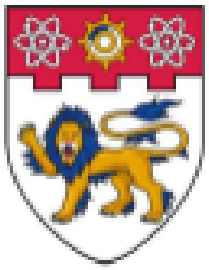

NANYANG TECHNOLOGICAL UNIVERSITY SINGAPORE

EFFECTS OF VIDEO CONFERENCING AFFORDANCES ON ENJOYMENT AND VIDEO CONFERENCING FATIGUE: A MOTIVATIONAL TECHNOLOGY APPROACH

YANG YUJIA

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A thesis submitted to the Nanyang Technological University in partial fulfillment of the requirement for the degree of Master of Communication Studies

2024

Statement of Originality

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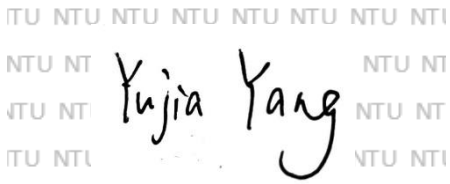

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Acknowledgments

I would like to express my sincere gratitude to all those who contributed to the successful completion of this research. Special thanks to my supervisor and co-supervisor, Professor Lee Chei Sian, and Assistant Prof. Li Junting Benjamin for their continuous support, practical guidance, and mentorship throughout my Master's journey.

In addition, I am also thankful to Shireen and all office staff for their collaboration and help. Their efficiency and support in handling various administrative matters ensured a smooth and seamless process.

Lastly, I am grateful to my family and friends, especially Wu Qian, Lang Cheng, Bao Bao, Gong Zhu, Heng, and Xuan, for their encouragement and understanding during the ups and downs of the research journey. Their unwavering support has been a constant source of motivation.

Love you all!

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Effects of Video Conferencing Affordances on Enjoyment and Video Conferencing Fatigue: A Motivational Technology Approach

Chapter 1: Introduction

Background

In the post-pandemic era, as students returned to physical campuses and traditional offline lectures resumed the extensive use of video conferencing (VC) during the global crisis has left a lasting impact on formal meetings (Jose Maria et al., 2021; Müller & Wittmer, 2023). However, staying in online meetings has brought forth a challenge known as VC fatigue: physical and cognitive exhaustion caused by VC tools (Riedl, 2021). It has been found that VC fatigue is a conceptually different phenomenon from face-to-face meeting fatigue (Knox et al., 2023). This distinction is supported not only by self-reports but also by neurophysiological findings (Riedl et al., 2023).

It comes to the forefront of VC research because it has many adverse effects on users, negatively affecting users' physical and mental well-being (Işıl & ERSOY, 2022). According to Deniz et al. (2022), VC fatigue is also a predictor of students' psychological distress, and it is negatively associated with students' life satisfaction and academic well-being. Beyond its implications for health and well-being, the inefficiency introduced by VC meetings also affects productivity (Bergmann et al.,

2023). The inefficiency caused by VC meetings, in turn, is significantly positively correlated with general burnout, stress, anxiety, and depression (Knox et al., 2023).

While numerous studies have tried to analyze the causes of VC fatigue and its mitigation, certain factors remain unavoidable, such as excessively long meeting times, unstable internet speeds, delayed audio-visual signals, and even gender (Li & Yee, 2022; Shockley et al., 2021). Hence, given the overwhelming utilization of VC and its increasing role in future work styles (Müller & Wittmer, 2023), comprehending how to deal with VC fatigue and ensure the efficiency of VC meetings is imperative.

This research focused on students' group meetings for educational purposes, for example, group discussions of courses, academic research conferences, or discussions related to academic projects. While there has been considerable research on student VC fatigue in the past (Massner, 2021; Oducado, Fajardo, et al., 2022), much of it focused on the overall use of VC during the pandemic. However, in the current stage, online lectures are gradually transitioning back to in-person, and VC, as a platform that students can use independently, will be more widely employed for group meetings. This research focuses on graduate students' use. The difference in using VC between undergraduates and graduates is that undergraduates usually use VC for lecture taking, and graduate students use VC for meetings (Chang et al., 2021), making it more pertinent to the current use of VC. Therefore, the most crucial use of VC for graduate students is meetings, making their formal meetings more deserving of attention.

VC technologies provide several features (Arellano & Parks, 2021; Reddy & Jansen, 2008). Given the varying levels of VC skills and objectives among graduate students, their perceptions of VC and subsequent actions will differ. Thus, when VC fatigue occurs, students with varying perceptions of VC will have different VC experiences (Sundar, 2015). Therefore, this study will unravel how VC affordances shape the VC's psychological experiences, ultimately mitigating VC fatigue and its impact.

Theoretical Framework: Motivational Technology Model

Sundar et al. (2012) introduced the Motivational Technology Model (MTM, Figure 1.1) to elucidate how individuals attain well-being as they are intrinsically motivated to achieve certain goals (Richard M. Ryan & Edward L. Deci, 2000). Intrinsic motivations are rooted in fundamental, inherent psychological needs, and the MTM draws from the concepts of "needs" in the Self-Determination Theory (SDT), which is a psychological framework that focuses on individuals' innate psychological needs for autonomy, competence, and relatedness, emphasizing their role in fostering motivation and well-being. (Richard M. Ryan & Edward L. Deci, 2000). It proposes three technological affordances – navigability, interactivity, and customization - that can enhance three intrinsic motivations: competence, relatedness, and autonomy. While the MTM builds upon the fundamental principles of SDT, it identified possible Information Communication Technology (ICT) affordances that support intrinsic motivations which refers to engaging in an activity for the inherent satisfaction and

enjoyment it provides, rather than relying on external rewards or pressures, leading to various psychological and behavioral outcomes.

According to the MTM, navigability refers to the ICT that allows users to explore any part of the information space (Fitzpatrick, 2000). Interactivity means that ICT affords users to exchange information reciprocally (Sundar, 2008b; Sundar et al., 2003). Customization is an affordance through which users can identify unique attributes using customized features (Sundar et al., 2012). According to SDT (Richard M. Ryan & Edward L. Deci, 2000; Ryan & Deci, 2017), competence, relatedness, and autonomy are critical psychological needs that trigger intrinsic motivation. Competence means a person's feeling capable of achieving a goal. Relatedness is the feeling of connection and belonging to others or the social environment. Autonomy denotes a person's perception of having choices, with low autonomy experienced when one feels compelled or controlled (Ryan & Deci, 2002).

While the MTM was initially created to explain the outcomes of self-monitoring technologies like health applications (Sundar et al., 2012), subsequent studies have constantly developed and applied the model to other contexts and media types. For example, Molina et al. (2022) used the MTM to identify factors that enhance students' learning motivation. Another study employed the MTM to explain how the affordances of Facebook can affect well-being (Jung & Sundar, 2022). Facebook's affordances, like interactivity and customization, significantly fulfilled users' psychological needs and increased their enjoyment of using the media, ultimately improving their subjective well-being.

Throughout these adaptations of the MTM, the model's fundamental components have often been redefined to suit specific contexts and media types. For example, Jung and Sundar (2022) changed the affordance from navigability to modality (see Figure 1.1). In their adjusted model, modality refers to the content presentation ways in ICT. In contrast to navigability, modality holds greater significance as an affordance in interactive social media like Facebook, enabling users to engage in diverse communication activities. Besides, the adjusted model also suggests that intrinsic motivation can be a predictor of well-being. Diverging from the original model, which focuses on behavioral outcomes, this adjusted model links affordances, basic needs, enjoyment as one of the intrinsic motivations (Ryan et al., 2006), and subjective well-being. Therefore, the adjusted model should be applied to the current research.

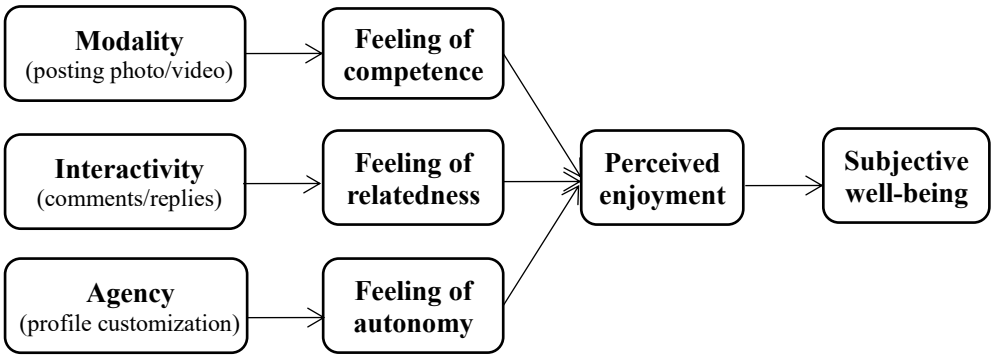

Fig 1.1. Adjusted Motivational Technology Model (Jung & Sundar, 2022)

The current study adopts the adjusted MTM to explain the effects of VC affordances. When students use VC to achieve their goals (e.g., group assignments), the technology's interactive features may help them fulfill psychological needs, thus increasing their enjoyment. Enjoyment is intense mental stimulation manifested as a

strong interest and deep engagement (Workman & Studak, 2007). It reflects the ability to control mental attention in a particular context (Hamilton et al., 1984). With increased enjoyment, users can be better engaged in the interactive setting, maintain their attention on meeting contents, and thus benefit their subjective well-being and improve their meeting efficiency.

Research gaps

Limited explanation of how VC affordances lead to positive psychological experience

Some positive and enjoyable features of VC may satisfy their psychological needs and enhance users' emotional experiences. Extensive research has examined the relationship between VC affordances and VC fatigue, concentrating on VC's limitations in comparison to face-to-face meetings. For example, VC use leads to insufficient cognition (Bailenson, 2021; Vidolov, 2022; Waizenegger et al., 2020) and eliminates eye contact and body language (Riedl, 2021). However, with diverse affordances and features, VC need not invariably lead to adverse psychological states and fatigue. Students have greater liberty and flexibility in VC by exploring various features to improve their mental states (Nadire & Daniel, 2021). The rich features improve students' attitudes toward and enjoyment of using VC (Minhas et al., 2021; Nehe, 2021).

Unexplored role of enjoyment in mitigating VC fatigue

In MTM, intrinsic motivation for activities is commonly operationalized as the enjoyment of engaging in the activity. People are intrinsically motivated when they find an activity to be fun, enjoyable, or interesting. Consequently, the feelings of "fun" or "enjoyment" in using technology have often served as indicators of intrinsic motivation (Pe-Than et al., 2014; Ryan et al., 2006; Tamborini et al., 2010; Yang et al., 2021).

Research indicates that enjoyment plays a vital role in reducing VC fatigue. First, enjoyment is an attitude (Nabi & Krcmar, 2004). Positive attitudes are known to alleviate fatigue in an activity, while negative attitudes towards VC are significantly linked to heightened VC fatigue (Oducado, Dequilla, et al., 2022). Second, enjoyment is a kind of intrinsic motivation, in the Intrinsic Motivation Inventory (IMI), it is the only factor that is related to intrinsic motivation (Ryan, 1982). Research revealed that students with high intrinsic motivation experience less fatigue (Karimi & Fallah, 2021). Enhanced motivation prompts individuals to actively engage with the media environment for task completion, ultimately leading to reduced fatigue (Ryan & Deci, 2002).

Although studies have examined enjoyment's effect in reducing other forms of fatigue, such as job burnout (Kim, 2018) and learning fatigue (Milyavskaya et al., 2021), little research has investigated how enjoyment can mitigate fatigue in VC. Thus, according to the MTM, this research introduces the enjoyment of group

meetings as a mechanism that mediates the relationship between basic needs and VC fatigue.

