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Virtual voices: Exploring individual differences in chat and verbal participation in virtual meetings☆

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ABSTRACT

A key component of team performance is participation among group members. One widespread organizational function that provides a stage for participation is the workplace meeting. With the shift to remote work, roughly half of all meetings are conducted virtually. One encouraging opportunity that can elevate meeting participation in this context is the use of written chat. Chat offers a second avenue of participation during a meeting, where attendees can synchronously contribute to the conversation through writing. This study explores factors influencing participation in virtual meetings, drawing on individual differences (status characteristics theory), psychological safety perceptions, and group communication. Results reveal gender and job level nuances: women engage more in chat, while men verbally contribute more frequently. Further, we found men highest in job level verbally contributed the most in virtual meetings, whereas women highest in job level use the chat the most frequently. Regarding type of chats sent, women use emoji reactions more often than men, and men send more attachments than women. Additionally, results revealed psychological safety moderated the relationship between job level and overall chat participation, such that employees low in job level with high perceptions of psychological safety sent more chats than their counterparts. This study provides insights into communication patterns and the impact of psychological safety on participation in technology-mediated spaces.

1. Introduction

Participation is crucial for groups to realize their full potential. Groups greatly benefit from the diverse skills possessed by their members being brought to bear during discussions (Oetzel, 2001; Woolley et al., 2010), particularly when the group is heterogeneous (Bear & Woolley, 2011; Hoffman et al., 1962; Nemeth, 1986). Unfortunately, failure to share information and ideas can lead groups to make less than optimal decisions (Stasser & Titus, 1985, 1987). One essential, widespread organizational function that serves as a stage for group member participation, discussion and decision-making is the workplace meeting (Schwartzman, 1989). Employees lead and

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attend hundreds of millions of meetings each day across the globe (Keith, 2015; Rogelberg, 2019), and this number is on the rise. Recent data suggests that time spent in meetings per week increased roughly 150 % within the past year (Doodle, 2021). Meetings, being an everyday aspect of organizational life, can serve as a mechanism for promoting and encouraging participation in groups. Unfortunately, research finds that only 35 % of employees report feeling able to contribute during meetings, even when they have something to add to the conversation (Cullinan, 2016). Stated differently, nearly two thirds of meeting participants do not feel empowered to speak up during their meetings.

For decades, scholars have been interested in understanding, predicting, and explaining the factors that influence group members' participation in discussions, given it is the group's communication behaviors that often determine the quality (and quantity) of work-related outcomes (Bonito & Hollingshead, 1997). For example, research in the meetings-context has shown that participation relates to increased perceptions of meeting inclusivity and effectiveness (Cutler et al., 2021; Hosseinkashi et al., 2023). Additionally, an individual's participation in meetings is linked to an increased commitment to executing the decisions made during the meeting (Rosenberg & Rosenstein, 1980; Sagie & Koslowsky, 1996).

Meeting participation is certainly influenced by meeting modality, which has changed dramatically over time. In fact, recent statistics suggest that nearly half of all meetings today are virtual, mediated through technology (Cisco, 2022). Computer-mediated communication (CMC) is defined as any human communication that occurs using electronic devices (Romiszowski & Mason, 2013). While CMC can be used both synchronously (e.g., conference calls) and asynchronously (e.g., email communications) and for organizational purposes (e.g., work tasks) or social purposes (e.g., social media), the focus in this study is the synchronous use of CMC in a work-related context: the virtual meeting.

Beyond being facilitated through technology, virtual meetings contain a unique feature: the opportunity to engage with others via a parallel chat.[1] Parallel chat offers an additional means of participation during a meeting, where group members can synchronously contribute to the conversation (Houtti et al., 2022). Chat is usually open to all meeting participants and appears via text panes, windows, or overlays on the computer screen. While verbal (i.e., spoken) participation is typically regarded as the primary channel for information in meetings, it only accommodates one participant at a time (with occasional exceptions, like shared laughter). However, the meeting chat serves as an intriguing parallel information space that individuals may engage with or pay attention to under specific circumstances. Meeting participants report using the chat to ask and answer questions, voice agreement/disagreement with the speaker, share resources (i.e., links, documents), add information to the discussion, and to socialize (i.e., make jokes, share GIFs; Sarkar et al., 2021). In their recent study of over 800 employees; Sarkar and colleagues found nearly 70 % of employees reported using parallel chat in their meetings (26 % reported using chat in every or almost every meeting; Sarkar et al., 2021).

The use of written chat in virtual meetings is a more recent practice that is largely underexplored in both the meetings and group participation literature. While research on computer-mediated communication (O'Conaill et al., 1993; van der Kleij et al., 2009), media spaces (Bly et al., 1993) and remote work (Felstead & Henseke, 2017; Wang et al., 2021) provide frameworks for multi-modal collaboration, there is little prior exploration of parallel chat in virtual work-related meetings despite its theoretical grounding and practical importance. The current study leverages the literature on (a) participation in virtual groups, (b) meeting science (c) individual differences in communication (e.g., status characteristics theory), and (d) employee perceptions of psychological safety to explore employee participation in virtual meetings.

1.1. *Participation in groups*

For decades, group researchers have explored the effect of participation on various outcomes, including information pooling, decision making, group cohesion and leadership (Bonito, 2001; Bonito & Hollingshead, 1997; Dasgupta et al., 2015; Michinov et al., 2011; Vaughan & Stasser, 1996). Research has found groups with relatively equal patterns of participation are reported as having greater enthusiasm and energy (Ruback et al., 1984). When team members are fully informed and participate in decisions, they are more committed and productive (Blechert et al., 1987). Additional evidence suggests a connection between participation patterns and group performance, indicating that groups achieve optimal performance when participation is relatively equitable (Yetton & Crawford, 1992). For example, studies on information pooling have shown that teams are more likely to reach optimal solutions and make improved judgments when each member offers their distinct information (Hollingshead, 1996; Stasser & Titus, 1985).

Unfortunately, research suggests group members tend to share common information (Lu et al., 2012; Mesmer-Magnus & DeChurch, 2009; Reimer et al., 2010). This is often referred to as the *hidden profile paradigm* (Sohrab et al., 2015; Stasser & Titus, 1985, 2003), where information known to all group members is shared, while unique information (known to only one group member) is withheld (Schulz-Hardt & Mojzisch, 2012). The absence of sharing unique information results in incomplete knowledge factoring into the discussion and ultimately negatively influencing the group decision (Wittenbaum et al., 2004). In the case of a 'hidden profile', a large portion of the information that favors the best choice remains undisclosed within the group. Hence, hidden profiles and their negative implications can only be resolved if all group members exchange and integrate their unique pieces of information by participating in the conversation.

Given that full group participation of shared and unshared knowledge is often associated with positive processes and outcomes, it is important to explore the conditions under which members choose to share information – and *how* or *where* group members choose to participate. One primary site for participation in groups is the workplace meeting (Schwartzman, 1989). In this context, group

[1] The meeting chat is in parallel (synchronous) to speaking/verbal participation in meetings.

members come together to collaborate, communicate, and share information, making it a critical forum for knowledge exchange and decision-making within organizations (Leach et al., 2009; Mroz et al., 2018; Rogelberg et al., 2007).

1.2. Meeting science

Work meetings are defined as "purposeful, work-related interactions occurring between at least two individuals that have more structure than simple chat, but less than a lecture" (Rogelberg et al., 2006). Beyond their task focus, meetings serve as important forums for establishing organizational roles and building relationships (Putnam & Fairhurst, 2001; Scott et al., 2012). In some cases, workplace meetings represent one of the limited chances for employees to voice their viewpoints, present ideas to organizational leaders, and develop relationships with peers (Allen & Rogelberg, 2013).

Meetings vary in their inclusivity and effectiveness. An inclusive meeting is when everyone gets a chance to contribute, and all voices are heard (Cutler et al., 2021). Across industries, research has found the strongest predictor of perceptions of meeting inclusiveness was whether the attendees participated in the conversation (Hosseinkashi et al., 2023). In fact, participating in meeting conversation was associated with four times higher odds of having an inclusive experience (Hosseinkashi et al., 2023). Moreover, recent research finds comfortability speaking up in meetings and perceptions of meeting inclusivity are both significantly related to perceptions of meeting effectiveness (Cutler et al., 2021).

Communication and involvement in meetings influence meeting-related perceptions and/or evaluations of one's meetings. For example, research suggests that positive and constructive interactions in meetings relate to team productivity and meeting satisfaction (Kauffeld & Lehmann-Willenbrock, 2012). Providing individuals with the chance to engage in constructive negotiation during meetings (such as participating in a productive exchange of ideas) enhances meeting satisfaction, as participants actively contribute to the decision-making process (Cionea et al., 2021). Positive humor and laughter patterns can help stimulate constructive behaviors and group performance in meetings (Lehmann-Willenbrock & Allen, 2014). However, dysfunctional communicative behaviors such as complaining or criticizing others has shown negative relationships with meeting satisfaction, group productivity and organizational success (Kauffeld & Lehmann-Willenbrock, 2012).

In essence, the quality of communication and interaction during meetings influences the overall meeting experience, highlighting the significance of prioritizing and fostering active meeting participation. Moreover, participation in virtual meetings, which encompasses the use of written chat, is an evolving area of interest (Hosseinkashi et al., 2023). In this study, we focus on the antecedents, particularly individual differences, that shape the use of verbal and written participation in a virtual meeting context.

1.3. Status characteristics theory

Status characteristics theory suggests that performance expectations in groups are influenced by the "status" or social meaning that individuals assign to characteristics of various group members (Berger et al., 1972, 1980; Bunderson, 2003). At the core of this process is the concept of "status characteristics," which includes the attributes possessed by individuals to varying degrees. These levels of attributes carry a level of value or importance (Berger et al., 1972; Ridgeway, 1993). When a group member's status characteristics are prominent, the group creates expectations regarding their performance (Berger et al., 1980). This status information reflects each individual's perceived level of ability or expected performance relative to other group members. A member's expected performance influences their position within the group's power and prestige hierarchy (Berger et al., 1972, 1980; Ridgeway, 1991). Those with higher expected performance are positioned more favorably in this hierarchy, which comes with certain advantages. For instance, these members often have greater opportunities to participate, initiate problem-solving, receive positive evaluations for their contributions, and exert influence over others (Berger et al., 1980).

