Distracting Moments in Videoconferencing: A Look Back at the Pandemic Period

Minha Lee
Department of Industrial Design, KAIST
Daejeon, Republic of Korea
minha.lee@kaist.ac.kr

Wonyoung Park
Department of Industrial Design, KAIST
Daejeon, Republic of Korea
parkwonyoung@kaist.ac.kr

Sunok Lee
Department of Industrial Design, KAIST
Daejeon, Republic of Korea
sunoklee@kaist.ac.kr

Sangsu Lee
Department of Industrial Design, KAIST
Daejeon, Republic of Korea
sangsu.lee@kaist.ac.kr

ABSTRACT

The COVID-19 pandemic has forced workers around the world to switch their working paradigms from on-site to video-mediated communication. Despite the advantages of videoconferencing, diverse circumstances have prevented people from focusing on their work. One of the most typical problems they face is that various surrounding factors distract them during their meetings. This study focuses on conditions in which remote workers are distracted by factors that disturb, interrupt, or restrict them during their meetings. We aim to explore the various problem situations and user needs. To understand users' pain points and needs, focus group interviews and participatory design workshops were conducted to learn about participants' troubled working experiences over the past two years and the solutions they expected. Our study provides a unified framework of distracting factors by which to understand causes of poor user experience and reveals valuable implications to improve videoconferencing experiences.

CCS CONCEPTS

• **Human-centered computing → Empirical studies in collaborative and social computing**; *Web-based interaction*; *Empirical studies in HCI*.

KEYWORDS

Videoconferencing, Remote work, Distraction, User experience

1 INTRODUCTION

As a result of the COVID-19 pandemic that began at the end of 2019, emergent changes have occurred in the paradigm of work. This is an important part of people's lives especially due to regulations such as city lockdowns, self-isolation, and social distancing in each country [36, 59]. People needed an alternative means to continue their usual various working activities without physical contact. As a result, to support remote working (also referred to as teleworking, telecommuting, and virtual working [2]), the use of online videoconferencing systems, such as Zoom (Zoom Video Communications, Inc., San Jose, CA), Teams (Microsoft Corp., Redmond, WA), Skype (Microsoft Corp., Redmond, WA), WebEx (Cisco WebEx LLC, Santa Clara, CA), and Google Meet (Google LLC, Mountain View, CA), has increased dramatically. Video-mediated communication has helped people work in various ways. Communication using videoconferencing tools is location-free, cost-saving, and sometimes even better than meeting in-person [29]. Although the concept of tele-meeting has long been used in practice and academia before the pandemic, remote working has been "a luxury for the relatively affluent," such as high-income earners and white-collar workers [14]. The COVID-19 shock has popularized remote meetings and lowered the psychological barriers people previously had. Remote work with videoconferencing tools became the "new normal" almost overnight [69].

However, billions of workers have encountered a new working paradigm of interacting with others via software interfaces in real-time within various types of working contexts with no preparation. In particular, many people have come to work in their living space or public space without a place optimized for videoconferencing. Various problems caused by the mingling of daily life with work often interfere with people's virtual work. This was not addressed majorly in pre-pandemic videoconferences at the time when remote work was not practiced on an unprecedented scale; rather, remote work more often occurred under conditions of sufficient readiness. However, it has become an important consideration that frequently distresses users in the current context. For example, in remote work situations after COVID-19, people living with their families were disrupted by unexpected situations their families caused [69]. This included having family members talking to them or needing their help during a videoconference. In addition, technical issues such as speech interruption due to unstable networks as well as noise from various places and sources diverted their attention. In

addition, many people shared the same space with other people (e.g., family members) for various purposes (e.g., personal, educational, or professional activities) while conducting videoconferences at home, a typical remote workspace [2]. As such, people who have difficulty securing personal space have the potential to face problems that are more diverse.

