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Mmilam Aiken
University of Mississippi

Jose Ablanedo
University of Mississippi

Mahesh B. Vanjani
Georgia College and State University

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Milam Aiken

School of Business, University of Mississippi, University, MS 38677
(662) 915-5777, aiken@bus.olemiss.edu

José Ablanedo

School of Business, University of Mississippi, University, MS 38677
(662) 915-5777, jablanedo@bus.olemiss.edu

Mahesh B. Vanjani

ISC Department – CBX 12, School of Business, Georgia College and State University, Milledgeville, GA 31061
(478) 445-2566, mahesh.vanjani@gcsu.edu

ABSTRACT

Multilingual groups often find communication difficult. Even with human interpreters, these groups still suffer from the inherent limitations of oral meetings: only one person at a time can talk, comments are not anonymous, and ideas must be recorded manually. Group Support Systems (GSS) have been used to increase the productivity of traditional, oral meetings by allowing participants to exchange automatically recorded, typed comments simultaneously and anonymously. Integration of language translation software with these systems could enable multilingual groups to achieve the same benefits obtained by monolingual groups. This paper investigates the feasibility of using automatic language translation in GSS meetings by converting sample comments from two archived transcripts typed in English to Spanish. Three human experts then evaluated these transcriptions for accuracy. Results showed that the translations contained numerous errors, but most of the comments could still be understood.

INTRODUCTION

Meetings and projects involving group participation are a common part of everyday life in the business world. Several organizational tasks require that groups communicate and achieve

consensus. Group dynamics are complicated and this gets compounded when the groups involve multilingual participants. The multilingual problem is further exacerbated when the participants are not fluent or comfortable with each other's language. This places an additional burden on a group member if they are to make a valuable contribution to the meeting process.

The conventional solution to the problem of language barriers in multilingual groups has been to use human interpreters for translation. However, traditional, multilingual meetings still have the same limitations of oral meetings: (1) Only one participant is allowed to speak at a time, (2) comments must be transcribed manually, and (3) many group members do not contribute because of shyness or because other speakers monopolize the available "air" time.

Many studies have shown that Group Support Systems (GSS) can improve the efficiency and effectiveness of common, oral meetings by: (1) allowing members to type, exchange, and view all comments simultaneously on individual computer screens, (2) automatically recording the typed comments onto a disk file for later dissemination or printout, and (3) providing anonymity --- no participant can determine who wrote a particular comment (Aiken, et al., 1995; Davison & Briggs, 2000; Fjermestad & Hiltz, 2000-2001; Huang & Wei, 2000). A large body of related research has indicated that the use of an automated meeting facility can enhance group productivity and interaction. The use of a GSS has the potential of decreasing meeting time and fostering collaboration, communication, and negotiation among group members. By integrating language translation software with a GSS, multilingual meetings might be able to experience the same benefits, even if the translations are not perfect (Hacken, 2001).

Gray and Olfman (1989) were perhaps the first to suggest integrating language translation with electronic meetings, but they described only the use of humans as translation agents. Several human translators would be required for large groups to keep pace with the rate of information generation, and the complexity would increase further if multiple languages were used. Automatic language translation through software is cheaper and faster. Many instances of a translation program can run simultaneously during a meeting, and each participant could have a devoted translator handling only his or her comments. However, translation software continues to be less accurate than humans, although it is still not clear how accurate translations must be for a successful meeting (Hutchins, 2001). Even human experts are not perfect, and with comments recorded on disk automatically, any confusion can be rectified by referring to the source.

PRIOR RESEARCH

Although some research has been conducted in other countries with other languages, most studies of GSS have been conducted with English-speaking groups (Briggs, et al., 1998; Davis & Vogel, 2000; Lewe & Krcmar, 1991; Mejias et al., 1997; Pervan, 1998; Wei et al., 1990). In addition, we have found only five studies that have investigated language translation within a GSS meeting.