Because of this, status is arguably one of the most studied group characteristics relevant to participation (e.g., Bonito & Hollingshead, 1997; Goar & Sell, 2005; Ridgeway & Walker, 1995; Walker et al., 2014). In situations where individuals collaborate to work towards shared objectives, a well-established body of research demonstrates that disparities quickly manifest in terms of each member's level of involvement, the attention and feedback they receive for their efforts, and their overall influence (for a comprehensive review, see Ridgeway & Walker, 1995). For example, prior research has shown that an individual's perceived position within the team influences outcomes such as their inclination to actively voice their opinions and participate in the conversation (Bienefeld & Grote, 2014; Nembhard & Edmondson, 2006). Below, we review two predominant and widely studied status characteristics which likely influence an individual's likelihood to participate in group discussions: gender and job level.[2]

There is extensive evidence that gender is a main status characteristic in groups research (e.g., Strodtbeck et al., 1957; Wagner et al., 1986) and in studies of conversation (e.g., Kollock et al., 1985; West & Zimmerman, 1977). This evidence suggests that gender stereotypes generate beliefs linking higher competence to men compared to women, especially in valued social contexts such as the workplace (e.g., Broverman et al., 1972; Williams & Best, 1990). This leads to men verbally contributing more to discussions, having more power in decision-making, more often assuming leadership positions, receiving more positive statements and fewer negative statements, interrupting more often, and so on (Karpowitz et al., 2012; Ridgeway & Smith-Lovin, 1999; Smith-Lovin & Brody, 1989). In

[2] A third widely researched, salient status characteristic relevant to participation in groups is race (Berger et al., 1972; Bunderson, 2003). However, the employees in our sample had minimal racial diversity which limited our ability to test for racial differences in chat use between multiple groups. We strongly recommend that future studies delve into disparities in chat engagement among low and high-status racial groups during virtual meetings using a racially diverse sample of employees.

fact, research finds men disrupt the speech of women far more frequently than that of other men (Smith-Lovin & Brody, 1989) and women routinely report being uncomfortable speaking up in group discussions - particularly in industries and organizations that are male-dominated (Heath & Wensil, 2019). In fact, a study conducted by researchers at Brigham Young University found that given a mixed population at the table, men take up 75 % of the conversation in an in-person meeting, leaving only 25 % of talking to women (Wrenn, 2012). Taken together, these findings show men are perceived as higher status actors compared to their women counterparts - and this has historically influenced participation patterns in mixed-gender groups.

A second widely researched status characteristic linked to spoken participation in work groups is job level or hierarchy within the organization (Hrebiniak, 1974; Islam & Zyphur, 2005). For example, research exploring differences in group participation among hospital personnel have revealed that participation rates in huddle meetings are influenced by one's position in the occupational hierarchy. In this context, the ward administrator participates more than the chief resident, the chief resident more than other residents, and the least active resident more than the most assertive nurse (Caudill, 2013). Likewise, within the nursing ranks, higher-ranking nurses spoke more often than their lower-ranking counterparts (Bloom, 1980). Extending these observations to an academic context, Pauchet (1982) found that higher-ranked university members, such as full professors, spoke nearly twice as frequently as their lower-ranked peers, including associate and assistant professors, during face-to-face meetings. In a similar vein, higher levels of attendee involvement in meetings are reported by more senior employees in the organization (Cohen et al., 2011). These findings suggest those higher up in the organization are perceived as high-status actors, and likely contribute to the discussion more frequently compared to employees at a lower rank within the company.

To summarize, gender and job level are two relevant status characteristics that can influence verbal participation in group contexts. This line of work has shown men, and those who are higher up in the organizational hierarchy, verbally contribute more frequently when in meetings compared to women and those who are lower in the organizational hierarchy. Given this theorizing, we hypothesize:

Hypothesis 1. a. Men verbally participate more often in their virtual meetings compared to women.

b. Employees high in job level verbally contribute more often in their virtual meetings compared to employees low in job level.

1.3.1. Status characteristics and virtual communication

In an extensive review of the literature, computer-mediated group interaction appears more egalitarian than face-to-face group interaction (see Kiesler & Sproull, 1992). Research suggests technology (i.e., CMC) can serve as a mechanism to ameliorate the social inequalities commonly associated with gender, physical disabilities, and social class (Connolly et al., 1990; Sproull & Kiesler, 1991; Wasserman & Richmond-Abbott, 2005). Several meta-analyses have indicated that groups using computer-mediated communication experience increased involvement, a more balanced distribution of influence within the group, and reduced member dominance in contrast to groups meeting face-to-face (Fjermestad, 2004; Rains, 2005). For example, research finds in electronic groups, both engagement in group discussions and the sway over decisions are more evenly distributed when compared to traditional face-to-face groups (McLeod, 1992; Rice, 1990; Zigurs et al., 1988).

One key feature that might explain the greater and more equal participation in virtual interactions is the use of written communication (i.e., 'chat') offered by meeting technology. In written text, a meeting participant can finish a message that can be comprehended without interrupting the speaker. This may result in more equitable participation during virtual meetings, as participants have an improved likelihood of conveying and being acknowledged in a virtual meeting. In fact, in an experiment where meeting participants were able to engage via written communication (chat), participants who chatted using the embedded tool were more satisfied with their group compared to participants who verbally contributed to the meeting (Li & Rosson, 2014). Relatedly, chat could mitigate interruption apprehension (i.e., one's reluctance to interrupt the speaker) and reduce production blocking. The term production blocking refers to two primary sources of process losses (Diehl & Stroebe, 1987; Lamm & Trommsdorff, 1973): (1) Individuals who are unable to express their thoughts when they initially arise may forget or suppress them as they appear less relevant as the discussion progresses and (2) as individuals wait for their opportunity to contribute, they often concentrate on recalling their ideas rather than generating new ones (Dennis et al., 1990). The parallel exchange provided by chat could significantly reduce these concerns, as members no longer need to wait to speak or participate in the discussion.

A third benefit of chat is its potential to address the hidden profile problem by offering a platform for participants to share their unique information, tapping into the diverse experiences and knowledge that meeting attendees bring to the table (Voigtlaender et al., 2009). To illustrate, Dennis (1993) found that face-to-face groups exchanged only a fraction (20 %) of available information, resulting in suboptimal decisions. In contrast, groups using computer-mediated communication exchanged approximately 50 % more information, resulting in the group making more well-informed decisions. In traditional face-to-face meetings, individuals with higher status or more assertive personalities might dominate the spoken conversation, limiting the contributions of others. With equal access to meeting tools such as the chat, all voices (regardless of status or position) can be heard simultaneously through written communication.

We propose those who occupy a lower status may harbor greater concerns about being talked over or disregarded if they rely solely on verbal participation in virtual meetings. Therefore, we argue individuals with lower status may use the chat, a secondary media, as a more accessible and comfortable means of participating compared to their high-status counterparts. In support of this theorizing, an exploratory internal study specific to chat in virtual meetings found women reported using chat more frequently and viewed it more net positive compared to men; in fact, women were twice as likely as men to report using chat during meetings (Sarkar et al., 2021). This finding not only supports the idea that individuals of lower status may use chat to ensure their voices are heard, but also reveals the complex communication medium hierarchy in virtual meetings. Given this positing on how status characteristics influence written participation in virtual settings, we hypothesize:

Hypothesis 2. a. Women send more chats in their virtual meetings compared to men.
b. Employees low in job level send more chats in their virtual meetings compared to employees high in job level.

1.4. Intersectionality

Scholarship in the social sciences emphasizes the interconnectedness of status characteristics and advocates for studying these social stratifications in conjunction with one another, conceptualizing them as a "matrix of domination" (Collins, 1990), "double jeopardy" (Beal, 2008), or "complex inequality" (McCall, 2002). A growing body of research on status highlights the importance of understanding how certain stereotypes intersect (Bowleg & Bauer, 2016). In their call for intersectional scholarship, Else-Quest and Hyde (2016) emphasize "research must attend to the experience and meaning of simultaneously belonging to *multiple* intertwined social categories" (p. 157). The authors recognize that individuals are characterized by several social categories, and rooted within each of these social categories is an aspect of status and inequality (Else-Quest & Hyde, 2016). In the social sciences, this experience is often referred to as intersectionality (Crenshaw, 1989, 1990; McCall, 2005).

Although the specific interpretation of intersectionality may differ depending on the research context, a common theme is that social identities, which act as foundational aspects of social connections, mutually shape, and strengthen each other (Collins, 1990; Crenshaw, 1989; Shields, 2008). Contemporary research on the impacts of class, race, gender, age, and other social attributes on inequality outcomes has seen a growing prominence of intersectionality theories (e.g., Walby et al., 2012) which recognize that power dynamics, social structures, and cultural norms influence the experiences and opportunities available to individuals with intersecting identities (McCall, 2005; Cho et al., 2013). Consequently, it is necessary to consider how gender and job level intersect to predict one's participation behavior in virtual meetings.

Intersectionality and status characteristics theory would suggest that highest status actors, being men who are high in job level, would verbally participate in virtual meetings more so than all other subgroups. On the contrary, this theorizing would predict (a) women (b) who are low in job level may use the chat, which feels like a safer method of communication, as their primary mechanism to contribute to the discussion. To further explore these intersections of status characteristics in relation to participation in virtual meetings, we propose:

Hypothesis 3. a. Men high in job level verbally participate in their virtual meetings compared to all other groups.
b. Women low in job level send more chats in their virtual meetings compared to all other groups.

1.5. Perceptions of psychological safety

Psychological safety in the workplace promotes a nurturing and inclusive work environment where individuals can take risks, express their ideas, and contribute without the fear of adverse implications (Edmondson, 1999). In a psychologically safe environment, employees believe their peers will embrace the expression of their thoughts and welcome their ideas (Edmondson, 1999; Newman et al., 2017). In terms of behavior, psychological safety promotes a workplace atmosphere where employees engage in transparent communication, fully immerse themselves in their tasks, express their concerns, and actively seek feedback (Kahn, 1990; Pearsall & Ellis, 2011). The concept of psychological safety is linked to positive communication outcomes, including greater error reporting and improved social interactions among teammates (Leroy et al., 2012; Siemsen et al., 2009; Zhang et al., 2010). Research at both the individual and group levels has shown psychological safety is positively related to information sharing (Bunderson & Boumgarden, 2010; Siemsen et al., 2009) and increases the likelihood that employees will perceive it as safe to question existing practices (Walumbwa & Schaubroeck, 2009).

In support of this, research shows psychological safety plays a crucial role in encouraging employee participation in meetings (Carmeli & Gittell, 2009; Frazier et al., 2017), and this active participation contributes to increased synergy, coordination, and collective achievement (Frazier et al., 2017). For one, employees who feel psychologically safe are more likely to share innovative ideas, suggestions, and feedback in their meetings (Edmondson, 2002; Lee, 2021). This participation in idea sharing can lead to increased creativity and innovation within the team and organization (Hargadon & Bechky, 2006; Shin & Zhou, 2007). Psychological safety in meetings is also linked to productivity levels: Constantinides et al. (2020) measured psychological safety in meetings using the survey question, "Did you feel listened to during the meeting, or motivated to be involved in it?" and found on average, the probability of a meeting being productive increased by 35 % for each standard deviation increase in the psychological safety participants reported.

1.5.1. Psychological safety and status characteristics

When employees feel psychologically safe, they feel comfortable speaking up and contributing to the discussion without fear of interruption or rejection. Thus, we propose psychological safety may mitigate the effects of status characteristics on participation in meetings where those low in status may feel more comfortable contributing to the meeting via the richer communication media (i.e., verbally) if they have high perceptions of psychological safety. However, low status employees who report *low* perceptions of psychological safety may rely more so on the chat to participate due to increased fear of rejection or interruption apprehension.

