Come Together: Facilitating Collocated Multilingual Group Discussion with a Language Support Tool

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Abstract

For global organizations, bringing individuals with diverse background together stimulates idea generation as well as extends existing knowledge base, which is beneficial for group productivity. However, native speakers (NS) may dominate cross-lingual teamwork communicating solely in a common language, which may reduce diversity and harm productivity of the whole group. As a solution, we consider it necessary to support non-native speakers' (NNS) contribution for equalizing NS' and NNS' participation. In this study, we examine how recent language support technologies might affect the group dynamics of collocated multilingual teams consisting of multiple NSs and NNSs. In our experiment, quads of two NSs and two NNSs were provided with a language support tool that integrates machine translation, automatic speech recognition and shared display to enable NNSs participating in multilingual teamwork without requiring them to use a common language. Automatic language detection allowed them to dynamically decide what language to use in their group discussions. We found that using the tool increased the variety of languages used (e.g., Chinese, English and Japanese) and had the potential to equalize NS' and NNS' participation.

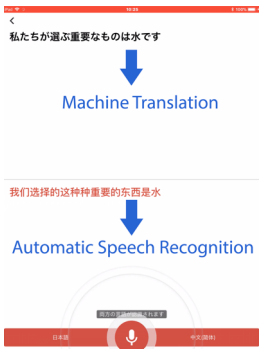

Figure 1: The interface of the real-time multilingual support tool. It displays the automatic transcripts and the results of machine translation. In this figure, a Chinese utterance is translated to Japanese (*"The most important item we chose is water."*)

Author Keywords
Multilingual communication; machine translation (MT); automatic speech recognition (ASR); collocated interaction; shared display.

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Introduction

To facilitate collaboration across national and linguistic boundaries, a common language is mandated in multilingual groups. However, when native speakers (NS) carry on a conversation in a rapid pace, non-native speakers (NNS) may be left behind and have difficulties expressing their ideas due to their incompetent language proficiency [9]. Consequently, NS may dominate the conversation with few contribution from NNS [7], which may bring negative influence to the group productivity.

Our goal is to support multilingual groups so that NSs and NNSs can participate more equally in group discussion. The key to equalizing participation in multilingual groups is to enhance NNS's comprehension as well as to encourage their contribution. According to previous research, automatically generated transcripts (using automatic speech recognition (ASR) technology) with reasonable recognition errors and time delay can improve NNS's comprehension [5]. As for NNS's contribution, machine translation (MT) was shown to facilitate NNS to produce more ideas in a brainstorming task [8].

While previous research exploring support tools for multilingual groups have primarily focused on distributed teams, we are interested in supporting collocated teams consisting of multiple NNSs and NSs. Compared to distributed teams, collocated team members have more access to social and contextual cues, which may induce helping behaviors among team members. For example, a NNS member may non-verbally communicate with one another about their intents through physical operations of a support tool, which may induce helping behavior from other team members. Furthermore, NNSs who share the same native language may help each other by shifting languages between common language and native language since side-talks are easier in a collocated setting [1].

In this paper, we study how a language support tool with ASR and MT features displayed on a shared screen (Figure 1) affects the group dynamics of collocated multilingual group discussion consisting of two NSs and two NNSs. In our study, we observed that NNSs switched their languages by using the shared display afforded by our tool in a sophisticated way. We found that the introduction of the tool helped NNSs to break the constraint of choosing only one common language for communication. The tool provided them more freedom for their choice of language, and allowed them to dynamically switch their language according to their needs. Two major findings are highlighted: (A) The variety of language used was increased when the tool was available. (B) The tool shows the potential to equalize the participation of group members, which may help elicit more diverse opinions and encourage people who share different native languages to engage in multilingual communication.

Figure 2: The bird's eye view of the experiment setting. The participants sat around the table and share the language support tools in collocated setting.

Background

Multilingual Support Tools

Machine translation (MT) can be useful for multilingual groups since it allows all members to communicate in their native language. While previous studies have shown that establishing common ground among NS and NNS is difficult due to translation errors and characteristic of asymmetry [10], the recent advance in translation accuracy leaves open the question how useful it is in its current level.