Study 1: Spanish to English Translation (Aiken, et al., 1992).

As far as we can determine, the first GSS with fully automated language translation was developed in 1992, and a study was conducted with four groups of four, five, seven, and eight undergraduate students. The meeting facilitator added comments in Spanish while the participants wrote in English. The experiment was conducted in two phases. In the first phase, students used the GSS for 10 minutes with no translation of comments. In the second phase, the software translated Spanish comments to English in a 10-minute meeting. A translation of 29 words took about six seconds.

Results from the first phase showed that only one of the students was able to understand one of three Spanish comments included in the discussion. All of the other students reported that they did not understand the Spanish comments. The mean and mode satisfaction rating for using the GSS in multilingual groups was 2 (somewhat dissatisfied). Results from the second phase showed that all students reported being able to understand all of the comments (including those translated). Only two of the 24 were able to correctly identify at least one of the comments translated from Spanish. The mean student rating of the GSS for use in a multilingual meeting was 4 (somewhat satisfied) with a mode of 5 (very satisfied). The mean student rating for the translation of Spanish to English was 4 (somewhat satisfied) with a mode of 5 (very satisfied).

Several grammatical mistakes were made in English (e.g., not capitalizing words, leaving out words, and misused punctuation). Ungrammatical English comments did not prevent the participants from understanding the comments, however, and relatively few words were misspelled.

Study 2: Spanish and English Translation (Aiken, et al., 1994a)

A group of nine students (three spoke Spanish and six spoke English) used a GSS for 10 minutes and generated 59 comments (24 Spanish and 25 English) in 20 minutes. Spanish-speaking students saw comments in Spanish (including those translated from English) on their screens and the designated English-speaking students saw only comments in English. Spanish-speaking students reported on average that 6.6 comments were grammatically incorrect (26% of the comments translated from English) and one comment was misunderstood (4% of the comments translated from English). English-speaking students reported on average that 10.7 comments were grammatically incorrect (55% of the comments translated from Spanish) and 3.5 comments were misunderstood (15% of the comments translated from Spanish). However, many of the errors in translation occurred because the originators misspelled words in the source comments.

In a separate study of the translation programs, objective, independent reviewers were asked to evaluate the grammatical accuracy and understandability of 100 comments translated from Spanish to English and 100 comments translated from English to Spanish. The English reviewers rated the Spanish-to-English grammatical accuracy at 46% and the understandability at 95%. The Spanish reviewers rated the English-to-Spanish grammatical accuracy at 75% and the understandability at 98%. The increase in accuracy was due in part to all of the source comments being spelled correctly.

Study 3: Spanish and English Translation (Aiken et al., 1994b)

A group of three Spanish-speaking and five English-speaking students used a GSS and wrote 36 comments (23 written in English and 13 written in Spanish) in 20 minutes. Seven of the 13 Spanish comments (54%) had some kind of error, while only seven of the 23 English comments (30%) had some kind of error. Again, many errors were caused by misspellings (e.g. "como" instead of "cómo"), grammatical errors (e.g. "i," "spanish," missing punctuation, etc.), and the use of colloquial terms or slang (e.g. "yankee") in the source comments.

Study 4: Spanish and English Translation (Aiken, et al., 1998)

Two Spanish and two English speakers used a GSS to discuss ways of improving trade with Mexico for 20 minutes. All comments were translated, but Spanish speakers saw comments only in Spanish and English speakers saw them in English only.

The translations were very fast (0.1 seconds per word) and were much faster than a human could translate and then type. An analysis of the translations showed that 24% of the Spanish comments had grammatical errors, and 29% of the English comments had errors. The Spanish speakers understood 81% of the Spanish comments, and the English speakers understood 91% of their comments.

Study 5: German, French, and English Translation (Aiken et al., 2002)

A Web-based GSS combined with software that could translate 20 words in any of the 1056 language-pairs in 0.5 seconds was used in another study. The GSS was designed to show all comments and their translations to all group members.

