Why Did They Do That? Exploring Attribution Mismatches Between Native and Non-Native Speakers Using Videoconferencing

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ABSTRACT

The meaning we attribute to another's actions significantly impact our subsequent behaviors and interactions towards that person. Distributed teams often combine native speakers (NS) and non-native speakers (NNS) and are particularly prone to making attribution errors. Language difficulties place NNS under a higher cognitive load, potentially leading NS to make inaccurate attributions of NNS. We conducted an exploratory laboratory study to investigate the attributions NS and NNS form about each other in multiparty videoconferencing. Our findings revealed significant mismatches in NS' attributions of NNS behavior, but no significant mismatch in NNS' attributions of NS behavior. Due to cognitive overload stemming from language challenges, NNS were only able to engage in "compromised" impression management during the task. Yet, NS were relatively unaware of how profoundly language difficulties impacted NNS' behaviors. Our findings identify opportunities for technology support for NS-NNS interactions, particularly with regards to impression construction and impression management.

Author Keywords

Impressions; Attributions; Non-native speakers; Native speakers; Computer-Mediated Communication.

ACM Classification Keywords

H.5.3 **[Group and Organization Interfaces]:** Computer-supported cooperative work, Synchronous interaction.

INTRODUCTION

During interactions, people form impressions of the other person – are they sincere, capable, intelligent or trustworthy? In the workplace, such impressions determine how people feel and behave towards others, as well as the attributions people make to infer the cause of their behavior [10]. Such evaluations significantly impact professional and organizational outcomes such as hiring decisions, performance evaluations, the allocation of tasks and resources [10] and team cohesion [5]. Thus, the ability to form accurate impressions and attributions about others is crucial to effective decision-making in the workplace [10].

Yet often, people do not have the time, information or cognitive resources to assess each new individual with regards to their idiosyncratic merits and flaws [10]. In such cases, people use shortcuts and make broad judgments and attributions of others' behaviors that can be inaccurate [10]. Such attribution misjudgments influence decisions about who to trust, doubt, defend, attack, hire, or fire [9] and can sometimes lead to unfortunate consequences [10].

While attribution misjudgments can occur in collocated teams, research shows they are exacerbated in distributed teams, due to geographic dispersion and the use of Computer-Mediated Communication (CMC) tools [8]. Distributed teams often span multiple cultural, linguistic, organizational and professional boundaries [8]. Compared to collocated teams, distributed team members experience a higher cognitive load [8] and have reduced access to social and contextual cues [47] – factors that exacerbate the likelihood of attribution misjudgments [8].

In this paper, we focus on the attribution misjudgments that result from disparities in linguistic fluency in distributed teams – that is, between native speakers (NS) and non-native speakers (NNS) over videoconference. Compared to NS, NNS experience a higher cognitive load due to the demands of foreign language comprehension and production [45] as well as anxiety and stress when speaking in a non-native language [32, 49]. Accordingly, NNS may speak less [2, 38], may not request clarification when needed [22], and may exhibit more apprehensive nonverbal behaviors [20]. In multiparty conversations with majority NS, discussions can move forward rapidly while NNS are left behind [50]. Consequently, NS may attribute NNS' low level of participation to dispositional factors (e.g. shyness, lack of assertiveness) rather than language difficulties. Alternately,

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NNS may make attributions about NS – for example, that they are uncaring or insensitive to NNS' language challenges. As multinational organizations increasingly mandate a *lingua franca* (common language) [26], attribution misjudgments between NS and NNS can disrupt collaboration and in turn, organizational success.

To support NS and NNS in CMC, previous work has explored various means to reduce the cognitive burden NNS experience (e.g. [50]), improve NNS comprehension (e.g. [39 16, 23]), and establish conversational grounding in multilingual conversations (e.g. [48, 49, 13, 17]). Yet, to date, little research has investigated the impressions and attributions NS and NNS form about each other in CMC and the technological opportunities to support accurate attributions in NS-NNS computer-mediated interactions.

To address this gap, we conducted an exploratory laboratory study with 16 groups (each group with 2 NS and 1 NNS) to investigate the impressions and attributions NS and NNS form about each other during videoconferencing. Each group completed a series of collaborative tasks, where during each task, a 3D camera detected participants' verbal and non-verbal behaviors. After the task, participants were shown a graph of the detected behaviors of all group members, and asked to write a self-reflection questionnaire to explain their own graph data, which was then shared with other group members. The graph and self-reflection questionnaire was used as a probe to elicit NS and NNS impressions and attributions of one another during the collaborative tasks. We explored four research questions:

- *RQ1:* What attributions did NS/NNS make to understand their own graph data?
- *RQ2*: Did mismatches occur between how NS/NNS attributed their own graph data versus how others attributed their data?
- *RQ3:* What function (if any) did writing and sharing the self-reflection questionnaire about one's own graph data serve for NS and NNS?
- *RQ4:* What influence (if any) did reading other group members' self-reflection questionnaires have for NS and NNS?

Our findings show that the graph and shared self-reflection questionnaire acted as an effective probe to elicit impressions and attributions between NS and NNS. Our findings revealed a significant mismatch between how NS attributed NNS' graph data, but no significant mismatch in how NNS attributed NS' graph data. Due to cognitive overload stemming from language challenges, NNS were only able to engage in a form of "compromised" impression management during the task. Yet, NS were relatively unaware of how profoundly language barriers impacted NNS' verbal and nonverbal behaviors. Our findings identify opportunities for the design of CMC technologies to support NS-NNS interactions, particularly in the domain of impression construction and impression management.

BACKGROUND AND RELATED WORK

We situate this study along several threads of related work: 1) impression and attribution errors in distributed teams, 2) attribution misjudgments between NS and NNS and 3) Computer-mediated support tools for NS and NNS.

Impressions and Attribution Errors in Distributed Teams

The impressions people form about others significantly impact how people perceive, evaluate, and treat them [31]. Impressions include a variety of attributions about the other person [35], where *attribution* is defined as the process by which people make inferences about the causes of events [8]. In the workplace, peoples' attributions of others significantly influence subsequent feelings, thoughts and behaviors towards them [8, 10], affecting organizational outcomes such as evaluations of performance [14], the allocation of credit or blame [14] and team cohesion [5].