Automatic speech recognition (ASR) is another potentially useful technology that facilitates NNS comprehension in multilingual group conversation when common language is used. According to previous research, it is beneficial to show automatic transcripts to both NS and NNS. Without mandatory instructions, NS contribute to correcting the errors in transcripts [2] and highlighting the key points [6] of their own volition. These work indicate that showing transcripts in public can induce human volunteer behaviors to compensate the deficiencies of current language technology. Therefore, one of our goals is to show both MT and ASR results (Figure 1) to collocated multilingual group members during their group discussions and observe how they induce voluntary behaviors.

Shared Displays in Collocated Multilingual Groups

In a collocated setting, the direct physical manipulation of digital contents on a shared display provides the affordance for people to naturally work together on the same device. Having access to social and contextual cues enhance smoother group collaboration [3]. According to Morris et al., interactive shared display encourages more equitable working style such as the transformation of working roles in face-to-face interaction [4]. Hinted from this previous work, we placed shared displays to the multilingual groups - each display showed the transcripts and translations of a predefined user, and others could look at them together (Figure 2). We expect that using shared displays in multilingual groups may help coordinate group members' communication behaviors, and further equalize the contribution from NS and NNS.

Method

Participants

In this study, we recruited 52 participants in total, including 26 Japanese native speakers and 26 Chinese native speakers aged from 18 to 31 (M = 23.48, SD = 2.36).

The Japanese participants (3 females, 23 males) were all university students and have lived in Japan since they were born. Their mean age was 22.58 (SD = 2.50). Their self-evaluated Chinese proficiency was very low (M = 0.30, SD = 0.54, from 0 = cannot use it at all, 1 = very low to 5 = very high) on 6-point Likert scale, and English proficiency was middle-low (M = 2.63, SD = 0.93).

The rest of the participants were native Chinese speakers studying in Japan (6 females, 20 males). Their mean age was 24.38 (SD = 1.83). Their self-evaluated Japanese proficiency was medium (M = 3.22, SD = 1.10, from 0 = cannot use it at all, 1 = very low to 5 = very high). Compared to the Japanese participants, the Chinese participants self-reported their English proficiency relatively higher (M = 3.78, SD = 1.00).

All the participants were randomly assigned to quads of two Japanese members and two Chinese members. In the end, there were 13 quads in total.

Setup

We conducted a within-subject experiment and compared two conditions: with and without a language support tool which affords participants to switch between a common language and other languages, such as their respective native languages in a collocated group discussion. In the with-tool condition, we gave each group four 12.9-inch iPad Pro tablets with Google translate app installed. Each tablet was linked to a predefined user – it showed the transcripts and translations of that user. The app was able to automatically detect between two languages, Japanese and Chinese, in this study. Since Chinese participants were university students studying in Japan, we expected Japanese to be their common language. Besides automatic language detection, ASR and MT were integrated to provide real-time communication support for all members (see Figure 1). Participants were assigned to sit around the table, and all tablets were placed together on the table, making them reachable to all members in the room (see Figure 2). All the instructions were given in English and Japanese. Chinese instructions were also provided when needed.

Tasks

In the experiment, participants in the same group were asked to collaboratively perform a series of decision-making tasks including Ocean, Desert and Lunar survival tasks[1] . The participants were asked to rank 6 different items based on how important it is to survive in the extreme fictional scenarios. For each group, participants had to reach an agreement and come up with the final order together. Participants were not instructed about what language to use for their discussion.

Procedure

After filling out the informed consent form, the participants were guided to get familiar with the multilingual support tool and performed Ocean survival task in the training session. Afterwards, they went through two main tasks and performed Desert/ Lunar survival tasks with or without the multilingual support tool respectively depending on the order of counterbalanced design. In the main tasks, before they started the group discussion, the Chinese pair and Japanese pair had 10-minute discussion as preparation for the group discussion. The purpose is to make them reach an initial consensus with same-language partner, and lay the foundations for further discussion. After completing the tasks, each participant was interviewed individually in their native language. In the interview, the participants were asked about when and how they used the tool for expressing or understanding each other's idea. Also, we asked them what was the major difference between with and without the tool in terms of their conversational experience.