In the first phase of the study, four participants in four different locations in three states and three time zones used the system asynchronously to discuss Osama Bin Laden. One used German, one used French, and two used English. Many translation errors occurred because of contractions found in the French source comments. In addition, the translated grammatical accuracy suffered because of problems with word gender in German and French. In the second case, five participants (two German- and three English-speaking) in four locations in three states and three time zones used the Web-based GSS synchronously to discuss the effect of terrorism on travel for five minutes.

All group members reported 100% understanding accuracy of their own language and could not easily tell which of the comments were translated and which were not. Although the grammar was not accurate, it did not affect the comprehension. Most of the English speakers reported 0% accuracy for understanding the comments written in German (not the translated English equivalent), and most did not even bother trying to read those comments. However, one designated English speaker reported that he did attempt to read the German comments, and was able to understand one of them. In addition, he stated that he recognized several words in the German comments and estimated that he understood 10-15% of the German text overall. Both of the German participants knew English and thus could understand comments in both languages.

A NEW STUDY

The prior studies suffer from several limitations including sample size, choice of treatments, etc. In an attempt to further investigate GSS with language translation, we selected random comments from two sets of archived GSS meeting transcripts written in English. In the first meeting, 10 faculty members discussed methods of improving the Business school for 30 minutes. In the second meeting, 15 participants including faculty, staff, and students discussed the status of computer services on campus. Each transcript was translated into Spanish with software used in study #4, and both are shown in the Appendices.

Three expert Spanish speakers evaluated the translated comments. Each was also given the source comments for comparison and was asked to judge three things:
1. Is the main idea of the comment the same? (YES/NO). Is the Spanish comment's overall idea or meaning understood?
2. How many major errors does the Spanish comment have? A major error was defined as a key word of the comment is traduced incorrectly producing a meaning completely different from the original.
3. How many minor errors does the Spanish comment have? A minor error was defined as a key word of the comment is traduced incorrectly, but the meaning of the comment remains the same.

The evaluators evaluated the comments separately. That is, each evaluation was done individually and independent of the other evaluators' comments or evaluations. Evaluators #1 and #2 were more informal and understood the context, but the third did not understand the importance of the context, and her evaluation was from the point of view of a Spanish Instructor. Consequently, her evaluation was more rigorous; she looked for grammar structures more than meanings. The intent was to have the comments analyzed for overall comprehension. In general, in a real world business meeting involving multilingual participants, comment meaning would be more critical than grammatical accuracy.

Evaluator#	1			2			3		
Comment#	A	B	C	A	B	C	A	B	C
1	No	1		No	1		No	2	
2	Yes			Yes			Yes		
3	Yes			Yes			Yes		
4	Yes			Yes			Yes		
5	No	1		No	3		No	1	
6	Yes			Yes			No	1	
7	Yes			Yes			Yes		
8	Yes		1	Yes		1	No	2	
9	Yes		2	Yes		1	No	2	
10	Yes		1	Yes		2	No	3	
11	Yes		1	No	2	1	No	2	

Comment#	A	B	C	A	B	C	A	B	C
12	Yes			Yes			Yes		
13	No	1		Yes			No	3	
14	Yes		1	Yes			No	2	
15	Yes		1	Yes			No	5	
16	Yes		1	Yes		1	No	2	
17	Yes			Yes			Yes		
18	Yes		1	Yes			Yes		
19	Yes		1	Yes		2	Yes		
20	Yes			Yes			Yes		
% Yes	85%			85%			45%		
% No	15%			15%			55%		

A. Is the main idea of the comment the same? (YES/NO).

B. How many major errors does the Spanish comment have?

C. How many minor errors does the Spanish comment have?

Table 1: Topic 1 Evaluations

Evaluator#	% Major Errors	% Minor Errors	*% Understood Errors*
1	15	45	*15*
2	15	25	*15*
3	*55*		*55*