In the human–computer interaction (HCI) field, many studies have focused on developing technologies in videoconferencing, such as audio and video performance improvement [23, 31, 48], to enhance the videoconferencing experience. In addition, researchers have actively explored videoconferencing tools' functions and design and have suggested design guidelines [8, 30, 31]. In addition to studies focusing on a specific technology or a specific videoconferencing platform element, a number of studies have focused on specific stakeholders (e.g., patients with epilepsy who have difficulty going out [25] or nurses who take care of infectious disease patients [6]) or usage contexts (e.g., education [6, 63] or therapy [42]) where the characteristics of videoconferencing such as meeting place flexibility [4, 28] can be well utilized. However, these previous studies were not conducted when remote work became popular on an extreme scale. Recently, according to the changed context of videoconferencing due to the COVID-19 pandemic [69], studies have identified broad challenges and implications researchers should consider in terms of videoconferencing and remote work [14, 36, 55, 59, 68, 69]. These studies have provided an overview, including situations that interfere with videoconferencing, such as work–home interference, but they did not focus on situations that distract users and did not understand them in depth from a user-centered perspective.

The popularization of videoconferencing over the past two years has created an opportunity to understand the various troubled meeting situations experienced by real users. In this study, we focused on the conditions that disturb, interrupt, or restrict users when they have remote meetings using videoconferencing tools. Our research aims to explore users' pain points and unmet needs by analyzing the difficulties people have experienced while using videoconferencing tools over the past two years and to discover design opportunities that provide a better videoconferencing experience. To understand the troubled experiences deeply over the past two years and users' needs from their perspective, we conducted focus group interviews and participatory design workshops employing various strategies to help participants recall their videoconferencing experiences. We analyzed 167 troubled remote meeting situations and 115 proposed solutions. In this paper, we provide a structured framework of distracting experiences, categorized by factors that cause distraction. Through the participants' solution ideas and workshop discussions, we could understand the difficulties and needs of the videoconferencing situation from a user-centered point of view that previous studies could not reveal. Based on this, we derive design implications to provide better support of videoconferencing experiences.

2 RELATED WORKS

2.1 Remote work and videoconferencing experiences

Remote work has long been an important topic in various communities in the field of HCI. A large body of research has been done on remote working and remote collaboration [2, 22, 37, 39, 51] to understand the psychological challenges or risks that remote workers have faced since before the COVID-19 pandemic. Allen et al. [2] reviewed previous research on telecommuting to understand it and its implications better. They gathered various terminologies and conceptualizations used in the literature (e.g., telecommuting, telework, or virtual teams) and reviewed existing findings and implications for employees' work–family issues, attitudes, and work outcomes (e.g., job satisfaction, stress, wages, or withdrawal behaviors). Keris et al. [32] studied individuals, teams, and meetings in various settings to understand how well remote collaboration works in companies with high technology. Cristina et al. [20] discussed the conditions that should be designed, managed, and implemented for effective virtual teamwork, focusing on the remote work of virtual teams. In addition, previous literature has discussed a wide range of issues, such as work–life boundaries [21], autonomy [16], and productivities [7].

Under the remote working context, our study targets conditions in which remote workers use video-mediated communication tools. Research on enhancing remote workers' experiences when using videoconferencing has long been conducted in various fields. Many researchers have conducted studies to develop specific technologies and understand user experiences important for videoconferencing. A series of studies have explored the role of spatial audio and video in supporting remote collaboration experiences that are more engaging [23, 48]. Mehrotra et al. [48] presented an implementation of a simple solution that allowed realistic audio spatialization of arbitrary positions in a 3D videoconference. In addition, studies have proposed design implications and guidelines for videoconferencing tools to enhance the videoconference experience. Junuzovic et al. [30] studied the layout guideline for designing more effective multi-party, gaze-aware desktop videoconferencing tools. Through these numerous studies, the HCI community has discussed several ways to improve the experience of remote work and videoconferencing, but previously accumulated knowledge on remote working and videoconferencing experiences before the pandemic lacks contextual relevance to the present [69], where an unprecedented scale of people work remotely due to the pandemic.

As the emergence of COVID-19 accelerates research on this changed work paradigm, several researchers have re-examined the videoconferencing experience, reflecting the remote working context that has changed due to the popularization of videoconferencing. Daraba et al. [12] investigated how the role of authentic leadership, psychological capital, and gender in the context of working from home during the COVID-19 pandemic affected employee performance. Kirchner et al. [35] investigated how managers have experienced their new role as distance managers during the pandemic. Waizenegger et al. [68] explored how the enforced working from home requirement affected team collaboration. These studies related to work performance, such as group performance and managerial leadership, rather than user-centered approaches for improving remote workers' overall work experiences. Some studies were conducted in an integrative approach to understand the overall work experience and consider the implications of remote work during the pandemic. Wang et al. [69] explored the challenges remote workers experienced during the pandemic period as well as which virtual work characteristics and individual differences