Data Analysis

The whole process of group discussion was video-recorded. To understand how the tool influenced the participation of NS and NNS participants, we calculated the speaking time of each participant. We also calculated the speaking time of different languages including English, Japanese and Chinese. We annotated

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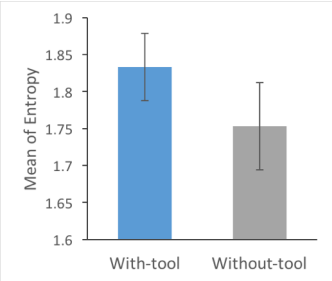

Figure 3: The mean entropy of participation in with-tool and without-tool conditions.

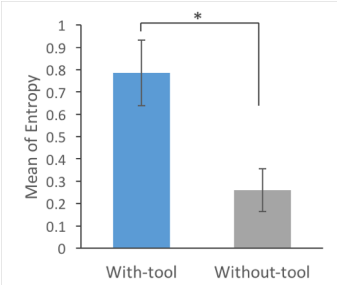

Figure 4: The mean entropy of language use in with-tool and without-tool conditions.

the start time and the end time for each sentence by following a simple coding scheme: (1) Backchannels and laughter are not included, (2) participants who talked to themselves is not included, (3) for cross-talks, conversational overlap is included.

Results

There were 3 groups that didn't use the tool at all even in the with-tool condition. Since our focus is to see how the language support influenced group interaction, in the following session, we focus on the other 10 groups, which used the tool at least once during their group discussion.

The Equality of Participation

In order to analyze the participation distribution for each group, we calculated the Shannon entropy which indicates the uncertainty level of participation for each group. A higher entropy value represents greater uncertainty. Therefore, the entropy would be highest when a group gets exactly same amount of participation by each group member.

A paired t-test was conducted to compare entropy values in with-tool condition and without-tool condition. It showed a slight trend that the shared display tool improve the equality of participation between with-tool condition (M = 1.83, SD = 0.14) and without-tool condition (M= 1.75, SD = 0.19); $t(9)$ = 1.85, p= .097. (see Figure 3). Since the mean entropy of with-tool condition is higher than without-tool condition, participation appeared to be more equal when the shared display tool was available.

The Variety of Language Used

In our study, instead of all using Japanese as the common language, half of the groups (6 out of 13) voluntarily used English in the discussion when the tool was not available.

For the variety of languages used, we also calculated the Shannon entropy to see the distribution of languages emerging in each group respectively. The higher the entropy value means that the variety is also greater. A paired t-test was conducted to determine whether the tool had an effect on the variety of languages used. There was a statistical significance showing that the presence of the tool affected their languages used in group discussion. The variety is greater in the with-tool condition (M = 0.79, SD = 0.46) than in the without-tool condition (M= 0.26, SD = 0.30); $t(9)$ = 4.19, p = .00. (see Figure 4).

Discussions

To sum up, our results suggest that shared display multilingual support significantly increased the variety of languages used. Multilingual members, especially NNSs who had language difficulties voluntarily switched their languages, and used their native language more frequently to elaborate their opinions when the tool was available than unavailable. The results also suggest that the shared display may potentially encourage helping behavior from other group members. From our field notes, when a group used Japanese in with-tool condition, there were cases where a Chinese member (C1) with lower Japanese proficiency switched the language to Chinese to explain their thoughts more thoroughly. All Japanese members and Chinese members paid attention to the information on the shared display. When the other Chinese member (C2)

with a higher level of Japanese proficiency noticed there was a translation error, some chose to correct the error orally in Japanese to Japanese members. Furthermore, when other members noticed that C1 was staring at a shared display, they also paid attention to the display and C1's face to check whether s/he needed further clarification. As such, the presence of the multilingual shared display motivated bilingual individuals to actively support cross-lingual group communication.

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