Yet, the attributions people make about others can often be inaccurate. When motivation is low, information is scarce, or cognitive capacity is strained, people rely on a minimally sufficient amount of cues to form a judgment of others [10]. In such cases, people tend to overweight dispositional factors (personal traits) over situational factors when attributing others' behaviors, known as the *fundamental attribution error* [24]. For example, if a colleague is late to an important meeting, observers may conclude he is disorganized or careless (dispositional), while the colleague may attribute his own lateness to a family emergency (situational). This happens because the actor typically has more information concerning the situation and the way it affected their behavior compared to the observer [28].

While the fundamental attribution error can occur in collocated teams, studies show it is exacerbated in distributed teams [8]. Distributed teams often span multiple cultural, linguistic, organizational and professional boundaries, collaborate on short-term tasks, and communicate heavily over CMC tools. Consequently, compared to collocated teams, distributed teams experience a higher cognitive load [8] and have reduced access to social and contextual cues [47]. These factors exacerbate the likelihood of the fundamental attribution error [8].

Attribution Misjudgments between NS and NNS

To facilitate collaboration across national and linguistic boundaries, the mandate of a *lingua franca* has become increasingly prevalent in multinational organizations [37]. However, disparities in coworker lingua franca proficiency have been identified as a "fault-line" dimension [30], contributing to subgroup formation of an "us versus them" dynamic [26], and a cycle of negative emotions that disrupt interpersonal relations and collaborative work [36].

Compared to NS, NNS experience a significantly higher cognitive load [45]. During multiparty conversations with NS, NNS are overwhelmed with multiple parallel processes including foreign language comprehension, production, and intensive thinking, which is typically accompanied by internal speech in their native language [45]. In conversations with majority NS, discussions can move forward rapidly while NNS are left behind [50]. In synchronous CMC, such challenges are only exacerbated due to imperfect audio conditions [50, 13].

For NNS, engaging with NS may also bring up negative emotions (e.g. fear, social discomfort, embarrassment), due to failure or perceived failure in such encounters [37]. In turn, NNS may exhibit more tense and apprehensive nonverbal behaviors with regards to facial activity, eye contact, smiling, posture, and gestures [20], may try to manage their self-presentation by speaking less [32, 49], and refrain from asking clarification questions [22].

Yet, not speaking also has costs. Previous research of NS-NNS collocated interactions suggests that NS may be unaware of the extent of language challenges faced by NNS and how such challenges may hinder interactions [51]. This conjecture may be particularly relevant in videoconferencing, where peoples' evaluations of others rely more on communication competence, than on task competence [44]. Since communication competence is directly influenced by linguistic fluency, the attributions NS form about NNS may be particularly affected. For example, if a NNS speaks very little during a meeting, NS may attribute their low level of participation due to dispositional factors (e.g. shyness) rather than language barriers. Alternately, NNS may make inaccurate attributions about NS – e.g. if the NS dominates the conversation, that they are uncaring or insensitive to NNS' language difficulties.

Computer-Mediated Support Tools for NS and NNS

Researchers have explored various support tools to facilitate NS-NNS interactions in CMC. Approaches include alleviating the cognitive burden experienced by NNS by providing them with additional processing time (e.g. [50]), the use of automated speech recognition (ASR) and real-time transcripts to support NNS in listening comprehension (e.g. [16, 23, 39]), as well as machine translation tools to facilitate conversational grounding in multilingual conversations (e.g. [13, 17, 48, 49]).

To date, the focus of this research has been to support NNS in improving comprehension and participation with NS in CMC. However, little is known about the impressions and attributions NS and NNS form about each other in synchronous CMC, and the opportunities for technology support. While impression management has been a topic of research interest in social networking sites (e.g. [29, 40, 43]), peer production sites (e.g. [33, 34]), and online dating sites (e.g. [52, 4]), such studies focus on asynchronous, rather than synchronous CMC interactions. Additionally, such studies have not investigated impression management or attributions within the context of linguistic fluency.

METHOD

To investigate NS-NNS impressions and attributions of one another over videoconferencing, we conducted an exploratory laboratory study with 16 groups (each group with two NS and one NNS). We chose this setup of majority NS and minority NNS, since NNS are often dominated in multiparty conversations with majority NS [50, 36]. We wished to evoke this scenario in the current study since we believed NS and NNS may form different attributions and impressions of each other in this context. A triad (two NS and one NNS) represent the minimum unit of multiparty interactions to evoke this pattern.

Participants

The study was advertised to participants as an exploration of "group dynamics over videoconferencing", where they would be "collaborating with two other people on a decision-making task over videoconferencing". We recruited 48 participants: 32 NS (12 female, 20 male) and 16 NNS (6 female, 10 male). NNS included 11 Japanese and 5 Chinese participants. NS in three out of sixteen groups knew each other to some capacity before the study, while none of the NNS knew any NS in any group. The mean age for NS participants is 30.34 (SD=6.25), and for NNS participants is 24.75 (SD=2.41). None of the NNS participants lived in an English-speaking country for more than one year. NNS rated their fluency as medium (14 NNS) or low (2 NNS) (M=3.62, SD=1.02 on a Likert scale of 1=not fluent at all, 7=very fluent). We did not recruit NNS with high English fluency, since we wished to evoke attributions related to discrepancies in linguistic fluency.

Setup

Upon arrival, participants were led into separate rooms located on the same floor. Instructions for the study were then given over Skype audio. All task documents were in English. NNS were provided an additional document containing task translations of possible unknown vocabulary, and the opportunity to ask clarifying questions in their native language to the interviewer in the room. During group discussions, participants collaborated over 3-way Skype videoconferencing, where each participant's behaviors were detected by a 3D camera. Video and audio data was recorded from a screen capture program and a camcorder located behind each participant.

Procedure

Each study lasted approximately 2 hours. During this time, participants completed three collaborative decision-making tasks over 3-way videoconference, where during each videoconference, participants' verbal and nonverbal behaviors were detected by a 3D camera. We introduce the study procedure below:

1. **Introduction** and instructions
2. **Training trial:** Collaborative decision-making (Task I)
3. **Trial 1:** Collaborative decision-making (Task II/III)
4. **View graph** (from Trial 1) of detected verbal and nonverbal behaviors of all group members
5. **Write** self-reflection questionnaire about own graph data (Shared)

6. **Write** other-reflection questionnaire about other group members' graph data (Private)
7. **Read** other group members' self-reflection questionnaires
8. **Trial 2:** Collaborative decision-making (Task III/II)
9. **Semi-structured interview**

The combination of graph data, the self-reflection questionnaire, and the other-reflection questionnaire were meant as probes to elicit NS-NNS impressions and attributions of one another during Trial 1. The semi-structured interview aimed to investigate how the graph, the self-reflection and other-reflection questionnaire influenced NS-NNS impressions and attributions of one another in Trial 2. We describe the main components below.