affected these challenges. Sigahi et al. [59] reviewed different aspects of work (e.g., workers' health, working conditions, and remote working) in the various economic sectors from previous studies and suggested key considerations (e.g., interindividual variability, subjective relation to work, and supportive workplace environment) in the current scenario. Rudnicka et al. [55] drew research and policy implications for supporting remote neophyte workers during and beyond the pandemic. These studies partially overlap in scope with ours in addressing the user experiences of remote workers during a pandemic. However, previous studies differ from ours in that they did not focus on the experience of videoconferencing, especially the experience of distractions that occur in the processes of using videoconferencing tools. Our work presents the understanding of distracted experiences that have not been resolved and systematically derives user needs that are not currently met, based on the long-term videoconferencing experience accumulated for about two years by users with various occupations forced to videoconference due to the pandemic.

2.2 Distracting moments of remote work with videoconferencing tools

The literature described in the previous section confirmed that a broad approach reflecting this changed remote working context is important and that many distractions are still unresolved. In addition, in the popularization of videoconferencing, problem situations (especially distractions) have exploded due to the blurred boundaries between daily life and work [34, 67, 69]. In this background, we have sought to understand the numerous types of distractions remote workers experience in the real world during videoconferencing and delineate how videoconferencing researchers and practitioners should approach them in the future. In our study, we defined distractions as events preventing remote workers from fully engaging in videoconferencing by disturbing, interrupting, and restricting them.

Several studies have discussed a part of distractions while videoconferencing that we intend to understand comprehensively through our work. Some of the studies explored the opportunities and challenges with a focus on hybrid meetings [56, 57], and their findings were good inspiration and reference for our understanding of a broad range of videoconferencing issues. Czerwinski et al. [11] targeted information workers and covered interruptions, including phone calls, emails, and personal requests, and they argued that the occurrence of these interruptions lowered the work efficiency of existing tasks. Similarly, Mark et al. [46] understood how user behavior at work changes when several potentially distracting websites and online applications are blocked. Although they did not focus on the remote work context, they briefly discussed the ways online sites that are potential distractors causing self-interruptions are examples of non-work-related distractions that affect productivity, perception of workload, and stress. Previous studies [11, 27] have investigated the interruptions experienced by remote workers in task switching and suggested design implications. These studies, compared to ours, have limitations in that the target context was limited to a certain type of online meeting or focused only on a specific distraction factor.

As a recent study most similar to ours, Wang et al. [69] attempted to understand the broad challenges and virtual work characteristics of remote workers in the changed working context due to the pandemic. They identified work–home interference, a part of distractions we explored in our study, as one of the four key challenges in the remote work context during the pandemic. Tan et al. [65] briefly highlighted the impediments to using a virtual collaborative system in an organizational context. They classified distractions that prevent effective virtual collaboration into two categories: technological barriers and organizational barriers. Yankelovich et al. [70] listed the top issues encountered during remote meetings, such as poor audio quality and extraneous noise. The audio, behavioral, and technical issues they presented were investigated before the pandemic, but several unresolved issues overlap with our study results. These approaches were conceptually similar to our study, but the distractions discussed in these previous studies are part of the potential distractions experienced by users during videoconferencing that we try to understand through our study. Our study comprehensively examines distractions while videoconferencing and extracts factors for reference by researchers and practitioners.

As a way to understand various types of issues in remote collaboration and meetings, many researchers have conducted experimental studies [56, 65, 70]. For example, Tan et al. [65] asked participants to use a specific virtual collaborative system, which is designed and developed for distributed teamwork, to derive issues that prevent effective virtual collaboration. We believe it is important to collect natural experiences accumulated by the target audience rather than experimental data under limited or controlled conditions to understand the various problems remote workers face. In this study, we try to understand their experiences based on more diverse and more realistic scenarios encountered during remote meetings. For this understanding, an effective approach to eliciting the various problematic situations that experienced videoconferencing users have encountered is important. We collected distractions that can occur during videoconferencing while stimulating the participants using several strategies to help them recall their videoconferencing experiences better, and we derived distracting factors that persistently bother users. We extracted factors causing various distractions from several videoconferencing issues, which is different from the previous studies mentioned above that categorized important issues from the data. Our study covers technical, physical, and social factors stemming from the videoconferencing experience.