Research on virtual teams supports this idea, revealing that in situations of high psychological safety, the adverse impacts of geographical dispersion, reliance on electronic communication, dynamic structural changes, and national diversity on team participation and innovation were mitigated (Gibson & Gibbs, 2006). Moreover, research has demonstrated that fostering a psychologically safe environment can effectively mitigate national disparities and diminish in-group/out-group biases within teams (Gudykunst et al., 1991; Maznevski, 1994). Gibson and Vermeulen (2003) found that the disparities linked to national demographic diversity within

teams could be mitigated when smaller subgroups formed and established a psychologically safe environment. Within these subgroups, members engaged in information exchange, and identified and cultivated greater common ground. This process led to a reduction in in-group/out-group divisions and an overall enhancement of the team's information processing capabilities (Gibson & Vermeulen, 2003).

The above line of research suggests that perceptions of a psychologically safe work environment are crucial for individuals to overcome participation challenges linked to computer-mediated communication, and this may be especially true for low status individuals (Gibson & Gibbs, 2006). From a status characteristics perspective, women, and employees low in job level who have *high* perceptions of psychological safety likely feel more comfortable verbally contributing to the discussion (e.g., they have less interruption and rejection apprehension) compared to their counterparts. They may be more inclined to use the richer form of communication medium and use their voice to contribute their ideas to the conversation. On the contrary, women and employees low in job level who have *low* perceptions of psychological safety may rely on the chat even more so to contribute to the discussion due to increased fear of rejection and reluctance to interrupt the speaker. Given this theorizing, we hypothesize the following moderations:

Hypothesis 4. a. Psychological safety will moderate the relationship between gender and verbal participation, such that women with high perceptions of psychological safety will verbally contribute more frequently compared to their counterparts with low perceptions of psychological safety.

b. Psychological safety will moderate the relationship between job level and verbal participation, such that those low in job level with high perceptions of psychological safety will verbally contribute more frequently compared to their counterparts with low perceptions of psychological safety.

Hypothesis 5. a. Psychological safety will moderate the relationship between gender and chat frequency, such that women with low perceptions of psychological safety will use the chat more frequently compared to their counterparts with high perceptions of psychological safety.

b. Psychological safety will moderate the relationship between job level and chat frequency, such that those low in job level with low perceptions of psychological safety will use the chat more frequently compared to their counterparts with high perceptions of psychological safety.

2. Methods

2.1. Participants and procedure

We recruited full-time employees from a global technology company to partake in our research. The recruitment post asked employees to participate in a one-time survey (expected to take 20 min) and agree to allow us access to three months of their objective meeting telemetry data. Telemetry involves gathering information from remote devices, sensors, or instruments and transmitting that information to a central hub or system for analysis (Ding et al., 2017). Of interest to our research, this telemetry has information on employees' virtual meeting behavior in *Microsoft Teams* spanning three months of time. Inclusion criteria limited participation to employees who: a) were 18 years of age or older and b) were full-time employees (worked at least 35 h per week). To encourage participation in our study, we informed employees that we would make an aggregate donation of £1 per person to UNICEF on behalf of all participants.

While this large-scale telemetry data provides a lens into how people behave during meetings, our collaborating company is committed to preserving privacy. Thus, we do not have access to all behavioral details such as the content of the chat, reactions to sent chats, or post-meeting chat follow-up. The telemetry data does not provide information on the behaviors, actions, or characteristics of other attendees in the meetings (i.e., we cannot compare the participant's chat behavior to others within the same meeting). Moreover, the telemetry data was collected in an anonymized form, and does not have sensitive attributes that could potentially reveal the identity of an individual employee or a group in the corporation.

When designing our survey, various steps were taken to reduce concerns of insufficient effort responding (IER), or when participants are unmotivated to "comply with survey instructions, correctly interpret item content, and provide accurate responses" (Huang et al., 2012, p. 100). IER influences the quality of the data collected and can inflate relationship magnitudes and chances of Type I error depending on how IER participants respond (c.f., DeSimone et al., 2018; Huang et al., 2015). To mitigate IER concerns, we added two survey items with clear correct answers (e.g., "Please select strongly agree for this item") that if answered incorrectly indicated IER (Huang et al., 2015). This strategy was used in tandem with a non-response cutoff, in which participants must have completed 50 % or more of the survey to be included in the final data set.

After consenting to participate in our research, 322 employees completed the one-time survey. The survey took, on average, 17 min to complete. We eliminated participants that did not complete at least 50 % of the survey ($n = 23$), as well as those that failed to pass both insufficient response questions ($n = 5$). This resulted in a sample of 294 participants. Following survey completion, we pulled the internal *Microsoft Teams* meeting behavior data for each of the 294 employees who completed the survey. We were able to link the survey data to the participant's meeting behavior over the course of the past three months using a participant id number. Three participants completed the survey, but either had no meetings over the course of the three months or the telemetry data captured zero meetings for these participants. Because they had no meeting data (i.e., our dependent variables were missing), we eliminated these three participants from subsequent analyses. Our final sample size included 291 participants.

2.2. Measures

In the one-time survey, we measured our independent variables and our predicted moderating variable, along with our proposed demographic control variables. Our dependent variables (verbal participation and chat participation) were captured in the telemetry meeting data for each participant.

2.2.1. Gender

We captured participant gender by asking which the participant most identifies as: man, woman, non-binary/gender diverse, self-described (written option), and prefer not to say.

2.2.2. Job level

We asked which of the following most accurately reflects their current job level based on job conceptualization and rank provided by the organization we recruited our sample from: (1) early career, (2) senior, (3) principal, or (4) above principal. The above principal response option reflected the highest job level, and early career was the lowest job level position.

2.2.3. Perceptions of psychological safety

We used Edmondson's (1999) 7-item Psychological Safety Scale to capture perceptions of psychological safety. Participants were asked to indicate how much they agree/disagree with each statement regarding their work experiences (1 = strongly disagree, 5 = strongly agree). The statements were: (1) "If I make a mistake on my team, it is often held against me (R)" (2) "Members of my team are able to bring up problems and tough issues" (3) "People on my team sometimes reject others for being different (R)" (4) "It is safe to take a risk on my team" (5) "It is difficult to ask other members of my team for help (R)" (6) "No one on my team would deliberately act in a way that undermines my efforts" and (7) "Working with members of my team, my unique skills and talents are valued and utilized." ($M = 4.21$ $SD = 0.68$, $\alpha = 0.77$).

2.2.4. Telemetry meeting data

Objective meeting behavior data was captured for each employee who completed our survey, and for every virtual meeting they attended or organized spanning the three months prior to when they completed the survey. Surveys were completed between April 27th and August 3rd (2023), meaning telemetry data dated back to January of 2023. This comprehensive telemetry dataset included: (a) when the employee had a meeting (i.e., the date of the meeting) (b) the duration of the meeting (c) the number of participants in the meeting (d) number of encoded audio frames in the meeting and (e) their chat behavior in the meeting (i.e., when they sent a chat). See Table 1 for an example of the structure of the data.[3]

2.2.4.1. Verbal participation. Verbal participation for each participant in each meeting was computed from the Number of Encoded audio Frames (NEF) throughout the virtual meeting. NEF is a technical measure related to the transmission of audio in a virtual meeting. When someone speaks during a virtual meeting, audio frames are encoded and transmitted. These frames are counted to estimate the participant's verbal activity. The NEF metric is normalized to approximate the proportion of the meeting during which a participant spoke. Normalization adjusts the raw NEF value to a percentage that represents the amount of time a participant was actively speaking. This is done because audio frames are only sent when a voice activity detector is triggered, meaning when there's actual speech. For example, if the NEF proportion reads 0.24, that would suggest sound was detected roughly a quarter of the meeting for a given participant. If the proportion reads 0.99, sound was detected nearly the whole meeting for that participant; and if there is a NA, the participant likely never participated (no sound detected). The NEF metric is considered more accurate for assessing verbal participation compared to simpler metrics like detecting when a participant mutes or unmutes their microphone. It provides a finer-grained view of when sound is detected during the meeting. In our sample, the average NEF proportion per participant was 0.09 per meeting (e.g., audio was detected 9 % of the time, averaged across meetings and participants; $SD = 0.17$).

2.2.4.2. Chat participation. We retained the following three meeting actions when creating our dependent variable "chat participation" in our study: (1) text message, (2) sent emoji reaction to a posted message and (3) added an attachment (e.g., a document). We changed the chat count variable listed as 'NA: no action during meeting' to equal 0, because these participants did not send any chats, emojis or attachments in the meeting. Thus, the telemetry count variable (our dependent variable) for each meeting contained either a 0 (no chat participation in the meeting) or a total chat post count for that meeting consisting of the sum of sent text messages, sent reactions via emojis or sent attachments (e.g., '2', '6' '10', etc.). This resulted in a total of 52,507 meeting chat posts spanning 33,812 meetings for the 291 participants in our sample.

In supplemental analyses, we independently analyzed each of the three chat actions to gain a more detailed comprehension of communication styles from each participant. Specifically, we re-evaluated our hypotheses using (a) solely sent text messages ($n = 34,231$), (b) exclusively sent emoji reactions to others' messages ($n = 18,069$), and (c) sent attachments only ($n = 207$) as dependent

[3] We excluded meetings consisting of two people (i.e., one-on-one meetings), as chat is likely less prevalent in one-on-ones given there are only two people that are communicating in the meeting and thus the window for verbal/spoken participation is much higher. The focus of our research was exploring meeting attendees' participation in virtual meetings of *three or more people.*

Table 1
Sample of raw telemetry data from Microsoft Teams.

pid	meetingId	meetingDuration	participantCount	isOrganizer	propAudio	chatActionName	chatActionCount
9	331	48	7	FALSE	0.23	clickInTextboxWhenEditing	1
9	331	48	7	FALSE	0.23	sendMessage	1
9	334	29	9	FALSE	0.12	NA	0
10	335	30	5	FALSE	0.45	addEmoji	2
10	336	35	15	FALSE	0.33	addAttachment	3
10	336	35	15	FALSE	0.33	removeEmoji	1
13	388	45	21	FALSE	0.00	sendMessage	1
13	389	56	15	FALSE	0.07	NA	0
13	390	22	8	FALSE	0.14	clickInTextboxWhenEditing	8
13	390	22	8	FALSE	0.14	sendMessage	6
13	390	22	8	FALSE	0.14	sendEmoji	2
13	390	22	8	FALSE	0.14	deleteMessage	1

Note. pid is the specific identifier of the meeting participant, meetingId is the identifier of the specific meeting in which the chat behavior occurred, meetingDuration captures the length of the meeting in minutes, participantCount is the number of participants in the meeting, isOrganizer signals whether the participant was the meeting organizer or not (if FALSE = not the organizer), propAudio represents the proportion of the meeting that the participant's audio was detected, chatActionName lists the specific action completed by the participant, and chatActionCount is the number of chat actions that resulted from that particular action. In our analyses, we aggregated the total chat count by pid to link to the survey dataset.

variables. This aimed to investigate potential individual differences in these distinct chat types among employees in our sample.