Collaborative Decision-Making: Survival Task Series

For a discussion topic, we chose the desert survival task series[1]. The survival tasks are often used in organizations to encourage team cohesion during initial team formation. We use this task series (steps 2, 3, 8 above) to mimic a workplace situation where distributed team members (two NS and one NNS) form impressions and attributions about one another in synchronous CMC.

Participants collaborated on modified versions of three survival tasks in different environments: desert, ocean and lunar. The goal is to rank salvaged items from most to least important for group survival. For each task, participants first ranked the items individually, and then discussed the rankings over videoconferencing to decide on a group ranking. Example items included a "cosmetic mirror" (desert), "opaque plastic sheeting" (ocean), and an "FM Receiver" (lunar). The desert task was used for training, to familiarize participants with the task, with each other and with videoconferencing as a communication channel. The ocean and lunar tasks were counterbalanced.

Graph of Detected Verbal and Nonverbal Behaviors

To elicit NS-NNS impressions and attributions of each other, we detected four simple measures of verbal and nonverbal behaviors that are 1) important cues that inform impressions and attributions [35], 2) might show up differently for NS and NNS during group discussions, based on related work and our previous experimental data of NS-NNS conversations (e.g. [13, 50]), and 3) easy to automatically detect in real-time. Detected verbal behaviors included the amount of words and the amount of verbal acknowledgements (e.g. "yeah", "ok", "uh-huh"). Detected nonverbal behaviors included the amount of time looking at others and the amount of time smiling. Graph data for verbal behaviors were calculated as ratios to total amount of verbal behaviors (i.e. amount of words / total amount of words) within the group, whereas graph data for nonverbal behaviors were calculated as ratios to total interaction time (i.e. time smiling / total interaction time).

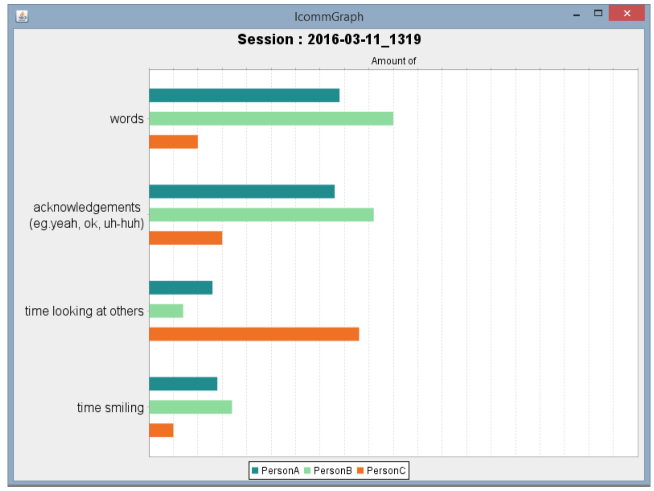

Figure 1. Example graph (from Group 7, Trial 1). Person A and Person B refer to NS, Person C refers to the NNS.

We detected "amount of words" since it is an indicator of speech fluency, which is the strongest predictor of perceived competence, credibility, persuasiveness [6], dominance and status [27]. Since NS have higher speech fluency than NNS, "amount of words" may reveal differing interpretations by NS and NNS. We detected "amount of verbal acknowledgments" since auditory backchannel responses can express agreement [41]. However, compared to NS, NNS use fewer backchannel responses to express acknowledgment [12], which may contribute to differing interpretations by NS and NNS. We detected "time looking at others" since speakers who engage in eye contact are perceived as more trustworthy and confident than those who continually avert their gaze [25]. Since NNS may limit eye contact when processing or communicating foreign speech [20], this measure may elicit differing interpretations. Finally, we detected "time smiling" due to its associations with higher persuasiveness [21]. NNS who are cognitively overloaded may smile less [20], potentially impacting the attributions NS form of them. The above four measures are by no means exhaustive - rather, they represent a sampling of behavioral cues, which we believed might elicit different attributions by NS and NNS.

To detect these behaviors, we used the Intel RealSense front-facing 3D camera[2], which we mounted on top of each participant's laptop. During introductions (step 1), participants were told that a 3D camera will detect their verbal and nonverbal behaviors during the videoconference and they will be shown this data later in the study. After Trial 1's group discussion, each remote participant was shown a simple bar graph (step 4), which visualized the detected behaviors of all group members (Figure 1).

[1] Human Synergistics Company. http://www.humansynergistics.com/

[2] Intel RealSense camera: https://software.intel.com/en-us/realsense/sr300camera

Self-reflection and Other-Reflection Questionnaires

Writing the self-reflection questionnaire (shared): After seeing the graph, participants were asked to reflect upon their own graph data in a questionnaire, which they were told would be shared with other group members (step 5). Instructions were to "Please discuss your OWN behavior based on the graphs" in an open-ended text-field. Each of the four detected behaviors provided an example prompt, such as "E.g. I talked the most/the least because…" or "E.g. I smiled the most/the least because…"

Writing the other-reflection questionnaire (private): Next, participants were asked to write reflections of other group members' graph data with the knowledge that their responses would not be shared (step 6). Questions were similar to the self-reflection, except asked about other members (e.g. "Person B talked the most/least because…").

Reading others members' self-reflection questionnaire: Next, the two NS were shown the self-reflection questionnaire of the NNS, while the NNS read the self-reflection questionnaires of NS1 and NS2 (step 7). Since this current study focuses on attribution misjudgments resulting from a disparity in linguistic fluency, NS were not shown each other's self-reflection questionnaires. Finally, we chose to only share participant reflections of their own graph data, since we felt participants may be uncomfortable sharing their reflections of other group members' data.

