An Empirical Study of Multilingual Electronic Meetings Using Smart Devices

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ABSTRACT

In a previous study comparing multilingual meetings on a simulated smart device with the more traditional, desktop interface, results showed group members were able to comprehend comments equally well and did not think there was a significant difference between the interfaces in terms of ease-of-use. In this paper, for the first time, groups used actual mobile, smart devices in a comparison with desktop computers to discuss a topic in multilingual meetings. Results show that, as in the prior study, there was no significant difference between the two types of meetings in terms of comprehension, ease of use, and usability.

Key words: Electronic meetings, mobile meetings, machine translation, smart devices

INTRODUCTION

As more of the world's population uses mobile devices (e.g., phones, PDAs, tablets, etc.) to communicate, there is a growing need for these technologies to translate text and speech into different languages. In particular, these machines could be used to support multilingual meetings. Several studies of mobile meetings using a single language have already been conducted (e.g.,

Antunes & Costa, 2002; Bravo & Garcia, 2006; Davis, et al., 1999; Myers, et al., 1998; Zurita, et al., 2008; Zurita, et al., 2006; Zurita & Baloian, 2005), yet, to our knowledge, only one study has focused on mobile devices using multiple languages.

In the study (Balan, et al., 2011), groups used Web-based multilingual meeting software running on either a computer desktop's full screen or on a desktop pc smart device emulator with a smaller comment viewing area. Students copied and pasted German and Spanish comments using the computer keyboard, simulating a multilingual group, and evaluated the final English translations. The group members were able to comprehend the comment translations to English equally well, and they did not think there was a significant difference in ease of use or usability. However, in both treatments, the students used the desktop computer's keyboard for text entry. The only difference was the size of the text area for viewing group comments.

In this paper, we attempt to address this deficiency by studying groups using desktop computers and actual smart devices (not simulated). Thus, there is a difference in the text viewing area and the method of text entry. First, we discuss multilingual meeting technology and then provide theory with hypotheses. Next we present the experiment and results followed by conclusions with limitations and directions for future research.

MULTILINGUAL MEETING TECHNOLOGY

Multilingual meeting technology was developed in the early 1990s (Aiken, et al., 1994), but many advances have been made in the last few years (Aiken, 2008). While early systems provided translations among only a few languages with poor accuracy, now, groups can exchange comments in any of 64 different languages with good translations provided in three or four seconds (Aiken, et al., 2010).

Polyglot, for example, is a Web-based system that allows participants to type a comment on one page and then view all of the group's comments translated to the user's chosen language (Aiken & Ghosh, 2009; Aiken & Vanjani, 2009). Further, studies using the software have shown that for many languages, translation accuracies meet group members' expectations (Aiken & Balan, 2011; Aiken, et al., 2011). Figure 1 shows the desktop pc version of the software in use during a multilingual discussion of how to improve a university.

Figure 2 shows a group member entering a Spanish comment about how to improve a university using the smart device version of the software. Other than the reduced screen size and the greater difficulty entering comments because of the small keypad interface, the software functions on a smart device exactly like its desktop counterpart.