Inadequate Identification of Antecedents in the Context of Student Collaboration with VC

Although many previous studies have examined the factors contributing to VC fatigue, necessarily be applicable to the context of students working in groups via video conferencing. First, VC fatigue is a relatively new research topic that gained prominence during the COVID-19 quarantine period. During this time, several studies gathered data from an environment defined by unprecedented disruptions normal routines (Brainard & Watson, 2021; Jang & Choi, 2022; Wiederhold, 2020). The unique circumstances of that period are not reflective of the current context, indicating that some factors identified during quarantine, such as disruptions of normal routines from home (Shahrvini et al., 2021), may not be as relevant or influential today. Second, this study focuses on the student population in Singapore, which is relatively homogeneous in terms of social status. Several previous studies have examined factors related to social status, such as ethnicity or professional seniority, with references to Asian cultural context (Ratan et al., 2022) or new employees (Shockley et al., 2021). However, these factors may not be applicable to the Singapore student group, which is why this study aims to identify new antecedents of VCF specific to this context. Understanding these unique influencing factors can contribute valuable insights to the broader research on video conferencing fatigue.

Research questions and objectives

Overall, this project aims to develop the MTM further to explain how different VC affordances mitigate VC fatigue and ensure meeting efficiency by satisfying psychological needs and increasing enjoyment. To address the research gaps, this research raised two research questions (RQ) to attain two research goals (RO):

RO1: To establish a novel taxonomy of VC affordances that enhance enjoyment.

RQ1: How do students perceive four affordances during VC meetings, and which affordances contribute to enhancing their enjoyment?

RO2: To discover the relationship between enjoyment on VC fatigue.

RQ2: What is the relationship between enjoyment and VC fatigue?

RO3: To investigate the antecedents of VC fatigue in the context of student collaboration.

RQ3: What other factors could influence VC fatigue when students collaborate in a VC setting?

This research conducted a focus group discussion (FGD) study to provide insights into these inquiries. University graduate students were invited to participate in FGDs, where they will share their experiences regarding VC usage for online meetings and their experience during use.

Research contribution

There are three main theoretical contributions to this project. This study makes the following theoretical contributions. First, the primary theoretical contribution lies in the extension of the MTM: This study extends the understanding of how MTM affordances can be realized in VC, particularly by introducing a new psychological mechanism: the idea that enjoyment can alleviate VC fatigue. Initially, the MTM framework was developed in the context of web environments (Sundar et al., 2012), and later expanding to social media settings (Jung & Sundar, 2022). This study further extends its application to VC, integrating existing affordances from earlier research into a new context. Second, this study sheds light on previously overlooked relationships among MTM factors. For example, it highlights that not only does enjoyment mitigate VC fatigue, but VC fatigue can also influence users' perception of enjoyment. Additionally, this study explores the relationships between different types of enjoyment and VC fatigue, providing insights into the bidirectional effects within the MTM framework. Third, this study contributes to the research on the antecedents of VC fatigue within a specific scenario, focusing on graduate student collaboration. By examining the dynamics of VC fatigue in this context, the study suggests future research directions for analyzing specific manifestations of VC fatigue within distinct social settings.

In terms of practical implications, this research offers practical strategies to help reduce students' fatigue during virtual meetings. It explores how VC functions can be leveraged to provide affordances that lead to higher enjoyment, thereby

mitigating VC fatigue. These insights can guide students in selecting VC features that enhance their experience and reduce fatigue. Additionally, the study provides useful insights for educators, helping them design more effective student group work. This might involve creating better rules for group collaboration or choosing more appropriate tasks that align with student capabilities and promote engagement. Furthermore, this research can inform video conferencing companies as they develop new features to enhance their platforms and improve user experiences. For example, incorporating features like anonymous emojis could help users express themselves when they need a break.

Chapter 2: Literature Review

Video conferencing

Definition of video conferencing

Modern-day VC technology includes video and audio to facilitate real-time communication and collaboration between multiple individuals over Internet Protocol (IP) networks (Billingsley, 2020). A diverse array of VC applications is currently available in the market, including Skype, Facetime, Zoom, Google Hangout, Zoho Meeting, Eyeson, Cisco Webex, GoToMeeting, and Signa (Gray et al., 2020; Henry & Shellenbarger, 2020). Notably, VC has emerged as a crucial tool during the quarantine, serving as a highly suitable substitute for in-person communication in

various sectors, including education, healthcare, government, and others (Sandhu et al., 2023).

VC is now widely accepted as a ubiquitous technology because of its recognized advantages, such as convenience, ease of use, and substantial time and cost savings (Li et al., 2020). Accordingly, in this research, VC is a synchronous remote communication technology that facilitates online face-to-face interactions through video and audio and other features such as file sharing, text chat, likes, virtual backgrounds, and avatars.

Collaboration in video conferencing

Many scholars share the same basic definition of collaboration as "individuals working together" (Shah, 2012), but the mere involvement of multiple participants does not guarantee true collaboration. Shah (2012) gave a collaboration model with five sets: communication, contribution, coordination, cooperation, and collaboration. The first four—communication, contribution, coordination, and cooperation—are deemed essential prerequisites for collaboration. Cooperation involves information exchange, mutual assistance in tasks, and connection with various agents (people and systems), and is governed by specific rules for a shared goal. While cooperation and collaboration share similar definitions, collaboration places a distinctive emphasis on group members working collectively to create solutions based on their knowledge and experience rather than just aggregating their independent results (Hansen & Widén,

2017). In collaborative efforts, members engage in interactive processes, contributing their efforts and assistance toward a common goal.

Meetings are a subset of collaboration, focusing more on specific activities and tasks. Collaboration encompasses all activities, including collaborative creation, collaborative design, and meaning construction (Neumayr et al., 2021). Meetings, on the other hand, concentrate on the gathering of two or more individuals for interactive and focused communication, such as seeking information, generating/discussing ideas, and presentations (Schwartzman, 1989). VC, designed to facilitate effective real-time remote meetings, captured academic attention early on, with its functionalities being discussed two decades ago (Hassler, 2004). However, its irreplaceable importance became evident only when quarantine altered people's work dynamics.

Before the quarantine during the pandemic, the significance of graduate students using VC for collaboration had already been recognized (Ku et al., 2013). During the pandemic, graduate students especially utilized VC for academic collaboration (Bal et al., 2020). Graduate students engage in more diverse and challenging collaboration tasks, leading to increased pressure and potentially diminishing the overall experience of VC meetings. Therefore, it is essential to explore the VC meeting experience specifically for graduate students.

Video conferencing fatigue

Technostress and fatigue

Fatigue has been the subject of extensive investigation across various fields (Sheng et al., 2023). Described as a "subjective, unpleasant feeling of tiredness that has multiple dimensions" (Piper et al., 1987), fatigue manifests itself both physically and psychologically (Zhang et al., 2016). Physiological fatigue is primarily indicated by deteriorating physical health, such as dry eyes resulting from overuse. On the other hand, mental fatigue is expressed through sensations of tiredness, exhaustion, burnout, and other negative emotions (Dhir et al., 2018; Sheng et al., 2023). Media fatigue is a kind of fatigue due to using media.

Users' negative feelings about technology have long been a focal point of investigation. In 1984, psychologist Brod introduced a new psychological experience called technostress, the disease of adaption to computer technology (Brod, 1984). Technostress serves as a general term for this negative experience due to technology, and as ICT progressed, scholars further categorized it into subtypes: technostrain and techno-addiction (Salanova et al., 2013). Techno-addiction depicts a state of uncontrollable use of ICT anywhere, anytime for a long time. Conversely, technostrain represents the feeling of anxiety, fatigue, scepticism, and inefficacy that result from using technology. Fatigue, in particular, stands out as one of the "most common affective experiences" in technology use (Salanova et al., 2013).

Media fatigue could be divided into different communication tools, like social network sites (SNS) fatigue, instant messaging (IM) fatigue, and VC fatigue (Dhir et al., 2019). Research on social media fatigue found its antecedents and consequences (Ou et al., 2023). This study focuses on VC fatigue rather than technostress because the latter is defined too broadly, and there is currently no research indicating that users may exhibit addiction tendencies specifically related to VC. Therefore, using VC fatigue is more targeted.

Video conferencing fatigue

The surge in VC usage in 2020 has led to extensive coverage of "VC fatigue" in the news (Brandon, 2020; Mark & Fast, 2020). Researchers have also begun to explore this phenomenon and its underlying causes. Scholars have tried to define this new phenomenon. Many stressed physical and mental negative effects, including exhaustion, tiredness, and burnout during using VC (Abdelrahman, 2022; Lee, 2020; Wiederhold, 2020). Riedl (2021) defined VC fatigue as “somatic and cognitive exhaustion that is caused by the intensive and/or inappropriate use of videoconferencing tools, frequently accompanied by related symptoms such as tiredness, worry, anxiety, burnout, discomfort, and stress, as well as other bodily symptoms such as headaches.” To sum up, VC fatigue is the adverse experience of participating in VC.

Previous research revealed the dimensions of VC fatigue. Fauville et al. (2021b) developed the Zoom Exhaustion & Fatigue Scale (ZEF Scale), which

identified five dimensions of fatigue: general, social, emotional, visual, and motivational fatigue. Further, Li and Yee (2022), proposed four dimensions of VC fatigue, encompassing physical, emotional, cognitive, and social aspects. Physical VC fatigue represents the physiological discomfort of VC usage, involving energy depletion and tiredness. The emotional dimension is operationalized as a series of negative emotions such as irritability, nervousness, and anxiety. Three factors: motivational fatigue (less willingness to engage in activities after VC usage), disengagement (feeling disconnected), and difficulties focusing (hard to concentrate), are under the cognitive dimension. Social VC fatigue manifests in a reluctance to communicate with others while using VC and afterward. In short, VC fatigue is a complex negative experience that extends beyond general burnout, featuring diverse dimensions.

Reducing video conferencing fatigue

Researchers have proposed practical strategies to mitigate VC fatigue. First, the strategic selection of VC functions could help reduce VC fatigue. Studies found that cognitive overload, induced by video and audio cues, is one of the most significant factors contributing to VC fatigue (Fauville et al., 2021a; Li & Yee, 2022). For example, facial dissatisfaction is a psychological factor of VC fatigue (Ratan et al., 2022). Therefore, users could decrease the self-focusing by the VC features, such as setting avatar to avoid natural face and enabling “speaker view” to look only at the

face of the speaker. Audio-related functions like muting the microphone can effectively minimize potential echoes (Döring et al., 2022).

Second, establishing the meeting norms is a benefit in alleviating VC fatigue. First, a well-established norm of conduct for VC use, such as encouraging participants to turn on cameras, will increase the sense of belonging among participants, thereby boosting engagement (Bennett et al., 2021). In addition, clear norms can clarify the purpose of the behavior, preventing unnecessary cognitive resource expenditure (Döring et al., 2022). For example, the use of Video Meeting Signals, a simple series of gestures, can significantly enhance the VC experience (Hills et al., 2022).

Third, increasing personal VC skills is crucial. Susceptibility to VC fatigue increases when the individual cannot meet the requirements of VC use (Döring et al., 2022; Shoshan & Wehrt, 2022). Participants who are powerless in the face of VC are more likely to have a negative impression of VC, and this impression is associated with a higher level of VC fatigue (Oducado, Fajardo, et al., 2022). Thus, improving VC techniques can positively influence attitudes toward VC, enabling individuals to alleviate VC fatigue.

Fourth, scheduling VC meetings with reasonable frequency and duration is essential. Increased frequency and prolonged meeting durations correlate directly with perceived VC fatigue (Döring et al., 2022). In addition, a short break during the meeting helps restore attention (Bennett et al., 2021). Therefore, proper arrangements for VC to avoid ineffective meetings and process arrangement of VC meetings can help reduce VC fatigue (Li & Yee, 2022).

Lastly, ensure that external physical conditions contribute to the VC usage experience. VC relies on the Internet and related electronic devices, and appropriate technical features, including a stable Internet connection and quality technical equipment, can mitigate the technical aspects contributing to VC fatigue (Nesher Shoshan & Wehrt, 2021).

Video conferencing affordances

Affordance theory

James Jerome Gibson, a famous American psychologist, formally proposed affordance as one of the key pioneers of visual perception (Gibson & Carmichael, 1966). According to Gibson (2014), "the affordances of the environment are what it offers the animal, what it provides or furnishes, either for good or ill." In the early 1980s, Donald Arthur Norman introduced the notion of affordances to the Human-Computer Interaction (HCI) community (Osborne, 2014). Norman defined affordances as action possibilities that users might perceive (Norman, 1988). Hutchby (2001), the first person to apply affordances to IT artifacts, believed that the likelihood of an actor's action arises from the bearable functions and relationships of the IT artifact. Affordance could explain the complex relationship between users and IT artifacts: they are inseparable (Pozzi et al., 2014). Therefore, in this research, affordance can give a unique perspective on how the media shapes users' behaviors and influences their affective dimensions.