Semi-structured Interviews

After Trial 2, we conducted semi-structured interviews (step 9), which lasted between 15 to 35 minutes. Participants were interviewed individually, where NS were interviewed in English and NNS in their native language (Japanese or Chinese). All interviewers followed the same protocol, which explored themes such as: impressions of the graph, attributions of the four graph measures for self and other group members, comparisons of impressions and attributions between Trial 1 and Trial 2, perceived usefulness of feedback and other topics that emerged.

Data Analysis

Semi-structured interviews: All interviews were partially transcribed. Using inductive qualitative methods [7], all participant quotes were then arranged into an affinity diagram by the first author, where high-level themes and relationships between the themes were inductively generated. Next, all authors collaboratively discussed the high-level themes to iteratively refine the codes. The findings below emerged from this collaborative analysis.

Self-reflection and other-reflection questionnaires: We will refer to the "self-reflection questionnaire" and the "other-reflection questionnaire" when referring to the study documents used by participants. We will use the term "self-attribution" and "other-attribution" to refer to the analysis we conducted on participants' self-reflection and other-reflection questionnaires. "Self-attribution" refers to how participants attributed their own graph data. "Other-attribution" refers to how participants attributed other members' graph data. To code the self-reflection and other-reflection questionnaire data, authors of this paper acted as two independent coders to annotate the data using the annotation scheme described in Table 1 (Cohen's $\kappa = 0.78$, 84.9%). After annotating the dataset independently, the two coders resolved all disagreements to create the final categorization. 16 out of 576 attributions were annotated by both coders as belonging to two categories (see Table 1), bringing the total number of data points for analysis to 592.

Category	Definition
Dispositional factors	Attribution to communication style, personality, identity, etc.
Situational factors	Attribution to study setting, task, group dynamics, etc.
Language	Attribution to language background, foreign language fluency, etc.
Culture	Attribution to cultural norms and differences, etc.

Table 1. Annotation scheme used for quantitative analysis of the self-reflection and other-reflection questionnaire

FINDINGS

We first present an overview of graph data in Trial 1 and Trial 2. Next, we present our findings, organized around our four research questions. The findings emerged from an analysis of the qualitative interviews and the self-reflection and other-reflection questionnaires. We interpret these findings within the lens of impression management literature. Participant quotes are referred to by the group number and whether the person is a NS or NNS (e.g. G3-NNS). Finally, we discuss comparisons between Trial 1 and Trial 2 and provide possible explanations for Figure 2.

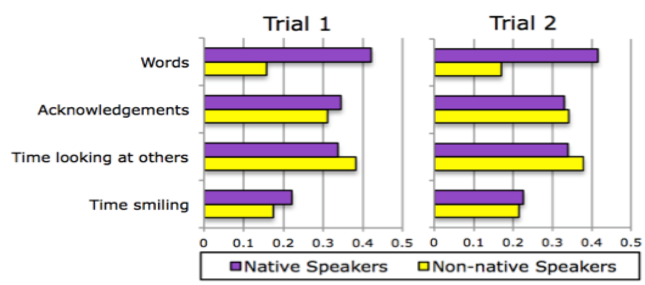

Figure 2. Average graph data for Trial 1 and Trial 2.

Overview of graph data in Trial 1 and Trial 2: The graph detected verbal and nonverbal behaviors of participants in all groups. The average graph data[3] for Trial 1 and Trial 2 is illustrated in Figure 2. Results from a Chi-square test indicated no significant difference for NS ($\chi^2[3]=0.005$, p=*n.s.*) or NNS ($\chi^2[3]=0.43$, p=*n.s.*) average graph data between Trial 1 and Trial 2.

[3] Due to a data logging error for three groups, the average graph data in Figure 2 is calculated from 13 out of 16 groups.

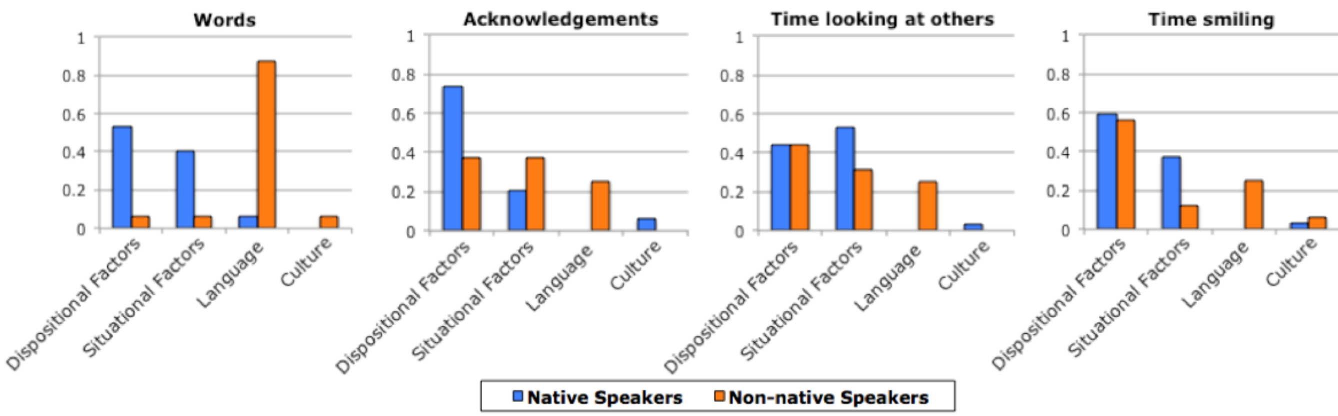

Figure 3. Ratio of self-attributions by NS (N=32) and NNS (N=16) regarding graph data for amount of words, amount of verbal acknowledgements, time looking at others and time smiling.

RQ1: What attributions did NS/NNS make to understand their own graph data?

We first present our quantitative results drawn from the self-reflection questionnaire. Next, we interpret these results from the lens of our qualitative interview data.

NS and NNS differed significantly in how they attributed their own graph data. Our quantitative findings (Figure 3) indicate that NS and NNS differed significantly in how they attributed their own graph data regarding amount of words ($\chi^2[3]=33.0$, $p<.05$), amount of verbal acknowledgements ($\chi^2[3]=12.9$, $p<.05$), time looking at others ($\chi^2[3]=9.61$, $p<.05$) and time smiling ($\chi^2[3]=10.6$, $p<.05$). For all graph measures, NS primarily attributed their own graph data to dispositional factors (e.g. personality, communication style) or situational factors (e.g. task, group dynamics). In comparison, over 85% of NNS attributed "amount of words" to language difficulties and at least 20% of NNS attributed the other graph measures of acknowledgements, time looking at others and time smiling to language challenges as well. Our qualitative findings below reveals that seeing one's own graph data represented different things for NS compared to NNS.

