of 46 students spoke Chinese as their native language and used it to exchange comments, and 42 used English. All meetings consisted of a mixture of Chinese and English speakers discussing various topics similar in terms of complexity and controversy, such as “How can we improve our university?” and “How can you be safe in winter weather?” Afterwards, students completed a survey (Appendix I) to determine how useful and usable the system was and how accurate the translations were. The questionnaire was used in a prior study [5] and was validated.

### Results

Table 1 shows a summary of the experimental results by device used. Students in smartphone and desktop computer meetings were able to understand the comments and believed their meeting systems were easy to use and useful. That is, all means were significantly higher than the neutral value of 4.0 on the 1-to-7 scale using an  $\alpha = 0.05$ . However, there was a significant difference between the treatments in that mobile device users generally were able to comprehend the comments better than desktop pc users.

**Table 1.** Device Comparison Statistics

|              | <b>Mobile</b> | (N=38)        | <b>PC</b>   | (N= 50 )      |          |          |
|--------------|---------------|---------------|-------------|---------------|----------|----------|
|              | <b>Mean</b>   | <b>StdDev</b> | <b>Mean</b> | <b>StdDev</b> | <b>F</b> | <b>p</b> |
| <b>Com1</b>  | 6.00          | 1.23          | 5.20        | 1.60          | 6.53     | 0.01     |
| <b>Com2</b>  | 5.89          | 1.33          | 5.14        | 1.29          | 7.17     | 0.01     |
| <b>Com3</b>  | 5.26          | 1.48          | 4.48        | 1.31          | 6.87     | 0.01     |
| <b>Ease1</b> | 5.87          | 1.34          | 5.82        | 1.37          | 0.03     | 0.87     |
| <b>Ease2</b> | 5.95          | 1.34          | 5.66        | 1.22          | 1.10     | 0.30     |
| <b>Ease3</b> | 6.16          | 1.26          | 6.02        | 1.42          | 0.22     | 0.64     |
| <b>Use1</b>  | 5.50          | 1.74          | 5.78        | 1.33          | 0.09     | 0.77     |
| <b>Use2</b>  | 5.66          | 1.56          | 5.40        | 1.41          | 0.16     | 0.69     |

As shown in Table 2, English speakers reported a higher level of comment comprehension than Chinese speakers. They were also more satisfied with their meeting devices (smartphone or PC) in terms of ease of use and overall usability. However, all users generally believed they could understand the comments and thought the systems were easy to use and useful. That is, with the exception of Com3 (“I believe the translations from the other languages were accurate.”) with the Chinese speakers, all means were significantly higher than the neutral value of 4.0 on the 1-to-7 scale using an  $\alpha = 0.05$ .

**Table 2.** Language Comparison Statistics

|              | <b>Chinese</b> | (N= 46)       | <b>English</b> | (N=42)        |          |          |
|--------------|----------------|---------------|----------------|---------------|----------|----------|
|              | <b>Mean</b>    | <b>StdDev</b> | <b>Mean</b>    | <b>StdDev</b> | <b>F</b> | <b>p</b> |
| <b>Com1</b>  | 5.11           | 1.58          | 6.02           | 1.26          | 8.91     | <0.01    |
| <b>Com2</b>  | 4.89           | 1.32          | 6.10           | 1.10          | 21.37    | <0.01    |
| <b>Com3</b>  | 4.37           | 1.27          | 5.31           | 1.46          | 10.45    | <0.01    |
| <b>Ease1</b> | 5.20           | 1.36          | 6.55           | 0.92          | 29.34    | <0.01    |
| <b>Ease2</b> | 5.20           | 1.31          | 6.43           | 0.86          | 26.69    | <0.01    |
| <b>Ease3</b> | 5.52           | 1.59          | 6.69           | 0.60          | 16.74    | <0.01    |
| <b>Use1</b>  | 4.85           | 1.41          | 6.10           | 1.44          | 15.60    | <0.01    |
| <b>Use2</b>  | 5.20           | 1.33          | 6.31           | 1.32          | 20.08    | <0.01    |

A correlation analysis was conducted with comprehension, ease of use, and usability items combined, and results are shown in Table 3. In agreement with Tables 1 and 2, results showed group members comprehended better with mobile devices, and English speakers understood comments better and thought the systems were easier to use and more useful. Finally, comprehension, ease of use, and usability were all strongly and significantly correlated, perhaps indicating that if participants understood better, they were more likely to rate the software more favorably. This could explain why Chinese students (who understood less well), rated their meetings systems lower.