The most considerable evolution of affordance is the more specific and subdivided types of affordances on different ICT platforms and different groups of people. Different media provide various affordances based on their functions and features. According to Treem and Leonardi (2013), social media has four main affordances: visibility, editability, persistence, and association. Another example of social media affordances is paralinguistic digital affordances (PDAs), "cues in social media that facilitate communication and interaction without specific language associated with their messages," like one-click tools (Carr et al., 2016). With the development of media technology, more and more diverse affordances in emerging media have been noticed by scholars. Sjöblom et al. (2019) stressed that Twitch streaming provides revenue affordances. Shin (2022) discovered the metaverse games' immersion affordance and spatiality affordance.

Affordances not only involve examining the IT artifacts themselves but also highlight the relationship between users and IT artifacts (Volkoff & Strong, 2013). Therefore, even for the same media, the affordances perceived by different people are unique. Researchers have also delved into the unique perceived affordances of different groups and organizations. For instance, one study examined six affordances provided by all media within an organization: pervasiveness, editability, self-presentation, searchability, visibility, and awareness (Rice et al., 2017). Kitzie (2019) applied affordance theory to analyze how social media shapes LGBTQ identity information behaviors. In summary, research on media affordances is becoming more specialized to fit the specific media user population and usage context. In this project,

the choice of affordances should be more appropriate to the context in which students use VC to mitigate VC fatigue.

Video conferencing affordance for reducing fatigue

Many researchers have employed affordance theory to analyze the relationship between features and usage in VC. Waizenegger et al. (2020) introduced VC's social and functional affordance for Work From Home (WFH) employees. A previous study found five affordances of VC: visibility, audibility, contemporality, simultaneity, and sequentially (Clark & Brennan, 1991). Another research stressed three VC affordances from students' perspective: modality, interactivity, and agency affordance, like customization, for example, changing names and backgrounds (Wu, 2021). However, not all VC affordances could be perceived to reduce fatigue.

To investigate which VC affordances are perceived to mitigate fatigue, this research is based on the four affordances listed in MTM: modality, interactivity, navigability, and customization. The reason for selecting the four mentioned affordances is that they have been present in past MTM studies and constitute essential components of the MAIN model. Initially, MTM included navigability, interactivity, and customization as three affordances (Sundar et al., 2012). As the application environment of MTM shifted from web pages to social media, modality replaced navigability (Jung & Sundar, 2022). In addition, the MAIN model subsequently evolved based on MTM (Sundar, 2008a). Many studies in the past have explored the impact on enjoyment based on the MAIN model (Downs & Sundar,

2011; Waddell & Sundar, 2017, 2020). The research also discusses how these affordances can be adapted to VC environments to provide support for students.

Modality

The most crucial feature of VC provided to users is the transmission of rich audio and video signals (Stewart et al., 2021). In contrast to traditional social media, VC boasts a higher bandwidth, representing the breadth of social cues it can deliver (Fox & McEwan, 2017; Zhou & Xu, 2022). According to Sundar (2015), the modality has a similar definition of bandwidth, which refers to information presentation ways.

Modality is one of the most critical affordances of VC, especially during collaborative tasks where students can benefit from diverse modality cues (Arellano & Parks, 2021; Burgoon & Walther, 2013; Develotte et al., 2010; Stewart et al., 2021). It suggests that distinctive features of VC can provide diverse modality affordances for specific task needs. First of all, according to Sundar (2008a), audio-visual modality promotes realism because it offers more information than a textual modality, depicts more realistically, and is easy to decode. Therefore, information transmitted through users' cameras and microphones could represent the VC modality.

Second, textual modality also plays a crucial role, allowing users to switch between videoconferencing, chatting, and sharing during a video meeting (Correia et al., 2020). Chat could allow users to provide comments (Riedl, 2021). A study even reported that students used chat functions more frequently than webcams when

collaborating (Arellano & Parks, 2021). In that case, considering the textual modality of VC is value.

Besides, VC features like whiteboard and screen sharing introduce alternative visual modality cues. Whiteboard brings a different type of visual presentation than webcam and text. Students can leave symbols, words, diagrams, and pictures on the whiteboard more freely (Arellano & Parks, 2021; Baggaley, 2003; Jia, 2012). In addition, screen sharing, one of the collaboration facilities in VC (Chawla, 2020), promotes better student focus on the same content by all members sharing a single screen, thus generating a shared understanding (Li et al., 2020). Therefore, whiteboard and screen sharing contribute visual modality cues for users.

Interactivity

According to Sundar et al. (2012), in MTM, interactivity refers to affording users to have "a reciprocal exchange with other people." More specifically, interactivity occurs when any information on the platform is feedback or comments on the previous one or more messages (Sundar et al., 2012). In the context of VC, this emphasizes that users can reflect on and respond to information provided by others.

As a communication and collaboration tool, VC provides multiple ways for users to interact. For example, students can nod or shake their heads in front of the camera to represent agreement or disagreement with the other students. Therefore, VC cannot afford interactivity through video and audio until they are used for reflection. Beyond utilizing features like chat or webcams, VC's interactivity is evident when

using features that directly provide feedback on the preceding information. One such feature is polling, where users initiate multiple- or single-choice polls to offer feedback on the current scenario or problem during VC collaboration (Lieux et al., 2021). Another feature contributing to interactivity is the use of emojis for users' reactions. Recognizing the significance of non-verbal responses, many VC platforms, such as Zoom, incorporate emojis like Clapping Hands, Thumbs Up, Heart, Tears of Joy, Open Mouth, and Party Popper under the "Reactions" button. These emojis not only grab the speaker's attention but also serve as a visual notification of users' sentiments toward other members (Dürscheid & Haralambous, 2021).

In addition to the mentioned features, interactivity can also be manifested through real-time responsiveness in VC. Sundar (2008a) states that interactivity could "transmit cues that imply a more robust flow of communication." Therefore, the synchronicity of VC provides graduate students with a sense of stable information exchange. Previous research has regarded synchronicity as one of interactivity (Shao et al., 2020), where media with high synchronicity allows users to receive prompt feedback.

Navigability

Navigability refers to the media capacity that individuals can navigate through a mediated environment and explore its features, one of the four affordances in MTM (Sundar et al., 2012). In the context of VC, users must be guided on how to perform

interactive operations, as they cannot concentrate solely on a single interface or function without engaging in interactive actions.

The navigability of VC encompasses both internal functions and external sharing capabilities. Internal functions are presented through icons or text buttons, such as a smiley face for the emoji function and a camera for switching cameras. Additionally, some VC platforms also allow the audience to switch between the pages of the speaker's slides, such as Teams. Instead of being confined to the current slide, the audience can freely explore all pages, as exemplified by Teams.

The navigability of VC extends beyond its internal functions to include seamless switching between different applications. For instance, when students need to share external interfaces like slides or Google search results, they can minimize the VC interface to display the content they wish to share. In addition to managing their interface, users can, with permission, control others' screens, which is also a unique manifestation of navigability in VC.

Customization

Customization, an important affordance of modern interactive media, means that users can choose the sources and categories of information according to their needs (Sundar, 2015; Sundar & Marathe, 2010). While using traditional social media to utilize customization by customizing content on a personal profile (Jung & Sundar, 2022), VC offers a broader range of customization features.

The VC profile stands out as a vital customizable feature. In platforms like Zoom, users can upload profile pictures, change profiles, and customize virtual backgrounds and filters to shape their self-image. Background settings include blurred backgrounds (pixelated) and virtual backgrounds (pictures or videos), influencing how users are perceived by obscuring their physical space. Filters, encompassing common filters and avatars, enable users to enhance their appearance, such as adding masks or transforming their features into 3D avatars while retaining expressions.

Beyond individual exposure features, users can customize their interface layout, deciding whom they wish to see or hide on their screens, including themselves (Kuhn, 2022). This level of customization adds a layer of personalization, allowing users greater control over their virtual presence during VC interactions.

Enjoyment

Enjoyment when using video conferencing

As a widely used communication tool, the enjoyment of using VC has been thoroughly surveyed. Early studies compared the enjoyment levels of face-to-face interactions and VC, revealing higher enjoyment in face-to-face groups (Credé & Sniezek, 2003). However, with the evolution of VC technology, the landscape of enjoyment has changed over the past two decades.

The enjoyment of using VC is multifaceted, influenced by various media features that cater to different purposes. Some research emphasizes that enjoyment is derived from the experience itself, irrespective of any anticipated performance

consequences or the instrumental value of the technology (Kang & Schuett, 2013). Therefore, discussing only overall media enjoyment may not capture the nuanced enjoyment experienced when a user performs a specific action on the media.

Previous literature discovered VC enjoyment for different purposes. First, when used for lectures, VC enjoyment varies across courses and student groups, with practical nursing courses showing lower enjoyment than theoretical courses (Vandenberg & Magnuson, 2021), and college students reporting higher negative emotions than K-12 students (Okabe-Miyamoto et al., 2022). Some studies explore the enjoyment of online courses delivered through VC platforms rather than direct VC use (Brown & Fraser, 2011; Hanson et al., 2010; Hanson & Kuraoka, 2009; Maltinsky et al., 2013).

Another common use of VC is for group meetings. Previous studies focused on group decision-making (Credé & Sniezek, 2003), workgroup performance (Townsend et al., 2001), and collaborative creative tasks (Grözinger et al., 2020). Leisure usage of VC, such as connecting with friends and family, has also garnered attention in some studies (Neustaedter et al., 2020). In short, while exploring enjoyment in using VC, it's crucial to recognize that the sources of enjoyment differ due to the diverse purposes of use.

Dimension of video conferencing enjoyment

The prevailing definition of enjoyment centers on pleasurable experiences, encompassing both emotional and non-emotional aspects (Davidson, 2018).

Therefore, this project used a three-dimension of media enjoyment by Nabi and Krcmar (2004), which proposes that enjoyment has three components: affective, cognitive, and behavioral.

The most widely used component of media enjoyment is the emotional dimension, which emphasizes the user's emotional experience of the media. According to Davis et al. (1992), enjoyment refers to "the extent to which the activity of using the computer is perceived to be enjoyable in its own right, apart from any performance consequences that may be anticipated." This definition is widely cited in later articles (Kang & Namkung, 2016; Pe-Than et al., 2014; Reychav et al., 2016).

In previous research, media enjoyment has been focused on both content and the media itself. For example, when it comes to content related to television programs, the emphasis is on the audience's cognitive and emotional enjoyment of the program (Nabi et al., 2006; Tsay-Vogel & Nabi, 2015). There is also research that considers media as a communication tool rather than a content producer, such as ease of use in specific contexts (Taylor et al., 2020). The definition of VC enjoyment in this study aligns more closely with the latter. VC itself does not generate content; it serves as a platform used by students. The following sections will delve into the specific definitions of VC enjoyment across three dimensions.

The most widely used component of media enjoyment is the emotional dimension, which emphasizes the user's emotional experience of the media. According to Davis et al. (1992), enjoyment refers to "the extent to which the activity of using the computer is perceived to be enjoyable in its own right, apart from any

performance consequences that may be anticipated." This definition is widely cited in later articles (Kang & Namkung, 2016; Pe-Than et al., 2014; Reychav et al., 2016). Based on this definition, in addition to just the affective responses to media, media enjoyment emphasizes the feeling of conducting activities or behaviors in media. Therefore, in this project, this affective experience places more emphasis on the experience of collaborating with other users using VC.

The cognitive dimension pertains to the knowledge and understanding a person acquires by critically assessing media or content. It follows that enjoyment is not solely an emotional encounter, as it also involves evaluation on a cognitive level (Nabi & Krcmar, 2004; Riddle et al., 2022). According to the Uses and Gratifications theory (Ruggiero, 2000), when users positively judge the media, they will be satisfied with the media experience. Therefore, when students find VC to be a suitable platform for online meetings, they can derive cognitive enjoyment.