For NS, the graph served as probe to elicit beliefs or perceptions of their concept of self. If NS' graph data matched their self-perceptions or expectations, participants would judge this as an acceptable representation of their concept of self, perceiving that they did "well". Some NS would then attribute their graph data to dispositional factors such as their personality or communication style. For example, G7-NS2: *"[The graph] didn't surprise me. I was happy to know I had the most acknowledgements. Because in group discussions, […] it's important for others to acknowledge that a person is being heard, otherwise that's when the dynamic falls apart. That's important to me."*

G6-NS2: "The graph wasn't surprising. […] I'm an introvert so looking at others and smiling is lower than others [in the graph] because of my personality."

However, sometimes NS' graph data did not match their concept of self. In such cases, participants perceived this discrepancy to be undesirable, where they perceived they did "worse" than they thought. We present the example of G4-NS1, who had the lowest values on all graph measures, relative to NS2 and NNS. In G4-NS1's interview, he said: "*I felt a bit ashamed [when I saw the graph]. […] It's three equal people in a videoconference, making a decision together. [The measures] should be equal hopefully."* However, in his self-reflection questionnaire, G4-NS1 attributed this discrepancy to situational factors (e.g. the task). For example, for the "smiling" graph measure, he wrote: "*I smiled the least because there were few humorous situations, and I believe there were few suitable situations in the conference to express happiness"*. This finding is consistent with attribution theory, which states that actors often use dispositional explanations when the behavior reflects well on them but not when the behavior reflects poorly on them [28].

NNS perceived the graph to be a representation of their behavior when limited by language difficulties, and thus did not discuss the graph in terms of concept of self. Whereas NS participants discussed the graph data in terms of their concept of self, NNS did not. NNS participants interpreted their own graph data merely as a representation of their behavior when constrained by language challenges. This was particularly true for "amount of words", where the NNS in all groups (except three) had the lowest value in Trial 1. (For these three groups, one NNS had the highest words, two NNS had the second highest words).

The majority of NNS attributed their "amount of words" graph data to language barriers. For example, *G8-NNS said: "The graph matched my expectations. They're native speakers. There was no chance for me to cut in."*

G9-NNS*: "Words matched my expectations. I was nervous. I wasn't confident in English. I felt it's really different from a discussion with three Japanese people. So I 'shrunk' my body language and that was reflected in the graph."*

For the graph measures of acknowledgements, time looking at others and time smiling, several NNS also attributed this to language challenges. For example, G13-NNS said: *"My acknowledgements is higher because I didn't know how to say it, so I just had more 'uh-huh, ah, mm'."*

G10-NNS: "Because I'm a NNS, it's difficult for me to understand everything by listening. So [looking at] visual cues, facial expressions, gestures helped supplement the things I couldn't understand only from listening."

G9-NNS: "I tried to smile more because I can't speak well in English. So I couldn't do anything else but smile. I didn't want to make the mood bad by making a serious face."

Since NNS felt the graph showed a representation of their behavior when limited by language difficulties, the notion of a discrepancy between the graph data and concept of self was not mentioned by any NNS during the interviews.

Interpretation of Results

While impression management is often understood as peoples' attempts to manage the impressions others form of them [18, 31], it can also refer to peoples' efforts to control their impression of themselves [19]. People try to maintain certain views of themselves for enhancement or maintenance of self-esteem and development of identity [19, 31]. In our study, the graph acted as a probe that elicited peoples' perceptions about their concept of self. However, this was only true for NS. None of NNS discussed the graph in terms of their self-concept, but rather perceived language limits as an external factor that impacted their behavior during the videoconference.

One interpretation of this result is that unlike NS, NNS are cognitively overloaded with foreign language production, comprehension and thus did not have the usual resources to do impression management as they would in their native language. Since NNS may have felt the graph did not portray an accurate impression of them, the graph did not act as a probe for eliciting their concept of self but rather portrayed a representation of NNS when they are only able to do "compromised" impression management, particularly on the behaviors they could control (e.g. smiling).

RQ2: Did mismatches occur between how NS/NNS attributed their own graph data versus how others attributed their data?

We compared participant responses in their self-reflection questionnaire (how they attributed their own graph data) to their responses in the other-reflection questionnaires (how they attributed other members' graph data). We categorized this using the annotation scheme presented in Table 1.

There was no significant difference between how NS attributed their own graph data versus how NNS attributed NS' graph data, except for "acknowledgements". Table 2 presents the ratio of NNS' attributions of NS graph data for the four graph measures: words, acknowledgements, looking at others and smiling. NS self-attributions are in brackets. Results from a Chi-square test showed that the distributions of NNS' attributions of NS graph data compared with NS self-attributions were significantly different for the amount of acknowledgements ($\chi^2[2]=9.89$, $p<.05$). For the other graph measures (words, looking at others, smiling), the distributions of attributions were not significantly different.

	Dispositional Factors	Situational Factors	Language	Culture
Words	0.32 (0.53)	0.59 (0.41)	0.09 (0.06)	0.00 (0.00)
Acknowledge-ments (*)	0.44 (0.74)	0.56 (0.21)	0.00 (0.00)	0.00 (0.06)
Time looking at others	0.27 (0.44)	0.70 (0.53)	0.03 (0.00)	0.00 (0.03)
Time smiling	0.56 (0.59)	0.44 (0.38)	0.00 (0.00)	0.00 (0.03)

** p < .05*

Table 2. Attributions of NS graph data by NNS (NS self-attribution in brackets).

There was a significant difference (mismatch) between how NNS attributed their own graph data versus how NS attributed NNS' graph data, except for "acknowledgements". Table 3 presents the ratio of NS attributions of NNS graph data for the four graph measures. Results from a Chi-square test showed that the distributions of NS' attributions of NNS graph data compared with NNS self-attributions were significantly different for amount of words ($\chi^2[3]=7.89$, $p<.05$), and marginally significant for time looking at others ($\chi^2[3]=6.88$, $p=.07$) and time smiling ($\chi^2[3]=7.45$, $p=.06$). The distributions of attributions were not significantly different for acknowledgements. These results indicate that NNS' attributions of NS graph data matched with NS self-attributions, for all measures except "acknowledgements" (Table 2). In contrast, NS' attributions of NNS graph data did not match NNS self-attributions, except for "acknowledgements" (Table 3). Qualitative findings are below.

