PARTICIPATION IN VIRTUAL MEETINGS: USING THE "CHAT" AS A MECHANISM TO ELEVATE ATTENDEE VOICES

by

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ABSTRACT

LIANA M. KREAMER. Participation in Virtual Meetings: Using the "Chat" as a Mechanism to Elevate Attendee Voices. (Under the direction of DR. STEVEN G. ROGELBERG)

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 now conducted virtually (Cisco, 2022). In this new context, meeting participation is mediated through technology, which presents new challenges and opportunities for meeting leaders and attendees. One encouraging opportunity that can elevate meeting participation is the use of written chat during virtual meetings. Text-based chat offers a second avenue of participation during a meeting, where attendees can synchronously contribute to the conversation through writing. The current study leverages research and theory on (a) individual differences (i.e., status characteristics theory), (b) employee perceptions of psychological safety and (c) work group participation to explore potential antecedents of engaging in chat during virtual meetings. Results suggest women participate in the meeting chat more frequently than their men counterparts. Further, we found perceptions of psychological safety moderate the relationship between job level and chat participation. Employees low in job level who have *high* perceptions of psychological safety participate in chat more frequently compared to their counterparts who report low perceptions of psychological safety. Results contribute to our understanding of written communication in virtual meetings, unpacking the individual differences in chat participation in a technology-mediated space. Further, our findings enhance our understanding of psychological safety; and how creating a psychologically safe environment can influence one's method of participation in virtual meetings.

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DEDICATION

To George: for your constant support, encouragement, understanding, and love for me throughout this entire process—I could not have done this without you. Thank you for being my best friend, colleague, teammate, and number one fan. To my family, friends, colleagues, and advisors - for always keeping me curious, grounded, and true to who I am.

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CHAPTER 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 (Woolley et al. 2010; Oetzel, 2001), particularly when the group is heterogeneous (Bear & Wooley, 2011; Nemeth, 1986; Hoffman et al., 1962). Unfortunately, failure to share information and ideas, especially from those with unique knowledge and expertise, 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 attend hundreds of millions of meetings each day across the globe (Rogelberg, 2019; Keith, 2015), 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, forecasting, 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 (Hosseinkashi et al., 2023), employee engagement (Hinkel & Allen, 2013; Yoerger et al., 2015),

increased job satisfaction and job performance (Lam et al., 2002). 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 likely manifests differently depending on the medium through which the meeting is held. 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). There are different types of CMC technologies, including but not limited to: electronic bulletin boards, email, Internet Relay Chat (IRC), video conferencing, conference calls, online social networking sites, short message service (SMS, i.e., text messaging), and social media interactions (Hancock et al., 2020, Siegel et al., 1986). 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 in the meeting via a written chat (i.e., parallel chat). 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. 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 / for casual conversation (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 literatures. 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 (Wang et al., 2021; Felstead & Henseke, 2017) provide frameworks for multi-method collaboration, there is little prior exploration of text-based chat in virtual work-related meetings despite its theoretical grounding and practical importance.

To investigate the use of parallel chat as an additional means of participation in virtual meetings, the current study leverages the literature on (a) participation in virtual groups, (b) meeting science (c) individual differences in communication, and (d) employee perceptions of psychological safety to explore potential antecedents of engaging in meeting chat (e.g., individual differences such as gender and job level), how these characteristics intersect, and how feelings of psychological safety can serve to moderate this relationship.

CHAPTER 2: LITERATURE REVIEW

In this section, we first review the literature on work group participation. We discuss how group participation manifests in meetings and review relevant research on work meetings. We transition into literature on virtual meetings, and how computer-mediated group interactions can influence participation patterns in virtual contexts.

2.1 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 (Dasgupta et al., 2015; Michinov et al., 2011; Bonito & Hollingshead, 1997; Vaughan & Stasser, 1996; Bonito, 2001). 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 accurate solutions and make improved judgments when each member offers their distinct information (Hollingshead, 1996; Larson et al., 1996, 1998; Stasser & Titus, 1985). Woolley et al. (2015) explored the collective (i.e., pooled) intelligence of groups and found that groups with more equal distribution of turn-taking and groups who had greater gender diversity had a higher collective intelligence (e.g., the ability of the group members to collectively solve problems, make decisions, or generate ideas that are superior to what any individual member could achieve alone).

Unfortunately, research suggests group members tend to share common information (Lu et al., 2012; Reimer et al., 2010; Mesmer-Magnus & DeChurch, 2009). This is often referred to as the hidden profile paradigm (Stasser & Titus, 1985, 2003; Sohrab et al., 2015), 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). According to a meta-analytic study conducted by Lu and colleagues (2012), teams that withheld unique information were eight times less likely to select the optimal choice in comparison to teams in which every member had complete access to all relevant information. In the case of a 'hidden profile', a significant portion of the information that favors the best choice (i.e., the benefits of one option and drawbacks of others) 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 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). The dynamics of these meetings can significantly impact the overall effectiveness and efficiency of group interactions, which further underscores their importance in the realm of group participation.

2.2 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 likely 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 profoundly 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 that has been shown to contribute to meeting inclusiveness and effectiveness (Hosseinkashi et al., 2023). In this study, we focus on the antecedents, particularly individual differences, that shape the use of written participation via the chat in a virtual meeting context.

2.3 Virtual Meetings and Participation

Recent data suggests many meetings today are conducted through computer-mediated technology, using platforms such as Zoom, Microsoft Teams, and Google Meet (Meluso et al., 2020). In an extensive review of the literature, computer-mediated group interaction appears more egalitarian than face-to-face group interaction (see Kiesler & Sproull, 1992). In electronic groups, both engagement in group discussions and the sway over decisions have been observed to be more evenly distributed when compared to traditional face-to-face groups (McLeod, 1992; Rice, 1990; Zigurs et al., 1988). For example, 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).

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. There are various ways in which the chat feature can elevate equality of contributions in meetings. First, chat could reduce production blocking. The term production blocking refers to two primary sources of process losses (Diehl & Stroebe, 1987; Lamm & Trommsdorff, 1973): (1) Individuals within the group 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) while awaiting their turn to contribute, people tend to focus on recollecting their idea rather than actively generating new ones (Dennis et al., 1990). This limits the quantity and potential quality of ideas contributed to the discussion. The parallel exchange provided by written communication could significantly reduce these concerns, as members no longer need to wait to speak or participate in the discussion. Attendees' ideas and contributions can be communicated in the chat instantaneously, without risk of forgetting or suppression.

Second, and relatedly, the use of text-based chat can help mitigate interruption apprehension (i.e., one's reluctance to interrupt the speaker). For instance, in written text, a meeting participant can finish a message that can be comprehended independently of the interrupter's input, a contrast to the limitations of listening to two people speak simultaneously in face-to-face interactions. This disparity in the capacity to interrupt 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, a recent study on nonverbal communication in meetings found computer-mediated cues such as use of humor and emojis signal informality, establish an equalitarian relationship, and indicate emotional involvement (Darics, 2020). Similarly, 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).

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). Additionally, chat can serve as a comment log, creating a collective 'memory' of the meeting which can streamline group decision-making (Haseman et al., 2005). This function enables meeting participants to readily retrieve and access previously shared information to make a more informed decision using all unique and available knowledge. 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.

Given the potential and underexplored benefits of written communication in synchronous CMC interactions, the primary purpose of the current work is to understand *who* is using text-based communication as a vehicle for meeting participation, and how employees' perceptions of their work climate may influence their chat behavior in virtual meetings.

CHAPTER 3: HYPOTHESIS DEVELOPMENT

To inform our hypotheses, we first leverage status characteristics theory to consider how status influences participation patterns in group meetings. Further, we explore the role that status characteristics may play in virtual interactions (i.e., how computer-mediated contexts may lessen the prevalence of status cues). We then discuss how differences in status might influence one's written participation in virtual meetings (i.e., the chat). We adopt an intersectionality approach to explore how multiple status characteristics can intersect to influence an individual's likelihood of engaging in the chat. Last, we leverage research on perceptions of psychological safety to understand how the perception of a safe work environment could impact employees' chat participation in their virtual meetings.

3.1 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, as is the case in face-to-face interactions, 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 (Ridgeway, 1991; Berger et al., 1972, 1980). 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, resist the influence of others in times of disagreement, and exert influence over others in the group (Berger et al., 1980).

Because of this, status is arguably one of the most commonly studied group characteristic relevant to participation (e.g., Ridgeway & Walker, 1995; Bonito & Hollingshead, 1997; Walker et al., 2014; Goar & Sell, 2005). 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 (Nembhard & Edmondson, 2006; Bienefeld & Grote, 2014). Below, we review two predominant and widely studied status characteristics which likely influence an individual's likelihood to participate in group discussions at work: gender and job level.[1]

There is extensive evidence that gender is a main status characteristic in groups research (e.g., Strodbeck 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

[1] 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.

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 (Ridgeway & Smith-Lovin, 1999; Smith-Lovin & Brody, 1989; Karpowitz et al., 2012). In 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). This is likely due to the feedback loop, where there is a lack of traction in women's ideas, and/or women receive greater critiques for their proposed solutions which influences their likelihood of sharing ideas in the future (Maltz & Borker, 2018). 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 (Islam & Zyphur, 2005; Hrebiniak, 1974). 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, Skvoretz (1981) examined disparities in participation among members of a hospital advisory board and identified that individuals with higher status, such as surgeons and administrators, spoke more frequently than

those with lower status, such as nurses. Moreover, 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. Members without a rank, such as staff and students, contributed the least in terms of speaking frequency. 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.

These previous studies have primarily examined the influence of status characteristics in face-to-face group interactions, focusing on spoken communication. However, virtual environments present distinct communication dynamics such as the opportunity to engage via a written medium. Our research aims to understand participation in virtual meetings, specifically how technology affects the influence of status-related attributes on individuals' participation in groups.

