# Groups in Groups: Conversational Similarity in Online Multicultural Multiparty Brainstorming

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**ABSTRACT**
Online collaboration, in comparison to face-to-face collaboration, is advantageous in making multiparty teamwork possible at a very low cost. As multicultural multiparty collaboration becomes ubiquitous, it is crucial to understand how communication processes are shaped in the social and media environments that computer-mediated communication affords. We conducted a laboratory study investigating how different types of cultural asymmetry in group composition (Chinese of the majority versus American of the majority) and communication media (text-only versus video-enabled chatroom) influence conversational similarity between Chinese and Americans. The paper presents an analysis identifying that the selection of media and the cultural composition of the group jointly shape intercultural conversational closeness.

**Author Keywords**
Computer-mediated communication, communication accommodation, multiparty teamwork, cross-cultural communication, group brainstorming

**ACM Classification Keywords**
H5.3 Group and Organization Interface: Computer-supported cooperative work

**General Terms**
Experimentation, Human Factors, Theory

## INTRODUCTION

Computer-mediated communication (CMC) technologies such as instant messaging (IM) and video conferencing have played important roles in enabling new forms of teamwork that did not previously exist. With CMC, the greater flexibility of work hours [30] and higher availability of team members make it convenient and commonplace for geographically dispersed and culturally diverse groups to collaborate online.

Cultural factors may introduce greater complexity in online collaboration especially when the group size increases. At the individual level, there has been ample research on cultural differences in individuals' social values [35] and cognitive processes [25]. At the level of pairs, some recent studies revealed that same- and mixed-cultural pairs may have distinct behavioral patterns of communication and collaboration [9][32]. What remains underexplored is the role of culture in online multiparty teamwork, in which groups may have an asymmetric distribution of cultural backgrounds among members, leading one culture to be more dominant and more salient than others. For example, for a three-person group representing two cultural backgrounds, two of the group members will share the same cultural background and will form a cultural majority and the other one will become a cultural minority in the group.

Studies of intergroup communication have suggested that individuals may adapt their communication styles, such as accent, speech rate and language use, to align with or diverge from that of their conversational partners when the partners are from heterogeneous social groups (e.g., cultural backgrounds) [15][18]. In intercultural multiparty collaboration (e.g., the bicultural triad exemplified in Figure 1), greater complexity in communication adaptation may occur than in dyadic collaboration because becoming conversationally more similar to the style of one culture might lead to greater divergence from the style of another culture. When there is a mix of same- and different-culture

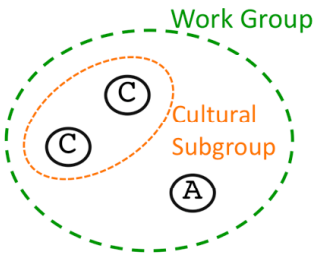


**Figure 1. A bicultural triad with three group members from two cultural backgrounds (A and C).**


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members in the group, it poses questions about whether and how individuals will become more similar or more dissimilar to each other in terms of conversational style. Also, when asymmetry in numbers of cultural members exists, does it matter which culture is of the majority?

We examine these research questions in the context of multiparty group brainstorming. Group brainstorming is a prevalent group task aiming at supporting creative idea generation through social means to break the limits of individual creativity [28]. Multiparty collaboration is especially critical to group brainstorming, as having more group members will increase the size of the knowledge base distributed among group members and heighten the likelihood of eliciting unconventional ideas through stimulating group discussions [27].

This paper continues recent efforts in investigating cultural and media effects on group brainstorming. In our previous work, we identified the effects of cultural backgrounds (Chinese or American), communication media (text or video), and types of group composition (same or mix-culture groups) on individuals' communication styles [36][38]. This paper further investigates the influence of cultural asymmetry in group composition on the complex adaptation of conversational styles in multiparty teamwork.

In a laboratory experiment, two types of online intercultural triads, AAC triads (two Americans and one Chinese) and ACC triads (one American and two Chinese), were formed. Triads used each of two different communication media, a text-only and a video-enabled chatroom. We found evidence that cultural adaptation of communication styles in three-person groups depends on the cultural structure of the groups' composition when cultural cues are salient, such as being able to see each other over video. It further matters which culture is of the majority. There was greater conversational similarity between American and Chinese participants when Chinese participants were of the majority (ACC group) and when the communication media was a video-enabled chatroom in comparison to other conditions. In the following, we present the theoretical background, the study and analyses, and the implications of our findings.