Figure 1: User reading German meeting comments about how to improve a university

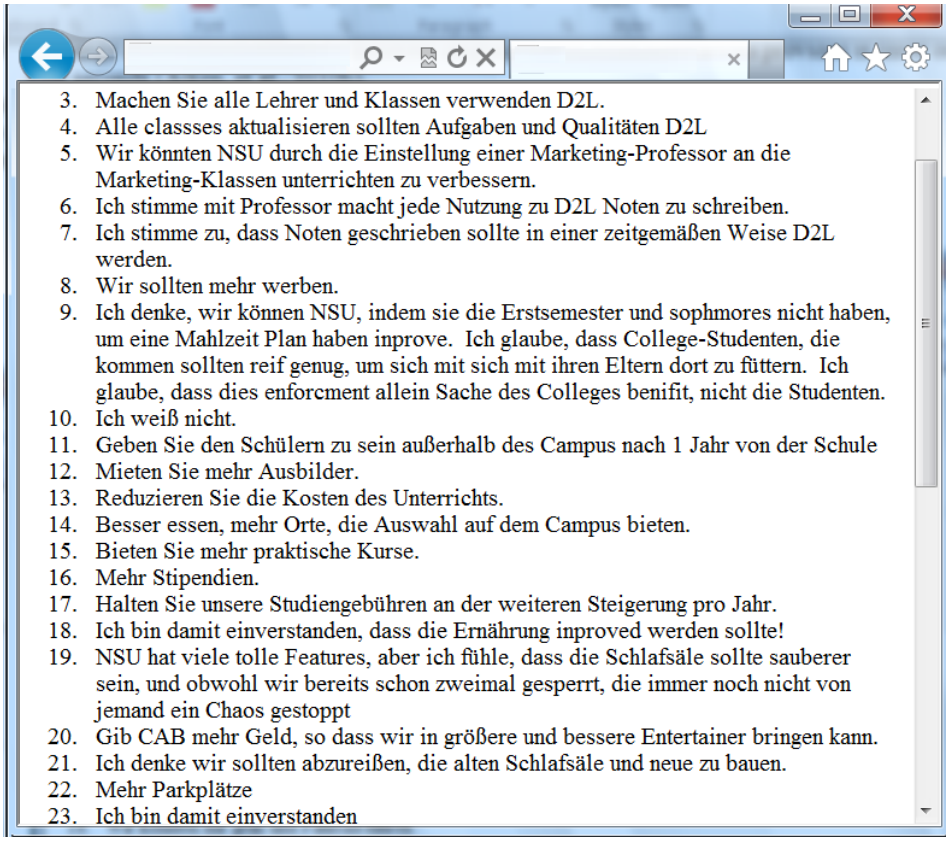
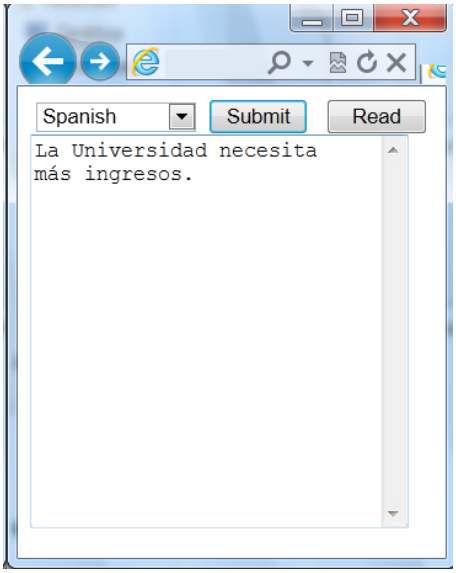


Figure 2: User entering a Spanish comment about how to improve a university



THEORY AND HYPOTHESES DEVELOPMENT

The prior study comparing *Polyglot* use with a smart device emulator and desktop pc was limited in that, in both treatments, users entered comments with a full-sized computer keyboard. Although many smart device users can type quickly with their thumbs, it is not clear how the two methods of text entry compare (Sarker & Wells, 2003).

Ease of use

Smart device ease of use can be a major determinant of successful utilization (Arninga & Ziefle, 2007; Cyr, et al., 2006; Pagani, 2004). On the other hand, some studies have found that ease of use did not significantly affect users' behavioral intentions (e.g., Wu & Wang, 2005).

On desktop PC's, viewable screen sizes are much larger and the keyboards allow all fingers to be used for typing. Thus, there could be greater difficulty entering and reading text with smaller devices (Buchanan, et al., 2001). For example, in one study (Jones, et al., 1999), users viewing screens showing only 15 lines of text were 50% less effective in completing tasks using a Web browser than those who were able to see 30 lines. However, another study (Dillon, et al., 1990) showed that users' ability to read and understand information was not adversely affected even when only a few lines of text were shown. A third study showed that the optimal height was just 4 lines of text (Duchnicky & Kolers, 1983). There were no significant improvements in comprehension when the display height was increased to 20 lines and reading times were only 9% slower on the small screen.

However, there could be a significant difference in ease of use based upon the difficulty of typing text (Motiwalla, 2007), and it is commonly believed that keypad-based text entry (as with mobile phones) is slower than that for a full keyboard (Trewin, 2006; Chen, et al., 2010).

Given these results, we propose the following hypothesis:

> H1: There will be no significant difference between the smart device and desktop groups in terms of ease of use.