**Table 3.** Correlation Analysis (1=mobile, 2=pc, 1= Chinese, and 2=English)

|                      | <b>Comprehension</b> | <b>Ease of use</b> | <b>Usability</b> |
|----------------------|----------------------|--------------------|------------------|
| <b>Device</b>        | -.314<br>.003        | -.066<br>.539      | .004<br>.971     |
| <b>Language</b>      | .414<br><.001        | .531<br><.001      | .427<br><.001    |
| <b>Comprehension</b> |                      | .595<br><.001      | .593<br><.001    |
| <b>Ease of use</b>   |                      |                    | .573<br><.001    |

### Comment Analysis

Appendix II gives an example of comments that English-speaking group members viewed in one of the electronic meetings using desktop computers. As is typical in many such meetings involving students as subjects, the text was somewhat informal and contained a variety of spelling and grammatical errors. Several sentences omitted punctuation, and a few began with words that were not capitalized. However, these errors were not likely to cause misunderstandings among the readers. Other problems caused more concern. For example, comment #4: “Storm coming, driving safety” was written in English, and yet was so ungrammatical that its meaning is not clear. Most readers could probably interpret the statement to mean “A storm is coming so drive safely.” Thus, group members can sometimes have difficulty comprehending comments in their original format prior to translation due to poor sentence construction, poor grammar, words left out, incorrect spelling, malapropism, etc.

One comment (#41) contained a cultural reference (“Dale Earnhart” – a famous American race car driver) that some of the non-American, Chinese-speaking students might not have understood. Even some native English speaking American students who may not have been very familiar with the automotive terminology and technology might not have understood comment #30 (“AWD”) as this is an acronym for All Wheel Drive. Again, these possible comprehension problems have nothing to do with the machine translation provided by the system.

In Appendix II, comments originally typed in Chinese and translated to English are indicated in italics. Some, e.g. comment #22 (“Keep calm, call the police, listen to police instructions.”) provided very good translations, while others, e.g. comment #25 (“In the storm approaching, we should travel more cautious driving, storm weather visibility than ever before will decline, the road is more slippery, slow is to ensure security. “) were ungrammatical, but still probably understandable. Other comments, e.g. #26 (“Everything seek safety, rather stop 3 minutes indisputable second.”) and #35 (“I do not want to storm the car scrape away “) were quite difficult to understand. It is likely that Chinese group members viewed similar translations that were equally hard to understand.

Even when comments are typed perfectly, the translations between Chinese and English might be poor. With the addition of errors, however, translations are likely to be much worse. For example, as was stated, punctuation was omitted in some sentences. Comment #27 contained “dont, thats, and whats” that are not actual English words with no Chinese equivalents. Further, several English sentences were ungrammatical, e.g. comment #45 (“This big snow, this is what skills?”). It is likely that the related Chinese translation would be very difficult to understand.

## CONCLUSIONS

### Summary

This paper demonstrates that bilingual groups (English and Chinese speakers) can use mobile devices with automatic translation in electronic meetings as well as they can with desktop computers. Results of this study showed that while all group members were able to comprehend meeting comments in general and thought the systems were easy to use and useful, Chinese speakers comprehended comments in their own language (some translated, others not) less well than English speakers. This probably caused the Chinese speakers to rate the systems lower on dimension such as easy to use and useful.

Participants in mobile meetings found that using the smaller devices was equally good for an electronic meeting, despite the smartphone’s smaller screen size and greater difficulty entering text. Perhaps most students are so accustomed to mobile phones now that these factors are not viewed as disadvantages. However, smartphone users comprehended comments in their meetings less well, despite using the same translation software.

### Limitations

The first limitation of the study was the choice of languages (English and Chinese). Earlier studies used Western European languages that provided greater translation accuracy. As expected, there were some comprehension problems in this study as these two languages are so different. It is likely that dissimilar languages (e.g., Hindi and Icelandic) will provide similar poor results, while languages that share a high level of similarity (e.g., Russian and Ukrainian) will result in better translations.

A second limitation was the choice of topics which were not complex, non-controversial, and, not very important to the students. The choice of topic may impact comprehension and satisfaction with translation [1]. Group members with mobile devices might not think the technology is appropriate for a meeting with a serious topic, although at least one study [4] found that translation quality did not vary with topic difficulty, intrinsic interest, solution multiplicity, knowledge, self-efficacy, and boundary fitness. Only topic ambiguity was significantly correlated with participant understanding of the discussion.

A third limitation is that group members were asked to self-asses how well they comprehended the comments. However, this evaluation is inherently subjective and inconsistent [16]. Prior studies [5, 9] in which group members took reading comprehension tests show that they often underestimate how much was really understood in the discussion.