Furthermore, we tried to reveal users' inherent needs and suggest approaches to solving future problem situations related to each factor. To improve the experience of remote workers more effectively, it is important to see how users want further support from their point of view when faced with these numerous distractions. Most of the previous studies used surveys [32, 46, 65, 69, 70] and interviews [27, 65, 69] to gather users' perspectives, not generative studies. We took a generative approach that allowed them to ideate and discuss solutions for combating each distraction to understand this more deeply and rigorously.

2.3 Research methodology and strategies to stimulate recall of past experiences

An important task to achieve the goal of this study was to find an effective way to elicit the videoconferencing experience that participants had accumulated over the past two years. To design our study methodology, we reviewed previous studies in which users were interviewed about users' past experiences regardless of the research domain.

Yoo et al. [71] conducted a study to understand everyday experiences of reminiscence for people with blindness. They selected the participants' homes, which contain their meaningful possessions, as the study site to provide direct insight. By conducting the study in an environment where the user experience that the study is observing is usually performed, the participants were able to look at objects in the surrounding environment and absorbed themselves in the situation at the time. Shin et al. [58] conducted a focus group interview to understand people's stress caused by mobile instant messaging. For participants to become deeply engaged in the subject, they asked participants to quickly write down one word that came to mind when they thought about their research subject, and then to explain why they wrote that word before their main study. By asking participants about their thoughts about the research subject before the study, these researchers encouraged them to think about the subject on their own and immerse themselves in it. Inspired by these studies, we conducted the entire study remotely using a videoconferencing tool, and requested remote access from their usual remote workplace where the experience we wanted to understand had occurred. Furthermore, at the beginning of the study, we asked the participants about their definition of videoconferencing and the reasons they defined it as such.

As a well-known research methodology that can stimulate participants to recall memories, we conducted focus group interviews [41]. According to Lederman, the focus group interview is a technique involving the use of in-depth group interviews in which participants are selected because they are purposive, although not necessarily representative, sampling of a specific population—this group being "focused" on a "given topic" [66]. Acocella [1] stated that through focus groups, each participant is quickly stimulated to formulate memories and ideas by listening to the other participants' interventions. Morrison [49] confirmed that the interaction among discussion participants helped them become more inclined to consider and reflect upon aspects of their daily lives that were usually taken for granted. In addition, visual materials such as photos and videos effectively stimulate participants to recall memories [5, 53]. Dewitt et al. [15] used photos and videos of participants in conditions they wanted to interpret through the study as stimuli to prompt their recall in interviews. Based on this, we designed the study to elicit participants' videoconferencing experiences in various environments by asking them to take pictures of their several remote working spaces before the study and to refer to them during the study.

3 METHODS

Our study's purpose was to present insights and implications for a more supportive videoconferencing experience by collecting and classifying the various distracting experiences and implicit needs when working remotely using video-mediated communication tools. We constructed the user study process using several strategies to stimulate participants to recall their videoconferencing experiences. We conducted a focus group interview to explore the types of problematic situations participants experienced during video-conferences and to understand the ways they affected their work experience over the past two years. Subsequently, we conducted a participatory design workshop in which participants directly ideated solutions to derive the main needs from a user-centered perspective.

3.1 Participants

To investigate various videoconferencing experiences, we recruited remote workers who 1) had more than 50 work experiences using videoconferencing platforms in two years and 2) shared both workspace and living space with others, making it difficult to secure a private space for videoconferencing. We used a screening survey to gather age, occupation, types of shared workspace and living space (including relationships and number of people sharing the space), and the number of uses of videoconferencing tools. We did not aim for statistical representation for generalization, but we did