Table 2: Topic 1 Error Summary

Evaluator#	1			2			3		
Comment#	A	B	C	A	B	C	A	B	C
1	Yes		1	Yes		1	No	1	
2	No	1	1	No	2		No	2	
3	Yes			Yes		2	No	3	
4	Yes			Yes		1	Yes		
5	Yes		3	Yes		6	No	3	
6	Yes			Yes			Yes		
7	Yes		1	Yes		1	Yes		
8	Yes		2	Yes		4	Yes		
9	Yes		2	Yes		1	No	2	
% Yes	89%			89%			44%		
% No	11%			11%			56%		

A. Is the main idea of the comment the same? (YES/NO).

B. How many major errors does the Spanish comment have?

C. How many minor errors does the Spanish comment have?

Table 3: Topic 2 Evaluations

Evaluator#	% Major Errors	% Minor Errors	*% Understood Errors*
1	11	56	*11*
2	11	78	*11*
3	*56*		*56*

Table 4: Topic 2 Error Summary

An analysis of errors for the first transcript is shown in Table 1, and Table 2 shows the percentage of comments that had errors, listed by evaluator. Tables 3 and 4 show the errors for the second transcript. With the exception of the third evaluator, "understood" errors were about 15% and 11% for the first and second transcripts, comparable to results in earlier studies.

DISCUSSION

Several studies of mixed, English-, Spanish-, French-, and German-speaking groups have shown grammatical accuracy ranging from 44% to 75% and understanding accuracy ranging from 44% to 100%. However, understanding accuracies were nearly always higher than grammatical accuracies, and in most instances, higher than 90%. That is, even though the grammar and word choices were wrong, the meaning of the comment was usually understood.

Many errors in translation continue to be caused by spelling or grammatical mistakes in the source comment rather than inadequacies of the software. Idioms, slang, contractions, abbreviations, acronyms, and technical jargon also make translation difficult. Therefore, group members in a multilingual meeting should attempt to proofread their comments before submission to the group and the translation software.

In our study, 50% of comments with slight errors were still understood. The most important problem is when key words are incorrectly translated. However, group members can employ several semantic methods to improve the understanding of a comment, including:
1. **Context of the meeting topic.** If the meeting is about methods to improve the parking problem on the university campus, a comment that appears to be about something else causes the reader to refocus and consider alternative meanings. For example, "at Ole Miss [a colloquial term for the University]" was translated by the software as "en la Srta. Ole" or "in Miss Ole," a completely different meaning. However, enclosing the slang term in quotes would have resulted in the correct translation "en el 'Ole Miss'."
2. **Context of the entire comment.** The Spanish phrase "¿como esta?" means "Do I eat it?", but "¿cómo esta?" means "What is she/it like?" and "¿cómo está?" means "How is

she/it? If the comment is about eating or food, the first comment would make sense; otherwise, the latter translation would be more meaningful.

3. **Context of the entire sentence and surrounding words.** The German phrase "bin Laden" means "are shop," but if the sentence is about Osama bin Laden, the reader would need to ignore these incorrect words and concentrate instead on the remainder of the sentence.

It is yet to be determined what an acceptable error rate in translation is, however. For example, if one or two comments in a lengthy discussion are completely undecipherable, redundant comments might make the omission tolerable. Further, if a comment is misunderstood, other group members can submit a comment asking for clarification. For informal GSS meetings, the presence of a larger number of errors might not deter the participants from having a satisfactory meeting. In more important meetings, human translators can provide backup, reviewing and editing each translation if necessary before it is sent out to the other participants.

CONCLUSION

A Group Support System combined with automated and human translators can increase the efficiency and effectiveness of multilingual meetings. Although machine translation is not perfect, it is very fast, and human experts can quickly inspect the translations and edit a few words relatively quickly before submission to the remainder of the group.