## THEORETICAL BACKGROUND

The work is situated in the theoretical contexts of communication accommodation, multiparty conversation, cultural variation in work groups, and media richness. In this section, we review each set of theories and relate them to online multicultural multiparty brainstorming.

### Communication Accommodation

Communication Accommodation Theory (CAT) is a theoretical framework that describes and explains the adaptation of communication styles in intergroup encounters in which conversational participants are associated with different social groups (e.g., culture, gender, power position in organizations, etc.) [12][15][18]. Styles of communication may converge, diverge or be maintained by operating upon different levels of communication, including non-verbal behaviors (e.g., gesture and posture [24]), features of vocalization (e.g., accent [14] and speech rate [34]), and language use (e.g., word choices [26][31]).

Discourse planning and management can also be employed as important language resources in the individual's repertoire of communication adaptation. Adaptation at the discourse level is especially relevant to computer-mediated intercultural communication because features of vocalization and non-verbal cues are often unavailable as tools for accommodation in CMC. Also for tasks like group brainstorming that rely on active information sharing and exchange, there can be variability in how conversational threads are initiated and managed due to organizational factors [17] (e.g., nesting brainstorming within projects that have higher order goals) and socio-cultural factors [38] (e.g., being shy and reluctant to initiate conversations or to respond). Normative brainstorming actually does not require participants to interactively discuss proposed ideas [28]. Responding and other conversational moves may serve as informative features of discourse management for purposes of accommodating or disaccommodating conversational partners.

### Multiparty Conversation

Multiparty conversation may introduce greater complexity to the progression of conversations presumably due to structural conditions that are not present in two-person interaction.

There are inherently more speakers, addressees and speaker-addressee links to be accounted for in multiparty conversations. For example, in three-person groups, it generally takes more conversational turns and words to achieve common ground and the same status of understanding than in two-person groups [1]. This is especially true when group members differ in their initial knowledge states, such that figuring out what information is not shared and filling in these knowledge gaps requires significant conversational effort [1]. Also, linguistic analyses suggest that the structure of multiparty conversations may promote the creation of alliances or subgroups within the group when conflict emerges [19].

Similarly, communication accommodation in multiparty conversations can become quite complex. In a three party conversation involving three participants X, Y, and Z, for example, there are three possible conversational links between the participants (X&Y, X&Z, and Y&Z). The adaptation of communication styles by any one of the participants (e.g., X) would consequently influence the similarities between that participant and the other two participants (e.g., X&Y and X&Z). Therefore, planning and managing discourses to achieve the *equilibrium* of communication styles that appears ideal to all the

participants in such a dynamic social system may be quite difficult. Little is known about how communication accommodation occurs in such group settings.

### Cultural Variation on Individualism-Collectivism

Prior work theorizing and studying cultural differences in social behaviors and cognitive processes has identified cultural variation on several dimensions.

*Individualism-collectivism* is often considered as one prominent dimension for distinguishing Eastern cultures from Western cultures [35]. Individualistic cultures, such as those of the U.S. and Canada, tend to value the independence and autonomy of individuals in groups and emphasize personal gain. Collectivistic cultures, such as those of China and Japan, tend to view individuals as part of the group and focus on group goals [35]. Recent studies have also suggested cultural differences in perceptual processes. Individuals with collectivistic cultural backgrounds tend to possess greater context-awareness and pay greater attention on peripheral information [5][23][25].

In multicultural multiparty brainstorming groups that have unequal numbers of group members from different cultural backgrounds, how individualism and collectivism are combined in groups may further influence and shape how the equilibrium of communication styles mentioned earlier is achieved.

To theorize, we pose the following two propositions:

First, *the collectivistic mental scheme that directs individuals' collectivistic behaviors may be reinforced when collectivists are of the majority in the group, and weakened when individualists are of the majority. Similarly, the individualistic mental scheme that directs individuals' individualistic behaviors may be reinforced when individualists are of the majority and weakened when collectivists are of the majority.*

Note that cultural theories of individualism-collectivism should be interpreted *probabilistically* at all levels, ranging from individuals to societies. Modeling cultures with individualism and collectivism does not constrain our interpretations dichotomously. At the individual level, people hold some attitudes and values that agree with those of the dominant culture in which they live, and other attitudes and values that are at odds with this culture. Which behaviors they evidence in a given situation depends on the context. For example, certain stimuli or social contexts (e.g., attending a family event on an important holiday) may be more likely to trigger collectivistic values. Recent studies show that people who have acquired multiple cultural schemes adapt their expression of cultural attitudes and behaviors based on the cultural cues they perceive [4].