Table 1: Summary of the basic information of participants

ID	Team	Age	Job
P1	1	22	Intern (UX design Team) & University student
P2	1	26	Book editor (Genre novel)
P3	1	34	Assistant manager (Strategic planning team)
P4	2	24	Intern (Space science team) & University student
P5	2	25	Designer
P6	2	31	High school science teacher
P7	2	24	Intern (Human resource team)
P8	3	37	Interpreter
P9	3	29	Project manager & Teaching assistant & Ph.D student
P10	3	19	Wind instrument instructor & University student
P11	3	56	Leadership coach
P12	4	25	Salesperson
P13	4	30	Assistant manager of public institutions
P14	4	26	UX designer
P15	4	25	Intellectual property officer (Pharmaceutical company)
P16	5	40	University professor
P17	5	35	Project manager (Advertising platform team)
P18	5	29	Startup operator

strive for general diversity, particularly around age and occupation. From this, we selected participants using two criteria expected to enhance the sample's richness: 1) variations in age and job (priority) and 2) more experience with videoconferencing tools. A total of 52 applications were received in this process, of which we selected 20 participants for this study. One participant dropped out during the scheduling process, and another participant left during the experiment. Finally, we conducted the user study in teams of three or four with a total of 18 participants (two groups of three participants, three groups of four participants) (Table 1). Participants ranged in age from 19 to 56, with all participants having different careers except for three design fields. All participants resided in South Korea at the time of the study, though some of them communicated internationally while working remotely.

3.2 Study procedure

First, before investigating the participants' experiences over the past two years, we wanted them to immerse themselves in the context of the videoconferencing and disturbed situations. Inspired by previous studies with strategies for participants to become deeply engaged in the subject [58, 71], the entire study was conducted remotely with each participant in their usual remote meeting place. We used Zoom, the most popular videoconferencing tool [60]. At the beginning of the study, we introduced the study's purpose and the specific scope that we would want to observe in the study. The participants introduced themselves and took turns sharing their definition of videoconferencing and the reason they chose that definition.

After that, we conducted focus group interviews [41] (audio-recorded) in which each group shared and discussed the distracting situations they had experienced for the past two years and their methods of self-control in managing distractions. One researcher moderated the focus groups, and another researcher observed and took notes. We overall overview semi-structured materials using Google Sheets for the focus group process. Acocella [1] noted that the presence of other people in focus group interviews could inhibit an individual and influence the way a judgment was formulated or an answer was given. To complement the communicative limits of focus groups, we asked participants to recall videoconferencing experiences individually before group discussions so they could focus on recalling their personal experiences. Each participant was assigned an individual sheet from the Google Sheets the moderator created. First, we asked them to write down the title of the remote meeting using videoconferencing platforms they had experienced over the past two years as much as they could quickly recall. Then, each participant was individually asked to recall and list their troubling experiences that were distracting during their videoconferences. Participants listed their experiences for about 30 minutes, referring to photos of their usual videoconference locations, which were supplementary materials we asked them to bring (Figure 1). All participants took turns individually, based on what they wrote on their sheet, explaining and discussing for about 30 minutes the distracting situations they experienced during the videoconference, their feelings or thoughts at the time, and their behavioral changes. We asked participants to discuss freely and

add content to their sheets when they heard other participants' experiences and thought of another experience.

Subsequently, a participatory design workshop was conducted to gather the distracting situations the participants listed onto one additional sheet, classifying them into distracting factors together with the moderator and the participants, and they devised solutions for each category. Participants discussed resources they needed to solve the classified problems and the types of solutions they expected. We did not aim to focus on deriving possible design solutions through this process, but to identify detail and implicit needs from the users' point of view according to each factor. Therefore, rather than extracting the solution's specific form or feasibility they wanted, we tried to understand deeply the reasons users wanted such a solution and the meaning of workshop discussions. We conducted both focus group interviews and participatory design workshops in the same group. Our study participants' diverse occupations created a certain level of heterogeneity of shared troubled experiences to facilitate the collection of a wider range of opinions and perspectives on our topic and to enrich the research's results [24]. With this group study, our participants could be triggered to talk more diversely through other participants' answers about the various distracting experiences they had become accustomed to over the past two years.

Lastly, a short interview was conducted at the end of the participatory design workshop to discover the participants' thoughts and perceptions on videoconferencing after COVID-19. We asked participants two main questions: "Do you think your industry will continue to use videoconferencing after the pandemic?" and "Do you want to continue to use videoconferencing after the pandemic?"