3.1.1 Status Characteristics and Virtual Communication

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, 1986; Wasserman & Richmond-Abbott, 2005). One possible explanation offered in the literature is that physical traits appear less salient in a virtual environment and do not necessarily have to be revealed in a virtual interaction (Walther, 1996). For example, gender identity could be concealed by selecting gender-neutral names to be presented on a virtual meeting platform. If video is turned off during the meeting, these physical status cues are even less apparent (if at all). For teams that exist in a fully virtual environment or have not met in person, these status cues could remain hidden for the duration of the working relationship. The point being, the information one gives about oneself is more selective and subject to self-censorship in a virtual context compared to a face-to-face interaction, which fosters a sense of anonymity that could encourage participation from underrepresented groups in these contexts (Suler, 2004). This can encourage more candid and honest input, as individuals may feel less pressure related to their status or identity (Jessup et al., 1990).

In our work, we propose and explore a second probable explanation for the more equal participation in virtual interactions: the use of written communication in these contexts. In virtual meetings, all participants often have equal access to communication tools, like the chat feature. This accessibility to communication tools creates a more level playing field for meeting participants, regardless of their status, role, or position within the organization. In traditional face-to-face meetings, individuals with higher status or more assertive personalities might dominate the spoken conversation (Ridgeway & Smith-Lovin, 1999; Caudill, 2013), 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, perhaps promoting more equitable participation in the virtual meeting context.

Yet, despite the chat feature's attempt to create equality in virtual meetings, research and theory indicates a communication 'hierarchy' still exists (Daft & Lengel, 1986; Lengel & Daft, 1988). For example, media richness theory proposes different media have varying levels of "richness" or the capacity to carry information (Daft & Lengel, 1986; Dennis & Kinney, 1998). According to this theory, communication media vary along a spectrum, which, in decreasing order of richness, includes face-to-face discussions, phone calls, and written communications (Trevino et al., 1987). The richer a medium is, the more effective and influential it is at conveying information. For instance, spoken communication can carry vocal cues (e.g., tone, pauses, inflection), making spoken participation more rich than written communication. Richness is also linked to a medium's capacity to encompass the full range of natural language and effectively convey personal emotions (Huber & Daft, 1987). This theory suggests spoken communication (i.e., verbal participation) is richer than written communication (i.e., chat participation) and thus more powerful at effectively conveying information (Daft & Lengel, 1986); whereas written communication via chat is a less rich and therefore less powerful form of communication. Consequently, it is likely that higher status individuals would be more inclined to use the richer form of communication (verbal/spoken) to participate in the group discussion. Conversely, individuals with lower organizational status (women, employees low in job level) likely gravitate towards using the chat feature, a lesser medium, as an avenue of participation in virtual meetings.

Furthermore, participating via the chat may reduce concern or anxiety around interruption when posting in a written form compared to if one were to verbally interject during the discussion. Normally, a conversation is organized so that one speaker talks at a time – and speakers alternate to prevent the conservation from becoming a monologue (Sacks et al., 1978).

An interruption occurs when one speaker verbally disrupts the turn of another (Smith-Lovin & Brody, 1989). To interrupt a speaker (i.e., to begin talking before the speaker's turn is finished) prevents that speaker from completing their thought or sharing their idea/s. Since interruptions represent a clear violation of turn-taking norms, it is not surprising that their occurrence is linked to dominance, power, and status (Drass, 1986). For example, studies have found that men interrupt women, doctors interrupt patients, and those with masculine identities interrupt individuals with feminine identities compared to the inverse (James & Clarke, 1993; Zimmermann & West, 1996; Matusitz & Spear, 2014; Butow et al., 1995).

In light of this, perhaps those low in status choose to use the chat to participate because (a) it is a lower-level method of communication compared to spoken participation, and (b) they are more reluctant to interrupt the speaker (i.e., the meeting leader). Moreover, those who occupy a lower status within the organization may harbor concerns about being talked over or disregarded if they rely solely on verbal participation in virtual meetings. Therefore, individuals with lower status may use the chat, a less-rich media, as a more accessible and comfortable means of participating compared to their high-status counterparts. In support of this theorizing, an internal study specific to chat in virtual meetings found women used 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). The authors contend “this may be because women, particularly younger women, find it difficult to be heard in meetings” (Sarkar et al., 2021, p. 5). 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 theorizing on how status characteristics influence written participation in virtual settings, we hypothesize:

Hypothesis 1a. Women send more chats in their virtual meetings compared to men.

Hypothesis 1b. Employees low in job level send more chats in their virtual meetings compared to employees high in job level.

3.2 Intersectionality

Scholarship in the social sciences is progressively emphasizing 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 and their accompanying value judgments 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 these categories are intersected. Moreover, 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; McCall, 2005).

The term intersectionality first emerged in the late 1980s, introduced by scholar Kimberle´ Crenshaw (Crenshaw, 1989, 1990). Intersectionality is a concept that recognizes and examines the complex and interconnected nature of social identities and systems of oppression. Intersectionality recognizes that individuals can experience multiple forms of disadvantage and/or discrimination at once, due to the intersection of their various status identities - such as gender, class, sexual orientation, job position, and more. At its core, intersectionality emphasizes that social identities and systems of power are not separate, but rather intersect and interact with

one another, creating unique experiences and forms of oppression. It challenges the notion of a single-axis approach to understanding social inequality and highlights the ways in which multiple social categories and systems of privilege and disadvantage shape an individual's experiences, opportunities, and outcomes (Crenshaw, 1990).

Although the specific interpretation of intersectionality may differ depending on the research context, a common theme found in various definitions is that social identities, which act as foundational aspects of social connections, mutually shape and strengthen each other (Crenshaw, 1989; Collins, 1990; 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). Both status characteristics theory and intersectionality draw attention to the importance of considering the historical, social, and cultural contexts in which these intersecting identities and systems of oppression operate. It recognizes 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).

Regarding gender differences in job hierarchy and/or job role within the organization, prior research has shown that men are more likely to be seen as leaders and evaluated as capable by both men and other women (e.g., Eagly & Karau, 1991; Brown & Geis, 1984; Wood & Karten, 1986). Despite the vast body of research demonstrating limited distinctions in the inherent leadership and management capabilities of men and women (Oakley, 2000; Dobbins & Platz, 1986), stereotypes persistently depict women as less capable leaders than their men counterparts. For instance, in leaderless groups, women are (a) less prone to being chosen as leaders and (b) less inclined to assume the leadership role within the group in comparison to men

(Eagly & Karau, 1991; Kolb, 1997). When women and men both are in similar job positions and rank, men are still perceived as having a higher status regardless of the equality of their formal positions (Kolb, 1997). Moreover, when women and men leaders exhibit identical behavior and have equivalent performance on work tasks, men are repeatedly evaluated more positively than women (Kolb, 1997). This line of work exploring multiple status characteristics suggests gender and job status likely intersect, where men high in job level (i.e., a leadership role) reap more positive benefits compared to females in a similar job level.

The conclusion to this theorizing suggests research on inequality, dominance, and oppression must pay attention to the intersections of status characteristics when considering human behavior (Acker, 2006). Therefore, it is appropriate and/or necessary to consider how gender and job level intersect to predict one's chat behavior in virtual meetings. Intersectionality and status characteristics theory would suggest (a) women (b) who are low in job level may use the chat, a lesser method of communication, as a primary mechanism to contribute to the discussion. To further explore these intersections of status characteristics in relation to chat use in virtual meetings, we propose:

Hypothesis 2. Women low in job level send more chats in their virtual meetings compared to all other groups.

3.3 Perceptions of Organizational Climate

The literature on status characteristics has explored perceptions of work climate as an important condition influencing work-related outcomes for low status employees (Nemhbhard & Edmondson, 2006). For example, research by Juvarich and colleagues (1993) found that employee attitudes, such as perceptions of work climate, predicted their job involvement and engagement above and beyond demographic characteristics (e.g., gender and age). In regard to

participation, research suggests having a supportive work climate (i.e., defined as a climate that incorporates values such as collaboration, encouragement, personal freedom and trust; Wallach, 1983) is a leading predictor of employee participation and involvement regardless of status (Shadur et al., 1999). Further, research indicates that organizational climate, operationalized as individuals' perceptions of their work environment, significantly influences employee attitudes, such as work motivation and performance (Parker et al., 2003; James & Jones, 1974). Studies find an individuals' perceptions of work environment relate to a host of outcomes such as job satisfaction, burnout, job involvement, job performance, and organizational citizenship behaviors (Schneider & Snyder, 1975; Gershon et al., 2007; Pritchard & Karasick, 1973; Brown & Leigh, 1996; Moorman, 1991). It is likely that a supportive work climate enhances participation and communication by fostering an atmosphere of cooperation and openness (Shadur et al., 1999).

In their systematic review of supportive work environments, Newman et al. (2017) identified psychological safety as the primary channel for positive outcomes, related to increased knowledge sharing, participation, engagement, creativity, innovation, and overall enhanced performance (Newman et al., 2017; Budd et al., 2010; Zhang et al., 2010).

3.3.1 Psychological Safety and Participation

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 that their peers will embrace the expression of their thoughts and welcome their ideas. They also recognize and respect each other's competence, display a genuine interest in one another as individuals, hold positive intentions toward their colleagues, engage in constructive

conflict and confrontation, and feel comfortable voicing their opinions (Edmondson, 1999; Newman et al., 2017).

In terms of behavior, psychological safety promotes a workplace atmosphere where employees are inclined to 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, improved social interactions, and increased knowledge sharing among teammates (Siemsen et al., 2009; Zhang et al., 2010; Leroy et al., 2012). For instance, Tynan (2005) observed that employees with a high level of other-psychological safety, meaning they believe that others are secure in their relationships, were more likely to express dissenting opinions, offer candid feedback, and highlight mistakes to their supervisors. Furthermore, the presence of psychological safety within dyadic relationships and teams can foster increased vocal participation among employees (Liang et al., 2012; Detert & Burris, 2007; Bienefeld & Grote, 2014) and a reduction in instances of silence (Brinsfield, 2013).