Comprehension

Translation comprehension can affect a user's perceptions of the software's usefulness, but screen size might not be a major factor. For example, in one study (Dillon et al., 1990), subjects were presented with 3,500 words in either a 20- or 60-line display window and were asked to summarize the main points. The study found that the comprehension rates on the smaller screen were as good as those on the larger. Although 20 lines of text is much larger than the display window of a typical smart device, most comments in an electronic meeting are only a few lines long. Because the only difference between the smart device and desktop pc implementation of the multilingual meeting software is the screen size and text input methods, we suggest:

> H2: There will be no significant difference between the smart device and desktop groups in terms of comment comprehension.

Some studies (e.g., Buranatrived and Vickers, 2004) indicate that the complexity and nature of a specific application have more influence on usability than the platform. If there is no difference in ease of use or comprehension, there should also be no difference in perceived usability.

> H3: There will be no significant difference between the smart device and desktop groups in terms of system usability.

EXPERIMENTAL DESCRIPTION AND RESULTS

Description

A study was conducted with 73 undergraduate Business students at a university in the northern region of the United States**.** Four groups of about 10 students each used personal smart devices (Table 1), and four groups of about 8 students each used desktop pcs provided in an electronic classroom. All group sizes met the minimum of eight where automated meetings success becomes evident (Aiken & Wong, 2003). The selected topic for discussion was "How can the university be improved" and 10 minutes were allowed, as previous studies have determined that this is an optimum amount of time (Wong & Aiken, 2006). All groups met in face-to-face environments.

Table 1: Smart devices used in the experiment

Model	Count
Blackberry	4
HTC	4
iPhone	16
iPod	5
Samsung Galaxy	4
LG Droid	4
Motorola Droid	6
Total	43

We chose English, German, and Spanish for the languages of discussion. Because the students were not familiar with German and Spanish, the meeting facilitator copied and pasted prepared comments (see Appendix 1) at random intervals into the discussion to simulate a true, multilingual meeting.

After the meeting, the students completed the questionnaire shown in Appendix 2.

Results

The Cronbach's alpha test (Table 2) was performed to verify the reliability of the questionnaire constructs, and the alpha coefficients for comprehension (0.829), ease of use (0.850), and

usablility (0.847) each met the standard minimum criterion of 0.7 set for most social research (Cronbach, 1970; Nunnally, 1978).

Table 2: Cronbach's Alpha test results

Variables:	Cronbach's Alpha		
	All (Mobile & Desktop) (N = 73)	Mobile GSS Group (N = 43)	Desktop GSS Group (N = 30)
Comprehension	.829	.711	.941
Ease-of-use	.850	.882	.813
Usability	.847	.883	.863

Table 3 shows summary results for the experiment. All of the means were significantly different from the neutral value of 4, indicating that students in both treatments believed they were able to comprehend the discussions and thought that each system was easy to use and useful. In addition, there was no significant difference in attitudes between the two types of groups in any of the measures (Table 4). Therefore, we cannot reject H1, H2, or H3.

Table 3: Experimental summary results

Variables		All (N = 73)		Mobile GSS (N = 43)		Desktop GSS (N = 30)	
		Mean	Std. Dev.	Mean	Std. Dev.	Mean	Std. Dev.
Comprehension	Understanding of translation (Q1)	6.70*	0.81	6.70*	.67	6.70*	0.99
	Obtaining of information (Q2)	6.41*	0.98	6.37*	.98	6.47*	1.01
	Belief in accuracy (Q3)	6.30*	1.11	6.28*	1.18	6.33*	1.03
Ease of Use	Ease of use (Q4)	6.29*	1.32	6.33*	1.15	6.23*	1.57
	Functionality (Q5)	6.21*	1.17	6.19*	1.24	6.23*	1.07
	Quick learning of system (Q6)	6.51*	1.04	6.51*	0.96	6.50*	1.17
Usability	Willingness of using system (Q7)	6.11*	1.22	6.14*	1.17	6.07*	1.31
	System benefit (Q8)	6.33*	0.91	6.35*	0.95	6.30*	0.88

(* Signifies a significant difference from the neutral value of 4 with α=0.05)

Finally, a correlation analysis showed that there were significant associations between comprehension and ease of use ($R = 0.677$, $p < 0.001$), comprehension and usability ($R = 0.467$, $p < 0.001$), and ease of use and usability ($R = 0.624$, $p < 0.001$).