3.3 Data analysis

The first author organized the list of distracted experiences from the focus group interview written by the participants during the study and the results of the participatory design workshop as well as transcribed the recorded audio. Because grounded theory is a more structured methodology than other methodologies are for building theories from primarily unstructured data [10, 62], we used the grounded theory as a qualitative analysis method for our study. We believe this approach can help identify important elements of the problem from participants' experiences from a wide variety of perspectives and contexts [44]. In particular, we adopted the (Straussian) grounded theory according to Stol et al. [62].
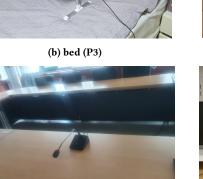
Based on the study results, we compared the entire transcript with the contents directly described by the participants during focus group interviews after each group's study, and we used the open and axial coding method as a thematic coding approach [19]. In this phase, we coded for each experience based on the types of factors that distracted the participants, and at this time, we took notes about their inherent needs and emotions. Based on this, we added, merged, and deleted the codes and further specified the direction to ask questions and discuss them with the participants (especially in the workshop) of the following group. Through this process, we were able to perform data collection and analysis simultaneously. Five groups of participants had been recruited and scheduled in advance. Through the iteration process of data collection and analysis,

(a) living room (P8)

(b) bed (P3)

(c) dormitory (P4)

(d) café (P13)

(e) meeting room in the company (P13)

(f) personal desk in the company (P17)

Figure 1: Examples of various remote workplaces of the participants

sufficient data were collected to discover an important initial theme pattern, so no additional participant recruitment was required.

After all studies, to prevent misunderstanding and accurately grasp the meaning or nuance of the data, we comprehensively reviewed the data of the entire study (Google Sheet results in our study) and cross-checked the transcript three times. In this process, 12 out of a total of 179 distracted experience samples investigated through user studies were excluded as outliers, and 167 samples were finally used in our analysis. These samples were categorized into five primary categories and 13 secondary categories of distracting factors.

After that, we added and modified the code through open coding the transcript and data of the participatory design workshop once again to extract examples and user needs and connect them to the classified category. These are added to the final framework of distracting experiences during videoconferencing. Consequently, we categorized our results into five primary categories and 13 secondary categories of distracting factors, creating a unified framework of distracting experiences.

4 RESULTS, DISCUSSION, AND IMPLICATIONS

In this section, we present a unified framework of distracting experiences during videoconferencing and report our findings and implications for our framework's distracting factors (Table 2). The five primary categories of distracting factors we categorize are (1) people and pets in the same physical environment, (2) other people engaged in the same videoconferencing, (3) environment around the user while videoconferencing, (4) usability of the videoconferencing platform, and (5) performance of the device executing

the videoconference. We set the source of disturbance as primary categories and the main characteristics that caused the users' distraction for each source as secondary categories. Each primary category had 2–4 secondary categories. The primary and secondary categories are described in Table 2 with examples and unmet user needs. The number of distracted experiences found through our study are listed along with each distracting factor, which is not for quantitative analysis, but rather helps researchers understand how often users experience problematic situations in each category.

Further, we will explain the detailed situations for each category in the order of this framework and discuss the ways each distracting factor and situation affected their work experience and their specific needs from a user-centered perspective. Based on this, we propose implications for design and research to improve the videoconferencing experience. Participants' ideas for solutions explored through the participatory design workshop are described in this section along with design implications. Some results of the participatory design workshop were logically impossible or already existing solutions because our study's participants were not experts. However, we conducted this workshop to focus on ways users try to solve problems and the types of discussions they have, and we used the results to discover their implicit needs.

4.1 People and pets in the same physical environment

The *people and pets in the same physical environment* category refers to the distraction experiences created by the people and pets around the user in a physical environment in which the user exists rather than in a virtual environment through a videoconferencing platform. Distracted experiences due to this factor were mentioned

Table 2: A unified framework of distracting experiences during videoconferencing (Numbers in parentheses are the number of distracted experiences found through our study)