The third dimension, behavioral, pertains to the actions and conduct of individuals while consuming media (Nabi & Krcmar, 2004). Past studies have endeavored to define behavioral enjoyment using varied concepts. The most commonly cited concept is "flow," whereby individuals become entirely absorbed in their media consumption experience (Schmierbach et al., 2014). Furthermore, immersion (Shin, 2022) and engagement (Davidson, 2018) are frequently cited concepts about behavioral enjoyment. In addition to the previous ongoing behavior, such as behavioral enjoyment during the process of using VC, the act of choosing to use VC itself is a form of behavioral enjoyment (Nabi & Krcmar, 2004). In this

research, behavioral enjoyment refers to the level of engagement and reuse in using VC.

The three dimensions of media enjoyment align with the paper's discourse on enjoyment dimensions concerning VC meetings. First, within the MTM model, enjoyment is seen as intrinsic motivation arising from meeting psychological needs (Sundar et al., 2012). Thus, media enjoyment is categorized as an attitude (Nabi & Krcmar, 2004), aligning with need satisfaction (Tamborini et al., 2010). Second, the three-dimensional model is widely used in media enjoyment research (Tsay-Vogel & Nabi, 2015), especially in interactive media contexts (Fang et al., 2010; Guo et al., 2017; Pe-Than et al., 2012), making it applicable for conceptualizing enjoyment during VC use. This research facilitated the conceptualization of students' perceived enjoyment, covering their positive affective, cognitive, and behavioral responses to VC use.

Motivational Technology Model in video conferencing

This project presents the theoretical foundation for how MTM provides VC affordance to reduce VC fatigue. First, VC enjoyment could be triggered by psychological needs. According to Richard M Ryan and Edward L Deci (2000), intrinsic motivation serves as an inherent driving force for engaging in specific activities without external rewards or pressures. The three psychological needs-competence, relatedness, and autonomy-trigger intrinsic motivation. Previous research rooted in SDT has demonstrated that these psychological factors can explain

enjoyment (Tamborini et al., 2010). A relationship well-supported in various studies, particularly within the context of games. Among these three needs, competence satisfaction is important (Schmierbach et al., 2014). Some studies found that fulfilling users' competence and autonomy could predict enjoyment (Neys et al., 2014; Reer et al., 2022; Rieger et al., 2014), while others found that only competency and relatedness are positively associated with enjoyment (Lee et al., 2015; Murcia et al., 2008; Zhao et al., 2011). Certain research integrates all three needs into the enjoyment framework (Reinecke et al., 2014; Velez et al., 2018). Therefore, the fulfillment of psychological needs in media environments leads to higher intrinsic motivation, conceptualized as media enjoyment or need satisfaction (Tamborini et al., 2010). SDT could be used in this research to predict the relationship between enjoyment and psychological needs in the VC context.

In addition, The majority contribution of MTM indicates that affordances could enhance intrinsic motivation factors and thus affect users' behaviors (Sundar, 2015). According to MTM (Jung & Sundar, 2022; Sundar et al., 2012), in the VC environment, four affordances: modality, interactivity, navigability, and customization, could imbue the psychological factors that could increase students' enjoyment.

Competence, in the context of user interaction with ICT, refers to users' perception of their effectiveness in expressing their abilities (Ryan & Deci, 2002). It's important to note that competence is distinct from users' actual ability; rather, it is the subjective confidence users feel in their interactions (Ryan & Deci, 2002). According

to Sundar et al. (2012), user-friendly features that could make users feel confident could enhance competence. According to the User Control Theory (Eveland & Dunwoody, 2001), when users can navigate and process online content based on their personal preferences, they experience a sense of empowerment and control over their environment. This is particularly relevant in environments with clickable buttons, where user control fosters a positive user experience. In addition, modality as an affordance represents the ways of information transmission, which emphasizes that users can express themselves and how they choose to do so(Jung et al., 2017). Using a variety of modals of VC could benefit users in expressing their ideas or opinions, demonstrating their ability for communication and collaboration in VC. Thus, utilizing the VC modality and navigability could enhance competence.

Relatedness can be understood as a feeling of being connected to others and of belonging with others, which does not represent establishing a real relationship but a "psychological sense of being with others" (Ryan & Deci, 2002). MTM posits that users perceive a connection with others through the use of VC functions with information interactivity (Sundar et al., 2012). The utilization of functions that provide feedback to other users enhances the interactivity of VC, influencing the users' sense of relatedness.

The concept of customization is defined as the extent to which users can select information sources and categories based on their individual needs (Sundar et al., 2012). Sundar (2008b) highlights that users experience a heightened sense of customization when they can personalize their profiles with various tailored features.

Increased levels of customization in ICT contribute to a greater sense of user identification and autonomy (Jung & Sundar, 2022; Sundar et al., 2012). According to Richard M Ryan and Edward L Deci (2000), a sense of autonomy can motivate users intrinsically. In essence, People are more likely to perceive enjoyment from VC when they perceive that it can be adjusted according to their needs or interests (Ryan & Deci, 2002).

Previous studies have illuminated the connection between enjoyment and users' mental health (Davis et al., 1992; Ryan et al., 2006). First, *affective enjoyment*, i.e., an enjoyable and fun experience when using media for entertainment (Islam et al., 2020), is a negative antecedent of fatigue. One study found that when individuals intrinsically perceive the process as enjoyable, they are more likely to experience less fatigue (Karimi & Fallah, 2021). Second, *cognitive enjoyment*, reflecting a favorable media judgment, has the potential to alleviate VC fatigue. According to the Uses and Gratifications theory (Ruggiero, 2000), a positive evaluation of the media contributes to overall satisfaction with the experience. For example, stronger perceptions of the helpfulness of social media negatively relate to fatigue (Bright et al., 2015). Thus, cognitive enjoyment may also relate to less fatigue on VC when users find their use of VC helpful. Lastly, researchers use *behavioral enjoyment* denoting immersion in the media to the extent that the surrounding reality is ignored and acts as a hindrance to potential threats such as fatigue (Lin et al., 2020; Wang et al., 2017). Consequently, behavioral enjoyment is likely to mitigate VC fatigue. In conclusion, all three dimensions of media enjoyment have a positive impact on mitigating media fatigue.

The previous discussion underscores the utility of MTM in comprehending the mechanisms for mitigating VC fatigue. Although prior research has applied MTM to investigate users' wellbeing, with a substantial body of evidence supporting how enjoyment contributes to alleviating VC fatigue, it is essential to note that MTM was originally designed to analyze how affordances enhance user engagement with health-related applications, subsequently influencing subsequent health behaviors. Furthermore, existing literature on the impact of enjoyment on media fatigue has often treated fatigue as a singular entity without distinguishing between its various types (Lin et al., 2020). C Consequently, clarity regarding whether and how MTM affordances can be harnessed through the mechanisms of MTM to ameliorate all four types of VC fatigue remains elusive. This report aims to explore the application of MTM in the VC context by employing focus group discussions to address these gaps in understanding.

Chapter 3: Methodology

This study employed focus group discussions (FGDs) to explore the MTM affordances of VC. The aim is to understand how these affordances contribute to mitigating VC fatigue. The objective of this study is to comprehend how graduate students perceive the four affordances of VC in order to enhance enjoyment and alleviate fatigue.

Research Design

This study employed a qualitative approach to address the three research questions (RQs). While MTM may explain the positive effects of VC affordances and enjoyment on VC fatigue, the dynamics of these relationships are complex. This study considered three aspects for choosing FGDs: affordances effect, enjoyment effect, and other new factors effect.

Regarding the impact of VC affordances, extensive research has explored their connection to VC fatigue, focusing on the limitations of VC compared to face-to-face meetings. For instance, VC usage has been linked to reduced cognitive performance (Bailenson, 2021; Vidolov, 2022; Waizenegger et al., 2020) and eliminates eye contact and body language (Riedl, 2021). VC affordances can contribute to VC fatigue but also offer opportunities to alleviate it. These nuances can be challenging to uncover with quantitative methods. Given this complexity, it is crucial to investigate how students leverage VC affordances in real-world settings to mitigate VC fatigue. This requires a qualitative approach, as quantitative results may not reveal these intricate

patterns. Through FGDs, we can explore how students use VC affordances to minimize fatigue, which can provide insights that quantitative methods might miss.

Regarding the impact of enjoyment, first, not all types of enjoyment are inherently beneficial, and overemphasizing certain types of enjoyment can be counterproductive. For instance, previous studies have indicated that excessive hedonic use of social networking sites (SNS) is positively associated with technostress and SNS exhaustion (Luqman et al., 2017). This suggests that quantitative approaches may not capture the negative implications of excessive use. Second, VC enjoyment can both reduce VC fatigue and, in some cases, exacerbate it. According to the Uses and Gratifications theory (Ruggiero, 2000), when users find a medium enjoyable, they tend to use it more frequently. However, frequent use of VC is a significant factor contributing to VC fatigue (Li et al., 2022). This duality implies that a quantitative approach might find enjoyment having contradictory effects on VC fatigue, with increased usage potentially leading to greater fatigue. This stands in contrast to the assumptions of MTM, and quantitative studies alone may not adequately explain these conflicting outcomes. Third, enjoyment not only alleviates VC fatigue, but VC fatigue can also negatively impact enjoyment, creating a complex bidirectional relationship. A study demonstrated that media fatigue negatively moderated the positive effect of enjoyment on continuance intention (Zong et al., 2019). Another study found that VC fatigue mediated the relationship between VC stressors, complexity and pattern adaptation, and cognitive enjoyment (user satisfaction) (Anh et al., 2022). This complex interplay between VC enjoyment and

fatigue complicates the establishment of causality, even when quantitative methods show correlations.

In addition, this research explores factors that might influence VC fatigue. While quantitative analysis is effective for examining the impact of affordances, qualitative research can enhance current VC studies by providing fresh perspectives derived from different task types and the nuances of human behavior in virtual environments.

This study will be based on FGDs with graduate students. There are two reasons for choosing FGDs over other qualitative methods. First, interview-based qualitative methods provide participants with the opportunity to articulate both objective situations and subjective feelings in considerable depth. This approach allows for a comprehensive exploration of their experiences. Second, FGDs offer a distinct advantage over other qualitative methods as students can engage in a collaborative and interactive environment, enabling mutual validation and inspiration. Through these discussions, participants engage in multi-level sense-making processes, enriching the understanding of their VC usage experiences.

Sampling and data collection

The participants were recruited from graduate programs in a large university in Singapore, specifically Nanyang Technological University (NTU). Eligible participants must be 21 years old or above. Ensuring diversity, students from various academic backgrounds and genders were sampled. The study organized a total of six

focus groups, each comprising 5-7 participants. The discussion guide and Institutional Review Board (IRB) approval details are provided in the appendixes.

Having five participants in a focus group is sufficient for this study, and there are several reasons to support this choice. First, this study involves several detailed sub-questions that require in-depth responses from each participant. These questions cover various aspects of the research topic, such as four types of VC fatigue, three types of enjoyment, and all VC functions need participants to address. Keeping the focus group smaller ensures that everyone has the opportunity to provide comprehensive answers and share their perspectives without time constraints. Second, larger focus groups, with more than 7 or 8 participants, can be challenging to manage (Carey & Asbury, 2012). When the group size exceeds this threshold, it becomes more difficult to maintain an organized discussion, and participants might not have enough time to express their views. Additionally, larger focus groups can lead to prolonged interview sessions, increasing the risk of participant fatigue and diminishing the quality of their responses (Bennett et al., 2021). By limiting the focus group to five participants, the study can achieve a balance between depth and manageability, ensuring a conducive environment for meaningful discussion and detailed feedback.

After obtaining IRB approval (IRB-2023-376) from Nanyang Technological University, six group discussions were conducted virtually using the Teams platform. The demographic details of participants across these six groups are outlined in Table 3.1.