We argue that it is likely that most people, despite their national cultural backgrounds, remain more or less socialized with multiple cultural schemes due to the complexity of real-world tasks they need to deal with (i.e., required to be independent under some circumstances while cooperative under others) and may have internalized the implicit associations that link cultural schemes and perceived *cultural cues* (e.g., language use, gestures, facial expressions and dressing etc.). In our context, people may exhibit stronger collectivistic tendencies when people from collectivistic cultures comprise the majority in a group, because there will be richer cues making collectivism more accessible. Similarly, people may reduce their collectivistic tendencies when such cues are diminished or competing individualistic cues are more salient.

Second, according to individualism-collectivism, *the collectivistic mental scheme is more prone to self-adaptation and pursuing the convergence of communication styles among group members than the individualistic mental scheme.*

This is because collectivists are more sensitive to cues of intercultural discrepancies. The collectivistic norm of valuing group harmony would drive them to adapt their behavior to reduce such discrepancies [3].

### Media Richness

Communication media are observed and theorized to differ in their richness, or the number of information channels available for supporting communication and enhancing understanding [6][8][33]. Richer media such as face-to-face or video conferencing afford visual channels for conveying facial expressions and eye contact that are not available in leaner media like text-only IM or email. Richer media thus may afford greater social presence and make cultural cues more salient than leaner media do.

In online multicultural brainstorming, being able to see conversational partners through video conferencing may provide richer cultural cues, and may further influence group members' perception of cultural discrepancies and the ways communication styles are adapted. Richer media may also make it easier to embed messages into non-verbal communication channels. For high-context cultures [16] (e.g., Chinese) adept at leveraging non-verbal channels for communication purposes, rich media may offer greater flexibility in how communication is accomplished, and may increase the variability of language use.

Recent empirical studies provide support of this view. When cultural cues are rich like in face-to-face negotiation, Chinese were found to seek deeper agreement than Americans [32]. Differential levels of context-awareness across cultures may heighten the influence of media richness. For example, Japanese were found to be more aware of the background and peripheral objects embedded in complex pictures [23].

### The Current Study

In this study we examine the effects of group cultural composition and media on intercultural communication

**Figure 2. The "Extra Eye" brainstorming task used in our study. Participants were asked, *"What are the benefits and difficulties if people had an third eye in the future?"***

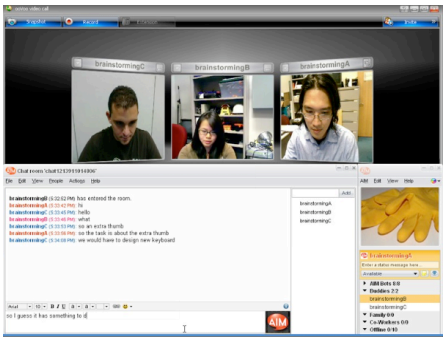


**Figure 3. The video-enhanced chatroom used in the study**

accommodation by using participants from Chinese and American cultures as representatives of collectivism and individualism [35]. Due to the unique structure of multiparty conversations, to investigate online conversational similarity, we identify that the appropriate *unit of analysis* is neither individuals nor the groups as a whole, but *pairs* nested within the groups.

Based on the discussions above, we propose two main hypotheses to be tested in the study.

*H1: The effects of cultural asymmetry*. Chinese and Americans (e.g., American-Chinese pairs within triads) will be conversationally more similar when Chinese participants are of the majority than when they are of the minority in the triad. This is because the collectivistic mental schemes (e.g., valuing group harmony and solidarity) will be primed to be more salient, eliciting a tendency to become more similar to one's conversational partners.

*H2*: *The effects of media*. Richer media such as a video enhanced chatroom, in comparison to leaner media such as a text-only chatroom, will heighten the effects of cultural asymmetry because richer cultural cues can be perceived when there are more communication channels available.

Next we present the experiment and the analyses for testing the hypotheses.

## METHOD

### Experimental Design

Three-person groups were asked to perform two structurally similar brainstorming tasks, one via a text-only chatroom and one via a video-enhanced chatroom. Two types of intercultural brainstorming groups were formed: two Americans and one Chinese (AAC) and one American and two Chinese (ACC). Group cultural composition was a between-subject manipulation. Media and brainstorming topics were within-subject manipulations and their orders were counterbalanced.