Research at both the individual and group levels has shown psychological safety is positively related to information sharing (Siemsen et al., 2009; Bunderson & Boumgarden, 2010). As psychological safety creates an environment that promotes taking interpersonal risks (Edmondson, 1999), it increases the likelihood that employees will perceive it as safe to offer suggestions and question existing practices (Walumbwa & Schaubroeck, 2009). Research also suggests that when employees experience high-quality relationships and report high levels of psychological safety, they are more likely to view their failures as learning opportunities and engage in productive future behaviors (Carmeli & Gittell, 2009). Psychological safety plays a crucial role in encouraging employee participation in meetings (Frazier et al., 2017; Carmeli &

Gittell, 2009), and this active participation contributes to increased synergy, coordination, and collective achievement (Frazier et al., 2017).

First, employees who feel psychologically safe are more likely to share innovative ideas, suggestions, and feedback in their meetings (Edmondson et al., 2002; Lee et al., 2021). They feel more empowered to contribute their unique insights and viewpoints, knowing that their contributions will be valued and considered. This participation in idea sharing can lead to increased creativity and innovation within the team and organization (Hargadon & Bechky, 2006; Shin & Zhou, 2007). Second, psychological safety can enhance employee participation in decision-making processes (Frazier et al., 2017). Employees feel confident voicing their opinions, collaborating with colleagues, and actively engaging in discussions related to important decisions. Their participation helps create a more inclusive and democratic decision-making environment, leading to better-quality decisions and increased employee buy-in (De Dreu et al., 2008; Jehn, 1995). Third, psychological safety fosters a culture of continuous learning and development. When employees feel safe to ask questions, seek feedback, and admit mistakes, they engage in ongoing learning and development (Marsick & Watkins, 2001; Gherardi, 2006). This participation in learning activities contributes to individual growth, team effectiveness, and overall organizational learning. Fourth, psychological safety promotes collaboration and teamwork. Employees who feel safe are more likely to engage in collaborative efforts, cooperate with others, and share knowledge and resources (Siemsen et al., 2009; Bunderson & Boumgarden, 2010). 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.

3.3.2 Psychological Safety and Status Characteristics

Overall, psychological safety creates an environment where employees feel comfortable, valued, and included, which positively impacts their level of participation in meetings. When employees feel psychologically safe, they feel comfortable speaking up and contributing to the discussion without fear of interruption or rejection. Thus, psychological safety may mitigate the effects of status characteristics on participation in meetings. 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 for communication can effectively mitigate national disparities and diminish in-group/out-group biases within teams (Gudykunst, 1991; Maznevski, 1994). Larkey (1996) found that in diverse teams, social categorization tended to lead to "divergence," which means adhering to culturally based communication patterns, as opposed to "convergence," characterized by adjusting one's communication style to align with their team members. However, they discovered in situations where a psychologically safe communication climate was present, convergence became more prevalent. This climate played a

pivotal role in mitigating the influence of in-group/out-group dynamics in virtual interactions. In further support of this, 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. Perceptions of psychological safety can foster a nurturing and open virtual atmosphere, where members feel comfortable asking questions, admitting to gaps in understanding, and outwardly expressing opinions (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. Thus, they may be more inclined to use the richer form of communication medium and use their voice to contribute their ideas to the conversation (i.e., come off mute to verbally participate). 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 voice and contribute to the discussion due to increased fear of rejection and reluctance to interrupt the speaker.

Given this theorizing, we hypothesize the following moderation:

Hypothesis 3a. 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.

Hypothesis 3b. 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.

See Figure 1 for the full hypothesized model.

CHAPTER 4: METHODS

4.1 Participants and Procedure

We have a collaboration agreement with a multinational technology company which produces computer software, consumer electronics, personal computers, and related services. This company has access to their employees' virtual meeting schedules and behavior within the *Microsoft Teams* meeting platform through 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). This can involve real-time monitoring, historical data analysis, or predictive modeling based on the collected information. Of interest to our research, this company has information on their employees' actual virtual meeting behavior in *Microsoft Teams* spanning three months of time through this telemetry hub.

Through our collaboration agreement, we were able to recruit full-time employees to partake in our research by having our internal collaborators post to multiple newsletters. The recruitment post asked employees to participate in a one-time survey (expected to take 20 minutes), and agree to allow us access to three months of their objective meeting telemetry data - such as how many people were in each meeting they attended, how many chat messages, emojis or attachments they sent, whether they used chat in or out of each meeting, etc. Inclusion criteria limited participation to employees who: a) were 18 years of age or older, b) were full-time employees (worked at least 35 hours per week) and c) were not in sensitive roles (e.g., HR). 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. Further, participants were informed they are contributing to the advancement of our knowledge on virtual meeting features and behaviors, with the goal of increasing meeting experiences.

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 percent or more of the survey to be included in the final data set. Both of these steps to reduce IER concerns enabled the collection of high-quality, self-report survey data to complement the objective, telemetry dataset.

After consenting to participate in our research, 322 employees completed the one-time survey. The survey took, on average, 17 minutes to complete. We eliminated participants that did not complete at least 50 percent 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 and met our inclusion criteria. 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. To ensure participant's privacy in the study, we de-identified all data before analysis (i.e., after the participants id was linked to their telemetry data, the survey data was scrubbed for names, places, and other identifying referents). Only authorized researchers had access to telemetry and survey data. With this linked dataset, we were able to test

whether there are individual differences in who is using the chat feature in their meetings, and if perceptions of psychological safety influence these relationships.

4.2 Measures

In the one-time survey, we measured our independent variables (gender, job level) and our predicted moderating variable (perceptions of psychological safety), along with our demographic control variables (age and race). Our dependent variable (frequency of chat participation) was captured in the telemetry meeting data for each participant, as well as an index of verbal participation via audio detection in each meeting and total time spent in meetings over the three months of time.

4.2.1 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.

4.2.2 Job Level

To capture the job level of participants, 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.

4.2.3 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, α = .77).

4.2.4 Telemetry Data & Operationalization of Chat

This objective meeting behavior data is captured for each employee who completed our survey, and for every 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) their audio detection in the meeting (e) their chat behavior in the meeting (i.e., when they drafted, sent and deleted chats) and (f) whether they were the organizer of the meeting. See Table 1 for an example of the structure of the data.

Meetings often have a leader or facilitator, and research suggests that the meeting leader typically speaks the most during the meeting (Rogelberg, 2019). Given the increased air time and power as the meeting facilitator or meeting leader, it is likely the chat is not as readily used as a mechanism to communicate during the meeting. When the individual is the meeting organizer, they may be driving the meeting, sharing their screen, presenting material, and verbally asking/answering questions. This leaves little time, attention, and energy to devote to the chat. Research supports this theorizing: in meetings with screen sharing, the presenter generally talked more than the audience, and their overall participation in meeting chat was less (Hosseinkashi et

al., 2023). On the contrary, when the individual is a meeting attendee, they likely leverage the chat feature more readily to communicate and participate in the meeting without apprehension of interrupting the formal meeting facilitator. Therefore, in the current study, we were focused on meeting *attendees'* experiences with chat in virtual meetings. We excluded the meetings where the participant was the leader/organizer of the meeting, retaining only the meetings where the participant was an attendee. Further, 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. Thus, the focus of our research was exploring meeting *attendees* chat participation in virtual meetings of *three or more people.*

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.

4.3 Potential Control Variables

In this section, we introduce four control variables we considered in our study to account for potential influences on chat frequency and participation in virtual meetings. These controls encompass: total time spent in meetings, verbal participation in meetings, age, and race.

4.3.1 Time Spent in Meetings

The amount of time spent in meetings naturally influences our dependent variable, total chat participation. Some employees attend more meetings than their counterparts. Therefore, they will have more opportunity to participate in the chat given the increase in time they are spending in meetings. Because of this, we control for the total amount of time participants spent in meetings over the three months. In our sample, participants spent an average of 16,211 minutes in meetings over the course of the three months (*SD* = 11,187). The average meeting length was 77 minutes (*SD* = 146) and the average number of meetings over the three months per participant was 274 meetings (*SD* = 111).

4.3.2 Verbal Participation in Meetings

Given our theorization that parallel chat offers an additional means of participation in virtual meetings, it is important to account for the traditional, richer method of communication in meetings: verbal participation. We hypothesize that low status individuals such as women and employees low in job level use the chat more frequently to participate in meetings compared to high status individuals such as men, and employees high in job level. The underlying assumption of our theorizing being high status individuals likely contribute via the richer communication avenue (i.e., verbally) to the meeting more frequently. Therefore, it is crucial to capture and control for verbal participation in virtual meetings when exploring individual differences in the use of written participation.

Verbal participation for 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. Essentially, 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. If the proportion reads 0.99, sound was detected nearly the whole meeting; and if there is a NA, the participant likely never came off mute or 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 was detected during the meeting. In our sample, the average NEF proportion per meeting was 0.09 (e.g., sound was detected nearly 9% of the meeting; *SD* = 0.17).

4.3.3 Age

Age differences 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 (Warr & Pennington, 1993; Lorence & Park, 2006). Younger generations, often referred to as digital natives (e.g., millennials and Gen Z), have grown up with technology as an integral part of their lives (Prensky, 2001; Bennett et al., 2008). They tend to adapt quickly to new technologies and use

them for various purposes, from communication to entertainment to work. Older generations, on the other hand, sometimes called digital immigrants (e.g., baby boomers and members of Generation X), 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 (Vodanovich et al., 2010; Hershatter & Epstein, 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 use of chat in virtual meetings, we captured and controlled for participant age: Participants were asked to indicate their age range using the following seven categories: (1) 18-24, (2) 25-34, (3) 35-44, (4) 45-54, (5) 55-64, (6) 65+ or (7) Prefer not to say.