2.3. Potential control variables

2.3.1. Time spent in meetings

The amount of time spent in meetings naturally influences our dependent variable, total chat participation across meetings. Some employees attend more meetings than their counterparts. Therefore, they will have more opportunity to participate given the increase in time they are spending in meetings. Because of this, we control for the total amount of time each participant spent in meetings over the three months. In our sample, participants spent an average of 16,211 min in meetings over the course of the three months. The average meeting length was 77 min and the average number of meetings over the three months per participant was 274 meetings.

2.3.2. Age

Age can significantly influence how individuals use and interact with technology (Czaja et al., 2006; Morris & Venkatesh, 2000; Posthuma & Campion, 2009). These differences are often attributed to factors such as generational upbringing, exposure to technology during formative years, and personal comfort levels with new tools (Czaja & Sharit, 1993; Kanfer & Ackerman, 2004). Research suggests younger individuals are generally more open to adopting new technologies and exploring their features (Lorence & Park, 2006; Warr & Pennington, 1993). Younger generations (e.g., millennials and Gen Z) have grown up with technology as an integral part of their lives (Bennett et al., 2008; Prensky, 2001). They tend to adapt quickly to new technologies and use them for various purposes, from entertainment to work. Conversely, older generations (e.g., baby boomers) may have had to learn and adopt technology later in life, which can result in differing levels of comfort and expertise (Prensky, 2001, 2009; Kesharwani, 2020). Further, research shows younger generations often gravitate towards instant messaging, social media, and other digital communication methods, while older individuals often prefer traditional forms of communication, such as phone calls or face-to-face interactions (Khoir & Davison, 2014; Metallo & Agrifoglio, 2015). In a work context, research finds younger generations integrate technology into their professional lives using collaboration tools, project management software, and other digital platforms for work; yet older generations might face a learning curve when adapting to these tools (Hershatter & Epstein, 2010; Vodanovich et al., 2010). Given virtual meeting chat is a newer form of technology unique to the past decade (Karl et al., 2022), it is important to consider the effect of age on chat use in these contexts. To account for age influencing an individual's participation method in virtual meetings, we captured and controlled for participant age: Participants were asked to indicate their age range using the following categories: (1) 18–24, (2) 25–34, (3) 35–44, (4) 45–54, (5) 55–64, (6) 65+ or (7) Prefer not to say.

2.3.3. Race

Race is one of the most widely researched status characteristics in the social and organizational sciences (Berger et al., 1980; McGuire, 2000, 2002). For example, research has found that in racially diverse work groups, White people initiate more interactions than Black people, and they speak more to other White people compared to their Black counterparts. Interestingly, even Black individuals speak more to White people than to other Black people (Katz et al., 1958; Katz & Benjamin, 1960). Analyzing communication in a group meeting, Kirchmeyer (1993) conducted a study examining the level of participation among minorities (defined as individuals not of European descent) in contrast to the participation of majorities (defined as individuals of European descent). Her findings indicated that minorities participated less frequently in verbal discussions compared to majorities. Research has also found that White women exert greater influence over Black women in task-focused discussion groups (Walker et al., 2014). These findings suggest White people are perceived as a higher status race, contributing more to conversations, and being spoken to or addressed more frequently compared to nonwhites. Thus, generally speaking, White people are perceived as higher status actors and nonwhite people

as lower status – which then influences the communication patterns and speaking dynamics in mixed-race groups. Considering the extensive research exploring the relationship between race and participation in groups, it is important to assess and control for participant race in our analyses. To gain a nuanced picture of race/ethnicity, we asked how the participant would best describe themselves: (1) American Indian or Alaska Native, (2) Asian, (3) Black or African American, (4) Native Hawaiian or Other Pacific Islanders, (5) White, (6) Other (written option), and (7) Prefer not to say.

3. Data preparation & analyses

We aggregated the total chat count (i.e., number of chat posts in the meeting) by each participant id in R, to calculate a total sum of chat posts for each of the 291 participants in our sample. This allowed us to determine how many chat posts each participant sent in their meetings over the course of the three months of telemetry data. The average number of chats sent per participant in our sample over the three months of meeting data was 180 chat posts. Using the same aggregation technique in R, we also aggregated both meeting duration and amount of audio detected during the meeting by participant id, eliminating redundant meeting ids, to capture the total time each participant spent in meetings and the total audio detection in meetings over the three months. In our sample, participants spent an average of 16,211 min (~270 h) in meetings over the course of the three months and sound was detected 9 % of the time in meetings, on average per participant.

We chose an aggregated approach (i.e., all at one level of analysis) instead of a multilevel, meeting-by-meeting approach because all our predictor and moderating variables were at the individual level of analysis (e.g., gender, job level, perceptions of psychological safety). Likewise, two of our theorized control variables were at the individual level (e.g., age, race). Moreover, this aggregated analysis allowed us to capture larger patterns and trends that might not be apparent in a meeting-specific approach. Aggregation enabled us to identify overall individual differences in chat participation and the role of psychological safety across the entire study period, providing a more comprehensive view of the factors influencing virtual meeting interactions over time.

We tested our main hypotheses using a form of Poisson regression in R, a statistical technique for count data (Cohen et al., 2013). Poisson regression models the relationship between the expected count and predictor variables. However, it assumes equal mean and variance, known as equidispersion (Sellers et al., 2012). In real-world scenarios with more variable count data, it is appropriate to use Negative Binomial regression, which handles overdispersion by allowing for greater variance (Gardner et al., 1995; Land et al., 1996). Our dataset showed overdispersion (the variance was greater than the mean), so we employed Negative Binomial Regression using the glm.nb function in the MASS package in R for hypothesis testing.

To test our Hypothesis 3a-b, the intersection between job level and gender, we created a dummy variable of eight subgroups consisting of various gender and job level combinations: (1) women, early career (i.e., lowest status group) (2) women, senior (3) women, principal (4) women, above principal (5) men, early career (6) men, senior (7) men, principal and (8) men, above principal (i.e., highest status group).[4] Recall, Hypothesis 3 expected subgroup eight (men, above principal) would verbally contribute more, and subgroup one (women, early career) would use the chat the most frequently compared to all other groups. To explore participation differences in meetings among the eight subgroups created by the combination of gender and job level, we used negative binomial regression using women early career as the referent group.

However, when creating subgroups, we were concerned about uneven and small sample sizes. For example, there was only one participant that identified as a woman at the above principal job level. Therefore, we combined the job levels above principal with principal and senior with early career, resulting in four subgroups: (1) women, senior or early career (2) women, above principal or principal (3) men, senior or early career and (4) men, above principal or principal. This resulted in more even subgroup sizes ($n = 85$, 26, 118, 53 respectively). We then ran the same negative binomial subgroup analyses as above to explore the intersection of gender and job level among these four groups. See Table 2 for an overview of the subgroup creation process.

To test Hypotheses 4a-b and 5a-b, and in accordance with best practices proposed by Dawson (2014), we mean centered our moderating variable, perceptions of psychological safety. Mean centering is used to reduce multicollinearity and aid in the interpretation of regression coefficients, especially when dealing with interaction terms. By mean-centering the variables, it ensures that the (unstandardized) regression coefficients for the main effects can be directly interpreted in the context of the original variables. Mean-centering involves subtracting the mean of a variable from each score of that variable. This shifts the distribution of the variable to be centered around zero (Dawson, 2014).

4. Results

4.1. Descriptive statistics

Most participants identified as men (58.5 %) followed by women (38.4 %).[5] Roughly 63.2 % of the sample were between the ages of 35 and 54 (32 % between the ages of 45–54; 31.2 % between the ages of 35–44). The sample consisted of mid- to high-level employees (56.8 % senior, 25.9 % principal). Sixteen percent of respondents reported they were early career. Most participants identified as White

[4] Note that the above principal level is the highest, followed by principal, then senior. Early career represents the lowest job level.

[5] Less than 2 % of our sample identified as non-binary/gender diverse (1.3 % non-binary/gender diverse, 1 % preferred not to disclose). In our analyses, we treated gender as a binary variable (0 = men; 1 = women). Participants that identified as non-binary/gender diverse or preferred not to disclose were not used in analyses ($n = 4$ and $n = 3$, respectively).

Table 2
Part I: Status characteristic subgroups for testing intersectionality (Hypothesis 3). Part II: Supplemental status characteristic subgroups for testing intersectionality (Hypothesis 3).

Part I

Subgroup	Gender identity	Job level	N =
Subgroup 1 (lowest status group)*	Woman*	Early Career*	23
Subgroup 2	Woman	Senior	62
Subgroup 3	Woman	Principal	25
Subgroup 4	Woman	Above Principal	1
Subgroup 5	Man	Early Career	21
Subgroup 6	Man	Senior	97
Subgroup 7	Man	Principal	50
Subgroup 8 (highest status group)	Man	Above Principal	3

Part II

Subgroup	Gender identity	Job level	N =
Subgroup 1 (lowest status group)*	Woman*	Early Career/Senior*	85
Subgroup 2	Woman	Above Principal/Principal	26
Subgroup 3	Man	Early Career/Senior	118
Subgroup 4 (highest status group)	Man	Above Principal/Principal	53

Note. The first row (indicated by *) was used as the reference group for testing Hypotheses 2.

(67 %), followed by Asian (18.7 %). Only four employees in our sample identified as Black or African American. In subsequent analyses, both gender and race were treated as binary variables (0 = Men, 1 = Women, 0 = White, 1 = People of color). The average reported psychological safety was 4.21 (out of a five-point scale), with a standard deviation of 0.66. Across all meetings spanning the three months of telemetry data, the average participant sent 180.44 chat posts ($SD = 232.90$) and the average proportion of audio detected in meetings was 9.00 % ($SD = 5.12$). Chat participation and audio detection in meetings were significantly correlated ($r = 0.37$; $p < .01$). In total, participants spent an average of 16,211 min in meetings over the three months (i.e., about 270 h in meetings; $SD = 11{,}187$). See Table 3 for an overview of descriptive statistics, including correlations with confidence intervals for our primary variables.

To get a more nuanced picture of the differences in virtual meeting behavior between various groups, we calculated a summary of descriptive statistics of chat posts and audio participation by (a) gender, (b) job level, (c) race and (d) age. See Table 4 for a summary of meeting participation statistics by group. We also calculated a summary of participation statistics by meeting size, which suggested an individual's audio is detected more often in small meetings (i.e., they are talking more) and more chat posts (written participation) were present in large meetings. See Table 5 for an overview of these descriptive statistics by meeting size.