### Participants

There were 78 participants (40% female) recruited from Carnegie Mellon University and the surrounding community. Among them, 40 participants were Americans living in the U.S. for more than 10 years with English as their first language. The remaining 38 participants were international students born in China (79%) or Taiwan (21%) whose first language was Chinese. The Chinese participants were all fluent or nearly fluent in English. Although they were all currently studying or working in the U.S., the majority had been in the U.S. less than 2 years. Participants were randomly assigned to brainstorming groups and experimental conditions. The majority of the participants (96%) reported that they did not know their fellow group members prior to the study. There were a total of 26 brainstorming groups (14 AACs, and 12 ACCs).

### Materials

Two brainstorming tasks of equivalent difficulty were created: the "extra thumb" question and the "extra eye" question. The extra thumb question asked participants to generate ideas about the benefits and difficulties for people having a theoretical extra thumb in the future. This task has been used in many previous brainstorming studies [11]. The extra eye question is a newly designed task that asked participants to generate ideas about the benefits and difficulties for people having an extra eye at the back of their heads in the future (see Figure 2).

A post-experimental questionnaire was used that included Triandis' individualism/collectivism scale [35] and basic demographic questions.

### Equipment

In the text-only chatroom condition, participants communicated via the chatroom function of AOL Instant Messenger (AIM, http://www.aim.com). In the video-enhanced chatroom condition, participants were allowed to see themselves and the other two group members via a video conferencing client called ooVoo (http://www.oovoo.com) while using the same text chat client (see Figure 3). Audio was unavailable for both media conditions to avoid the possible confound of being able to speak over the video but not with the text. Participants in both conditions worked on the brainstorming topics by typing into the text-based chatroom. At the right hand side of the computer display, a series of images related to the current brainstorming topic were shown as cues for

**Table 1. Definitions and examples of coding categories**

| Category | Type | Definition | Example from Transcripts |
|---|---|---|---|
| Ideation | Active | Ideas offered for the first time in the brainstorming session | "(If having an extra eye,) I think it would be harder to concentrate..." |
| Meta-strategy | Active | Strategizing, orienting and coordinating brainstorming | "Any other ideas?" "What about privacy?" |
| Response | Reactive | Question, elaboration and opinion evoked by previous contributions | "(An idea about hard to concentrate was introduced earlier)<br>Maybe people would close their third eye" |
| (Dis-)Agreement | Reactive | Acknowledgement and explicit consent/dissent | "Ya, I agree with you" |
| Explanation | Reactive | Explaining ideas | (An idea about hard to concentrate was introduced earlier)<br>"I know I have to not have things to look at if I'm trying to study" |
| Picture | N/A | Talking about the peripheral pictures | "Look at the pictures on the right of the window. it seems that they are advertising about what we are talking" |
| Others | N/A | Other utterances | "Hi" ":-)" |

participants' idea generation (e.g., a pair of gloves for the extra thumb task).

### Procedure

Participants were brought to the laboratory and instructed about the brainstorming topics and brainstorming rules. They were provided with four conventional brainstorming rules [28]: (a) the more ideas the better; (b) the wilder the ideas the better; (c) combination and improvement of ideas are sought; and (d) avoid evaluating others' ideas. Groups were given 12 minutes for each of the brainstorming tasks. Between tasks, we switched which version of the chatroom they were using (text only or video enhanced text).

### Measures

Three measures were derived by counting the total number of words typed and by coding the content of the conversations. Triandis' individualism/collectivism scale [35] was used to check the validity of the cultural manipulation.

#### *Talkativeness*

Brainstorming is characterized by open-endedness. People may voluntarily determine how much they want to contribute to the conversation. Talkativeness is considered as an informative feature for distinguishing cultural communication styles as collectivists and shy people may be more sensitive to peer evaluation and talk less [36].

The number of words typed by individuals is considered an ideal measure of talkativeness. Transformations have been undertaken to make word counts suitable for analyses. Numbers of words typed were first log-transformed (due to the skewed distribution of raw word counts) and then standardized by brainstorming topics (due to the minor difference between the two topics) as our measure of talkativeness.

#### *Responsiveness*

Brainstorming is flexible in its conversational structure. Unlike grounding-driven conversations in which patterns of consecutive questioning and answering are prevalent [2][6], brainstorming can have greater variability in how conversations are constituted. In some brainstorming sessions, group members may straightforwardly throw out their ideas without responding interactively, while in others, people may engage in behaviors like explaining ideas, agreeing or disagreeing with each other, and off-task socializing. Responsiveness is considered a stylistic feature of brainstorming conversations.