Many NS seemed unaware of the magnitude of language challenges experienced by NNS and its impact on "amount of words". In the other-reflection questionnaire, several NS made dispositional attributions of NNS for "amount of words". For example, G10-NS2 wrote: "*[NNS] talked the least because he was polite and let others explain their reasoning first before agreeing, disagreeing or elaborating."* In contrast, G10-NNS wrote: *"I talked least because my English skill is most least [the worst]."* In a different group, G12-NS1 wrote: *"[NNS] talked the medium amount likely because he was confident about his ideas, but not naturally dominant to take control."* In contrast, G12-NNS wrote: *"I was talking in the medium level because I am not fluent in explaining my opinion in English, so I think it is better if someone else could speak more and initiate the discussion."*

During the qualitative interviews, several NS mentioned their surprise when reading NNS' self-reflection questionnaire with regards to their language difficulties during Trial 1. For example, G10-NS2 said: *"I thought [NNS]'s command of the language seemed rather good […]. He clearly understood the question and had a coherent response. In his self-reflection, he seemed less confident in his speaking abilities than I gave him credit for."* In another group, G2-NS2 said: *"[NNS] said [wrote] she wasn't confident in her English. But I felt, she seemed okay to me. That's the only discrepancy I felt there was."*

	Dispositional Factors	Situational Factors	Language	Culture
Words(*)	0.23 (0.06)	0.29 (0.06)	0.43 (0.88)	0.06 (0.06)
Acknowledge-ments	0.18 (0.38)	0.39 (0.38)	0.18 (0.25)	0.24 (0.00)
Time looking at others (+)	0.16 (0.44)	0.63 (0.31)	0.16 (0.25)	0.06 (0.00)
Time smiling (+)	0.21 (0.56)	0.45 (0.13)	0.27 (0.25)	0.06 (0.06)

** p < .05, + p < .10*

Table 3. Attributions of NNS graph data by NS (NNS self-attribution in brackets).

Many NS seemed unaware of how language challenges impacted NNS' behavior, with regards to "time looking at others" and "time smiling". We present the example of G1-NS1, who in his other-reflection questionnaire, attributed G1-NNS's "time looking at others" graph data to engagement with the task: *"[NNS] spent the most time looking at others likely because he was intently listening to the conversation".* In contrast, G1-NNS attributed his own graph data for "time looking at others" to language challenges by writing: *"I looked at others the most because I think I cannot understand what other participants say well without looking at them."* For the graph measure of "time smiling", we present the example of G15-NS1, who attributed NNS' behavior to frustration with the task: *"Maybe [NNS] was tied for the least [in smiling] due to frustration and having his list almost completely disagreed with."* In contrast, for "time smiling", G15-NNS wrote, *"I struggle to understand others, so I must focus on listening".*

For many NS, having awareness of how profoundly language challenges impacted NNS behaviors was difficult because group members met for the first time and were unsure what could be attributed to dispositional or situational factors versus language. For example, when asked whether the NNS' graph would change if the conversation had been in his native language, G12-NS2 said: *"Yeah maybe just a bit. Not a massive difference but definitely a discernible difference. […] I'm not sure how much is language and how much is personality. Maybe he's just very introverted."* In contrast, G12-NNS felt his graph data would be significantly different, had it been in his native language*: "If the task were in Chinese, yeah, I would probably be like [NS1]. But in this situation [because I'm a NNS], I'm definitely not suited for this [leadership] role."*

Interpretations of Results

One interpretation of this result is that NS were able to engage in impression management during the videoconferencing. Thus, the attributions NNS made about NS' graph data matched with self-attributions of NS, for most of the graph measures. In contrast, due to language challenges, NNS may not have been able to engage in impression management during the videoconference. Attribution mismatches may have occurred since NS were not aware of how much language challenges impacted NNS' verbal and nonverbal behaviors. This was reflected in the qualitative interviews, where many NS were surprised to learn about the language struggles mentioned in NNS' self-reflection questionnaires, for "amount of words", "time looking at others" and "time smiling".

RQ3: What function (if any) did writing and sharing the self-reflection questionnaire about one's own graph data serve for NS and NNS?

For NS and NNS, writing and being able to share their self-reflection questionnaires with other group members allowed participants to explain or justify their graph data, with the intention to resolve possible mismatches in attributions or impressions. However, the ways NS and NNS used the self-reflection questionnaire to achieve this goal differed.

When NS perceived an undesirable discrepancy between their graph data and their concept of self, NS used the self-reflection questionnaire to write about their ideal self – how they wish they would have behaved. In such cases, NS would mention in their self-reflection questionnaire how they could have communicated or collaborated better in a group. For example, G8-NS1 wrote: *"Apparently I talked the second most. […] Unfortunately, it seems that [NNS] spoke far less than us, so I think we could have done a better job allowing him to speak more."*

G10-NS2 wrote: *"Acknowledgements are useful in letting people know you're listening to them and I should probably use more to make others in the group feel valued."*

NNS used the self-reflection questionnaire to resolve possible attribution mismatches due to language. As identified in RQ1, NNS perceived the graph to be representation of their behavior when constrained by language challenges, where they could only do a compromised form of impression management. Many NNS realized NS might not have this awareness when attributing causality of NNS' graph data. To address this, NNS used the self-reflection questionnaire to explicitly attribute their graph data to language challenges. Some NNS used their self-reflection questionnaire to indirectly ask for help from NS, with the hope that NS would be more understanding to their language difficulties. For example, G1-NNS said, *"My English skill is low, so I can't express myself very well. Sharing the self-reflection gave me another channel to express myself. […] It was really good to share my feelings.*

*But I felt guilty, it was like asking them to pay more attention to me. […] It was good that others got to understand me more. It became easier to collaborate. But I feel like if they *had* to help me, I would feel bad."*

G11-NNS: "If it's just the graph that's shown, then I feel a bit embarrassed because it's just showing how bad I'm doing. But the self-reflection gave me a chance to explain."