4.2. Control variable inclusion

To be included in subsequent analyses, control variables should be theoretically relevant and significantly related to primary variables of interest (Becker et al., 2016; Bernerth & Aguinis, 2016; Spector & Brannick, 2011). In our case, two of the three proposed control variables were significantly related to predictor variables (gender, job level) as well as the outcome variables (verbal and chat participation). Based on this cutoff, the following two variables were included in analyses: total time spent in meetings and age. Race was not significantly related to our primary variables, and thus was not included as a control variable in subsequent analyses.

4.3. Hypothesis testing

In alignment with status characteristics theory, we were interested in whether there were significant main effects between our independent variables (gender, job level) and verbal participation in meetings (Hypothesis 1a-b). Using Negative Binomial regression, we ran analyses using 'total detection of audio over the course of three months' as the dependent variable. Results revealed there were no significant relationships between job level and audio detection in virtual meetings ($\beta = 0.09$, $p > .05$). However, results revealed there was a significant relationship between gender and audio detection suggesting women talked significantly less in their virtual meetings compared to men ($\beta = -0.17$, $p < .05$), supporting

Hypothesis 1a. See Table 6 for a summary of results.

Regarding Hypothesis 2a-b, results revealed a positive relationship between gender and total chat participation, such that women participated in the chat more frequently compared to men ($\beta = 0.19$, $p < .05$). This provides support for Hypothesis 2a. Hypothesis 2b exploring the relationship between job level and chat participation was not supported ($\beta = 0.08$, $p > .05$). See Table 7 for results of our model.

We explored Hypothesis 3a-b utilizing two subgroup approaches (refer to Table 2). First, we explored participation differences between all eight subgroup combinations by job level (4 levels) and gender (2 levels). Results were not significant, indicating there were no meaningful differences in virtual meeting participation between the eight subgroups ($p > .05$). However, due to uneven and

Table 3
Correlations between primary variables and control variables with confidence intervals.

Variable	1	2	3	4	5	6	7
1. Race							
2. Age	−0.18**						
	[−0.29, −0.07]						
3. Gender	−0.03	−0.01					
	[−0.15, 0.09]	[−0.13, 0.10]					
4. Job level	−0.09	0.39**	−0.12*				
	[−0.20, 0.03]	[0.29, 0.48]	[−0.23, −0.00]				
5. Psychological safety	−0.19**	0.14*	0.02	0.02			
	[−0.30, −0.08]	[0.02, 0.25]	[−0.10, 0.14]	[−0.10, 0.13]			
6. Time in meetings	0.08	0.11	−0.04	0.21**	−0.07		
	[−0.03, 0.19]	[−0.01, 0.22]	[−0.15, 0.08]	[0.10, 0.32]	[−0.18, 0.05]		
7. Audio detection	−0.00	0.22**	−0.08	0.18**	−0.04	0.50**	
	[−0.12, 0.12]	[0.11, 0.33]	[−0.20, 0.03]	[0.07, 0.29]	[−0.15, 0.07]	[0.41, 0.58]	
8. Chat participation	−0.06	0.00	−0.00	0.05	−0.06	0.53**	0.37**
	[−0.18, 0.06]	[−0.11, 0.12]	[−0.12, 0.11]	[−0.06, 0.17]	[−0.18, 0.05]	[0.44, 0.61]	[0.27, 0.47]

Note. Gender is coded as a binary variable (0 = men, 1 = women). Job level consists of four levels (1 = early career, 2 = senior, 3 = principal, 4 = above principal). Race is coded as a binary variable (0 = White, 1 = people of color). Age is a continuous variable [(1) 18–24, (2) 25–34, (3) 35–44, (4) 45–54, (5) 55–64, (6) 65+]. The mean value of Psychological Safety is 4.21 (*SD* = 0.66). The average time spent in meetings over the course of three months was ~16,211 min (*SD* = 11,186.98). The average audio detection was 9 % of the meetings (*SD* = 5.12 %). The average number of chats sent over the three months was 180 (*SD* = 233). Values in square brackets indicate the 95 % confidence interval for each correlation. The confidence interval is a plausible range of population correlations that could have caused the sample correlation (CumB127ming, 2014). * indicates $p < .05$. ** indicates $p < .01$.

Table 4
Description of chat and audio participation by gender, job level, age, and race.

Group	Total chat participation (*n*)	Audio detection per meeting (%)	Sample size (*n*)
Gender			
- Women	178.31	12.58	111
- Men	176.65	14.54	171
Job level			
- Early Career	177.79	8.44	47
- Senior	166.84	14.65	164
- Principal	212.41	15.31	76
- Above Principal	161.51	18.80	4
Age			
- 18–24	79.22	6.06	9
- 25–34	215.31	10.14	39
- 35–44	176.57	13.32	91
- 45–54	183.42	14.40	93
- 55–64	174.37	17.38	51
- 65 +	142.17	16.92	6
Race			
- White	190.03	13.67	197
- People of color	159.39	13.66	92

Note. This reflects the average virtual meeting participation for each group over the course of the three months of telemetry meeting data. For example, women, on average, sent a total of 178.31 chats in their virtual meetings over three months of time. The audio detection (%) represents the average proportion of time the participants in the group had audio detected through the speaker in a meeting. Recall, early career is the lowest job level, followed by senior level, principal and above principal reflects the highest job level in the company from where our sample was drawn. The sample size indicates the number of participants who identified in each group.

small sample size issues noted above, we ran the subgroup analyses using four subgroup combinations by job level (now 2 levels) and gender (2 levels). We found men higher in job level had significantly more audio detection women lower in job level ($\beta = 0.38$, $p < .05$). This provides partial support for Hypothesis 3a, indicating men highest in job level are verbally contributing to virtual meetings significantly more often than women low in job level. While both women high in job level and men low in job level had more audio detection than the referent group (i.e., women low in job level), these results were not significant. See Table 8.

Regarding Hypothesis 3b exploring the intersection of gender and job level on chat participation, we found men (both low and high in job level) sent less chats than the referent group (women low in job level); however, these findings were not significant. Interestingly, contrary to our expectations, results indicated women *high* in job level (i.e., principal or above principal level) used chat significantly more frequently than women low in job level ($\beta = 0.36$, $p < .05$). See Table 9 for a summary of results. To further explore the finding that women high in job level use chat more frequently than other subgroups, we ran analyses using the women/high job level subgroup as the reference and chat participation as the dependent variable. Results revealed *all three* subgroups participated in

Table 5
Description of chat participation by meeting size.

Meeting size	Total no. of meetings in the dataset	Total no. of chat actions in the dataset
Small meetings (3–4 attendees)	8009	4866
Medium-sized meetings (5–10 attendees)	13,681	18,554
Large meetings (>10 attendees)	12,122	29,087
All meetings attended	33,812	52,507

Meeting size	No. of chats per participant	Prop. of audio in meetings per participant	Time spent in meetings (min)
Small meetings (3–4 attendees)	17	19.31 %	1144
Medium-sized meetings (5–10 attendees)	64	9.98 %	2922
Large meetings (>10 attendees)	100	2.98 %	7841
All meetings attended	180	9.00 %	16,211

Note. Chat actions included when participants (a) sent a message, (b) added an emoji or (c) added an attachment to the chat.

Table 6
Hypotheses 1a-b: Negative binomial regression results with total proportion of audio detected (i.e., verbal participation) as the dependent variable.

Variable	Estimate	Std. error	z-Value	$p > \|t\|$
(Intercept)	1.318e+00	1.711e-01	7.70	0.00***
Meeting duration	2.689e-05	4.140e-06	6.50	0.00***
Chat participation	7.043e-04	1.906e-04	3.70	0.00***
Age	1.496e-01	3.917e-02	3.82	0.00***
Gender	−1.664e-01	8.268e-02	−2.01	0.04*
Job level	8.053e-02	6.489e-02	1.24	0.21

Note. $N = 291$ participants and 33,812 meetings. Gender is a binary variable (0 = men, 1 = women). Job level contains four levels (1 = early career, 2 = senior, 3 = principal, 4 = above principal). Age has six levels depicting various age ranges in equal increments spanning 18–65+. Chat participation reflects the total number of chats sent over the course of three months. Meeting duration reflects the total amount of time the participant spent in meetings over the course of three months. * indicates $p < .05$. ** indicates $p < .01$. *** indicates $p < .001$. Dispersion parameter for Negative Binomial (2.7573) family taken to be 1.

Table 7
Hypothesis 2a-b: Negative binomial regression results with total chat frequency as the dependent variable and gender and job level as the predictor variables.

Variable	Estimate	Std. error	z-Value	$p > \|t\|$
(Intercept)	4.032e+00	1.323e+00	1.08	0.00***
Meeting duration	4.755e-05	4.405e-06	6.13	0.00***
Audio detection	1.943e-02	1.971e-04	5.81	0.00***
Age	−9.996e-02	4.045e-02	2.32	0.03*
Gender	1.856e-01	5.381e-01	−1.76	0.05*
Job level	8.471e-02	4.236e-01	1.24	0.26

Note. $N = 291$ participants and 33,812 meetings. Gender is a binary variable (0 = men, 1 = women). Job level contains four levels (1 = early career, 2 = senior, 3 = principal, 4 = above principal). Age has six levels depicting various age ranges in equal increments spanning 18–65+. Audio detection is captured via the NEF metric of total proportion of audio. Meeting duration reflects the total amount of time the participant spent in meetings over the course of three months. * indicates $p < .05$. ** indicates $p < .01$. *** indicates $p < .001$. Dispersion parameter for Negative Binomial (1.6765) family taken to be 1.

chat significantly less frequently compared to women at the principal or above principal level: women in early career or senior level ($\beta = -0.36$, $p < .05$), men in early career or senior level ($\beta = -0.44$, $p < .01$) and men at the principal or above principal job level ($\beta = -0.36$, $p < .05$). This finding suggests that women, *higher* in job level engage in the chat the most frequently of all. See Table 10.

Hypothesis 4a predicting psychological safety would moderate the relationship between gender and verbal participation in virtual meetings was not supported ($\beta = 0.11$, $p > .05$). Hypothesis 4b predicting psychological safety would moderate the relationship between job level and verbal participation in virtual meetings was not supported ($\beta = 0.18$, $p > .05$). See Table 11 for results.

Hypothesis 5a predicting psychological safety would moderate the relationship between gender and chat participation was not supported ($\beta = -0.25$, $p > .05$). Interestingly, Hypothesis 5b predicting psychological safety would moderate the relationship between job level and chat participation was supported ($\beta = -0.28$, $p < .05$). Contrary to our prediction, those low in job level who had *high* perceptions of psychological safety used chat more frequently compared to their counterparts who had low perceptions of psychological safety. Thus, the direction of the moderation was counter to our original hypothesis. See Table 12 for a summary of the results; see Fig. 1 for a graph of the interaction.

Table 8
Hypothesis 3a: Intersectionality approach - Results from subgroup analysis using negative binomial regression with total proportion of audio detected as the dependent variable.