Table 3.1. Characteristics of FGDs

Number of participants	**FG1**	**FG2**	**FG3**	**FG4**	**FG5**	**FG6**	**Total**	**%**
	5	7	7	5	6	5	35	
Gender								
Female	2	7	7	4	1	2	23	65.7%
Male	3	0	0	1	5	3	12	34.3%
Educational level								
Master by Coursework	0	3	6	3	3	2	17	48.6%
Master by Research	1	1	1	1	1	0	5	14.3%
PhD	4	3	0	1	2	3	13	37.1%
Educational Background								
Humanities and Arts	1	0	0	1	0	0	2	5.7%
Social Sciences	4	7	2	1	2	1	17	48.6%
Education	0	0	4	0	0	0	4	11.4%
Business	0	0	0	1	1	1	3	8.6%
Engineering	0	0	1	1	3	1	6	17.1%
Science	0	0	0	1	0	2	3	8.6%

This study employed convenience sampling and snowball sampling, which are typical qualitative strategies for recruiting participants with domain-specific knowledge and experience (Etikan et al., 2016; Yu et al., 2021). Given the use of these sampling methods, I grouped the 35 participants based on the order in which they were recruited. When I had enough participants for a group, I conducted a group interview. Consequently, the six groups exhibited no significant background differences. I chose this grouping method for several reasons. First, because this study focused on graduate students in Singapore, who generally have high demographic homogeneity (Wu et al., 2001), grouping by demographic characteristics was not suitable. Graduate students typically share similar educational qualifications, study in the same location, and belong to a comparable age and social cohort. Second, to ensure a broader representation, I invited students from all eight academic areas at NTU, with at least two students from each area. Additionally, I aimed to include participants from every type of graduate degree program. Third, thought heterogeneity among participants is essential for effective focus group discussions (Katz-Buonincontro, 2022; Lin et al., 2020; Zhou et al., 2022). Thus, to promote diverse perspectives, I ensured that each group included participants from at least two different degree programs or majors. This way, participants could share their experiences using video conferencing (VC) for group collaboration within their respective programs. Different graduate programs often involve various task types, enabling participants to engage in in-depth comparisons and discussions during the focus group sessions.

Table 3.2. Characteristics of Participants

	1	**2**	**3**	**4**	**5**	**6**	**7**
FG1	Social Sci. PhD Male	Social Sci. PhD Male	Art PhD Female	Social Sci. Research Male	Social Sci. PhD Female		
FG2	Social Sci. Coursework Female	Social Sci. PhD Female	Social Sci. PhD Female	Social Sci. Coursework Female	Social Sci. Research Female	Social Sci. Coursework Female	Social Sci. Coursework Female
FG3	Education Coursework Female	Engineering Research Female	Education Coursework Female	Education Coursework Female	Social Sci. Coursework Female	Education Coursework Female	Social Sci. Coursework Female
FG4	Engineering Coursework Female	Science Coursework Male	Humanity Research Male	Business Coursework Male	Social Sci. PhD Female		
FG5	Social Sci. PhD Male	Engineering Coursework Male	Social Sci. PhD Female	Engineering Coursework Male	Engineering Research Male	Business Coursework Male	
FG6	Science PhD Male	Engineering PhD Male	Business Coursework Male	Social Sci. PhD Female	Science Coursework Female		

Interview procedure

Before the interviews, to gather participants' demographic information, email addresses, and available times, I distributed a survey. Based on the responses, I sent an invitation letter (Appendix C) and a Microsoft Teams meeting link to each participant. To ensure a sufficient turnout, I scheduled each session with at least six confirmed participants, providing a buffer in case some could not attend. One hour before each session, I sent a reminder email and required participants to return their signed consent forms.

The focus groups were conducted in a semi-structured format on Microsoft Teams. **During the FGDs**, the moderator had the camera on, while participants were not required to do so, which helped mitigate participants' VC fatigue (Fauville et al., 2021). The following outlines the specific steps during the FGDs: 1. Opening Remarks: The moderator welcomed participants and encouraged them to speak freely, emphasizing the importance of politeness and that they could withdraw from the discussion at any time. 2. Introductions: After obtaining verbal consent, participants introduced themselves and shared recent experiences with courses where they engaged in group tasks using VC for collaboration. 3. VC Collaboration: Participants described the overall process of VC-based collaboration, providing details on how these sessions were conducted and any challenges faced. 4. Combating VC Fatigue: The moderator then asked participants to discuss strategies for combating VC fatigue, exploring both personal and collaborative approaches. 5. Participants' Enjoyment: The discussion moved to participants describing their feelings during VC use, focusing on

competence, relatedness, autonomy, and overall enjoyment. 6. Open Discussion: At this point, participants could share any additional insights or experiences they wished to add. 7. Closing Remarks: The moderator concluded the session by thanking the participants, reminding them that the data would only be used for research purposes, and addressing any final questions.

The detailed questions for the interview are provided in Appendix A. These questions are open-ended to allow participants to freely share their experiences and feelings (Spradley, 1979). The moderator might ask follow-up questions to delve deeper into specific or complex topics, given the intricate nature of some of the concepts discussed.

The training for the moderator involved ethics training, a review of qualitative research methods, and two rounds of mock interviews (Goodell et al., 2016). Although some authors suggest five steps, including three mock interviews, they acknowledge that completing this sequence may be challenging in the context of FGDs (Goodell et al., 2016). The moderator's training comprised several key elements: 1. Ethics Training: The moderator completed the CITI Program course, which includes comprehensive ethics training to ensure adherence to ethical standards in research. 2. Role Review: The moderator reviewed the role and responsibilities of an interviewer, focusing on the appropriate techniques to elicit detailed and impartial responses. This step also included training on how to guide the discussion based on participants' personalities and responses. 3. Note-taking Practice: The moderator practiced taking notes during FGDs, following open-source guidelines. This practice

was essential for accurately capturing key points and insights during the discussions. 4. Mock Interviews: To simulate real-world conditions, the moderator conducted a mock interview with two experienced qualitative researchers acting as participants. This exercise provided the moderator with valuable feedback and allowed them to refine their interviewing techniques. Through this comprehensive training, the moderator was well-prepared to conduct FGDs, facilitating meaningful discussions while maintaining ethical and methodological rigor. The open-ended nature of the questions and the thorough preparation of the moderator contributed to creating an environment conducive to in-depth exploration and effective data collection.

Data analysis

This study employed thematic analysis as defined by Braun and Clarke (2006), which is “a method for identifying, analyzing and reporting patterns(themes) within a data. It minimally organizes and describes your data in rich detail. However, frequently it goes further than this and interprets various aspects of the research topic”. In other words, thematic analysis is a method of analyzing textual data (such as interview transcripts) to extract themes that represent key patterns or concepts.

Thematic analysis is a methodological approach for analyzing data, involving six stages. Here's how the process unfolded for this study: first, after transcribing data, one coder reads through the material in detail to gain a comprehensive understanding of its content. Second, generating some initial codes. In this phase, the coder identifies

and labels elements of the text that represent relevant ideas or concepts. Thematic analysis can be either inductive or deductive, depending on the approach chosen by the researcher. In this study, both methods were used to address different research questions. For RQ1 and RQ2, deductive thematic analysis was applied, with codes derived from established theories and literature, such as four VC affordances from the MTM (Sundar et al., 2012), three enjoyment components (Nabi & Krcmar, 2004), and four dimensions of VC fatigue (Li & Yee, 2022). For RQ3, which explores other factors related to VC fatigue, inductive thematic analysis was employed to identify patterns emerging from the data. The third phase, Searching for Themes, involves grouping the initial codes under broader themes that capture commonalities or patterns in the data. This step requires critical thinking to identify which codes naturally fit together and form coherent themes. Fourth, the coder reviews the themes to ensure they are representative of the entire dataset. The coder also checks that the extracted codes align with the overarching themes. Fifth, refining each theme's details so the data is presented in an overall story, and generates clear definitions and names for each theme. This phase aims to create a coherent narrative that encapsulates the essence of each theme. The final phase involves connecting the thematic analysis results to the research questions and generating a comprehensive report that presents the findings.

Table 3.2. Sample of data analyzing process

Raw Data	*So I think there are two functions that are very powerful for information exchanges. First, I don't know whether you guys*

	using the pencil function. There is a pencil function of the VC. So we can use the function, the "pencil" to draw something and use the eraser to erase something. Another is, that we use the sharing documents of work. For example, someone sharing something. Then we just used some of the pencil function, and the whiteboard function to join some of the remarks.		
Initial Codes	**Focused Codes**	**Code Categories**	**Themes**
pencil function draw something Whiteboard	Modality	Affordances for meetings	VC Affordance
share documents	Modality		

Table 3.3. Coding Summary

Initial Codes	**Code Categories**	**Themes**
Modality	Affordances for meetings	VC Affordance
Customization		
Navigability		
Interactivity		
Modality	Affordances for enhancing enjoyment	
Customization		
Navigability		
Interactivity		
Modality	Affordances for mitigating VC fatigue	
Customization		

Navigability		
Affective Enjoyment	Three-dimension perceived Enjoyment for mitigating VC fatigue	VC enjoyment
Cognitive Enjoyment		
Behavior Enjoyment		
Fake Enjoyment	Enjoyment expression	
Emotional Fatigue	Types of fatigue could be mitigated by enjoyment	The relationship between VC fatigue, affordances, and enjoyment
Cognitive Fatigue		
Emotional Fatigue	Types of fatigue could be mitigated by affordances	
Cognitive Fatigue		
Emotional Fatigue	Types of fatigue could mitigate enjoyment	
Cognitive Enjoyment	Conflicts between cognitive and affective enjoyment	Other relationships with VC fatigue
Affective Enjoyment		
Contribution	Conflicts between VC group members	
Others' affordances		
Familiarity with group members	Characteristics of group and group members	
Good communicators		
Number of attendees		
Suitability	Characteristics of tasks	
Level of Interest		

Chapter 4: Findings

This study presents the primary results of the first two groups, which discover VC affordances and fatigue experienced by graduate students during group meetings.

VC affordances and VC enjoyment

The **RQ1** sought to answer: How do students perceive four affordances during VC meetings, and which affordances contribute to enhancing their enjoyment? The findings indicate that while graduate students can perceive all four types of affordances, not all affordances benefit from enhancing enjoyment.

VC affordances

First, the primary affordance identified is **modality**, driven by the diverse information presentation channels. A social sciences master by coursework from FG2 (FG2-1) highlighted, "*It's like creating a kind of virtual room for everybody to like because it's kind of like a WeChat group, but a little bit different because you can just use your voices and simultaneous. You can also just type in a chat box.*"

Graduate students utilized various features for communication, favoring alternatives to video communication. For instance, a social science Ph.D. student from FG1 (FG1-1) mentioned using the whiteboard function to emphasize documents: "*So we were using the word file for the share, for example, someone sharing something. Then we just use some of the whiteboard functions to join some of the remarks.*" Additionally, many students pointed out the significance of "Screen Sharing," with an education master student by coursework from FG3 (FG3-1) stating, "*I think the best*

thing about it is that you can share the screen and then you can do anything on your computer."

As a result, students perceived VC modality by utilizing multiple functions based on their varying needs. The emphasis is on leveraging modality including and beyond video interactions to enhance collaborative engagement.

The second VC affordance is **interactivity**, perceived through the sense of two-way communication and synchronicity. The main way for two-way communication is by audio call. In terms of nonverbal interaction, graduate students employ video to convey facial expressions or use emojis to directly respond to speakers. An education master student by coursework in FG3 (FG3-1) expressed, "*I may use it to give him some reaction, or including opening the camera and nodding, or giving him a like or something, or sending an emoticon and so on.*"

To prevent disruptions while someone is speaking, some students opt for text rather than using a microphone for conversation: "*If I need to ask for clarification. Then I'll turn to the chat box function. And then again, I rely on the host to notice this collection and ask about it, or he can invite me to speak up,*" mentioned a social science PhD student from FG1 (FG1-2).

Students highlighted that VC meetings enable them to confirm that team members have received information and provide real-time feedback. For example, one engineering master student by coursework from FG5 (FG5-4) compared VC to other tools: "*When we email or use WeChat or WhatsApp, the efficiency is very low, because when we send some message to someone, they may respond in 1-2 hours, I'm*

not sure. But if we get together to attend a meeting to discuss something, I think the response is immediate. So, the efficiency to finish this assignment is higher than using emails or sending a message."

The interactivity affordance in VC meetings enables rich verbal and nonverbal communication and immediate feedback, enhancing efficiency compared to traditional communication tools like email or messaging apps.