Interpretations of Results

Impression construction is defined as the process by which people alter their behaviors to affect others' impressions of them [31]. For both NS and NNS, writing and sharing the self-reflection questionnaire allowed participants another channel for impression management and specifically, a tool for impression construction. The self-reflection questionnaire acted as a "meta-channel" to communication, allowing NS and NNS to justify or explain their graph data, with the intention to correct any attribution mismatches. Thus, both NS and NNS used the self-reflection questionnaire for impression construction, in terms of how they wanted others to perceive their graph data and in turn, how they wanted others to perceive them. It is interesting to note that all participants, except one (G12-NS1), believed that what others wrote was indeed an honest reflection of their own graph data. Only G12-NS1 said in his interview that the self-reflection questionnaires of others may not necessarily represent their true character, but rather how they wanted to be perceived by others.

RQ4: What influence (if any) did reading others' self-reflection questionnaires have for NS and NNS?

For NS and NNS, reading others' self-reflection questionnaires allowed participants to gain insight and understand the other person better. This often led to intentions to adapt their behavior in Trial 2.

NS became aware of how profoundly language challenges impacted NNS' behaviors, which led to intentions to accommodate NNS more in Trial 2. As identified in RQ2, many NS were surprised at how much language impacted NNS' verbal and nonverbal behaviors. This information usually led NS to having more empathy for NNS, where NS would try to accommodate NNS more in Trial 2. For example, G3-NS1 said: *"[NNS], [he wrote] he felt nervous, he felt pressure, less confidence. […] I wanted him to smile more, speak more. I can't put a finger on how exactly I reacted to that but I wanted to help him make those changes."*

G8-NS2 said: *"In the last task, I tried to give [NNS] more time to talk, because he put me as the 'chairman' [in NNS' self-reflection]. […] I thought maybe I was a bit overpowering, so I tried to mellow out a bit [in Trial 2]."*

Some NS would adapt their communication style to what NNS wrote they needed help on (e.g. speaking slower or looking to give more visual cues). For example, G10-NS2 said*: "It was surprising but definitely explained the graph better. […] I read, […] how a lot of visual information helped him understand the situation more. […] Just how much he picked up visually, made me feel bad for not looking so much at the camera, to give him the information that he was looking for."*

For NNS, reading NS' self-reflection questionnaires sometimes encouraged NNS to participate more in Trial 2. As discussed in RQ3, some NS used the self-reflection questionnaire to write about their ideal self – how they think they should have behaved – when there was a discrepancy between the graph and their self-concept. Such reflections often placed an importance on equal group participation, and sometimes explicitly mentioned the NNS. After reading this, many NNS felt encouraged to participate more in Trial 2. For example, G8-NNS said: *"They're native speakers. They intentionally gave care to me. It was written there. So I felt happy, I felt like I have to work hard. […] By looking at their self-reflections, I felt encouraged, I felt they gave me more of a chance to talk."*

After reading the self-reflection questionnaire of NS, NNS sometimes adapted to mimic NS' communication style. In the interviews, many NNS talked about learning how to become a "better communicator" through what NS wrote in their self-reflections. For example, G11-NNS said: *"[NS1] wrote she intentionally used fewer acknowledgements since it acts as noise during the discussion. So I also tried to use fewer acknowledgments in the second trial. […] I always thought acknowledgments are polite, to show I'm listening. […] But after I read [NS1]'s self-reflection, oh, I thought that makes sense."*

Interpretation of Results

Reading the self-reflection questionnaire of other members was informative for NS and NNS in different ways. For NS, reading NNS' self-reflection questionnaire allowed NS to gain insight into NNS' language difficulties and its impacts on their verbal and nonverbal behaviors. This often led NS to have more empathy for NNS, which led to intentions to accommodate NNS more in Trial 2. Sometimes, reading NS' self-reflections were also valuable for NNS, in that it motivated NNS to participate more in Trial 2.

Comparisons between Trial 1 and Trial 2

Agreement between individual and group survival item rankings: As a measure of team performance, we calculated a Spearman's correlation coefficient comparing each participant's final item ranking to the group's ranking, for Trial 1 and Trial 2. The correlation coefficient represents participants' agreement with the group ranking after each trial, where agreement reflects participant satisfaction with the group ranking. Correlation values less than one indicate that the participant did not fully agree with the group's decision regarding the importance of one or more of the items. Results from a non-parametric Wilcoxon signed-rank test showed that the difference in NS' agreement score with group ranking between Trial 1 (M=0.87, SD=0.19) and Trial 2 (M=0.84, SD=0.28) was not statistically significant (Z=0.09, p=*n.s.*). The difference in NSS' agreement score with the group ranking between Trial 1 (M=0.89, SD=0.24) and Trial 2 (M=0.84, SD=0.26) was also not statistically significant (Z=0.17, p=*n.s.*).

Average graph data: We now discuss possible reasons why despite intention to adapt behavior, Figure 2 showed no significant change in the average graph data for Trial 1 and Trial 2. We offer several possible explanations.

First, behavior change may have occurred in Trial 2, though the changes in relative position within these groups (i.e. who talked most, who talked second most) were not unidirectional – some participants increased their own graph data, while others decreased their own graph data. Table 4 illustrates that behavioral change in terms of relative position changes did occur within some groups.

Words	2/16
Acknowledgements	6/16
Time looking at others	8/16
Time smiling	4/16

Table 4. Number of groups (N=16) where NNS relative positions changed for amount of words, amount of acknowledgements, time looking at others and time smiling.

Another possible explanation is having an intention to change may not necessarily result in actual behavior change. One reason for this may be group dynamics – it is not enough that one wants to change – others in the group must also allow space for this change. For example, G7-NS1 said: *"In the training and first task, [NS2] was the first one [in amount of words]. […] She reacted to her being the top speaker and tried to slow herself down [in Trial 2]. I had to start the second time. But pretty soon, things went back to the same thing. [NS2] is good at interjecting, in a good way. So we reverted back to our natural personalities."* Another reason may be that participants felt that they could only change behaviors that were under their conscious control. For some NS, "amount of words" was easier to control, whereas for some NNS, "time looking" and "time smiling" were easier to control. For example, G3-NS2 said: "*I thought maybe I should change something but I assumed I couldn't change my behavior that much. […] Time looking and smiling is very personality-wise, it's hard to change that automatically. […] But 'words' is easier to control for me."* In contrast, G6-NNS said: "*In the second trial, […] I tried to look at others more. Within this short time frame, I can't improve my English, so I can't increase number of words. The only thing I could improve is to look at others more."* This finding may potentially explain why in Table 4, 8/16 NNS changed their relative position for "time looking at others", whereas only 2/16 NNS changed their position for "amount of words".