Variable	Estimate	Std. error	z-Value	$p > \|t\|$
(Intercept)	1.231e+00	2.000e-01	6.15	0.00***
Meeting duration	2.697e-05	4.133e-06	6.53	0.00***
Chat participation	7.113e-04	1.908e-04	3.73	0.00***
Age	1.623e-01	3.724e-02	4.36	0.00***
Women, Principal or A.P.	5.036e-02	1.519e-01	0.33	0.74
Men, Early Career or Senior	1.904e-01	1.468e-01	1.30	0.19
Men, Principal or A.P.	3.758e-01	1.907e-01	1.82	0.05*

Note. Women, Early Career or Senior level (i.e., lowest status group) were used as the reference group. Age has six levels depicting various age ranges in equal increments spanning 18–65+. Chat participation reflects the total number of chats sent over the course of three months. Meeting duration reflects the total amount of time the participant spent in meetings over the course of three months. A.P. = Above Principal * indicates $p < .05$. ** indicates $p < .01$. *** indicates $p < .001$. Dispersion parameter for Negative Binomial (2.7509) family taken to be 1.

Table 9
Hypothesis 3b: Intersectionality approach - Results from subgroup analysis using negative binomial regression with total chat frequency as the dependent variable.

Variable	Estimate	Std. error	z-Value	$p > \|t\|$
(Intercept)	4.296e+00	1.771e-01	24.26	0.00***
Meeting duration	4.743e-05	4.766e-06	9.95	0.00***
Audio detection	1.943e-02	4.779e-03	4.07	0.00***
Age	−9.432e-02	4.365e-02	−2.16	0.04*
Women, Principal or A.P.	3.584e-01	1.743e-01	1.71	0.05*
Men, Early Career or Senior	−1.409e-01	1.103e-01	−1.28	0.20
Men, Principal or A.P.	−3.376e-03	1.384e-01	−0.02	0.98

Note. Women, Early Career or Senior level (i.e., lowest status group) were used as the reference group. Age has six levels depicting various age ranges in equal increments spanning 18–65+. Audio detection is captured via the NEF metric of total proportion of audio. Meeting duration reflects the total amount of time the participant spent in meetings over the course of three months. A.P. = Above Principal * indicates $p < .05$. ** indicates $p < .01$. *** indicates $p < .001$. Dispersion parameter for Negative Binomial (1.6912) family taken to be 1.

Table 10
Supplemental Analysis: Results from subgroup analysis using negative binomial regression with total chat frequency as the dependent variable and woman, principal or above principal as the referent group.

Variable	Estimate	Std. error	z-Value	$p > \|t\|$
(Intercept)	4.595e+00	2.288e-01	24.26	0.00***
Meeting duration	4.743e-05	4.766e-06	9.95	0.00***
Audio detection	1.943e-02	4.779e-03	4.07	0.00***
Age	−9.432e-02	4.365e-02	−2.16	0.03*
Women, Early Career or Senior	−3.631e-01	1.743e-01	−1.71	0.05*
Men, Early Career or Senior	−4.393e-01	1.691e-01	−2.60	0.01**
Men, Principal or A.P.	−3.618e-01	1.866e-01	−1.92	0.05*

Note. Women, Principal or Above Principal were used as the reference group. Age has six levels depicting various age ranges in equal increments spanning 18–65+. Audio detection is captured via the NEF metric of total proportion of audio. Meeting duration reflects the total amount of time the participant spent in meetings over the course of three months. A.P. = Above Principal. * indicates $p < .05$. ** indicates $p < .01$. *** indicates $p < .001$. Dispersion parameter for Negative Binomial (1.6912) family taken to be 1.

4.4. Supplemental analyses

To further explore if there were individual differences in the *type* of chat participation in virtual meetings, we ran three supplemental analyses exploring our model with solely (1) sent text messages (2) sent emoji reactions to messages and (3) sent attachments as dependent variables.[6] By exploring gender, job level and the influence of psychological safety in regard to three specific types of chat, we were able to gain a more nuanced picture of chat behavior in virtual meetings. Interestingly, results revealed employees high in job level sent more 'text messages' compared to those low in job level ($\beta = 1.40, p > .01$), women sent significantly more 'emoji reactions' in their virtual meetings compared to men ($\beta = 2.73, p > .01$), yet men sent significantly more 'attachments' compared to women ($\beta = 2.22, p > .05$). Further, psychological safety moderated the relationship between gender and emoji use, such that women with high

[6] In our total sample of 52,507 chat posts included in our original analyses, 34,231 were sent text chats, 18,069 were sent emoji reactions and 207 were sent attachments.

Table 11
Hypothesis 4a-b: Negative binomial regression results with total proportion of audio detected (i.e., verbal participation) as the dependent variable, gender and job level as the predictor variables, and psychological safety as a moderating variable.

Variable	Estimate	Std. error	z-Value	$p > \|t\|$
(Intercept)	1.284e+00	1.714e-01	20.63	0.00***
Meeting duration	2.718e-05	4.204e-06	9.63	0.00***
Chat participation	7.440e-04	1.899e-04	4.09	0.00***
Age	1.513e-01	3.935e-02	−2.14	0.00***
Gender	−1.620e-01	8.217e-02	2.00	0.05*
Job level	8.457e-02	6.445e-02	1.33	0.19
Psych. safety	−4.788e-01	2.272e-01	1.63	0.04*
Gender x psych. safety	1.084e-01	1.322e-01	−1.66	0.41
Job level x psych. safety	1.846e-01	9.580e-02	−1.61	0.06

Note. N = 291 participants and 33,812 meetings. Gender is a binary variable (0 = men, 1 = women). Job level contains four levels (1 = early career, 2 = senior, 3 = principal, 4 = above principal). Perceptions of psychological safety was mean centered in the interaction. Age has six levels depicting various age ranges in equal increments spanning 18–65+. Chat participation reflects the total number of chats sent over the course of three months. Meeting duration reflects the total amount of time the participant spent in meetings over the course of three months. * indicates p < .05. ** indicates p < .01. *** indicates p < .001. Dispersion parameter for Negative Binomial (2.8057) family taken to be 1.

Table 12
Hypothesis 5a-b: Negative binomial regression results with total chat frequency as the dependent variable, gender and job level as the predictor variables, and psychological safety as a moderating variable.

Variable	Estimate	Std. error	z-Value	$p > \|t\|$
(Intercept)	4.000e+00	1.939e-01	20.63	0.00***
Meeting duration	4.700e-05	4.879e-06	9.63	0.00***
Audio detection	1.957e-02	4.787e-03	4.09	0.00***
Age	−9.949e-02	4.645e-02	−2.14	0.03*
Gender	1.899e-01	9.499e-02	2.00	0.04*
Job level	9.952e-02	7.505e-02	1.33	0.18
Psych. safety	4.370e-01	2.674e-01	1.63	0.10
Gender x psych. safety	−2.533e-01	1.531e-01	−1.66	0.09
Job level x psych. safety	−2.820e-01	9.962e-02	−1.49	0.05*

Note. N = 291 participants and 33,812 meetings. Gender is a binary variable (0 = men, 1 = women). Job level contains four levels (1 = early career, 2 = senior, 3 = principal, 4 = above principal). Perceptions of psychological safety was mean centered in the interaction. Age has six levels depicting various age ranges in equal increments spanning 18–65+. Audio detection is captured via the NEF metric of total proportion of audio. Meeting duration reflects the total amount of time the participant spent in meetings over the course of three months. * indicates p < .05. ** indicates p < .01. *** indicates p < .001. Dispersion parameter for Negative Binomial (1.7071) family taken to be 1.

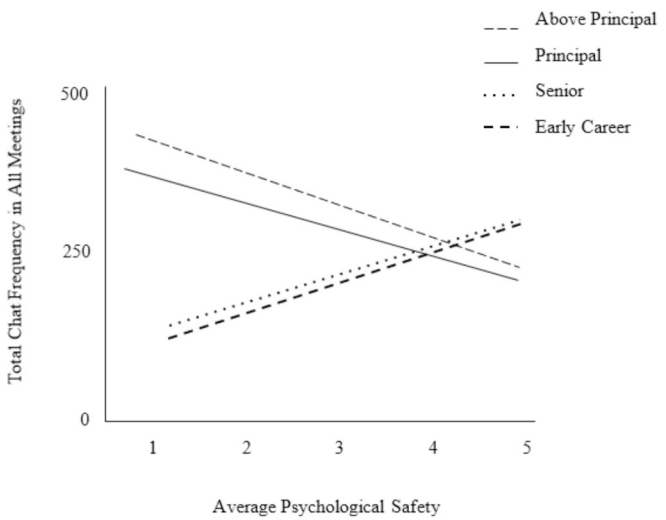

Fig. 1. Interaction between job level and psychological safety on total chat participation in meetings.

Table 13
A. Negative binomial regression results with total sent messages (only) as the dependent variable, gender and job level as the predictor variables, and psychological safety as a moderating variable. B. Negative binomial regression results with total emoji reactions (only) sent as the dependent variable, gender and job level as the predictor variables, and psychological safety as a moderating variable. C. Negative binomial regression results with total attachments sent (only) as the dependent variable, gender and job level as the predictor variables, and psychological safety as a moderating variable.

A.

Variable	Estimate	Std. error	z-Value	$p > \|t\|$
(Intercept)	6.608e+00	1.501e+00	4.40	0.00***
Meeting duration	5.239e-05	4.953e-06	10.58	0.00***
Audio detection	2.367e-02	4.678e-03	5.06	0.00***
Age	−1.333e-01	4.493e-02	−2.97	0.00**
Gender	8.097e-01	5.832e-01	1.39	0.16
Job level	1.398e+00	4.847e-01	−2.88	0.00**
Psych. safety	−7.667e-01	3.496e-01	−2.19	0.03*
Gender x psych. safety	−1.726e-01	1.352e-01	−1.28	0.20
Job level x psych. safety	3.161e-01	1.145e-01	2.76	0.01**

B.

Variable	Estimate	Std. error	z-Value	$p > \|t\|$
(Intercept)	2.506e+00	2.163e+00	1.16	0.25
Meeting duration	5.206e-05	7.132e-06	7.30	0.00***
Audio detection	1.960e-03	6.747e-03	0.29	0.77
Age	−8.268e-02	6.439e-02	−1.28	0.20
Gender	2.728e+00	8.394e-01	3.25	0.00**
Job level	−1.094e+00	6.985e-01	−1.57	0.12
Psych. safety	9.304e-02	5.035e-01	0.19	0.85
Gender x psych. safety	−5.519e-01	1.946e-01	−2.84	0.00**
Job level x psych. safety	1.997e-01	1.650e-01	1.21	0.22

C.