The conversations were coded by applying a coding scheme consisting of seven behavioral categories [36], including *ideation* (proposing ideas), *meta-strategy* (strategizing and coordinating moves), *response* (questioning or commenting antecedents), (*dis)agreement* (acknowledgement, consent or dissent), *explanation* (explaining prior ideas), *picture* (talking about the peripheral pictures) and *others* (greetings, smileys and other conversational acts that did not fall into the other categories). Table 1 shows examples for the coding categories. Two independent coders performed the coding task. Inter-coder reliability across the seven categories based on 6% of the data was satisfactory (Cohen's Kappa=.65).

Among the coding categories, two general types were identified. Ideation and meta-strategy are *active codes* featuring self-initiated contributions. On the other hand, response, (dis)agreement and explanation are *reactive codes* elicited by antecedents (see Table 1).

The measure of responsiveness is operationalized as the percentage of reactive utterances out of the total of active and reactive utterances:

*Responsiveness = Number of Reactive Codes* / (*Number of Active Codes + Number of Reactive Codes*)

The higher the value, the more responsive a participant's messages are to others' prior contributions.

### *Conversational Distance*

Talkativeness and responsiveness measures are simple and highly interpretable features of discourse at the individual level. However, these two simple measures are inevitably summative and holistic, and might miss subtle discourse patterns that may characterize conversational similarity between two people (i.e., at the level of pairs).

By taking a probabilistic view, the coding we have done essentially captures the probability distributions of possible conversational moves by individuals, that is, the proportion of their messages in each of our content categories shown in Table 1. We may then derive the conversational similarities (or dissimilarities) between two people by computing the distance between the two probability distributions that represent their conversational styles. Statistical theories have provided appropriate techniques for this purpose [21].

The symmetric form of Kullback-Leibler divergence [21] can be used to compute the *conversational distance* between two people's probability distributions of conversational categories. Therefore, people are conversationally more similar when the measure is low. A similar technique has been applied to study the productivity aspects of group work [37].

### *Individualism and Collectivism*

Participants completed Triandis' individualism and collectivism scale [35]. The instrument consists of 6 items for collectivism (e.g., "what I look for in a job is a friendly group of coworkers," "aging parents should live at home with their children," Cronbach's alpha = .48) and 7 items for individualism (e.g., "I tend to do my own things, and most people in my family do the same," "what happens to me is my own doing," Cronbach's alpha = .61).

## ANALYSES

A screening of the Chinese participants' data indicated no differences between those born in China or Taiwan for either talkativeness or responsiveness (both $F \leq 1$, *ns.*) Therefore, all native Chinese speakers were considered as a cultural group in our analyses.

We checked the validity of our cultural manipulation by examining whether Chinese and Americans differ on Triandis' cultural scale as theorized. Although Chinese and Americans did not differ on the individualism subscale ($t$=-0.59, *ns.*), Chinese and Americans differed significantly on the collectivism subscale ($t$=2.01, $p$<.05). Consistent with theories, Chinese were more collectivistic than Americans.

Also, there was no effect of participant gender on either talkativeness and responsiveness. Thus we did not include gender as a factor in our analyses.

To examine the hypotheses about conversational similarity in multicultural groups, we adopted two analytical strategies, discriminative analysis and linear mixed modeling, with different sets of measures, as a way to triangulate the results.

### Analysis of Talkativeness and Responsiveness

#### *Strategy*

The goal of the first analysis was to *explore* conversational similarity based on known dimensions of brainstorming communications along which cultures differ [36]. We used Fisher's linear discriminative analysis (LDA) as a way to discriminate cultural backgrounds based on individuals' high-level conversational features (talkativeness and responsiveness). This is essentially an *indirect* analytical strategy as no similarity measures were computed or involved. The evidence comes from the comparisons of whether we can tell two cultures apart under different conditions by using the same set of features. If we cannot distinguish Chinese and Americans under some conditions but can distinguish well under others, then we get clues about what conditions are likely to result in conversational closeness and what conditions are not.

#### *Results*

Four separate LDAs were conducted using talkativeness and responsiveness as features for each of the cultural asymmetry-media conditions (AAC using text chatroom, AAC using video enhanced chatroom, ACC using text chatroom and ACC using video enhanced chatroom). LDAs showed significant differences between Chinese and Americans under the following conditions, AAC groups using the text chatroom (Wilk's Lambda=.78, $F$[2,39]=5.45, $p$<.01), AAC groups using the video enhanced chatroom (Wilk's Lambda=.76, $F$[2,39]=6.1, $p$<.01), and ACC groups using the text chatroom (Wilk's Lambda=.78, $F$[2,33]=4.67, $p$<.05). However, there was no significant difference between Chinese and Americans in ACC groups using the video enhanced chatroom (Wilk's Lambda=.89, $F$[2,33]=1.97, *ns.*).