The third VC affordance, **customization**, emphasizes that graduate students can adjust their source of interaction by themselves. In VC meetings, customization takes on a pronounced role, particularly in shaping personal self-presentation. Notably, students frequently mentioned features like filters, avatars, or virtual backgrounds. As expressed by a social science PhD student in FG1 (FG1-1), "*At one time, my room is very messy, and I hope to turn on the background.*" The VC background allows students to conceal their actual physical surroundings.

In addition to personalization, students brought attention to other noteworthy features that support their preferred modes of information reception. One international student highlighted the importance of AI subtitles, "*I don't need to hear. I just see the subtitle*" an engineering PhD student from FG6 (FG6-2).

Another interesting finding is that VC customization extends beyond the actual meetings and extends into the planning phase. For instance, when graduate students schedule appointments, they have the flexibility to choose the meeting time and participants.

In summary, customization in VC offers students the ability to shape their interaction environment, ensuring a personalized and accommodating experience for effective communication and collaboration.

Navigability is also an unavoidable affordance in VC, involving the exploration of the VC platform and other associated applications. For instance, an art and huminity PhD student from FG1 (FG1-3) emphasized switching between VC and other platforms by stating, "*When we have the VC meeting, we go through different web pages to find some appropriate plan for a design or other kind of project*". In addition, the discussion highlighted how navigability extends to other members' interfaces. A social science Ph.D. student from FG1 (FG1-1) provided an illustrative example, "*I remember one of the features helps to control others computer… And he or she may not be familiar with. We can just use the controlling computer function to help him do it directly.*" In short, navigability in VC encompasses both cross-application and cross-user-interface exploration, facilitating efficient interaction and collaboration.

VC affordances for enhancing enjoyment

During the discussions, graduate students utilize VC affordances for enjoyment. The most highlighted VC enjoyment is **cognitive enjoyment**-favorable media judgment. Many students stressed the "convenience" and "professionalism" of VC. All four affordances could benefit cognitive enjoyment.

First, modality affordance brings graduate students cognitive enjoyment. Graduate students prefer or have a positive judgment to use VC for meetings because

of VC's supportive features for presentation compared to the other platforms. A social science PhD student from FG6 (FG6-4) said, "*(Instant messaging) cannot share screen if you need to discuss with like programs you need. And sometimes you need to share a lot of things, a lot of details. But if we use WeChat, we both need to have the same document and then you need to guide us.*" Therefore, the multiple information presentation ways of VC could bring graduate students' cognitive enjoyment.

The interactivity in VC could be demonstrated in synchronicity. The high level of synchronous also makes graduate students have cognitive enjoyment. A business master student by coursework in FG6 (FG6-3) said: "*I think that compared with group chat or text messages, VC is much more convenient because we can hear the people staying immediately.*" With real-time feedback, students could work closely and smoothly.

Customization also benefits cognitive enjoyment. One international student highlighted, "*My second language and the video conference can help me better understand how the speaker is talking about because I can open the subtitles,*" a social science student by coursework from FG2 (FG2-1). This highlights how international students, in particular, benefit not only from auditory but also visual aids, enhancing their comprehension.

Last, navigability could enhance cognitive enjoyment during searching. For example, as a social science Ph.D. student from FG4 (FG4-5) stressed, "*VC is okay to searching something… When you talk with your team member, talk with your profs (in*

person), you will do that search after the meeting. But if online, when he is asking, I can just do the searching at the same time."

Another enjoyment dimension is **affective**, which refers to the fun and enjoyable experience during VC meetings. Interactivity is another VC affordance that could be beneficial to enhance affective enjoyment. Students have reflections of other members. An engineering coursework master student in FG5 (FG5-2) mentioned the importance of two-way communication, "*I think open cameras make it more pleasant. If you have some gesture or some emotional exchanges, and your audience can see that.*"

Behavioral enjoyment, which refers to the engagement and reuse of VC meetings could be benefited by low-level modality and customization. Interestingly, modality could enhance behavioral enjoyment because of its low-level modality than offline. Due to the fewer social cues than in offline meetings, students could ignore the attention from audiences which benefits their performance. "*When I stay in front of my classmates, I will become nervous, and my voice is sometimes high and sometimes low. It's not stable,*" an engineering master student by research from FD5 (FG5-5) stated, "*but in front of a camera during VC this situation won't happen.*"

VC affordances for mitigating VC fatigue

In addition to contributing to increased enjoyment, this study also found that VC affordances can directly aid in alleviating VC fatigue.

Graduate students utilize **modality** for mitigating emotional fatigue by adding on another communication channel which assists them in shifting their attention. An

art Ph.D. student from FG1 (FG1-3) mentioned "*When I feel very bored, I will have a private chat with my friends, like have a small chat about the meeting, like discuss what other people said. I will feel it's released much pressure and tired of myself*."

The same reason, not just focusing on meeting itself, also could explain why graduate students utilized **navigability**. A social science student by coursework from FG2 (FG2-6) also highlighted the helpfulness of navigability: "*I will also search for some information associated with that project to distract myself if I cannot follow the speaker*." It could help graduate students get more involved in the context.

The primary affordance for reducing fatigue is **customization**. Customization could be actualized not only during the meeting but also before the meeting. VC tools could provide an appointment plugin to add the meeting section to the calendar. Therefore, hosts could set the duration of the session.

> "*One of the strategies I used to set the duration to, for example, 30 minutes. We should rush the time. Otherwise, the meeting will automatically terminate it. It would be a good way to decrease the likelihood of fatigue because somehow a folk concentrating in 30 minutes is not hard*," a social science PhD student from FG1 (FG1-1).

Relationship between VC enjoyment and fatigue

The **RQ2** asked: What is the relationship between enjoyment and VC fatigue? This study found that enjoyment could not only benefit the fatigue itself but also help mitigate the factors that might cause VC fatigue and combat its negative impact.

Affective enjoyment is highlighted by many participants, specifically, it plays an important role in reducing emotional and cognitive fatigue. A social science Ph.D. student in FG1 (FG1-1) talked about how affective enjoyment could decrease stressful emotion (a kind of emotional fatigue), "*I'm just doing the avatar for a big, pig head. Then I just, you see, maybe you feel well. It's very funny, and everybody, ha ha ha. And then this is a very good way to release the stress.*" In addition, with a great atmosphere among the VC group, students could have less cognitive fatigue, which means having a higher level of engagement. "*If the atmosphere is very lovely, everyone becomes more engaged,*" a master student by coursework in science student in FG6 (FG6-5) stated, "*When everyone has something to say it also stimulate others, desire to express themselves. And this may reduce and fatigue*."

Behavioral enjoyment, which refers to immersion or engagement in the media, could prevent students from recognizing their cognitive fatigue. As a social science student (FG6-4) said: "*I think it will reduce the fatigue because you are getting involved in the topic. So you may generally forget the inconvenience or the disadvantages of the conference in mind*." In the same group, another student (FG6-1) also shared the same experience: "*Sometimes after I raise a question, I feel concentrated and the one who answers it will also feel concentrated about the topic we are talking about. And after that, the cooperation will become much easier, and the initial fatigue will just disappear later as time goes*."

This study found that **cognitive** enjoyment could directly help in mitigating emotional and cognitive fatigue. First, cognitive enjoyment could mitigate emotional

fatigue. As previous findings discussed, students believe that VC is a suitable tool for conducting meetings, especially with professors due to the limited cues. "*When we use VC meeting, we don't have such mental burden when we talk to others,*" an engineering master student by coursework in FG4 (FG4-1) stated, "*because you don't need to turn on the video, don't have a direct eye contact or physical contact with others.*" Therefore, students might easily have less emotional fatigue during meetings.

In addition, even if students had physical and emotional fatigue, cognitive enjoyment could help them avoid cognitive fatigue. A social science Ph.D. student from FG1 (FG1-2) stated "*When we use the tools, we are quite aware of why we are here and how VC helps. We join this meeting, we are here to finish a particular task. We have this in mind, and it might also remind us why we are here and doing this...even when we feel tired.*" This kind of awareness of VC and VC meetings could make students keep engaging in VC meetings, which means perceiving less cognitive enjoyment.

The findings revealed that physical fatigue is frequently linked to chronemic factors, such as the duration of a meeting. When meetings last less than 30 minutes, physical fatigue tends not to occur. Moreover, none of the three dimensions of enjoyment were found to directly mitigate physical fatigue. However, the results provided evidence that cognitive enjoyment can assist students in avoiding cognitive fatigue, even when they perceive a higher level of physical fatigue. Therefore, while enjoyment may not directly alleviate physical fatigue, it can effectively assist students

in maintaining high engagement despite potential physical discomfort during prolonged VC meetings.

Reciprocal causation between enjoyment and VC fatigue

The interplay between enjoyment and VC fatigue is intricate. Firstly, both phenomena are intricately linked to the utilization of VC affordances, as discussed earlier. However, their relationship is not unidirectional; enhancing enjoyment can mitigate VC fatigue, yet excessive fatigue can diminish perceived enjoyment among graduate students. On one hand, using avatars serves as a strategy to regulate the group atmosphere, mitigating members' fatigue. On the other hand, students noted that fatigue impeded their perception of cognitive enjoyment, with a social science Ph.D. student from FG1 (FG1-5), "*If someone has fatigue, that kind of meeting is not so efficient.*"

"Fake enjoyment" during VC meetings

Although many students have emphasized the assistance of stickers in expressing affective enjoyment, it still cannot replace the natural expression of human emotions. A social science Ph.D. student in FG1 (FG1-2) emphasized the weakness of positive emojis. He observed, "*People tend to give positive reactions in the online meeting, right? But offline, people are more likely to challenge you in the face. But on the online site, we seldom use negative emojis, and we always encourage others... It has the opportunity to give people a stronger sense of achievement.*" The other students in FG1 also agreed that they hardly sent negative emojis during VC meetings and would be "sad" and "confused" when others sent to them.

However, this type of emoji use may not authentically reflect real feelings. The participant noted that relying on positive emojis exclusively could convey a sense of "fake enjoyment" for users: "*When I feel super tired, I just can't hide it. Everyone can tell I'm tired, and I don't really enjoy it, or any negative emotions come out very naturally in an offline setting. In online settings, I don't turn off the camera, and I still can give positive feedback.*" This kind of fake enjoyment can lead group members to misjudge the collaborative content; they might mistakenly believe that everyone is satisfied with the outcomes of the meeting. "E*veryone gets a sense that everyone is so enjoyable here. Everyone is enjoying, but actually, no.*"

Other relationships with VC fatigue

The conflict between cognitive enjoyment, affective enjoyment, and VC fatigue

As discussed earlier, students experiencing higher cognitive enjoyment with VC, believing it is suitable for meetings, can alleviate emotional and cognitive fatigue among students. However, excessively emphasizing cognitive enjoyment may result in a lack of affective enjoyment for students. Compared to offline meetings, VC meetings are more efficient for tasks, and students spend a longer time on the collaborative content. Consequently, students have less time for free talk unrelated to the topic, creating a more serious and professional atmosphere within the group, thus reducing affective enjoyment.

Furthermore, due to the high-efficiency demands of VC meetings, students' tolerance for free talk that could alleviate group atmosphere decreases. A social science Ph.D. student in FG5 (FG5-1) complained about the free talk during VC meetings: "*Sometimes they discuss a lot of useless things for my master's class… They just share their emotions or stress, their feelings about Singapore. It is not quite closer to what I want to do for the VC*." This student also emphasized the difference between offline and VC meetings: "*If we are talking about the physical meeting like in the classroom, it's much easier for me to get the emotional connection and happiness for the talking with people. But video conference is task-oriented. I just want to finish the task and get rid of the online meeting.*"

The emphasis on cognitive enjoyment does contribute to students focusing on tasks within a limited time, thereby reducing VC fatigue. However, without free talk, students find it challenging to attain affective enjoyment, leading to an increase in VC fatigue.

Conflict between VC group members

This study has yielded some intriguing findings. In addition to individual conflicts in enjoyment, there can also be fatigue conflicts between teams. Specifically, students who perceive lower VC fatigue may have team members who, simultaneously, perceive higher VC fatigue.