Variable	Estimate	Std. error	z-Value	$p > \|t\|$
(Intercept)	2.605e-02	2.372e+00	0.01	0.99
Meeting duration	6.614e-06	9.159e-06	0.72	0.47
Audio detection	1.420e-02	7.212e-03	1.97	0.05*
Age	−1.106e-01	8.863e-02	−1.25	0.21
Gender	−2.220e+00	1.011e+00	−2.20	0.03*
Job level	1.444e+00	7.675e-01	1.88	0.06
Psych. safety	1.019e-01	5.646e-01	0.18	0.86
Gender x psych. safety	3.351e-01	1.269e-01	1.36	0.06
Job level x psych. safety	−3.440e-01	1.857e-01	−1.85	0.06

A. *Note*. N = 291 participants and 34,231 sent chat texts. * indicates p < .05. ** indicates p < .01. *** indicates p < .001. Dispersion parameter for Negative Binomial (1.9041) family taken to be 1.
B. *Note*. N = 291 participants and 18,069 sent emoji reactions. * indicates p < .05. ** indicates p < .01. *** indicates p < .001. Dispersion parameter for Negative Binomial (1.9041) family taken to be 1.
C. *Note*. N = 291 participants and 207 sent attachments. * indicates p < .05. ** indicates p < .01. *** indicates p < .001. Dispersion parameter for Negative Binomial (4.9851) family taken to be 1.

perceptions of psychological safety sent more emoji reactions to messages compared to their counterparts with low perceptions of psychological safety ($\beta = -0.55$, $p > .01$). See Table 13 for a summary of results, and Fig. 2 for a graph of the interaction between gender and psychological safety on emoji reaction use. We unpack the trends from our collective results below.

5. Discussion

Participating in meetings is essential for effective communication, decision-making, engagement, and overall organizational success (Hosseinkashi et al., 2023; Oetzel, 2001; Woolley et al., 2010). It facilitates the exchange of information, fosters teamwork, and ensures that everyone is aligned with the organization's goals (Hinkel & Allen, 2013; Yoerger et al., 2015). The shift to remote and hybrid work introduces new avenues of participation in meetings, such as the parallel chat feature. Our research is one of the first to explore individual differences in both audio (i.e., spoken) and chat (i.e., written) participation in virtual meetings. We leverage research and theory on status characteristics, computer-mediated group interaction, and perceptions of psychological safety to investigate individual differences in meeting participation, the intersection of these identities, and how positive perceptions of one's work environment can influence verbal and written participation in virtual meetings. Our results reveal interesting findings regarding

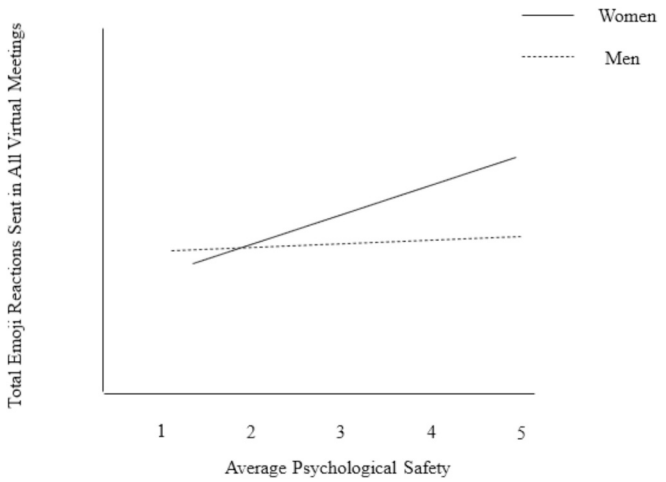

Fig. 2. Interaction between gender and psychological safety on emoji reaction use in virtual meetings.

participation patterns in virtual meetings.

First, we found evidence of gender differences in verbal and chat participation. Across all virtual meetings over the course of three months, women participated significantly more frequently than men in overall chat posts. In virtual meetings, it can be challenging for everyone to have an opportunity to speak due to time constraints, turn-taking logistics, or dominant voices. Women may use the chat to ensure their questions, comments, or ideas are heard, particularly if they feel they might not get a chance to speak verbally. Aligned with the expectations of status characteristics theory, research has shown that historically, women are more likely to be interrupted in verbal conversations (Smith-Lovin & Brody, 1989). Using the chat feature could reduce interruption apprehension for women, providing a way for them to ensure their contributions are not talked over by male counterparts. In support of this, we found significant gender differences in audio (i.e., verbal) participation in virtual meetings, where men had more audio detection in their meetings. This finding supports prior research indicating that men tend to speak more during group discussions (Lee & Mccabe, 2021; Smith-Lovin & Brody, 1989), which often manifests in the meeting context (Wrenn, 2012). Further, we found evidence that men *highest* in job level speak significantly more often than women low in job level. This highlights the combined effect (i.e., intersection) of multiple status characteristics (gender, job rank) on speaking patterns in virtual meetings. Taken together, our findings suggest women use the chat more frequently to participate in virtual meetings, whereas men verbally participate more often, particularly when they are high in job rank. While further research is needed to delve deeper into the connection between status-related factors and participation in virtual meeting environments, our results indicate the chat feature could provide an avenue for women to engage and contribute to discussions. These findings could have noteworthy consequences for women, particularly in male-dominated sectors like computer science and information technology.

Interestingly, we found that women *high in job level* use the overall chat significantly more often compared to all other subgroups (men at various job levels, women low in job level). This finding could be influenced by several factors. For example, women in senior positions may have greater self-confidence and expertise in their respective fields (Chusmir & Koberg, 1991, 1992; Kolb, 1999), leading them to actively engage in meetings to share their knowledge and insights. Similarly, women in higher job levels may hold leadership positions where their input is crucial for decision-making and strategy development. Their active participation ensures that their perspectives are considered in shaping organizational directions. In terms of time management, women in leadership roles often have demanding schedules. Engaging through chat may enable them to efficiently manage their time during meetings, contributing via chat posts when convenient without disrupting their workflow. Additionally, perhaps women in higher job levels feel a sense of responsibility to represent and advocate for other women in the workplace (High-Pippert & Comer, 1998). Women who have broken through barriers to reach senior positions may be more aware of the importance of inclusivity and gender diversity.

In supplemental analyses, we found that overall, women react more to others' chat posts using emojis compared to men. This aligns with prior research which has found in various settings, such as text messages, social media platforms, and online chat rooms (Fullwood et al., 2013), women tend to use emojis more frequently than men (Jones et al., 2020; Prada et al., 2018). In fact, Chen et al. (2017) conducted a global study involving 134,419 users from 183 countries to investigate gender disparities in emoji usage within text messaging. Across the top 10 countries with the highest emoji activity, the overall prevalence of emoji usage was notably higher among women (53 %) compared to men (47 %). Collectively, these findings indicate women may use and react via emojis more frequently than men counterparts. This likely extends to the virtual meeting context, as our results suggest. Interestingly, further supplemental analyses revealed men send more attachments than women in their virtual meetings. One potential explanation for this finding is men may be more task-oriented in their communication (Kimbrough et al., 2013), opting to send attachments that convey specific information or support their points, while women might use emojis to express emotions or reactions within the conversation (Wolf, 2000). Further, societal norms and expectations regarding gender roles and communication could contribute to these differences (e.g., Social Role Theory; Eagly & Wood, 2012; Guadagno & Cialdini, 2002). If there are perceived norms around how men and women are expected to communicate in professional settings, individuals may align their chat behavior with these expectations. This

could explain the gender differences in the *types* of chat posts being sent by men and women in virtual meetings.

Our additional analyses also indicated employees high in job level contributed to the chat via 'sent text messages' more frequently than their counterparts. In other words, employees high in job rank sent more written text messages - excluding the use of emoji reactions and attachments - compared to those low in job level. This is counter to our hypothesizing that employees lowest in job level would rely on the chat (a secondary medium) more frequently to voice. However, the issue of whether individuals across diverse job levels *should* contribute equally to meetings is an important consideration, particularly when assessing their relevance to the meeting's objectives. While the overall goal of more equal participation across job levels is appropriate given the benefits of hearing diverse perspectives, it is essential to acknowledge contextual nuances that challenge this notion, particularly concerning the relevance of contributions. Lower-level employees may naturally contribute less to the meeting chat due to factors such as being in a learning phase, seeking context, or having less experiential knowledge. Consequently, expecting equal participation from individuals at various job levels may not align with the inherent differences in their roles and responsibilities. Moreover, not all meeting attendees possess the same degree of relevance to the meeting's agenda, raising questions about the appropriateness of expecting uniform participation. The concept of Legitimate Peripheral Participation (Lave & Wenger, 1991, 2001), which describes an evolving process where newcomers gradually engage in more complex activities within a group as they become more experienced and integrated, could explain the gradual progression from observation to active involvement in tasks (such as the meeting chat) based on experience. In essence, the argument suggests that equitable participation might not align with the dynamics of learning, experience, and task relevance within organizational contexts. While the pursuit of equal contribution in meetings is worthy, it necessitates a nuanced understanding of the varying roles, experiences, and levels of relevance among meeting participants.

We found evidence for the role of psychological safety on chat participation: (1) Employees low in job level who had high perceptions of psychological safety contributed to the overall chat more often compared to those who had low perceptions of psychological safety and (2) women with high perceptions of psychological safety used emoji reactions more frequently than their counterparts with low reported psychological safety. Yet, we found perceptions of psychological safety did not moderate the relationship between job level and verbal participation. These findings suggest that while psychological safety may be important when it comes to influencing written participation for those low in status (low job level; women) – it does not necessarily increase or encourage *verbal* participation for these individuals in virtual meetings. One potential explanation for this finding is that individuals, especially those low in status, may perceive potential risks or consequences associated with verbal participation (e.g., fear of backlash, criticism) and psychological safety might not fully alleviate these concerns. However, these employees may be less concerned about being misunderstood or misinterpreted when using chat as a means of communication where they have more time to edit and refine their response or contribution. Thus, perceptions of psychological safety may lead to increased chat participation as employees feel confident that their written messages will be received without negative judgment or miscommunication.

It is worth noting that there was a significant correlation between audio detection and chat participation in virtual meetings ($r = 0.37$). This finding suggests individuals who actively contribute through verbal communication (e.g., speaking during virtual meetings) also tend to engage actively through written communication (e.g., using chat). If certain individuals are consistently dominating both verbal and written communication in a way that stifles others' contributions or hinders productive discussions, it could be a sign of a communication imbalance or a dominance issue (Brown & Miller, 2000). Dominant participants can hinder the equitable sharing of ideas and perspectives in a meeting, making it challenging for others to participate fully (Markman, 2018). However, and perhaps more optimistically, it could be that some individuals prefer to use multiple modes of communication to reinforce their messages or provide additional context (Oviatt et al., 2004). They may speak during the meeting to convey their main points and use written communication to share details, references, or links that support their contributions. This could be a signal of active participation where these individuals are engaged, contribute relevant insights, ask questions, and provide valuable input to advance the discussion.

Taken together, our findings depict the evolving nature of communication in virtual meetings, with the chat feature playing a significant role in ensuring more participation for certain groups of employees. Below we discuss the theoretical and practical implications of our work, before turning to limitations and discussing future directions.