4.3.4 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, Whites initiate more interactions than Blacks and speak more to other Whites compared to their Black counterparts. Interestingly, even Blacks speak more to Whites than to other Blacks (Katz et al., 1958; Katz & Benjamin, 1960).

Relatedly, 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, such as Asian or Indian) 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 Whites are viewed as a higher status race, contributing more to conversations, and being spoken to or addressed more frequently compared to nonwhites. Thus, generally speaking, Whites are perceived as higher status actors and nonwhites 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: American Indian or Alaska Native, Asian, Black or African American, Native Hawaiian or Other Pacific Islanders, White, Other (written option), and Prefer not to say.

CHAPTER 5: DATA PREPARATION AND ANALYSES

5.1 Data Preparation and Descriptive Statistics

5.1.1 Survey Data Preparation

After eliminating participants who completed less than 50% of the survey (n = 23) and those who failed both IER questions (n = 5), we had a total of 294 participants in our sample who completed the one-time survey. 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 variable of chat participation was missing), we eliminated these three participants from subsequent analyses. Our final sample size included 291 participants.

5.1.2 Telemetry Data Preparation

In the telemetry dataset, there was a total of 59,029 meetings across all participants resulting in 94,233 specific meeting chat actions (e.g., "click in text box," "send message," "delete message," "add attachment," "NA: no action during meeting," etc.)[2]. Based on our inclusion criteria, we eliminated chat actions in the meetings that the participant organized (n = 19,972) as well as chat actions in meetings that had two or less participants (n = 8,981). We also excluded meetings and their chat actions in the telemetry dataset from the twenty-seven participants who were eliminated from the survey because they failed the IER, or they completed less than 50% of the survey (n = 5,210).

Because we are interested in when participants participated in the chat, we retained the following three meeting actions when creating our dependent variable "chat participation" in our

[2] Note that a participant can engage in multiple meeting actions within one meeting. For example, if a participant is "clicked in the text box," and then "sends a message," this counts as two separate meeting actions for each meeting in the dataset (and would occupy two rows in the dataset).

study: (1) sent message, (2) sent emoji and (3) added attachment. We excluded meeting actions that did not signal chat *participation*; for example, when participants opened the chat pane, copied messages, discarded messages, edited drafts, clicked in the text box, or shared a message to outlook. These meeting actions did not signal that the employee actually participated in the chat. For example, if a chat action read "edited draft," followed by a chat action, "sent message," we only retained the sent message chat action in our data and not the actions leading up to the sent message.[3]

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 count for that meeting consisting of the sum of sent messages, sent emojis or sent attachments (e.g., '2', '6' '10', etc.). This resulted in a total of 52,507 meeting chat actions spanning 33,812 meetings for the 291 participants in our sample.

5.1.3 Data Aggregation of Chat Participation

We adopted an aggregated approach to test our hypotheses to see if there were individual differences based on gender and job level in the total number of chats sent over the course of three months of virtual meetings. We also explored individual perceptions of psychological safety as a moderating condition. 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

[3] There were times a participant opened the chat pane, clicked in the text box, began a draft - but this was *not* followed by a sent message; meaning the participant did not actually send the chat and participate in the meeting. Thus, we did not include these actions as chat participation in our dataset.

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.

In the telemetry dataset, we aggregated the total chat count (i.e., number of chat actions in the meeting) by each participant id in R, to calculate a total sum of chats for each of the 291 participants in our sample.[4] This allowed us to determine how many chats 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 chats.

Using the same aggregation technique in R, we then 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. These served as our control variables for subsequent analyses. In our sample, participants spent an average of 16,211 minutes (~270 hours) in meetings over the course of the three months and audio was detected 9% of the time in meetings, on average.

5.2 Analysis Plan

To test our Hypotheses 1a-b and 3a-b, we used a variation of Poisson regression in R. Poisson regression is a statistical modeling technique specifically designed for situations where the dependent variable is a count or a rate of occurrences of a particular event within a fixed unit

[4] R is widely used for statistical computing, data analysis, and graphics. It provides a wide variety of statistical and graphical techniques and is extensible, allowing users to add new functions through packages. Researchers, statisticians, and data analysts often use R for tasks such as data manipulation, statistical modeling, and creating visualizations (Tonidandel et al., 2018; Ihaka & Gentleman, 1996).

of observation (Cohen et al., 2013). The key idea behind Poisson regression is to model the relationship between the expected value of the count (the mean) and a set of predictor variables. The assumption is that the number of events generated in a period of time depends on an underlying rate parameter (Cohen et al., 2013). Because the dependent variable in our research is the number of chats sent in virtual meetings (e.g., a count variable), Poisson regression is a more appropriate analysis than linear regression.[5]

The Poisson regression is the most basic probability distribution applied to regression when the outcomes are count data (Cohen et al., 2013, p. 526). However, Poisson regression assumes that the count data follows a Poisson distribution, which is characterized by a mean and variance that are equal. This is often referred to as the equidispersion assumption (i.e., variance = mean; Sellers et al., 2012). In many real-world scenarios, count data can be more variable than what a Poisson distribution can adequately model. In cases where the equidispersion assumption is violated (i.e., when the variance is greater than the mean), modifications of Poisson regression, such as Negative Binomial regression, can be employed to account for overdispersion (Gardner et al., 1995; Land et al., 1996). [6]

The primary distinction between negative binomial regression and Poisson regression is the ability for negative binomial to handle overdispersed count data. The negative binomial regression model assumes for each individual, a Poisson distribution applies, but that the rates for individuals, given specific values on the predictors, vary across individuals. A new

[5] The problems we encounter in applying OLS regression to count data are like those we encounter when applying OLS regression to dichotomous outcomes: the residuals are not normally distributed and exhibit heteroscedasticity (Cohen et al., 2013). Furthermore, predicted scores can be out of range (e.g., below zero), which is impossible for count data. Additionally, the standard errors from the OLS regression may underestimate the true standard errors (Gardner et al., 1995). These factors contribute to bias when applying OLS regression to count data.

[6] Overdispersion often occurs when there are unaccounted for or unobserved sources of variation in the data. These unobserved sources can lead to extra variability beyond what would be expected in a simple Poisson model. Negative binomial regression addresses this issue by allowing for this extra variability.

probability distribution – known as the negative binomial distribution – is used to characterize the variance of the residuals. In other words, a negative binomial model of the errors allows greater variance than what is permitted by Poisson regression.

When the dispersion parameter is equal to 1, the model simplifies to a Poisson distribution. When the dispersion parameter is greater than 1, it indicates overdispersion. In our dataset, the variance of chat use is greater than the mean and the dispersion parameter is greater than 1. Because of this, we chose to use negative binomial regression to test our hypotheses using the function glm.nb in the MASS package in R.

Similar to Poisson regression, the dependent variable in negative binomial regression is a count variable and the predictor variables can be categorical or continuous. These predictors are used to explain or predict variations in the count. Negative binomial regression uses a logarithmic link function to model the relationship between the expected value of the count (λ) and the predictor variables. The link function is typically expressed as $\log(\lambda) = \beta 0 + \beta 1X1 + \beta 2X2 + ... + \beta nXn$, where $\beta 0$, $\beta 1$, $\beta 2$, etc., are coefficients to be estimated from the data. We can interpret the estimated coefficients (β) in negative binomial regression to understand the relationships between predictor variables and the expected count of events. Exponentiating these coefficients provides estimates of the relative change in the count for a one-unit change in the predictor variable while holding other variables constant.

To test our Hypothesis 2, 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 (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.[7] Recall, Hypothesis 2

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

expected subgroup one (women, early career) would use the chat the most frequently compared to all other groups in alignment with status characteristics theory and intersectionality. To explore differences in chat participation in meetings among the eight subgroups created by the combination of gender and job level, we used negative binomial regression to compare subgroups using the women, early career group as the reference 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 (i.e., the highest) 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 (i.e., low job level) (2) women, above principal or principal (i.e., high job level) (3) men, senior or early career and (4) men, above principal of 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 amongst these four groups. See Table 2 for an overview of the subgroup creation process.

To test Hypothesis 3a-b and in accordance with best practices proposed by Dawson (2013), 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, 2013).

CHAPTER 6: RESULTS

6.1 Descriptive Statistics

Most participants identified as men (58.5%) followed by women (38.4%).[8] 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 (67%), followed by Asian (18.7%). Only four employees in our sample identified as Black or African American. In subsequent analyses, race was treated as a binary variable (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 chats (*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 minutes in meetings over the three months (i.e., about 270 hours in meetings; *SD* = 11,186.98).[9] 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 and audio participation by (a) gender, (b) job level, (c) race and (d) age. On average, women sent 178 chats over the three months, and men sent an average of 177 chats. Participants early in career sent an average

[8] Less than two percent 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).

of 178 chats, senior level employees sent an average of 167 chats, participants at the principal level sent 212 chats, and employees at the highest job level (above principal) sent an average of 162 chats over the three months of meeting data. Employees between the ages of 25 and 34 sent the greatest number of chats (215 chats), followed by those between the ages of 45 and 54 (183 chats). Employees identifying as White sent roughly 190 chats, and people of color sent an average of 159 chats over the study time frame.

Regarding audio participation, men had an average of 14.5% of audio detection in meetings and women had an average of 12.6% audio detection. Participants at the highest job level (i.e., above principal) had the greatest audio detection at 18.8%, followed by those at the principal level (15.3%). Those early in their career (lowest job level) and at the senior level (second lowest job level) had the least amount of audio detection in their meetings. Regarding age differences in audio detection, employees between the ages of 55 and 64 had the greatest average audio detection (17.4% of meetings), followed by those 65 and older (16.9% audio detection in meetings). Participants identifying as White and participants identifying as a person of color had roughly equal audio detection, with 13.67% and 13.66%, respectively. See Table 4 for a summary of meeting participation statistics by group.