Figure 4 shows the plots of how Chinese and American participants are distributed in the first two LDA dimensions that are synthesized from talkativeness and responsiveness in each condition. The figure shows the 95% confidence intervals of the means (represented as blue circles in solid lines for Chinese and red circles in dashed lines for

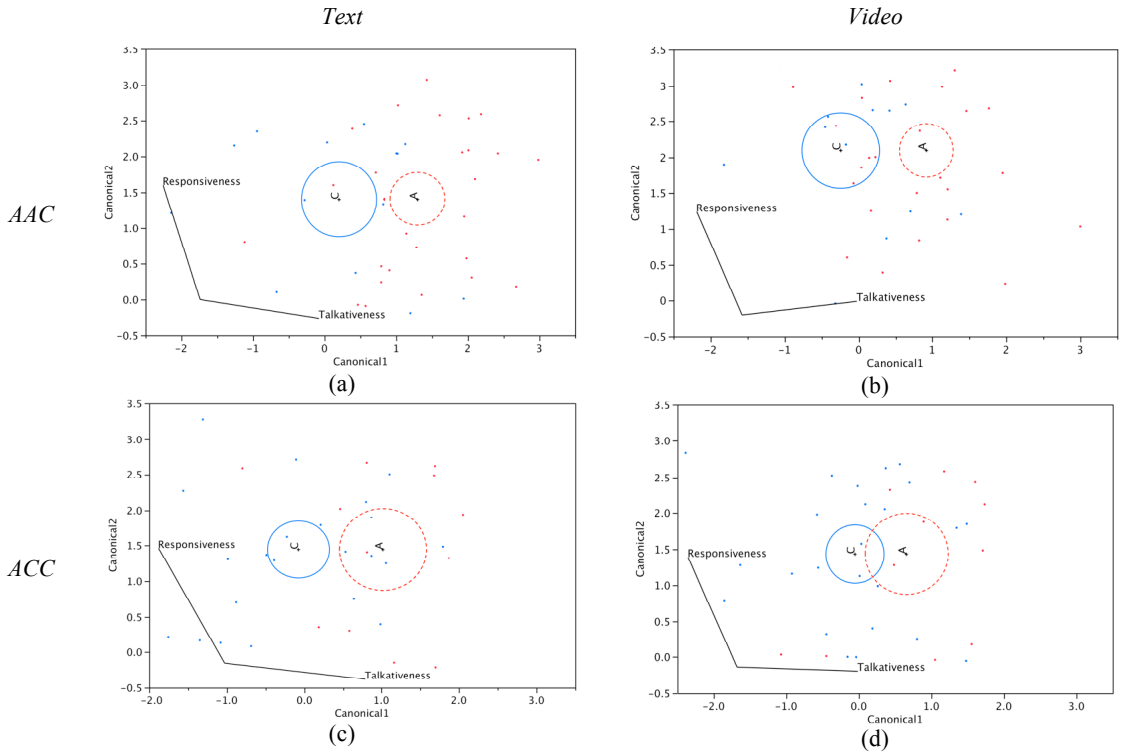


**Figure 4. Linear discriminative analyses (LDA) by four cultural asymmetry-media conditions. Blue (in solid line) and red (in dashed line) circles represent the 95% C.I. of the means in LDA dimensions for Chinese and Americans respectively. Conditions are (a) AAC using Text, (b) AAC using Video, (c) ACC using Text, and (d) ACC using Video.**

Americans), which are the possible ranges of the means for 95% of the times when the analysis is replicated with different samples. Therefore, when the two circles (confidence intervals) overlap, it implies that we cannot reject the hypothesis that Chinese and Americans may be conversationally the same. This may then serve as evidence of conversational closeness.

When ACC used the video chatroom, the 95% confidence intervals of means for Chinese and Americans participants partially overlapped. For all other conditions they were distinct. By examining the relation between the synthesized LDA dimensions and the original input features (shown in the bottom-left corner of each LDA plot in Figure 4), we found that talkativeness is almost in parallel with the first LDA dimension. This is in consistence with prior work [36] and suggests that talkativeness is the feature that distinguished Chinese and Americans the most (Americans in general talked more than Chinese). However, when ACC groups used video (Figure 4d), it appears that Chinese members increased their talkativeness, making it harder to tell the two cultures apart.