Access to the use of an automated language translator has significant practical implications for multilingual meeting participants. They are no longer limited by attempting to communicate in an unfamiliar or non-native language. They can instead concentrate and focus their energies on the task at hand. This has a strong potential for having a positive impact on the outcome of such meetings. Since the translations are automated a significant amount of time might be saved since the meetings will likely be shorter.

Five earlier studies of automatic translation in GSS meetings show a wide range of absolute and understanding accuracies. These studies suffered from small sample sizes, inconsistent treatments, and other deficiencies. In our study, we have attempted to demonstrate further the efficacy of automatic translation by converting two historical GSS transcripts written in English into Spanish. An analysis of the translations were consistent with earlier results, and it appears, with the current state of the technology, mistakes in source comments, and other sources of errors, an "understanding" error rate of about 10% might be about the best that can be expected in multilingual GSS meetings. Additional research will investigate larger groups and sample sizes as well as additional languages for translation.

APPENDIX 1

Comments from Meeting #1

Misspelled source words in **bold** font.

Topic: How can we improve the Business School?

What can we do to make the strongest possible Business school?	¿Qué podemos hacer para hacer la escuela de negocio posible más fuerte?
1. I think we need to get more alumni money.	1. Pienso que necesitamos conseguir a más alumnos el dinero.
2. Have each BAC member hire a faculty member as a consultant.	2. Haga que cada miembro de BAC emplee a miembro de la facultad como consultor.
3. Improve the physical facilities for computer work for students, particularly graduate students.	3. Mejore las instalaciones físicas para el trabajo de la computadora para los estudiantes, particularmente estudiantes graduados.
4. Try to keep comments relevant to the discussion.	4. Intente mantener comentarios relevantes a la discusión.
5. strongest equals quality????? I so----	5. el?? más fuerte de la calidad de los iguales I tan
6. BAC members could hire faculty to consult on problems.	6. Los miembros de BAC podrían emplear a facultad para consultar sobre problemas.
7. smaller classes	7. clases más pequeñas
8. BAC workshops with students could sensitize them to the diverse workplace and expectations.	8. Los talleres de BAC con los estudiantes podían sensibilizarlos al lugar de trabajo y a las expectativas diversos.
9. Having BAC members take an intern each semester and/or summer would help provide students with a more realistic view of the workplace.	9. Teniendo miembros de BAC tome a interno cada semestre y/o el verano ayudaría a proveer de estudiantes una vista más realista del lugar de trabajo.
10. I really like the idea of getting the BAC involved. Getting feedback from faculty, staff, alumni, students, etc is important.	10. Realmente tengo gusto de la idea de conseguir el BAC implicado. Conseguir la regeneración de facultad, del personal, de alumnos, de estudiantes, del etc es importante.
11. improve placement, by which I mean get more of the Fortune 500 firms to **inverview** here	11. mejore la colocación, por la cual significo consigo más de las firmas de la fortuna 500 al inverview aquí
12. Build stronger relationships with the business community.	12. Construya relaciones más fuertes con la comunidad de negocio.
13. BAC can impact the image of the school through word of mouth -passive.	13. BAC puede afectar la imagen de la escuela con la palabra de la boca - voz pasiva.
14. Get a well-structured internship program in place.	14. Consiga un programa bien-estructurado del puesto de interno en lugar.
15. more **resourses** primarily financial from whatever source	15. más resourses sobre todo financieros de cualquier fuente
16. Have each faculty member commit to participate in faculty seminars and all proposal defenses.	16. Haga que cada miembro de la facultad confíe para participar en seminarios de la facultad y todas las defensas de la oferta.

17. Faculty internships would be useful as well.	17. Los puestos de interno de la facultad serían útiles también.
18. the development of corporate affiliates for faculty internships.	18. el desarrollo de los afiliados corporativos para los puestos de interno de la facultad.
19. In intensive weekend retreats, BAC and faculty/admin could brainstorm how to revise educational processes.	19. En retratamientos intensivos del fin de semana, BAC y faculty/admin podían inspirarse cómo revisar procesos educativos.
20. Create a crystal clear focus	20. Cree un foco claro cristalino

APPENDIX 2

Comments from Meeting #2

Misspelled source words in **bold** font.