Next, we calculated a summary of participation statistics by meeting size: Participants sent roughly 17 total chats in small meetings consisting of 3-4 attendees (*SD* = 22.51); they sent 64 chats in medium-sized meetings of 5-10 attendees (*SD* = 82.97) and sent 100 chats in large meetings of greater than 10 attendees (*SD* = 161.04) over the course of three months. However, the proportion of audio detected was greatest in small meetings (*M* = 19.31% of the meeting; *SD* = 8.48%). The proportion of audio detected in medium-sized meetings was 9.98% (*SD* = 6.12%) and proportion of audio was detected 2.98% in large meetings (*SD* = 2.87%). These findings

suggest an individual's audio is detected more often in small meetings (i.e., they are verbally participating more) and more chat (written participation) is present in large meetings. See Table 5 for an overview of these descriptive statistics by meeting size.

6.2 Control Variable Inclusion

To be included in subsequent analyses, control variables should be significantly related to primary variables of interest (Becker et al., 2016; Bernerth & Aguinis, 2016). In our case, three of the four proposed control variables were significantly related to predictor variables (gender, job level) as well as the outcome variable (chat participation). Based on this cutoff, the following three variables were included in analyses: total amount of audio detected (i.e., verbal participation), total time spent in meetings, and age. Race was not significantly related to predictor variables nor outcome variables, and thus was not included as a control variable in subsequent analyses.

In alignment with best practices, we tested our hypotheses with and without control variables (Spector & Brannick, 2011). By comparing results with and without controls, we can identify and address confounding factors. Further, models with fewer variables are often preferred for simplicity and interpretability; testing the model without control variables allows us to assess whether the inclusion of additional variables significantly improves the model's explanatory power. This supports the principle of parsimony, favoring simpler models when they perform comparably to more complex ones (Bormann & Rowold, 2018). We report the output of our results both with and without control variables in Tables 6-8.

6.3 Hypothesis Testing

In alignment with status characteristics theory, Hypothesis 1a predicted women send more chats in their virtual meetings compared to men, and Hypothesis 1b predicted employees

lower in job level send more chats in their virtual meetings compared to employees high in job level. Adopting an intersectionality approach, Hypothesis 2 expected that women lowest in job level send more chats in their virtual meetings compared to all other groups. Hypothesis 3 explored the role of psychological safety, predicting that perceptions of psychological safety would moderate the relationship between status characteristics (gender, job level) and chat participation. Specifically, Hypothesis 3a proposed women with low perceptions of psychological safety would use the chat more frequently compared to their counterparts with high perceptions of psychological safety. Likewise, Hypothesis 3b proposed those low in job level with low perceptions of psychological safety would use the chat more frequently compared to their counterparts with high perceptions of psychological safety. As noted above, we tested our hypotheses with and without control variables, in accordance with best practices (Spector & Brannick, 2011).

Results from the negative binomial regression showed a positive relationship between gender and total chat participation, such that women participated in the chat more frequently compared to men after controlling for time spent in meetings, total audio detection, and age (β = 0.19, $p < .05$). This provides support for Hypothesis 1a. Hypothesis 1b exploring the relationship between job level and chat participation was not supported. See Table 6 for results of our model, both with and without control variables.

We explored Hypothesis 2 utilizing two approaches (refer to Table 2). First, we explored 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 between the eight subgroups when tested both with and without control variables ($p > .05$). However, due to uneven and small sample size issues noted above, we then ran the subgroup analyses using

four subgroup combinations by job level (now 2 levels) and gender (2 levels). While we found men both low and high in job level sent less chats than women low in job level, these finding were not significant. However, counter 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, after controlling for time spent in meetings, total audio detection, and age (β = 0.36, $p < .05$). See Table 7 for a summary of results both with and without control variables. We further explore this finding below in supplemental analyses, retesting this hypothesis using women high in job level as the reference group.

Hypothesis 3a, predicting psychological safety would moderate the relationship between gender and chat participation in virtual meetings, was not supported in either model ($p > .05$). Hypothesis 3b predicting psychological safety would moderate the relationship between job level and chat participation was supported in the basic model without control variables (β = -0.28, $p < .05$). However, 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. There were no significant interactions when testing the model with the inclusion of control variables. See Table 8 for a summary of the results; see Figure 2 for a graph of the interaction.

6.4 Supplemental Analysis #1: Audio Detection (i.e., Verbal Participation)

We were interested in whether there were significant main effects or interactions between our independent variables (gender, job level) and audio detection in meetings. Recall, in our dataset, we had access to the proportion of time the participant's audio detected noise during each meeting. This serves as a proxy for verbal participation in meetings; when noise is detected

through the audio device, it likely indicates the participant is verbally contributing to the discussion. Using negative binominal regression, we ran supplemental analyses using 'total detection of audio over the course of three months' as the dependent variable. We ran analyses with and without three related control variables: time spent in meetings, chat participation, and age. This tested whether there were differences in gender or job level in verbal participation in virtual meetings over the course of the three months. We also tested whether perceptions of psychological safety moderated the above relationships.

Results revealed there was a significant relationship between job level and audio detection in the basic model without control variables. Specifically, those high in job level had greater audio detection in their meetings compared to those low in job level (β = 0.23, p < .01). This suggests employees higher in the job hierarchy are verbally participating more so than their counterparts. However, this effect was not present when running the model with the inclusion of control variables. Interestingly, the model inclusive of control variables suggested there is a significant relationship between gender and audio detection. Women had significantly less audio detection in their virtual meetings after accounting for time spent in meetings, chat participation and age (β = -0.17, p < .05). There were no significant interactions between gender or job level and perceptions of psychological safety on audio detection. See Tables 9 and 10 for a summary of results, both with and without control variables.

6.5 Supplemental Analysis #2: Chat Participation for Women High in Job Level

To further explore the finding that women high in job level use chat the most frequently compared to other subgroups, we ran negative binomial regressions using the women/high job level subgroup as the reference and chat participation as the dependent variable. Results revealed all three subgroups participated in chat significantly less frequently compared to women at the

principal or above principal level after accounting for time spent in meetings, audio detection, and age: women in early career or senior level (β = -0.36, p < .05), men in early career or senior level (β = -0.44, p < .01) and men at the principal or above principal job level (β = -0.36, p < .05). See Table 11.

In sum, results indicate women consistently participate in the chat more frequently than men when controlling for time spent in meetings, audio detection, and age. Yet, counter to our hypothesizing, our results suggest that women, *higher* in job level engage in the chat the most frequent of all. Further, perceptions of psychological safety moderate the relationship between job level and chat participation; employees low in job level with high perceptions of psychological safety participate in the chat more frequently compared to their counterparts. Our supplemental analyses reveal interesting differences in audio participation between these various groups, highlighting the nuances of participation (both written and verbal) in virtual meetings. We unpack these findings in the discussion section.

CHAPTER 7: DISCUSSION

Participating in meetings is essential for effective communication, decision-making, engagement, and overall organizational success (Hosseinkashi et al., 2023; Woolley et al. 2010; Oetzel, 2001). It facilitates the exchange of information, fosters teamwork, and ensures that everyone is aligned with the organization's goals and objectives (Hinkel & Allen, 2013; Yoerger et al., 2015). Notably, equal participation is critical for harnessing the full potential of a diverse set of voices (Bonito & Hollingshead, 1997; Wittenbaum et al., 2004). It promotes inclusivity, optimal decision-making, innovation, and a sense of ownership and commitment among group members (Lu et al., 2012). When all voices are heard and valued, it contributes to more effective and equitable group dynamics and outcomes.

The shift to remote and hybrid work introduces new avenues of participation in meetings, such as the written, text-based chat feature. Our research is one of the first to explore individual differences in chat 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 chat use, the intersection of these identities, and how positive perceptions of one's work environment can influence chat participation in virtual meetings. Our results reveal interesting findings regarding written participation patterns in virtual meetings.

First, as expected, we found support for gender differences in chat participation. Across all meetings over the course of three months, women participated significantly more frequently than men in the chat after controlling for their audio detection, time spent in meetings, and age. 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). Related research on education and gender differences in the classroom context have consistently shown that men raise their hand, initiate participation, and verbally interject more in class discussions compared to women classmates (Aguillon et al., 2020; Younger et al., 1999; Hall & Sandler, 1982). For example, recent research on gender differences in college classrooms has found men speak out without raising hands, interrupt, and engage in prolonged conversations during class more than women students (Lee & McCabe, 2021). These socialization practices and behaviors in the classroom could extend to the workplace, where women hold more fear of interruption as they have become accustomed to these behaviors from men peers over time. Using the chat feature could reduce interruption apprehension for women, providing a way for them to ensure their contributions are not talked over.

Another possible explanation for the increased chat participation for women could be their preference for or comfort with written expression as a form of communication (Bourke & Adams, 2012; Reynolds et al., 2015; Pargulski & Reynolds, 2017; Babayiğit, 2015). For example, some studies have suggested that women may be more inclined to use written communication, and men may prefer face-to-face or verbal communication (Al-Shibel, 2021; Engin & Ortaçtepe, 2014). The chat feature provides a platform for expression, allowing individuals to carefully construct their thoughts and emotions. From a young age, boys and girls often are socialized differently, with girls encouraged to express their emotions and thoughts through written means (Reynolds et al., 2015). However, society often places more pressure on

men to conform to traditional notions of masculinity, which may discourage them from openly expressing their thoughts or emotion in writing (Bourke & Adams, 2012). This logic would assume men verbally participate more in meetings, while women are more active in the chat.

In support of this, we found significant gender differences in audio (i.e., verbal) participation in virtual meetings in our supplemental analyses. Men had more audio detection in their meetings compared to women, suggesting men are verbally participating more frequently than their women counterparts after controlling for time they are spending in meetings, chat participation, and age. This finding aligns with prior research indicating that men tend to speak more during group discussions (Smith-Lovin & Brody, 1989; Lee & McCabe, 2021), which often manifests in the meeting context (Wren, 2012).