Consistent with predictions, when richer collectivistic cues were available (i.e., ACC groups over video-enhanced chatrooms), Chinese and American participants were conversationally indistinguishable. However, ACC groups using text-only chatrooms were less conversationally similar. This raises the question of whether the technique and the high-level features we used for exploratory purposes are sensitive enough to detect subtleties.

### Analysis of Conversational Distance

#### *Strategy*

To gain finer grained evidence, the second analytical strategy tested our hypotheses more directly. We used the symmetric KL divergence as the dependent variable representing conversational distance in a mixed model ANOVA analysis.

The measuring of conversational similarity inherently requires two conversational participants. There will be only one measure for each pair of participants, and therefore *pairs* are the appropriate units of analysis. Note that in each multicultural triad (AAC or ACC), there are two types of pairs nested within it, *intercultural pairs* (AC) and *intracultural pairs* (AA in AAC and CC in ACC). In the analysis, we are mainly interested in comparing the intercultural pairs' conversational distances in different cultural asymmetry and media conditions.

Mixed model ANOVA is employed to account for possible local interdependency between data points caused by repeated measures and social interactions in brainstorming groups [20]. In the mixed model, brainstorming trial was nested within pair. Pair was a random effect nested within group, and group was treated as a random effect. Because of the hierarchical nesting of random effects, it is standard to estimate the degrees of freedom associated with the

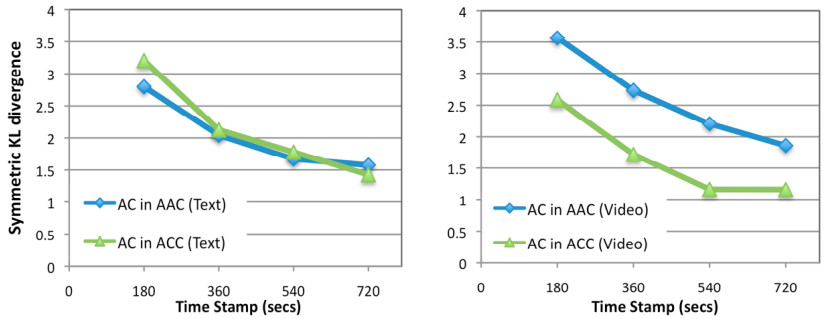


**Figure 5. Means of conversational distances (raw symmetric KL divergences) of Chinese and Americans pairs evaluated at different time stamps when using different media. Left: Text-only condition. Right: Video-enabled condition.**

denominators by using Satterthwaite's approximation. Non-integer degree of freedoms may result [22].

In the analysis, types of multicultural groups (AAC versus ACC), communication media (text versus video), time stamps of assessing conversational distances (at 180, 360, 540 and 720 seconds since the beginning of the brainstorming session) and the interactions among these variables were included as fixed effects in the models.

We included the time stamps as an independent variable here for two reasons. First, the conversational dynamics might change over time during the sessions (e.g., pairs might be conversationally similar at some points but not at others). Second, stable conversational patterns at the discourse level may need some time to emerge due to the turn-taking nature of the conversations. These two points essentially suggest that only evaluating conversational distances at the end or the later stage of the session may be insufficient to capture subtleties of conversational patterns, while at the same time we should be careful about sampling conversations within short time intervals. To balance these two concerns, we evaluated probability distributions and conversational distances at each time stamp by *accumulating* counts for coding categories since the start of the session.

The symmetric KL divergence measures were log-transformed for the mixed model analysis because the distribution of the raw measure was positively skewed with a long tail.

### *Results*

We ran an initial mixed model ANOVA for model diagnostics and outlier detection by using the criterion of studentized residuals exceeding ±2 [22]. There were 28 out of a total of 416 observations with studentized residuals exceeding the criterion. These were excluded in the model for estimating the main and interaction effects.

There was no main effect for type of cultural group (AAC vs. ACC) or for media (text chatroom vs. video enhanced chatroom). However, there was a main effect of time stamp on conversational distance ($F$[3,278.1] = 20.5, $p$<.0001). Conversational distances evaluated at later times were in general smaller than those evaluated earlier (see Figure 5). However, as we used accumulated counts of coding categories as the basis for estimating probability distributions and conversational distances, this time effect may include statistical regression to the means, and is not of our main interest in this paper.