### Future Research

Studies in the future should use other languages and different devices. For example, electronic meetings with tablet and surface computers are more likely to resemble those using desktop computers than those using smartphones due

to differences in screen size, difficulty of typing, etc. In addition, research might focus on the integration of voice into multilingual, mobile meetings, as many devices now contain speech recognition and speech synthesis [2, 7].

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## APPENDIX I

Please answer the follow questions using the scales below:

The language I used in the meeting was \_\_\_\_\_ (Chinese/English)

Please answer the following on a 1-to-7 scale where:

|                      |   |   |         |   |   |                   |
|----------------------|---|---|---------|---|---|-------------------|
| 1                    | 2 | 3 | 4       | 5 | 6 | 7                 |
| Strongly<br>Disagree |   |   | Neutral |   |   | Strongly<br>Agree |

### Comprehension

1. **Com1** - I understood the comments translated to my selected language.
2. **Com2** - I obtained information from the comments translated to my selected language.
3. **Com3** - I believe the translations from the other languages were accurate.

### Ease-of-use

1. **Ease1** - The multilingual meeting system was easy to use.
2. **Ease2** - The functionality of the multilingual meeting system (how it works) was clear.
3. **Ease3** - I learned how to use the multilingual meeting system quickly.

### Usability

1. **Use1** - I would use this system in a multilingual meeting.
2. **Use2** - A multilingual meeting could benefit from this system.

## APPENDIX II

Example meeting comments about how to be safe in winter weather (those translated from Chinese are in *italics*):

1. I thoroughly believe that this winter storm is a very treacherous one when it comes to the driving/road conditions.
2. The best way to drive safely during a winter storm is to be entirely aware of your surroundings.
3. There are a good amount of safety precautions that should be taken while driving during a snow storm.
4. Storm coming, driving safety.
5. With a winter storm on the way, we must take precautions when we drive. The best way to stay safe is to drive very carefully and slowly.
6. Don't slam on your breaks.
7. Being sure that you do not exceed the speed limit during a winter storm is critical.
8. It is important that you drive at a slow speed.
9. DO NOT DRIVE, IT IS UNSAFE!
10. Is there really a storm coming?
11. While learning to drive my parents always taught me that you must give the weather conditions the 'respect it deserves.'
12. if your car starts to slide, that's not good.



13. Maybe you should just stay away from the steering wheel today dude.
14. If you don't understand counter steer, you're gonna have a bad time.
15. Always have your headlights and windshield wipers on.
16. If you don't have to drive, don't.
17. Driving is fun in the winter
18. I love to drive in the winter
19. Pull over if it is too difficult to see if front of you
20. I drive a jeep so I'm all about driving in the snow...
21. *We drove in a blizzard should be noted that the slow driving, open fog and low beam lights, turn on the emergency lights.*
22. *Keep calm, call the police, listen to police instructions.*
23. hopefully you have 4 wheel drive.
24. I do not like to drive in any condition other than the winter because I enjoy the thrill of it, thrill of it.
25. *In the storm approaching, we should travel more cautious driving, storm weather visibility than ever before will decline, the road is more slippery, slow is to ensure security.*
26. *Everything seek safety, rather stop 3 minutes indisputable second.*
27. You actually dont need to knock all the snow off your car, thats what the man whats you to do.
28. Pull over if you cannot make a steady stop(sliding)
29. Make sure you don't wreck
30. AWD!!!
31. If you are a person who is nervous about driving in the winter and snow, you probably just shouldn't.
32. Once upon a time I drove in the winter.
33. buy some damn snow tires
34. *Send your seat belts. The emergency lights turned on. Pay attention to maintaining the distance between the front of the car, do not rear-end. Pay attention to the surrounding environment*
35. *I do not want to storm the car scrape away*
36. Try to not jerk the wheel while the roads are bad.
37. *Note that the driving speed, call the police, listen to police tips.*
38. My parking spot may run out of time, should I go throw another quarter in the slot before my car gets ticketed or towed? Winter parking is unsafe.
39. *People looking for help around it, Hold on*
40. Chances are you may not survive driving in the winter storm
41. Don't drive like Dale Earnhart.
42. *Open beam lights, fog lights and emergency lights, parked at the roadside waiting for rescue.*
43. *It really is a bad season, or like summer*
44. Always keep your eyes open for deer.
45. This big snow, this is what skills? I was slowed down!
46. TIs Friday but that doesn't mean you're completely safe, look out for the dangerous winter conditions everybody
47. *I hope I will not matter, I love my parents*
48. *Weather the storm, a matter of personal driving needs attention outside, but also the security and deployment of a safeguard external conditions, such as snowy local people driving with snow tires is best, so you can effectively guarantee vehicle.*
49. *Normal driving, it is not only responsible for yourself, but also responsible for the others.*