One key factor is the diverse contributions of team members to VC meetings. Many students noted a direct correlation between their sense of fatigue and their level of contribution to the meeting. This correlation manifests primarily in two aspects: the

roles undertaken within the group and the individual capabilities of each member. Firstly, in different roles, students are more likely to experience fatigue when serving as group leaders. Group leaders need to focus on the contributions of each member during the meeting, requiring more energy and engagement compared to other members. Secondly, the individual capabilities of other members also influence the overall VC meeting experience. When a member possesses exceptional personal capabilities, contributing more to the meeting, other members find the experience more enjoyable and less fatiguing. As articulated by a Ph.D. student in social science in FG6 (FG6-4), "*One member is very clever. He knows what questions we should discuss. And for each question, to what extent he knows and he knows how we are doing good about this part... when you work with some smart people, everything goes very easily.*"

Furthermore, there is a conflict regarding members' perceptions of affordances. As discussed earlier, when students use a lower level of modality, they may perceive a higher level of behavioral enjoyment, making them less likely to experience emotional fatigue. However, when members reduce their modality to lower their fatigue, it may lead to decreased interactivity, resulting in lower levels of affective and cognitive enjoyment and increased VC fatigue for others. An example is when students choose not to turn on their cameras to relax. However, when other members do not turn on their cameras, they may increase fatigue because they cannot perceive their classmates' expressions, as articulated by a Ph.D. student in social

science in FG2 (FG2-2): "*So sometimes I wish they could just open their cameras, but I don't want to open my cameras.*"

Characteristics of group and group members

Member factors not only include the contribution but also some specific characteristics of the group and the group members. First, familiarity with other group members could be one factor related to enjoyment and VC fatigue. As an education master student by coursework from FG3 (FG3-1) said, "*If I spend time with strangers online, the emotional consumption may be less for me, and the negative effect will be less.*" Online VC meetings could help the unfamiliar members not be so nervous and therefore perceive higher behavioral enjoyment.

Second, group members who are good communicators could create a great atmosphere and bring less VC fatigue. A student (FG4-4) shared the experience with a pleasant atmosphere. "*I think the key element is that the people who engage the people in the team working, they were engaged in the discussing, and they don't interrupt others. Sometimes if the people always interrupt others, there is no possibility that we have a pleasant atmosphere. And if there is no one to speak, no one wants to deliver their opinion. There is also no possibility for a pleasant atmosphere.*" Another student from FG3 (FG3-2) also highlighted the same opinion. "*I think whether you are tired or not depends largely on your team members. If it is the kind of person who communicates well and understands quickly, you will not feel tired for a long time*." Also, other members' behavior enjoyment could encourage the member, thus increasing the behavior enjoyment. "*If everyone is speaking, while you just keep*

silent, it makes me feel a little bit guilty or a little bit awkward," student (FG6-4) showed her feeling, "*So I always chose to say something. So where everyone is talking, it also stimulates my desire to rise myself*."

Third, the number of attendees in the VC group is also an antecedent of VC fatigue, especially physical fatigue. A master student from FG2 (FG2-7) talked about what made her experience VC fatigue: "*I think it depends on the number of attendees. but I think online meetings are more suitable for a smaller number of people because everyone can participate and we can still pay attention to everyone's reactions and situations*." Another student in FG2 (FG2-2) also agreed with it, "*Usually if a team with a lot of members, the discussion will last too long. So sometimes it will be tiring for my eyes*." Therefore, a small group in VC meeting could benefit all members.

Characteristics of tasks

In addition to VC platform and member factors, the nature of the collaborative project itself can also impact students' VC fatigue. Firstly, not all projects are suitable for collaboration on VC. As mentioned by a Ph.D. student in FG1 (FG1-3) from the arts field, when they collaborate on design assignments, it requires remotely operating other members' design software through VC. This activity, which is straightforward offline, becomes challenging in the VC setting. "*We feel like it's really difficult because even if I control her computer, I can't edit this video very well because it will be very slow. So I think VC is more suitable for just having a meeting to plan or discuss the test but not to perform the task because it will be exhausting.*"

Furthermore, the level of interest in the project is also a crucial factor influencing VC fatigue. The degree of project interest directly impacts the overall experience of the VC meeting. Many students emphasized the importance of the project's level of interest, and intriguingly, this level of interest is not significantly influenced by the project's difficulty. Even if the project is challenging, students remain enthusiastic and do not feel fatigued if they find it interesting. As expressed by a social sciences Ph.D. student in FG1 (FG1-2), "*I think it depends on how you like it because even though the task is very difficult, if you are interested in it, you will be excited to complete it*." A similar sentiment was echoed by an engineering Ph.D. student in FG6 (FG6-2), "*If we can talk about something interesting, I think I will never feel tired, never feel fatigued*."

Chapter 5: Conclusion and Discussions

This article aims to explore how the affordances of VC can enhance enjoyment, thereby alleviating fatigue among graduate students during VC meetings. The main finding of this study includes the following aspects: Firstly, the research identifies the impact of affordances on enhancing the three dimensions of enjoyment and mitigating VC fatigue. All three types of enjoyment could mitigate cognitive VC fatigue. The influence between enjoyment and fatigue is bidirectional, with enjoyment playing a role in alleviating VC fatigue, and VC fatigue having a reciprocal effect on inhibiting the perception of enjoyment. Secondly, the study reveals that factors influencing individuals and the group can mutually interact, leading to conflicts. At the individual level, there may be a disparity between perceived enjoyment and actual expressed enjoyment, and the expression of fake enjoyment may further contribute to VC fatigue. Additionally, there is a relationship among different dimensions of enjoyment, where an overemphasis on cognitive enjoyment may result in a decrease in affective enjoyment, leading to VC fatigue. At the group level, unequaled individual contributions and affordance actualization can induce fatigue in other group members. Fourth, the characteristics of group members could also influence the VC experience. Finally, the nature of the project task itself also impacts students' VC experiences, as projects that are suitable for the VC environment and interesting are less likely to induce VC fatigue.

This study contributes to practical aspects in the following ways: from the graduate students' perspectives, first, they can enhance their VC enjoyment and prevent VC fatigue by adopting diverse VC usage strategies. For example, using some emojis or avatars could create a great atmosphere. Second, based on the findings, the study suggests that students should balance cognitive and affective enjoyment. Specifically, it is advised to avoid overly pursuing meeting efficiency at the expense of neglecting VC fatigue resulting from the unenjoyable group atmosphere. Students could have a small chat in the long meeting to balance the social and professional dimensions of their relationships. Third, establishing effective workload distribution and meeting norms before meetings, and addressing varying levels of contribution and engagement among group members can help mitigate fatigue. Fourth, students should also increase their communication skills which could help to reduce the group members' fatigue. Lastly, selecting collaborative projects suitable for VC platforms and avoiding disruptions in collaboration due to VC limitations is recommended. For educators and institutions, creating more engaging collaborative tasks can enhance student engagement and alleviate the impact of VC fatigue. Also, consider the suitable count of students in a group, especially for the online courses. For VC companies, the consideration of developing anonymous alert buttons, enabling users to self-report the need for breaks or terminate unproductive meetings, is suggested. Therefore, students could explain real enjoyment for the other members.

This study offers several key theoretical contributions. The primary theoretical contribution is the extension of MTM framework, specifically within the context of

VC. This research explores the actualization of affordances in the VC domain, providing a theoretical framework that explains how affordances can enhance positive experiences in VC. The extension not only includes the media type but also the media effect. MTM has been widely utilized in health communication studies. Previous research has focused on the effects of media on long-term health behaviors (Molina & Sundar, 2020) or overall subjective well-being (Jung & Sundar, 2022) However, the effects of media aren't limited to post-use outcomes; they can also manifest during media use. By considering VC fatigue from this perspective, the scope of MTM in health communication is broadened, highlighting the short-term mechanisms for adjusting negative impacts caused during using media.

Second, the findings extend the MTM framework by exploring the theoretical mechanism of VC affordances with task types acting as moderating factors. A prior study demonstrated that age could moderate the relationship between media use and the satisfaction of three psychological needs: competence, autonomy, and relatedness (Jung & Kang, 2022) . Similarly, in this study, task types play a moderating role in the context of VC collaboration. When students work on tasks that are interesting and appropriate in a VC setting, they are more likely to experience enjoyment. This adds a new dimension to MTM by showing how task variety can impact the effectiveness of VC affordances.

Third, the study revealed potential negative associations among different dimensions of enjoyment. The original MTM framework assumed relationships between enjoyment and other factors but did not address the interactions among

different enjoyment dimensions. found that overemphasizing cognitive enjoyment could lead to a reduction in affective enjoyment among students. While earlier research emphasized the positive role of cognitive enjoyment in promoting behavioral enjoyment (Nabi & Krcmar, 2004), this study suggests the importance of maintaining a balance among the different dimensions of enjoyment. The recognition that excessive focus on one type of enjoyment can detract from others is a critical contribution to the ongoing development of the MTM framework.

Fourth, it is not that enjoyment can alleviate VC fatigue; rather, VC fatigue can also impact users' perception of enjoyment. Many past studies have highlighted the adverse effects of fatigue on enjoyment (Anh et al., 2022; Zong et al., 2019). This study provides evidence that when students experience VC fatigue, their ability to perceive cognitive enjoyment diminishes. This underscores a bidirectional relationship between VC enjoyment and VC fatigue, indicating that fatigue not only results from excessive VC use but can also dampen the enjoyment that might otherwise mitigate fatigue.

Fifth, the study also contributes to other members' VC fatigue. While existing literature has identified several factors influencing individual-level VC fatigue (Fauville et al., 2021; Kushner, 2021), this study suggests that VC fatigue may vary among team members. Due to differences in individual skills and roles within a team, the level of contribution to teamwork can vary, and higher contributions tend to result in increased VC fatigue. Additionally, the way team members perceive VC affordances can influence how other individuals perceive their own VC affordances,

which may also contribute to fatigue. T his finding offers a new perspective for future research on VC fatigue, encouraging a more holistic examination of the interactions and dynamics within collaborative virtual environments. It also raises important considerations for understanding and managing the relationships between team members in virtual settings, especially where workloads and contributions are not evenly distributed.

There are two limitations to this project. First, this project only focuses on a specific scenario: students using VC to collaborate on course-required group projects. While this study examines the actualization and effects of VC affordances for student online meetings, it overlooks other settings of VC use, such as employee meetings. However, the focus group discussions could also be replicated in other groups and the antecedent of VC fatigue-task types- could also give a hint to VC fatigue studies in other settings.

Second, participants in the groups are mainly social science students. Students with similar backgrounds share significant similarities in certain viewpoints and experiences, resulting in a lack of diversity in interview outcomes. To ensure a broader representation, I invited Singapore graduate students from all eight academic areas, with at least two students from each study area. Also, in each group, at least one student had a different study background (different program or study area) than others.

I identified future research opportunities at conceptual, contextual, and methodological levels. Here's an outline of these recommendations. First, for the

conceptual front, could consider incorporating additional moderating factors, such as task performance or efficiency. Typically, students collaborate online to achieve certain outcomes, and efficiency is often a key goal for participants in VC settings (Bergmann et al., 2023). Therefore, how affordances, enjoyment, and VC fatigue influence efficiency deserves a clear understanding. Adding the final factor after VC fatigue in MTM could extend the research area of MTM.

Second, at the contextual level, MTM be applied to different contexts, such as online VC lectures or group work among employees using VC. Although this study demonstrated that MTM supports VC in the context of graduate student collaboration, some elements—like task types—may not be relevant in all VC scenarios. For instance, in a lecture setting, students primarily listen to professors and engage less in collaborative tasks. Therefore, examining different contexts, such as online VC lectures, could yield additional insights. VC affordances in lecture settings and the resulting VC fatigue have garnered interest from researchers (Brainard & Watson, 2021; Chen et al., 2020; Wu et al., 2022; Yu et al., 2021), further studies are needed to explore how VC affordances can be used to alleviate VC fatigue in these specific contexts.

Third, other qualitative methods could complement the FGDs used in this study. While FGDs can provide rich qualitative information, participants might not always remember the details of their immediate experiences during VC sessions. A diary study, where participants record their daily experiences, could capture details that are easily forgotten (Khan, 2021). This approach allows for real-time data

collection, offering a more precise understanding of users' interactions with VC technologies.