Taken together, our findings suggest women use the chat more frequently to participate in virtual meetings, whereas men use audio more often. 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 in discussions. These findings could have noteworthy consequences for women, particularly in male-dominated sectors like computer science and information technology. In terms of making contributions and participating, virtual meetings might offer advantages for women via the chat, whereas men may find traditional face-to-face meetings more advantageous when it comes to participation rates.

We found that women high in job level use chat significantly more often compared to all other subgroups (men at various job levels, women low in job level). Recall, while we expected women to participate in chat more often, we expected women *low* in job level would contribute the most in the chat. Our finding that women high in job level are the group that participates the

most in the meeting chat 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. 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. This might motivate them to participate more actively in the meeting chat to address gender-related issues and promote equality and women empowerment.

Third, we found evidence for the role of psychological safety on chat participation. Employees low in job level who had high perceptions of psychological safety contributed to the chat more often compared to those who had low perceptions of psychological safety regardless of age, time spent in meetings and audio detection. In other words, regardless of these additional variables, the employees with high perceptions of psychological safety in the low job level category consistently contributed more to the chat than their counterparts with low perceptions of psychological safety. These results suggest when employees who are low in job level (e.g., early career) feel safe to take risks, make mistakes, bring up problems, and ask for help – they are more likely to use chat as a means of participation. However, when these early-career employees have reduced perceptions of psychological safety (e.g., they do *not* feel it is safe to take risks, make mistakes, voice problems, etc.) they are less likely to participate in the chat. Interestingly, this result did not apply to those higher in job level. Perceptions of psychological safety did not

significantly increase chat participation for more senior (i.e., above principal or principal) employees in our sample.

This finding suggests psychological safety may be particularly important for employees lower in the organizational hierarchy when it comes to written participation and contribution in meetings. Yet, in our supplemental analyses, we found perceptions of psychological safety did not moderate the relationship between job level and audio participation. Taken together, these two findings suggest while psychological safety may be important when it comes to influencing written participation for those low in job level – it does not necessarily increase or encourage verbal participation for these individuals in virtual meetings.

Psychological safety may have different effects on written and verbal participation in meetings due to various factors related to communication preferences and the nature of the communication medium. For example, individuals, especially those low in job level, 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. Likewise, verbal participation often requires strong communication skills, including the ability to articulate thoughts clearly and confidently. Even in psychologically safe environments, individuals who lack these skills may still hesitate to contribute verbally but may feel more comfortable contributing to the chat as a means of participation.

In our supplemental analyses, we found significant differences in audio detection between those low and high in job level. Employees higher in job level had significantly more audio detection in their meetings compared to their counterparts regardless of their age, time spent in meetings and chat participation. This suggests that individuals high in the job hierarchy (i.e., high status) are verbally contributing more to the meeting discussion. This is in alignment with status characteristics theory, which posits that within group dynamics, individuals evaluate each other's status based on socially relevant factors - such as job level (Berger et al., 1972; Ridgeway, 1993). This perceived status can influence communication patterns within the group, such as individuals in higher job levels contributing more verbally to discussions compared to those in lower job levels (Bloom, 1980; Caudill, 2013; Skvoretz, 1981). First, higher job levels are often associated with greater perceived expertise, leading others to expect more substantive contributions from individuals in these positions. Additionally, the authority and leadership roles typically associated with higher job levels may create a sense of responsibility for active participation in discussions. Moreover, individuals in higher job positions may have developed greater confidence and assertiveness in expressing their opinions, contributing to their willingness to speak up. Lower-status individuals may experience a heightened concern about how their contributions will be evaluated, leading to a more passive role (and less verbal participation). This complex interplay of perceived status, expectations, and group dynamics can shape communication patterns within a workplace or group setting, with those in higher job levels often taking on more active roles in verbal discussions.

Regarding the differences in chat use by meeting size, descriptively we found that employees participated in chat more frequently in larger meetings of greater than 10 participants. Chat was used significantly less in small meetings of 3-4 people. However, more audio was

detected in small meetings; the least amount of audio was detected in large meetings. These results suggest that chat is perhaps more helpful in large meetings and less relevant in small meetings. In larger meetings, chat may serve as a complementary communication tool, allowing individuals to contribute their thoughts, ask questions, or provide feedback without interrupting verbal conversations. It can help manage group dynamics, fostering a more balanced discussion and ensuring that all participants have a chance to engage. In contrast, small meetings with fewer participants may have fewer interruptions and fewer barriers to verbal communication, making audio participation a preferred and more efficient method. Moreover, the detection of more audio in small meetings highlights the importance of voice communication in intimate or small group discussions. The use of audio may be preferred in these settings due to its personal and immediate nature, which could foster deeper engagement and collaboration. In sum, the relevance of chat varies with meeting size and dynamics, suggesting that organizations should consider adapting their meeting formats and communication strategies accordingly.

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 simply 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. This differs from dominating the discussion, where individuals monopolize the conversation, talk excessively, interrupt others, and may not allow others to have their say.

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. Our results revealed significant differences in meeting participation: Women participate more frequently in the chat compared to men, yet men contribute more on audio (i.e., verbally). Further, we found women high in job level participate the most frequently in the meeting chat compared to all other gender/job level subgroups. Our findings highlight the importance of psychological safety in encouraging chat participation, particularly among lower-level employees. In our supplemental analyses and in alignment with status characteristic theory, we found those high in job level verbally contribute more frequently than those low in job level. Last, our findings suggest chat participation is more prevalent in large meetings, audio is detected more frequently in small meetings, and audio detection is significantly correlated with chat participation. Below we discuss the theoretical and practical implications of our work, before turning to limitations and discussing future directions.

7.1 Theoretical Implications

The findings from our research have several theoretical implications that can contribute to our understanding of individual differences in virtual communication and participation, teamwork, and collaboration in organizational settings. Specifically, our findings contribute to

the literatures on (a) status characteristics theory (b) perceptions of psychological safety and written participation, and (c) meeting science, particularly meetings mediated through technology (i.e., virtual meetings).

First, our findings align with 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 status and behavior within those situations (Berger et al., 1972, 1980; Bunderson, 2003). Adopting this theory, we expected and found support that women use chat to participate in virtual meetings more often than their male counterparts. Further, we found evidence that men are verbally participating more frequently in virtual meetings. Several factors derived from this theory may help explain these participation patterns. For instance, woman may adopt alternative communication strategies (such as chat) to assert themselves or gain recognition in situations where they are traditionally disadvantaged or viewed as low status (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). Second, gender stereotypes can shape expectations about how men and women *should* behave in professional settings (Heilman, 2001; Bobbitt-Zeher, 2011). Traditional stereotypes may associate women with being more collaborative, empathetic, and thus inclined toward written communication such as chat in virtual meetings (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). Communication styles, recognition patterns, perceived expertise, and socialization from early years can further contribute to this finding. By providing empirical support for these theoretical underpinnings, our research contributes to the ongoing development and refinement of status characteristics theory. It highlights the real-world applicability of this theory in explaining gender-related differences in virtual meeting participation patterns.

Interestingly, our findings also present a noteworthy departure from the expectations proposed by status characteristics theory. Contrary to our predictions, we found no significant differences in chat participation between those low and high in job level. While status characteristics theory would predict that individuals with low status might rely more on alternative forms of communication such as chat to assert themselves, our results did not support this. Our finding suggests that employees both high and low in the job hierarchy equally use chat. However, we did find employees high in job level have greater audio detection in virtual meetings. This supplemental finding *is* in alignment with status characteristics theory, which expects high status individuals (such as those higher in job level) would verbally participate more frequently compared to employees low in status. Individuals high in job level may be more likely to engage actively in meetings compared to those lower in job hierarchy due to the influence of perceived status and authority. Higher-ranking individuals often carry a perceived status associated with decision-making authority and expertise. This heightened status can translate into a greater expectation for these individuals to contribute meaningfully during meetings, reflecting their elevated position in the organizational structure. Additionally, status characteristics theory suggests that individuals may attribute more influence and credibility to

those with higher status, further reinforcing their active participation. To promote equality in meeting dynamics, it is essential to recognize and address the potential impact of status characteristics, ensuring that individuals at all job levels feel empowered to contribute their insights and perspectives.

In sum, our research provides valuable insights into the application and nuances of status characteristics theory in the context of virtual meetings, particularly regarding gender-related differences in participation patterns. The alignment of our findings supports the idea that individuals bring social characteristics into social situations, influencing their behavior. The impact of gender stereotypes on communication behavior is evident in our findings, highlighting the real-world applicability of status characteristics theory. This research underscores the dynamic interplay between social characteristics, status, and communication behavior in virtual work contexts, encouraging further exploration of the diverse purposes behind chat usage and its evolution across job levels.

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. This sense of safety is characterized by mutual respect, open communication, and the ability to engage in constructive conflict (Kahn, 1990; Pearsall & Ellis, 2011). It encourages employees to engage in open communication, state concerns, and seek feedback. It also leads to greater knowledge sharing, error reporting, and interpersonal communication among team members (Siemsen et al., 2009; Zhang et al., 2010). 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). Our study aligns with these previous findings and extends them to the realm of virtual meetings, revealing the role of psychological safety in facilitating chat participation, particularly among employees who occupy lower status positions (e.g., those in lower job levels). 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.

Last, our findings advance the research on work meetings – particularly those mediated through technology, such as virtual and hybrid meetings (Constantinides & Quercia, 2022; Standaert et al., 2022). We find there are significant gender and job level differences in audio detection (i.e., verbal participation) in virtual meetings. This suggests both men, and those high in job level, are verbally contributing more frequently in virtual meetings compared to their low-status counterparts. However, our investigation into meeting chat participation uncovers a nuanced layer of meeting dynamics. It reveals that women show a preference for 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.