5.1. Theoretical implications

First, our findings show some support for status characteristics theory, which suggests that individuals bring various social characteristics (such as gender and job level) into social situations, and these characteristics can influence their behavior within those situations (Berger et al., 1972, 1980; Bunderson, 2003). Adopting this theory, we expected and found that women use chat to participate in virtual meetings more often than their male counterparts. Further, we found evidence that men, particularly men higher up in the organization, are verbally participating the most frequently in virtual meetings. Several factors derived from this theory may help explain these participation patterns. For instance, women may adopt alternative communication strategies (such as chat) to assert themselves or gain recognition in situations where they are traditionally disadvantaged (Heath & Wensil, 2019). In meetings, women may perceive themselves as having lower status due to historical gender disparities in leadership and decision-making roles (Carless, 1998; Venkatesh et al., 2000). Relatedly, gender stereotypes can shape expectations about how men and women should behave in professional settings (Bobbitt-Zeher, 2011; Heilman, 2001). Traditional stereotypes may associate women with being more collaborative, empathetic, and thus inclined towards written communication such as chat (Eagly & Mladinic, 1994). The tendency for men to speak more in meetings can be attributed to a combination of cultural, societal, and individual factors. Cultural norms often prescribe certain expectations for gender behavior, with men traditionally encouraged to assert themselves in public spaces, including professional meetings (Ridgeway, 2001). Additionally, studies suggest that men may, on average, exhibit higher levels of confidence and self-assuredness in such settings (Guillén et al., 2018). Power dynamics within organizations, often skewed towards male leadership,

can also influence men to feel more empowered to speak up (McCarty, 1986). This heightened status can translate into a greater expectation for these individuals to contribute during meetings. By providing empirical support for these theoretical underpinnings, our research contributes to the ongoing development and refinement of status characteristics theory.

Second, our work contributes to the literature on psychological safety and participation in groups (Edmondson, 1999; Newman et al., 2017). Psychological safety at work creates a supportive and inclusive environment where individuals can freely take risks, express their ideas, and contribute without fear of negative repercussions (Kahn, 1990; Pearsall & Ellis, 2011). In meetings, research has found feelings of psychological safety can encourage employees to share innovative ideas, actively participate in decision-making, engage in continuous learning, and collaborate effectively (Frazier et al., 2017; Schaubroeck et al., 2011). This highlights the notion that psychological safety's positive influence transcends traditional face-to-face interactions to also include virtual communication platforms encompassing a written forum such as text-based chat and emoji reaction use.

Last, our findings advance the research on work meetings – particularly those mediated through technology (Constantinides & Quercia, 2022; Standaert et al., 2022). We find there are significant gender differences in audio detection (i.e., verbal participation) in virtual meetings. This suggests men are speaking more frequently in virtual meetings compared to their women counterparts. However, our investigation into chat participation uncovers a nuanced layer of meeting dynamics. It reveals that women use written participation, utilizing the chat feature more frequently than their men counterparts. This dual perspective on verbal and written participation contributes to our understanding of virtual meetings and highlights the need for comprehensive research to capture the multifaceted nature of contemporary workplace communication in a virtual environment. By uncovering the nuances of written participation within different meeting contexts, our research provides a foundation for designing more effective and inclusive meetings, advancing the field's knowledge base, and resulting in several practical implications which we discuss below.

5.2. Practical implications

First, the finding that women tend to participate more in chat during virtual meetings suggests that organizations, leaders, and teams should actively encourage gender-inclusive communication. This could involve creating an environment where both verbal and written contributions are valued and where all participants feel heard and respected, regardless of their gender and chosen method of communication. This can be achieved by setting clear meeting expectations and norms for respectful communication and ensuring that chat messages are acknowledged and integrated into discussions when relevant. For example, meeting leaders could assign a chat moderator to monitor the chat discussion during virtual meetings to ensure these comments and questions are being heard and incorporated into the discussion.

Second, our results indicate that men tend to verbally participate more frequently in virtual meetings. Further, we found men who are high in job level verbally participate the most. Recognizing that men may be more active through spoken communication, leaders should ensure that this does not inadvertently silence voices from women. For example, meeting facilitators could encourage women and employees at lower job levels to voice their opinions (either through chat or verbally) by actively seeking their input during meetings. Additionally, meeting leaders could adopt a rotation system for speaking roles during meetings, ensuring that different team members, irrespective of their gender or job rank, take turns leading discussions or presenting their ideas. Such an approach not only ensures equitable participation but also leverages the diverse perspectives and expertise within the team, ultimately contributing to more effective and well-rounded decision-making processes (Larson Jr et al., 1998; Stasser & Titus, 1985).

Third, our findings highlight the role of psychological safety in shaping communication behavior. Low-level employees who have higher perceptions of psychological safety are more likely to participate in the chat. Likewise, women who have high perceptions of psychological safety use emojis to react to others messages more often than their counterparts. To promote open and inclusive communication, organizations should foster an environment where all employees feel safe to express their opinions both verbally and through text (i.e., chat). This can be achieved by fostering a culture of trust, openness, and respect. This includes recognizing and appreciating individual contributions, demonstrating respect for diverse perspectives, and ensuring that feedback is constructive rather than punitive. Organizations could consider implementing training programs that focus on psychological safety and communication skills. These programs could help employees understand the concept of psychological safety, its importance in fostering an inclusive work environment, and practical techniques for creating a safe space for open communication in a virtual work context.

5.3. Limitations and future directions

Just like any research endeavor, there are limitations of our work which lead way for future research opportunities. First, due to the sensitivity of the data source, we were unable to capture the content of the spoken or chat discussion beyond knowing whether the participant (a) had audio detected (b) sent a chat (c) sent an attachment (d) sent an emoji. We could not discern *what* the participants were saying or posting (e.g., if they were sharing resources, telling jokes, asking or answering questions, etc.). Future telemetry data could strive to capture the specific content of the meeting participation if privacy concerns allow. Alternatively, studies could have employees self-report on the purpose of the chat feature and how/why they use the chat to communicate in a virtual work environment. This would provide insight into how and for what purposes the chat is leveraged in virtual meetings, compared to when audio is preferred.

Second, due to the limited racial and ethnic diversity in our sample, we were unable to adequately explore race as a predictor of participation in virtual meetings. Our sample was primarily White, followed by Asian. We only had four participants identify as Black or African American in our sample. Moreover, we had no participants who identified as Indian, Alaska Native, Native Hawaiian or Other Pacific Islander. Because of these uneven sample sizes and limited racial diversity in our sample, we could not appropriately test

for significant racial differences in participation. We encourage future research to explore racial and ethnic differences in participation using a racially diverse sample of employees. Relatedly, future research could explore other individual differences beyond gender, race, and job level to see if people vary in their use of verbal vs. chat participation depending on, for example, personality differences (e.g., introversion/extraversion), experiences with technology, or tenure.

Third, the telemetry data available to us was able to provide information on the proportion of audio detected for each participant and in each meeting over the span of three months. While this provides some insight into audio participation in meetings, it is an imperfect metric of verbal contribution. It could be that background noise was detected, causing a false illusion of actual contribution to the virtual meeting. Future research should more accurately explore verbal contribution in virtual meetings (e.g., through direct meeting observation, analyzing meeting transcripts, etc.) to better understand individual differences in spoken participation in virtual meetings. Further, research should consider the link between chat participation and verbal participation in meetings. We found audio detection and chat participation were correlated, suggesting individuals who are verbally contributing more frequently are also posting in the chat more often. Future research should investigate the link between written and verbal communication in meetings to prevent certain voices from dominating discussions and ensure all employees are heard and included.

Our data tracked meeting behavior for individual participants over three months. However, we could not discern who else was in the meeting (i.e., gender or job level composition of all attendees in the meeting). It would be interesting to see if the gender or job level composition of the meeting influences meeting participation and engagement. For example, in a meeting with all women, is chat used more frequently compared to meetings with all men and one woman? If the meeting is composed of all junior-level employees, is chat used more frequently compared to a meeting with all senior executives and one lower-level employee? Exploring how the composition of the meeting and the dynamics of the group or team influences chat participation and/or verbal interaction in a virtual environment is a fruitful area for future research.

While we were interested in exploring the mitigating role of psychological safety on participation in virtual meetings, there could be other perceptions of the work environment that influences verbal and chat participation. For example, perceptions of employee voice or interpersonal justice could impact one's likelihood of using the chat to participate in virtual meetings. Additionally, the culture of the team or organization could play a significant role in meeting engagement: if the company values open communication, inclusivity, and collaboration, individuals may be more likely to feel comfortable participating in meetings. Understanding how perceptions of work climate can influence group participation could be a powerful tool in mitigating the effects of status characteristics on individual participation behavior.

Last, our research explored individual differences in participation in virtual meetings. Future research should investigate an individual's participation patterns and preferences in hybrid meetings, where some attendees are physically present while others join remotely via a device. Hybrid meetings represent a novel blend of physical and virtual interactions, offering an intriguing field of future study. Understanding the dynamics of chat use and spoken communication in hybrid contexts, encompassing both in-person and remote attendees, can reveal how technology shapes communication and collaboration when individuals share the same physical space but engage through digital channels. Moreover, this line of research could explore how the remote audience engages in the chat as a means of participation when they are physically not present, but other attendees are in-person and collocated in a conference room. In hybrid meetings, the role of meeting leaders and facilitators is especially important. Prospective studies could delve into how leaders leverage chat to guide discussions, address questions, and maintain the meeting's overall flow, particularly in the context of a diverse audience comprising both in-person and remote participants.

6. Conclusion

With the increasing prevalence of remote work, virtual meetings have become a cornerstone of organizational communication and group interaction. Meeting participation takes on new dimensions in this virtual landscape, providing alternative modes of communication during meetings. Leveraging insights from individual differences, psychological safety, and work group participation, we explored the factors influencing verbal participation and chat behavior in this virtual context. Our findings reveal gender and job level have an impact on the type/s of participation in virtual meetings; women tend to be more active participants in the meeting chat, particularly using emoji reactions, whereas men tend to verbally participate more often. Further, our study highlights the moderating effect of psychological safety on the relationships between gender, job level, and chat participation. Women with high perceptions of psychological safety use more emojis than their counterparts, and employees lower in job level, but equipped with perceptions of psychological safety, contribute to the chat more frequently compared to those with low perceptions of psychological safety. This research contributes to our understanding of spoken and written communication within virtual meetings, depicting the interplay of individual characteristics and work perceptions in a technology-mediated environment.

CRediT authorship contribution statement

Liana M. Kreamer: Writing – review & editing, Writing – original draft, Visualization, Methodology, Investigation, Formal analysis, Conceptualization. **Steven G. Rogelberg:** Writing – review & editing, Supervision, Conceptualization. **Lev Tankelevitch:** Writing – review & editing, Resources, Methodology, Data curation, Conceptualization. **Sean Rintel:** Writing – review & editing, Resources, Investigation, Data curation, Conceptualization.

Declaration of competing interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

Data availability

The data that has been used is confidential.

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