Table 4: Analysis of variance results

Variables		F	Pr > F
Comprehension	Understanding of translation (Q1)	.000	.990
	Obtaining of information (Q2)	.161	.689
	Belief in accuracy (Q3)	.041	.839
Ease of Use	Ease of use (Q4)	.084	.773
	Functionality (Q5)	.029	.866
	Quick learning of system (Q6)	.002	.963
Usability	Willingness of using system (Q7)	.062	.804
	System benefit (Q8)	.050	.824

CONCLUSION

Summary

To our knowledge, this study represents the first time that mobile, smart devices have been used in a multilingual meeting. Results of a comparison between these mobile devices and desktop pcs showed that group members were able to comprehend the English comments (some of which were translated) equally well, and they did not think there was a significant difference in ease of use or usability.

Limitations

The primary limitation to this study is that both types of groups met in face-to-face environments to keep the comparisons fair. But, mobile phones are meant to be used when group members are in different locations and perhaps doing other tasks such as walking. Thus, we cannot conclude that true mobile, electronic meetings are as effective as traditional, desktop pc meetings.
Second, only three languages were used in the meetings (English, German, and Spanish) and only English was used for evaluation of comprehension. Other language combinations (e.g., Urdu, Swahili, and Croatian) could yield better or worse comprehension results.

Third, there were many different types of smart devices used in the study, possibly confounding the results. Although many mobile devices are similar, slight differences in screen sizes and text entry might have affected the results.

Finally, only comprehension, ease of use, and usability were investigated in the study. Many more factors should be explored for a greater understanding of how multilingual meetings perform.

Future research

Obviously, future research should focus on groups using smart devices in geographically dispersed environments to further investigate the feasibility of mobile meetings. In addition, such

meetings using a variety of different languages should be studied to determine the limits of the technology.

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Appendix 1 – Added Comments

Added German comments:	**English translations by *Polyglot*:**
Wir sollten mehr werben.	We should advertise more.
Ich weiß nicht.	I do not know.
Mieten Sie mehr Ausbilder.	Hire more instructors.
Reduzieren Sie die Kosten des Unterrichts.	Reduce the cost of tuition.
Bieten Sie mehr praktische Kurse.	Offer more practical courses.
Mehr moderne Technologie benötigt wird.	More advanced technology is needed.
Ich habe nicht eine Meinung.	I do not have an opinion.
Die Universität braucht mehr Studenten.	The university needs more students.
Die Kursgebühren müssen gesenkt werden.	Course fees must be reduced.
Added Spanish comments:	**English translations by *Polyglot*:**
El costo de la matrícula es demasiado alto.	The tuition is too high.
La Universidad debe ofrecer más cursos de negocios.	The University should offer more business courses.
NSU está haciendo muy bien ya.	NSU is doing very well now.
Tenemos que atraer a más de fuera del estado a los estudiantes.	We need to attract more from out of state students.
La Universidad necesita más ingresos.	The university needs more revenue.
NSU debe diferenciarse de otras universidades.	NSU must be differentiated from other universities.
¿Cuántos estudiantes deben estar matriculados en la NSU?	How many students must be enrolled at NSU?
Todas las universidades necesitan más ingresos.	All universities need more revenue.
Otras fuentes de ingreso son necesarios.	Other sources of income are needed.

Appendix 2 – Experimental Questionnaire

Please answer the follow questions using the scales below:

Comprehension

1. I understood the comments translated to English.

1	2	3	4	5	6	7
Strongly Disagree			Neutral			Strongly Agree

2. I obtained information from the comments translated to English.

1	2	3	4	5	6	7
Strongly Disagree			Neutral			Strongly Agree

3. I believe the translations were accurate.

1	2	3	4	5	6	7
Strongly Disagree			Neutral			Strongly Agree

Ease-of-use

4. The multilingual meeting system was easy to use.

1	2	3	4	5	6	7
Strongly Disagree			Neutral			Strongly Agree

5. The functionality of the multilingual meeting system (how it works) was clear.

1	2	3	4	5	6	7
Strongly Disagree			Neutral			Strongly Agree

6. I learned how to use the multilingual meeting system quickly.

1	2	3	4	5	6	7
Strongly Disagree			Neutral			Strongly Agree

Usability

7. I would use this system in a multilingual meeting.

1	2	3	4	5	6	7
Strongly Disagree			Neutral			Strongly Agree

8. A multilingual meeting could benefit from this system.

1	2	3	4	5	6	7
Strongly Disagree			Neutral			Strongly Agree