Regarding meeting characteristics such as size, our findings show chat is used more often in large meetings (>10 participants) compared to small meetings of 3-4 participants. However, audio was detected more frequently in small meetings compared to large meetings. This emphasizes the importance of considering meeting size as a crucial contextual factor influencing communication dynamics within the virtual meeting setting. It implies that chat serves a distinct purpose in larger meetings, potentially facilitating the management of diverse inputs,

disseminating information efficiently, or encouraging more inclusive participation. Conversely, its reduced usage in smaller meetings hints at a potential redundancy or diminished need for chat when communication channels are already more intimate. The prevalence of verbal participation in smaller meetings suggests that these settings may foster an environment conducive to active spoken contributions. Smaller groups may naturally facilitate turn-taking, have more personalized interactions, and offer more opportunities for participants to speak (i.e., 'have the floor'). However, in larger meetings it can be difficult to make spoken contributions because many people may like to contribute, but only one person can speak at a time. Utilizing the chat feature enables multiple 'voices' to be heard simultaneously in large meetings.

By uncovering the nuances of written participation within different meeting contexts, our research provides a foundation for designing more effective and inclusive meetings, ultimately advancing the field's knowledge base, and resulting in a several practical implications which we discuss below.

7.2 Practical Implications

Our findings have several implications for individuals, leaders, teams, and organizations who partake in and organize virtual meetings. 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. Given our finding that chat is more common in large meetings of ten or more attendees, having a designated person to moderate the chat could be especially important in large meetings containing ten or more attendees.

Second, our supplementary results indicate that men, and employees at higher job levels, tend to verbally participate more frequently. Recognizing that these 'high-status' employees may be more active through spoken communication, leaders should ensure that this does not inadvertently silence voices at lower job levels. 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 level, take turns leading discussions or presenting their ideas. Meeting organizers could also encourage chat participation from all attendees by posing questions and asking meeting attendees to post their answers/responses in the chat. 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 et al., 1998; Stasser & Titus, 1985).

We found women at higher job levels participate the most in chat. This highlights the importance of acknowledging individuals' communication preferences and behaviors can be influenced by a multitude of interconnected factors, including gender and job level, which can further intersect to impact how employees choose to engage in meetings. To foster more effective communication strategies, meeting leaders should adopt an inclusive approach that

accommodates diverse communication preferences and recognize there is no one-size-fits-all approach to participation in virtual meetings.

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. 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. When employees trust that their ideas will be treated respectfully, they are more likely to engage openly in discussions. 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. Furthermore, leadership plays a pivotal role in setting the tone for psychological safety. Leaders should model the behaviors they wish to see in their teams by actively seeking input in meetings, being open to feedback, and demonstrating empathy and respect in their interactions. When employees witness leaders embracing psychological safety, they are more likely to follow suit.

When it comes to organizing meetings, it is not a one-size-fits-all approach; rather, it involves selecting the right format to maximize effectiveness. For example, for critical discussions that demand active verbal interaction, smaller meetings are recommended. These settings, as our study showed, are characterized by higher audio detection (i.e., verbal

participation), making them ideal for in-depth conversations. In smaller groups, participants have a greater opportunity to engage in real-time dialogue and turn-take to share perspectives. On the other hand, our findings indicate that larger meetings tend to garner more chat participation. This format can be strategically employed for different purposes, such as information dissemination, presentations, updates, or announcements. In these scenarios, chat serves as a valuable channel for participants to ask questions, seek clarifications, and provide feedback while not disrupting the flow of the main presentation. Alternatively, it may be beneficial to adopt a hybrid meeting model that combines elements of both small and large meetings, allowing for a versatile approach that caters to various aspects of communication and collaboration. Ultimately, by considering the appropriate meeting size for different types of discussions, meeting leaders can enhance the overall participation and effectiveness of meetings within their organization.

Last, and importantly, organizations should encourage a feedback-rich culture where employees are comfortable providing feedback about communication processes, including meetings. Meeting leaders should regularly solicit input from employees on how to enhance meeting effectiveness and inclusivity. They should then use this feedback to adapt meeting structures and practices to better align with the organization's goals of promoting open and equal communication. This can help identify and address any communication challenges and ensure that the virtual environment is conducive to effective collaboration. To address potential disparities in communication patterns, organizations can implement inclusivity measures such as anonymous input channels to ensure that everyone's voice is heard, respected, and valued.

Our findings emphasize the complexity of virtual meeting dynamics. Individuals, leaders, teams, and organizations should consider conducting their own research and collecting data to better understand their specific communication patterns and take actions tailored to their unique

meeting culture and experiences. Overall, the practical implications we offer can help organizations, teams and leaders create more inclusive, effective, and psychologically safe virtual meeting environments where all employees have an opportunity to contribute and collaborate effectively whether it is in the meeting chat or through verbal participation.

7.3 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 chat beyond knowing whether the participant (a) sent a chat (b) sent an attachment (c) sent an emoji. We could not discern *what* the participants were 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 chat 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. There could be individual differences in the purpose or types of chats that employees are sending in their virtual meetings. For example, women may utilize the chat to share resources or provide words of affirmation; whereas men may rely on chat to share feedback and provide input to the discussion. Relatedly, future research should explore employee perceptions of and experience with chat, to see how individuals view chat in virtual meetings (e.g., do they find chat helpful? Do they find chat distracting? Do their perceptions of chat alter depending on meeting-related factors, such as meeting type or meeting size?) Answering these questions by having employees report on their evaluations of chat use in virtual meetings would increase our understanding of the potential

benefits and limitations of using chat as a method of participation in virtual meeting environments.

Second, due to the limited racial and ethnic diversity in our sample, we were unable to adequately explore race as a predictor of chat use 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 chat frequency between racial minorities and White employees. We encourage future research to explore racial and ethnic differences in chat use 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 chat 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, recording meetings, 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. On the contrary, those who are verbally contributing less often to virtual meetings are also engaging in the chat less frequently. 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 chat 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 comprised 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 in this domain.

While we were interested in exploring the mitigating role of psychological safety on chat use, there could be other perceptions of the work environment that influences chat behavior. 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 chat engagement: if the company values open communication, inclusivity, and collaboration, individuals may be more likely to feel comfortable using chat for various purposes in virtual 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 in a virtual environment.

In our theorizing, we leveraged media richness theory which suggests that various communication channels, such as face-to-face communication, phone calls, emails, or written documents, differ in their ability to convey complex and ambiguous information (Daft & Lengel, 1986). Verbal/spoken participation is viewed as a richer form of communication compared to typed/written participation and is argued to be 'best suited' for conveying complex and ambiguous information (Daft & Lengel, 1986). Adopting this framework, our research operated under the assumption that chat is a secondary (i.e., less rich) means of communication in virtual meetings, and verbal/spoken participation is the richer, 'higher order' method of communication. In support of this, research on computer-mediated communications has suggested spoken communication tends to get more attention in terms of its perceived value (Jibril & Abdullah, 2013), often because there are additional psychological interpretations connected to it (Sproull & Kiesler, 1986; Daft & Lengel, 1986). For example, facial expressions, eye contact, voice, tone, and volume are present in verbal communication but absent in written communication (Walther & Tidwell, 1995; Jibril & Abdullah, 2013). Future research should confirm or challenge this assumption to determine whether media richness theory applies to the chat feature in meetings. For example, it could be that synchronous meeting chat is considered equally rich or as valuable as verbal participation in virtual meetings.

The focus of our research was on predictors of chat frequency as we were interested in unpacking the individual differences in chat use in virtual meetings. Future research should explore the outcomes of chat. For example, does chat frequency relate to meeting outcomes such as perceptions of meeting inclusivity or meeting effectiveness? Does using chat more often

predict team and organizational outcomes such as team cohesion, job satisfaction, job commitment, or employee engagement? We encourage future research to explore the effects of meeting chat on individual, team, and organizational outcomes – both in the short term and in the long term.

Last, our research explored individual differences in chat participation in virtual meetings. Future research should investigate an individual's chat use 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 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. This research can offer guidance for effective leadership practices in hybrid meeting settings.

Preliminary research has already hinted at the additional complexities that hybrid meetings bring, particularly concerning equitable participation and effective communication between in-person and remote participants (Saatçi et al., 2019). Expanding on this research could provide deeper insights into how chat use can effectively bridge communication gaps, fostering inclusivity within hybrid meeting environments. An essential aspect to explore is whether chat

empowers remote participants, granting them an equal voice and enabling them to contribute effectively, thus playing a pivotal role in the design of inclusive hybrid meeting practices.

In summary, our research offers valuable insights into chat dynamics in virtual meetings. Yet, the virtual and hybrid meeting landscape remains largely unexplored especially regarding written communication in these contexts. The complexities of chat participation, spanning content, individual differences, and outcomes, call for deeper investigation. As remote and hybrid work arrangements continue to persist, understanding chat behavior becomes crucial for fostering effective and inclusive communication. Our research lays the foundation for further exploration, promising valuable insights for the future of virtual workplace interactions, particularly within the context of meetings.

7.4 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. Our investigation highlights the role of text-based chat as a tool for fostering participation in virtual meetings. By providing an additional channel for synchronous contributions, chat enables attendees to actively participate without disrupting the verbal discussion. Leveraging insights from individual differences, psychological safety, and work group participation, we explored the factors influencing chat behavior in this virtual context. Our findings reveal gender has an impact on chat participation in meetings; women tend to be more active participants in the meeting chat. Further, our study highlights the moderating effect of psychological safety on the relationship between job level and chat participation. Employees lower in job level, but equipped with perceptions of psychological safety, contribute to the chat

more frequently compared to those with lower perceptions of psychological safety. This research contributes to our understanding of written communication within virtual meetings, depicting the interplay of individual characteristics and work perceptions in a technology-mediated environment. Recognizing these insights, organizations and meeting leaders can navigate the virtual landscape more adeptly, fostering inclusive and effective communication practices that resonate with the evolving nature of work.