Topic: A discussion of computer services at the University

1. Spreadsheets, email, web pages	1. Hojas de balance, email, Web pages
2. Many of the students need to attend seminars on Course Info for the courses they TA. Anything on statistical software, literature searching, etc. would be helpful.	2. Muchas de la necesidad de los estudiantes de atender a seminarios sobre el curso Info para los cursos ellos TA. Cualquier cosa en software estadístico, la literatura que busca, el etc. sería provechoso.
3. None that I can think of. Students can be required to achieve certain competencies. Just knowing the help provided by IT in achieving these skills is sufficient.	3. Ninguno en las cuales puedo pensar. Los estudiantes pueden ser requeridos alcanzar ciertas capacidades. Apenas saber la ayuda proporcionada por ÉL en la realización de estas habilidades es suficiente.
4. I find that many of the students are more sophisticated than faculty, so I am not sure how to respond to this.	4. Encuentro que muchos de los estudiantes son más sofisticados que facultad, así que no soy seguro cómo responder a esto.
5. I would like to see a number of the IT seminars offered over the campus TV network to our dorm residents. This is a great need and we have the facility to do this. If our IT staff does not have the time to produce such shows, we should consider buying commercial training videotapes and running them over the cable network. In terms of research students, I wish we had a really in-depth series on the use of statistical and visualization software packages. Also, they need to attend CourseInfo seminars.	5. Quisiera ver un número de ÉL los seminarios ofrecidos sobre la red del campus TV a nuestros residentes del dormitorio. Esto es una gran necesidad y tenemos la facilidad para hacer esto. Si nuestro personal no tiene la época de producir tales demostraciones, debemos considerar el comprar de videocintas comerciales y del funcionamiento del entrenamiento ellos sobre la red del cable. En términos de los estudiantes de la investigación, deseo que teníamos una serie realmente profundizada en el uso de las paquetes de software estadístico y de visualización. También, necesitan atender a los seminarios de CourseInfo.
6. I agree with number 2.	6. Convengo con el número 2.

7. Although it's becoming less of a problem, many freshmen (and some sophmores) need a crash course in the use (and proper use) of email.	7. Aunque se está convirtiendo en menos de un problema, muchos estudiantes de primer año (y algunos sophmores) necesitan un curso acelerado en el uso (y el uso apropiado) del email.
8. We do a good deal of this training inside the School. However, refresher courses in interpersonal collaboration tools, Excel, Word, and PowerPoint would be useful to the students as well. At the upper levels, we need seminars on using the major statistical programs such as SAS and SPSS. These seminars should start at the basic level and progress to more advanced levels of usage.	8. Hacemos mucho de este entrenamiento dentro de la escuela. Sin embargo, los cursillos de perfeccionamiento en herramientas interpersonales de la colaboración, sobresalen, redactan, y PowerPoint sería útil a los estudiantes también. En los niveles superiores, necesitamos seminarios sobre usar los programas estadísticos principales tales como SAS y SPSS. Estos seminarios deben comenzar en el nivel básico y progresar a niveles más avanzados del uso.
9. Our students (undergraduate and graduate) can benefit from seminars on e-mail, presentation software, internet applications, and web page development. The school hosts an orientation for our incoming undergraduates with the help of the IT folks and the help desk, this has been invaluable.	9. Nuestros estudiantes (estudiante y graduado) pueden beneficiar de seminarios sobre E-mail, software de la presentación, usos del Internet, y el desarrollo del Web page. La escuela recibe una orientación para nuestros estudiantes entrantes con la ayuda de ÉL gente y el puesto de informaciones, éste ha sido inestimable.

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