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Appendix A: Focus Group Discussion Guides

Pre-session

When participants arrive and register, the research assistant will hand out consent forms to participants to obtain their signed consent.

Introduction

Thank you for joining our study! My name is Yang Yujia. I'm a student in Information Studies at NTU. This project is about using video conferencing (VC) for

group projects. Video conferencing is software that allows two or more people to emulate a person-to-person meeting over the Internet using real-time, multidirectional video and audio streaming, including Teams, Zoom, Google Hangout, and Skype. I am particularly interested in your feature use, feelings, and experience of VC.

Your thoughts and opinions will be precious. There are no right or wrong answers to any questions I will pose, and I encourage you to **speak freely**. Because we want to respect everyone and ensure everyone is heard, we have one basic rule in this session – we will allow only **one person to speak at a time**.

You may find that you disagree with an opinion voiced here by another person. That is OK, and I hope you will say so when that happens respectfully and politely. You also may change your mind during our discussion, perhaps due to something someone else says, and again I hope you will say so if and when that happens.

Our focus group discussion will be audio-recorded and then transcribed. Again, the focus group discussion is confidential, and we won't name you in either the transcripts or the final papers. Also, your participation is voluntary, and you can opt out at any time you want. Now, I'd like to ask for your informed consent verbally. Do you consent to participate in this focus group discussion? Please say yes if you agree.

Thank you. If you have further questions about your rights as a participant, or if you are dissatisfied with any aspect of this study, you may contact, anonymously if you wish, the Institutional Review Board at 62 Nanyang Drive, Blk N1.2, B1-02A, Singapore 637459, Tel: (65) 6592 2495; Email: IRB@ntu.edu.sg.

Let's start with a few questions if you have no questions now.

Questions

Opening Questions

1. Please briefly introduce yourselves, like how can we address you? What is your year of study and your major?
2. Please consider the courses you have taken at NTU in the past few semesters. You should have used VC apps for group project collaboration in the courses. Now, I need each of you to describe to me:
    a) What was the course, and what was the group project? How was the project? Is it difficult? Interesting? Time-wasting?
    b) What VC app did you use? Why did you choose this one, not other VC apps?
    c) How many members were there? Who were these VC participants? What was your role? *(Probe for note-taker, leader, time manager, and information finder)*
    d) How's your relationship with each other? How often did you contact each other about this project and other kinds of topics? *(Probe for the closeness of the team)*
    e) How frequently did you use VC? If it was regular or one-off? How long per VC section? What was the time of the VC section (morning or evening)? Did you have all the meetings in VC?

f) Did you use other media for this project? What were they? How frequently did you use these?

g) What was the goal of your team to use VC? Is it necessary to have a meeting (maybe only an email could solve the problem)? *(Probe for task assignments, information sharing, or discussing project requirements, the difference between VC and other meeting venues.)*

h) Why did you use VC, not other video calls like WhatsApp and WeChat?

i) How often did you meet in person instead? Why don't you meet offline? Is VC your primary way of meeting or an alternative to meeting in person? Why do you have to or prefer to use VC? Which one do you like to meet? *(Probe for the difference between VC and offline meetings.)*

Key questions

Now, let's talk about your collaboration process on VC. In this section, we will talk about **VC providing various opportunities for action**. I hope you think of how VC has facilitated your collaboration, for example, how VC provides you the opportunities to do something for collaboration. *(Probe for VC affordances.)*

3. First, did you and your team members engage in collaborative behaviors while **seeking, searching, and retrieving** information during the VC sections? What specific actions did you take? Do you think the VC environment or any VC

features provide you with opportunities for these actions? How did VC provide you with the opportunities?

4. Then I'm interested in information **exchange, sharing, and accessing** among your members, including sharing artifacts, such as files, and sharing coordinating information. Did your team conduct these kinds of activities during the VC sections? What specific actions did you take? Do you think the VC environment or any VC features provide you the opportunities for these actions? How did VC provide you with the opportunities?
5. Your team might **select, evaluate, and clarify** information addressing your team's needs. What specific actions did you take? Do you think the VC environment or any VC features provide you the opportunities for these actions? How did VC provide you with the opportunities?
6. Finally, you and your team might **integrate and conclude the information** to decide what to use. Did your team conduct the activities during the VC sections? What specific actions did you take? Do you think the VC environment or any VC features provide you the opportunities for these actions? How did VC provide you with the opportunities?

VC fatigue refers to exhaustion caused by using VC tools. VC fatigue has four dimensions, including physical (e.g., eye dryness and tiredness), emotional (e.g., nervousness and anxiety), cognitive (e.g., disengagement and difficulties focusing), and social (e.g., reluctance to communicate).

7. I want to know if you have experienced any dimensions of VC fatigue. What makes you feel such fatigue? Please keep in mind that we are still discussing the collaboration situation.
8. What action possibilities that VC provides do you think are helpful for you to deal with VC fatigue? For example, what action on VC did you take or think you could take to reduce or avoid such fatigue? What did some VC features, designs, or characteristics make you think help reduce or avoid VC fatigue? How could you actualize them? *(Probe for VC affordances' effects)*

Now we will discuss some positive feelings when you use VC for collaboration.

9. What did these perceived action possibilities for the above four types of information behavior make you feel? Did you feel competent (feeling capable of achieving the task goal), relatedness (feeling of connection and belonging to other members), and autonomy (feeling you have a choice)? Why? What activities did you do? *(Probe for VC affordances' effects)*

10. Did you enjoy using VC for group project collaboration? Enjoyment has three dimensions including: affective, cognitive, and behavioral. Affective enjoyment reflects the **pleasant atmosphere** of the VC group. Cognitive enjoyment refers to a **judgment of whether VC is a helpful medium** for collaboration. Behavioral enjoyment describes the **engagement** of using VC for collaboration. What did

these perceived action possibilities for the above four types of information behavior make you feel? *(Probe for effects of VC affordances and enjoyment on four dimensions of VC fatigue, including physical, emotional, cognitive, and social)*

- Did you have an affective enjoyment of using VC for collaboration? What did these perceived action possibilities make you feel? Do you believe affective enjoyment contributes to reducing fatigue?
- Did you have cognitive enjoyment of using VC for collaboration? What did these perceived action possibilities make you feel? Do you believe cognitive enjoyment contributes to reducing fatigue?
- Did you have behavior enjoyment of using VC for collaboration? What did these perceived action possibilities make you feel? Do you believe behavior enjoyment contributes to reducing fatigue?

11. How is your evaluation of the task performance during VC? Did your group achieve your goals after the VC section?

Closing questions

12. Is there anything you would like to add? Please let me know.

<u>Ending Remark</u>

Thank you so much for your time. Your responses are precious! Again, please be assured that the data will be only used for research purposes, and your name will not be identified in any documents. Thank you again. Have a good day!

[RELEASE THE HANDOUT, INCLUDING THE FOLLOWING ITEMS, TO HELP THEM REMINDING VC FEATURES]

- Camera (Open/Close)
- Microphone (Open/Mute)
- Screen sharing
- Whiteboard
- Instant messaging
- Search bar for messaging
- File sharing
- Emoji
- Virtual hand-raising
- Avatar
- Virtual background
- Face filter
- Layout/ Presenter mode/ Together mode/ Spotlighting people
- Recordings
- Subtitles
- Remote control
- Annotation and co-annotation
- Add-on applications (e.g., polls, OneNote, Word, and PowerBI)
- Switching to other applications (e.g., Google, Word, and email)
- Other features

Appendix B: IRB Approval

NANYANG TECHNOLOGICAL UNIVERSITY SINGAPORE

Reg. No. 200604393R

RESTRICTED

IRB-2023-376

9 June 2023

Assoc Prof Lee Chei Sian
Wee Kim Wee School of Communication and Information

Dear Assoc Prof Lee Chei Sian,

NTU INSTITUTIONAL REVIEW BOARD (NTU-IRB) APPROVAL

Project Title: VC affordance and fatigue

We are pleased to inform you that the NTU-IRB has approved the application as titled above under **Expedited** review.

The documents reviewed were:
a) NTU IRB application form dated 16 May 2023
b) Non-HBR Study Informed Consent Form.docx
c) Invitation for Participation.docx
d) Focus Group Discussion Protocol.docx

The approval period is from **9 June 2023** to **9 December 2024**. The NTU-IRB reference number for this study is **IRB-2023-376**. Please use this reference number for all future correspondence.

The following protocol and compliances are to be observed upon NTU IRB approval:

1. Any research involving subjects less than 21 years old would require IRB approved written Parental Consent and consent from the participant before any research protocols can be administered unless waiver of consent is given by the IRB.

2. Only the approved Participants Information Sheet and Consent Form should be used. It must be signed by each subject prior to initiation of any protocol procedures. In addition, each subject should be given a copy of the signed consent form.

3. Consent forms are important confidential documents therefore they should be stored in the strictest arrangement. Loss of consent form could result in disciplinary action. Please refer to NTU's Data Governance Policy for handling and storage requirements.

4. No deviation from, or changes of, the approved protocol, the consent form, or advertisement should be initiated without prior written NTU IRB approval of an appropriate amendment. Modifications to an approved protocol require an amendment application.

Research Integrity and Ethics Office, NTU Institutional Review Board
62 Nanyang Drive, Block N1.2-B1-02A, Singapore 637459, T: (65) 6592-2495, www.ntu.edu.sg

NANYANG TECHNOLOGICAL UNIVERSITY SINGAPORE

5. The Principal Investigator should report promptly to NTU IRB regarding:
    a. Any incidents arising from the study (e.g. unanticipated problems, protocol deviations, adverse events, data loss, etc.).
    b. Changes increasing the risk to the subjects and/or affecting significantly the conduct of the study.
    c. New information that may adversely affect the safety and welfare of the subjects.
    d. Completion of the study.

6. Continuing Review / Project Closure forms should be submitted to NTU IRB for the following:
    a. Continuing Review: Status of the study should be reported to the NTU IRB at least annually using the Continuing Review form.
    b. Study completion or termination: Project Closure form is to be submitted within 4 to 6 weeks of study completion or termination.

7. All Principal Investigators should comply with existing legislation that would have an impact on the domain of their research.

Yours sincerely
Assoc Prof Kandiah Nagaendran
Chair, NTU Institutional Review Board
encl.

(This is an electronically generated document. No signature is required)

Appendix C: Invitation Letter

NANYANG TECHNOLOGICAL UNIVERSITY
SINGAPORE

Invitation for Participation

PIs: Dr. Lee Chei Sian, Dr. Li Junting Benjamin

Student PI: Ms. Yang Yujia

Institution: Wee Kim Wee School of Communication and Information, Nanyang Technological University, Singapore

NTU-IRB project reference number: IRB-2023-376

Research title: VC affordances and fatigue

Dear students,

Thank you for your interest and for taking the time to read this letter. I am Yang Yujia, a Ph.D. student in the WKWSCI at NTU. On behalf of my research team, I'm writing with pleasure to invite you to participate in our focus group discussions. The current project aims to investigate the role of VC affordances in enhancing VC experiences and mitigating VC fatigue.

The eligibility criteria are 1. Current undergraduate and graduate students of NTU. 2. Aged 21 or above. 3. With experience in using video conferencing tools (e.g., Zoom and Teams) for **group projects** in their courses with their group members.

You don't need to prepare anything prior to the focus group discussion. Just come with your valuable thoughts, sit with me/us (physically or virtually), and share your experience of using video conferencing tools like Zoom or Teams for **group projects assigned in a course**. The audio-recorded focus group discussion will last for **around 60-90 minutes**. The plan is flexible, and we will schedule several sections so you can choose what best works for you. Also, you can choose from two modes of meeting: **virtual or face-to-face**. Let's connect via video conferencing if you prefer to meet virtually. If you'd like to talk in person, please visit our Wee Kim Wee School of Communication and Information.

Above all, your kind participation will be much appreciated. Please don't hesitate to let me know if you have other questions about the discussion. Should you have questions about participants' rights in the study, please contact NTU-IRB at IRB@ntu.edu.sg.

Thank you!

Yujia