What is of interest is the interaction effect between group type and media on conversational distance ($F$[1, 48.83] = 3.68, $p$<.06). Post-hoc t-tests showed a significant difference between AAC and ACC groups using the video-enhanced chatroom ($t$=2.14, $p$<.04, Cohen's d=.5). When using the video-enhanced chatroom, Chinese and American participants were conversationally more similar when they were working in ACC groups than in AAC groups. Working in ACC, as opposed to AAC, groups lowered conversational distance by a half standard deviation, which is considered a medium-sized effect [7].

It is also important to note that group type and media did not further interact with time stamp. The pattern of interest was not changed by sampling conversational distance at different stages of the brainstorming session. There were no other interaction effects.

## DISCUSSION

Results from the two analyses support H1 in part and H2 in an even stronger form than what we had hypothesized.

H1 stated that when Chinese are in the majority (i.e., ACC groups), Chinese and American group members will become conversationally similar. In the discriminative analysis, we saw conversational closeness when ACC groups used the video-enhanced chatroom but not the text-only chatroom. In the mixed model ANOVA, we did not detect a main effect of group. However, we did see an interaction between group type and medium. When video made richer cultural cues available, American and Chinese group members were more similar in conversational style in ACC triads, in which collectivistic participants were in the majority, than in AAC triads. Text alone did not have the same effect.

H2 posited that video will heighten the difference between group types, reflecting different types of cultural

asymmetry in group composition. The group type by media interaction supports H2 in an even stronger form. H2 predicted the difference between group types would be greater over video. Instead, we found no effects of cultural asymmetry at all in groups using the text only chatroom.

Prior studies of intercultural teamwork have identified many cultural differences and culture by media interactions in online groups (e.g., [9][32][36]). The focus was on how cultures differ in their language use and style at the individual or group level, under different media conditions. Our results point to a new phenomenon at the level of intercultural pairs, media, and cultural asymmetry-dependent communication accommodation. It is interesting to note that simply putting Americans and Chinese into intercultural pairs may not be sufficient to trigger communication accommodation. The cultural backgrounds of the rest of people in the work group, and what media are used for communication, also matters.

Theoretically, our paradigm may further reach the general motivational issues in communication accommodation. Although the adaptation of communication styles in intergroup encounters is an established empirical phenomenon that has been repeatedly observed at different levels of communication, it has been less clear why individuals are *motivated* to engage in communication adaptation, and whether accommodation is automatic or whether it involves an intentional decision to pursue conversational closeness. Early interpretations tended to interpret communication accommodation and disaccommodation in terms of social identity and the inequality of social status between social groups [15]. Recent psycholinguistic research holds the view that the processes of conversational alignment may be cognitively unconscious and automatic when conversational cues appear [13][29]. In multicultural groups, our current results seem to be in agreement with both views to some extent, such as the role of external cues and social context (e.g., group cultural composition). It is also interesting to note that either cueing or group cultural composition alone fails to drive conversational closeness. More theoretical development and refinement work may be undertaken with this paradigm.

### Implications for Technology Use and Design

We identified that media play a role in interpersonal communication dynamics. If the purpose is to eliminate the influences of cultural asymmetry in multicultural groups on collaboration, then using text-based media may better meet the goal. If instead the goal is to increase divergence, richer media will be a better choice.

Another application of the results may be to read the message in the other way. Interpersonal conversation as a joint activity may be considered as unpredictable in its direction and consequence, such as the length of the joint activity and whether conversational styles will converge. In a cue-rich environment such as video conferencing and face-to-face communication, what culture is of the majority in the work group may provide informative clues about whether the conversations will converge or not. This may serve as a basis to intervene in group communications with artifacts to make people conversationally closer with each other. As a consequence of being conversationally aligned, better interpersonal trust may develop [31]. For example, we may use animated avatars rather than real videos to represent individuals in a way that is designed to exhibit more collectivistic cues to promote convergence and trust. In a two-person intercultural collaboration consisting of one individualist and one collectivist, if a robot that is designed to be collectivistic also participates in the meting as a facilitator, we may also be able to reinforce the convergence of conversational styles.

## CONCLUSION

In this study, we investigated the influence of cultural asymmetry in multicultural groups (i.e., which culture is of the majority) and communication media on conversational similarity. In three-person brainstorming groups consisting of American and Chinese participants, there was an interaction effect between type of cultural asymmetry and communication media. When using rich media (video-enhanced chatroom), Chinese and Americans were conversationally more similar in Chinese-majority groups than American-majority groups. The results demonstrate that conversational closeness is shaped by the cultural composition of online multicultural groups. The findings have implications for choices of technologies to use to support multicultural group CMC and for designing interventions to improve intercultural CMC.


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