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Table 1

Sample of raw telemetry data from Microsoft Teams

pid	meetingId	meetingDuration	participant Count	isOrganizer	propAudio	chatActionName	chatAction Count
9	331	48	7	FALSE	0.23	clickInTextboxWhen Editing	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	clickInTextboxWhen Editing	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.

Table 2

Part I: Status characteristic subgroups for testing intersectionality (Hypothesis 2)

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

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

Part II: Supplemental status characteristic subgroups for testing intersectionality (Hypothesis 2)

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.

Table 3

Correlations between primary variables and control variables with confidence intervals

Variable	1	2	3	4	5	6	7
1. Race							
2. Age	-.18** [-.29, -.07]						
3. Gender	-.03 [-.15, .09]	-.01 [-.13, .10]					
4. Job Level	-.09 [-.20, .03]	.39** [.29, .48]	-.12* [-.23, -.00]				
5. Psychological Safety	-.19** [-.30, -.08]	.14* [.02, .25]	.02 [-.10, .14]	.02 [-.10, .13]			
6. Time in Meetings	.08 [-.03, .19]	.11 [-.01, .22]	-.04 [-.15, .08]	.21** [.10, .32]	-.07 [-.18, .05]		
7. Audio Detection	-.00 [-.12, .12]	.22** [.11, .33]	-.08 [-.20, .03]	.18** [.07, .29]	-.04 [-.15, .07]	.50** [.41, .58]	
8. Chat Participation	-.06 [-.18, .06]	.00 [-.11, .12]	-.00 [-.12, .11]	.05 [-.06, .17]	-.06 [-.18, .05]	.53** [.44, .61]	.37** [.27, .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 minutes (*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 (Cumming, 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.

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)	8,009	4,866
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

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

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%	1,144
Medium-sized meetings (5-10 attendees)	64	9.98%	2,922
Large meetings (>10 attendees)	100	2.98%	7,841
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

Hypothesis 1a-b: Negative binomial regression results with total chat frequency as the dependent variable and gender and job level as the predictor variables

Excluding the control variables

Variable	Estimate	Std. Error	z-value	*p*>|t|
(Intercept)	4.907	0.204	24.10	0.00***
Gender	0.125	0.860	1.46	0.15
Job Level	0.004	0.119	0.03	0.97

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). * indicates p < .05. ** indicates p < .01. *** indicates p < .001. Dispersion parameter for Negative Binomial (1.0653) family taken to be 1.

Including the control 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.

Table 7

Hypothesis 2: Intersectionality approach - Results from subgroup analysis using negative binomial regression with total chat frequency as the dependent variable

Excluding the control variables

Variable	Estimate	Std. Error	z-value	*p*>|t|
(Intercept)	5.1248	0.1053	48.68	0.00***
Women, Principal or A.P.	0.1956	0.2174	0.90	0.37
Men, Early Career or Senior	-0.0226	0.1381	-0.16	0.87
Men, Principal or A.P.	0.2190	0.1698	1.29	0.20

Note. Women, Early Career or Senior level (i.e., lowest status group) were used as the reference group. A.P. = Above Principal * indicates p < .05. ** indicates p < .01. *** indicates p < .001. Dispersion parameter for Negative Binomial (1.0683) family taken to be 1.

Including the control variables

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 8

Hypothesis 3a-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

Excluding the control variables

Variable	Estimate	Std. Error	z-value	*p*>|t|
(Intercept)	4.870	1.323e+00	1.08	0.00***
Gender	0.028	5.381e-01	-1.76	0.82
Job Level	0.134	4.236e-01	1.24	0.12
Psych. Safety	0.489	3.061e-01	0.32	0.14
Gender x Psych. Safety	-0.052	1.246e-01	1.86	0.79
Job Level x Psych. Safety	-0.277	9.966e-02	-1.48	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. * indicates p < .05. ** indicates p < .01. *** indicates p < .001. Dispersion parameter for Negative Binomial (1.0851) family taken to be 1.

Including the control variables

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	-1.820e-01	1.132e-01	-1.61	0.11

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.

Table 9

Supplemental Analysis #1a: Negative binomial regression results with total proportion of audio detected (i.e., verbal participation) as the dependent variable.

Excluding control variables

Variable	Estimate	Std. Error	z-value	*p*>|t|
(Intercept)	2.1494	0.165	13.05	0.00***
Gender	-0.1045	0.096	-1.09	0.28
Job Level	0.2342	0.069	3.38	0.00***

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). * indicates p < .05. ** indicates p < .01. *** indicates p < .001. Dispersion parameter for Negative Binomial (1.8602) family taken to be 1.

Including control variables

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 10

Supplemental Analysis #1b: Negative binomial ergression 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.

Excluding the control variables

Variable	Estimate	Std. Error	z-value	*p*>|t|
(Intercept)	2.1351	0.165	12.96	0.00***
Gender	-0.100	0.096	-1.04	0.30
Job Level	0.2385	0.069	3.44	0.00***
Psych. Safety	-0.1846	0.266	-0.69	0.49
Gender x Psych. Safety	0.1565	0.155	1.01	0.31
Job Level x Psych. Safety	0.0390	0.112	0.35	0.73

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. * indicates p < .05. ** indicates p < .01. *** indicates p < .001. Dispersion parameter for Negative Binomial (1.8718) family taken to be 1.

Including the control variables

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 11

Supplemental Analysis #2: 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.

Excluding control variables

Variable	Estimate	Std. Error	z-value	*p*>|t|
(Intercept)	5.3204	0.1902	27.97	0.00***
Women, Early Career or Senior	-0.1956	0.2174	-0.90	0.37
Men, Early Career or Senior	-0.2181	0.2102	-1.04	0.30
Men, Principal or A.P.	0.0234	0.2323	0.10	0.92

Note. Women, Principal or Above Principal were used as the reference group. A.P. = Above Principal * indicates p < .05. ** indicates p < .01. *** indicates p < .001. Dispersion parameter for Negative Binomial (1.0683) family taken to be 1.

Including control variables

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.

Figure 1

Hypothesized model depicting individual differences in chat participation in virtual meetings

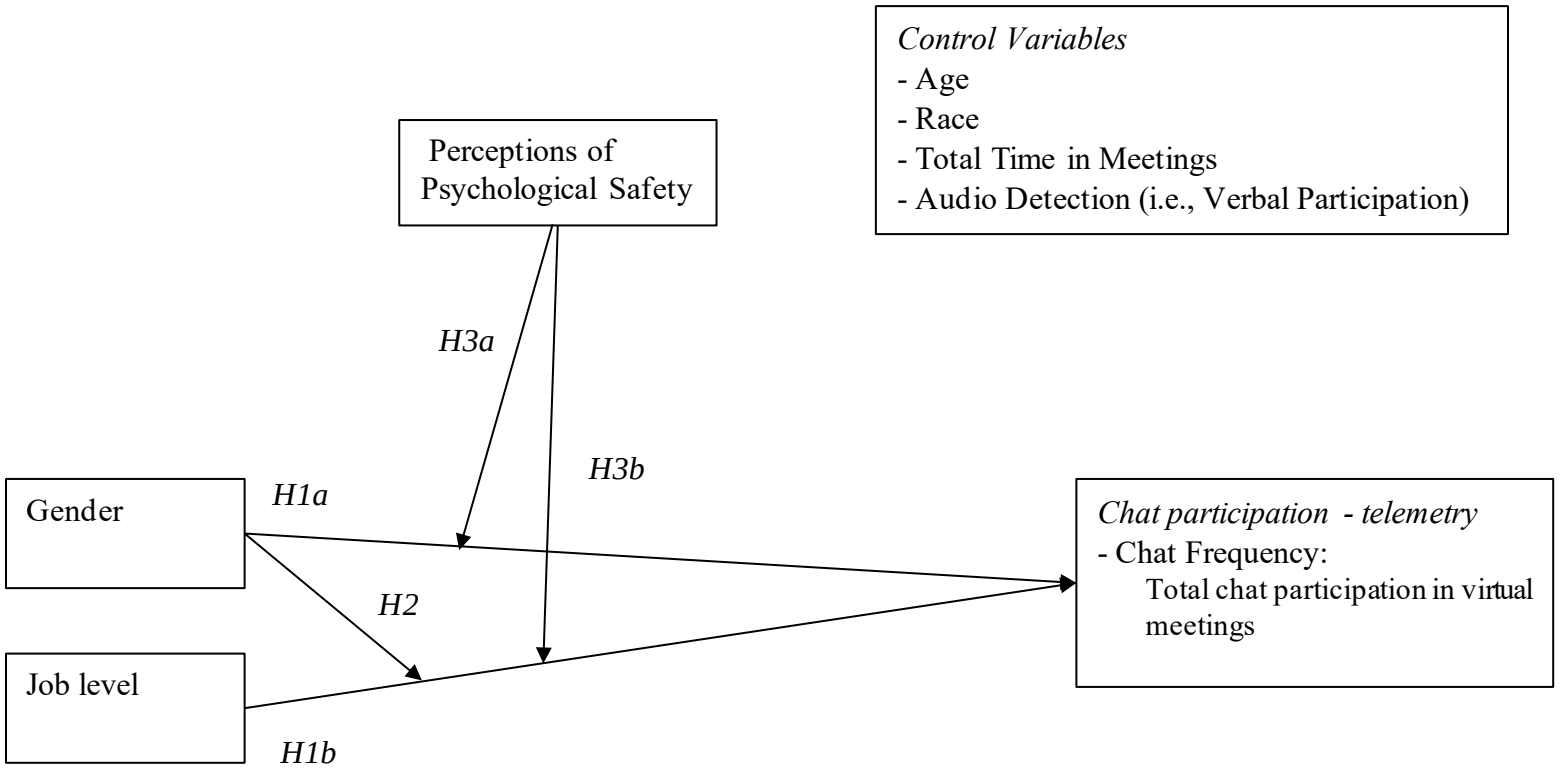

Figure 2

Interaction between job level and psychological safety on chat participation in meetings