Finally, although Figure 2 reflected little (actual) behavior change between Trial 1 and Trial 2, several NNS explicitly stated in their interviews that they were happy to be able to share their self-reflection questionnaires with NS members. In many cases, NNS participants said the quality of interaction felt better in Trial 2 and that NS members were more mindful of them. For example, G1-NNS said: *"In the second trial, I felt it was easier to say what I wanted to say. […] Maybe it's because they paid more attention to me. I felt they were more mindful […], I felt they waited more."*

OPPORTUNITIES FOR TECHNOLOGY SUPPORT

We discuss several opportunities for technology support: 1) implications for automatic sensing technologies, 2) provide NNS with alternate channels for impression construction, and 3) highlight the "invisible" language barrier.

Implications for automatic sensing technologies: Peoples' verbal and nonverbal behaviors all contribute to the formation of impressions about them [1]. As automatic sensing technologies become increasingly advanced, it becomes easier to non-intrusively detect such behaviors in multiparty meetings. Current approaches often provide quantitative feedback of such detected behaviors, such as a graph showing group participation (e.g. [11]) or social dynamics (e.g. [12, 42]). The idea is that such feedback can motivate more balanced group participation and in turn, improve collaboration and productivity [12].

While such approaches can be beneficial for multiparty groups communicating in the same native language [12], our findings indicate that providing only quantitative feedback of detected behaviors can be detrimental in teams where members differ in linguistic fluency. As found in our study, NNS felt the graph reflected poorly on them, particularly with regards to detected behaviors they had limited control over (e.g. amount of words). Consequently, we argue that designers supporting NS-NNS interactions should be cognizant of which behavioral cues to detect, how such cues are presented, and most importantly, that the same feedback may elicit different interpretations by NS versus NNS, which in turn, may impact team members' impressions and attributions of one another.

Provide NNS with alternate channels for impression construction: In workplace contexts, the primary dimension in how people evaluate others is impressions of competence (i.e. capability, intelligence, confidence) [10]. Yet in videoconferencing, impressions of distributed team members are primarily formed based on communication competence cues, rather than on task competence cues [44]. This may be because the communication abilities of distributed members are more visible to the camera's eye than behaviors related to task competence [44]. This finding may be particularly relevant for NNS, since communication competence is predominately relayed through linguistic fluency – a factor that many NNS in our study felt they had limited control over (in the short-term). One way to address this is to provide NNS with alternate channels to construct or manage impressions of competence, either through explicit self-generated cues (e.g. the self-reflection questionnaire as in our study), explicit other-generated cues (e.g. others' ratings of NNS' task expertise or knowledge), or alternate channels that allow NNS to implicitly convey communication competence and/or task competence (e.g. a collaborative visual workspace).

Highlight the invisible "language barrier": Our findings revealed that attribution mismatches were frequent in NS attributions of NNS' behavior, compared to NNS' self-attributions. NS participants were often unsure as to whether NNS behavior was due to dispositional factors, situational factors or language barriers. This indicates that the notion of "language barriers" is asymmetric. Although the term suggests the barrier is equally visible to all parties, many NS did not realize how profoundly language barriers impacted NNS' verbal and nonverbal behaviors.

To address this asymmetry, one approach is to highlight the invisible language barrier by 1) supporting NS in gaining awareness of the cognitive load NNS experience, and 2) revealing the potential impacts of this cognitive load on NNS' behavior and self-presentation. To address (1), work such as [16, 17] have explored the use of awareness applications that inform NS of NNS' challenges with comprehension and communication. To address (2), designers might explore how CMC tools can be augmented to support NS in conscious reflection of how they interpret NNS behaviors. Since others' impression-relevant cues are processed at a pre-attentive or nonconscious level [31], creating opportunities for "conscious, intentional inquiry" is an important component of the reflection process [3] – one that may mitigate inaccurate attributions and cognitive biases. Through conscious reflection, NS may also engage in perspective-taking and develop empathy for NNS, as indicated in our findings. Finally, it is important to note that in our (laboratory) study, NNS were glad to be able to explicitly attribute components of their behavior to language struggles. However, in an ethnographic study of a global tech company that mandated English as lingua franca, NNS employees hesitated to expose their language deficiencies for fear of its impact on the stability of their employment [37]. This suggests that managing impressions resulting from language barriers is a sensitive and complex issue - perhaps what to reveal and how much to reveal of the "invisible" language barrier in CMC interactions should be managed and controllable by the NNS themselves.

FUTURE WORK

First, our study explored the detection of a small sample of verbal and nonverbal behaviors. Future work should increase this sample to other behaviors that might lead to attribution mismatches between NS and NNS (e.g. speech rate, voice inflections, gestures). Second, our study focused on attribution mismatches stemming from a discrepancy in linguistic fluency. Yet language and culture are intertwined [51], where culture may influence attribution processes [28]. Future research should explore the relationship between culture, language and attributions over CMC. Third, while our study recruited NNS of primarily self-perceived medium fluency, future work should explore the attributions between NS and high fluency NNS. Finally, future work should explore the longitudinal impacts of sharing self-reflections on team members' expectations of one another and its impact on collaboration (e.g. NNS may feel that since NS understand them better, NS should be more considerate of NNS' language difficulties).

CONCLUSION

We conducted an exploratory study to investigate the impressions and attributions NS and NNS form about each other in multiparty videoconferencing. Our results show that the graph of detected verbal and nonverbal behaviors, combined with shared self-reflections was an effective probe to elicit impressions and attributions. Our findings revealed significant mismatches in NS attributions of NNS' behavior, but no significant mismatch in NNS attributions of NS' behavior. Due to cognitive overload stemming from language challenges, NNS were only able to engage in a form of "compromised" impression management during the task. Yet, many NS were unaware of how profoundly language difficulties impacted NNS' behaviors. Our findings point to opportunities for NS-NNS technology support, with regards to automatic sensing technologies, alternate channels for impression construction and highlighting the invisible "language barrier".

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