Distracting factors	Description	Examples	Unmet user needs
1. People and pets in the same physical environment (50)	Distracting experiences created by other people or pets around the user's physical environment		
1.1 Intrusion of remote workplace (17)	Entering user's space where the videoconference is held	Family member enters the room; roommate passes behind; cat comes up to the desk	- To inform people surrounding the users they are engaged in a meeting - Not to expose others in the background to other participants
1.2 Demand in user's attention and action (19)	Requiring users' attention and additional actions	Family members talk to user; phone call comes in; parcel arrives	- To inform people surrounding the users they are engaged in a meeting - To resolve the matter while remaining in their seat - To instantly inform and be excused by other participants when needing to leave their seat - To follow up on missed contents while the users left their seats
1.3 Generation of background noises (14)	Creating noises around the user	The sound of chatter; others engaged in phone calls; snoring; discussion at another meeting	- To filter out surrounding noise and deliver only the user's voice - To inform people surrounding the users they are engaged in a meeting
2. Other people engaged in the same videoconferencing (50)	Distracting experiences created by other participants in the same videoconferencing		
2.1 Inexperienced use of videoconferencing tools (7)	Lack in knowledge of using videoconferencing tools	Low understanding of how to join the meeting; how to set up the meeting; how to use host authority; how to resolve sound transmitting errors	- To receive refined description of the interface - To assist other participants in resolving their own immature use of the interface
2.2 Accidental mistakes (32)	Making unintentional mistakes	Exposing unrelated presentations, messenge, documents while screen sharing; speaking in a mute state; forgetting to mute	- To prevent frequently made mistakes - To know if they are currently making a mistake - To effectively advise other participants of their mistake
2.3 Lack of prior preparation (4)	Being less prepared when attending videoconferencing in their living spaces	Showing disorganized appearance	- The virtual environment to embellish themselves
2.4 Physiological phenomenon (7)	Wanting to resolve natural body functions	Being thirsty; wanting to go to the bathroom; cramping on their feet; being hungry; being sleepy beyond sleeping time	- Enforcement on pausing or stopping delayed meetings - Some practical and friendly way of informing the user's status
3. Environment around the user while videoconferencing (31)	Distracting experiences created by the variety in physical environmental characteristics of around the remote workers		
3.1 Living environment unfit as a workspace for remote working (11)	Being not set for work purposes in one's own surroundings	Messy living space; multiple purposes in one space; no sense of presence	- An independent remote workspace apart from the living space - Supplementary stimulation for boosting the sense of presence - To hide the background from other participants
3.2 Noise in one's own workspace (20)	Being noises from the surrounding space and environment	The sound of interior construction, washing machines, dishwashings, fans, airplanes, cars; coffee shop background music; subway announcement	- To filter out surrounding noise and deliver only the user's voice - To be notified of surrounding noises being broadcasted - To easily notice and be excused by other participants for the noise
4. Usability of the videoconferencing platform (10)	Distracting experiences created by technological, functional, systematic, and visual features of the videoconference tool		
4.1 Low quality in audio output (8)	Providing low-quality audio output by default	Pronunciation is not delivered properly; the beginning and end of the word are cut off; the instrument sounds in the high range are output low	- To identify both text and voice collectively - To individually identify overlapping sounds - To effortlessly determine their point of articulation
4.2 Restrictions on screen control (2)	Limitation in freely controlling the screen according to the needs	Screen control limit when giving remote control function; difficulty checking the function of the tool when sharing the screen	- To control the screen even after handing over the screen control authority - To clearly check the messenger notifications during screen sharing
5. Performance of the device executing the videoconference (25)	Distracting experiences created by the performance of appliances used for videoconferencing		
5.1 Low technical performance (2)	Lack of technical performance of devices used for video conferencing	Unstable Bluetooth earphones connection; unexplainable error on laptop	- To instantly know device's connection loss
5.2 Unstable network (23)	Poor network communication	Forced exit; choppy and frozen audio, video screen, shared screen; shared screen out of sync with the sound	- To know the cause of the problem - To know missed portions of the conference - To selectively adjust the performance of the platform in an unstable network state

50 times in our study. We classified three secondary categories in this category: *intrusion of remote workplace, demand in user's attention and action, and generation of background noise.*

4.1.1 Intrusion of remote workplace. This occurred when other people entered the space where the user was having a videoconference and distracted the user's attention away from video-mediated communication. The emergence of unexpected people embarrassed users (P1, 3, 9, 16, 17), inhibited their ability to concentrate on the meeting (P3, 6), and made them miss the meeting's contents (P6, 9).

> *"I supervised the test using Zoom. I reserved a seminar room to use an independent space, and I was observing the students there by myself. But that overlapped with the cleaning time of the cleaner."* (P9, teaching assistant)

While some participants could prevent further intrusions by locking their doors in advance or notifying others of their meeting schedule in advance (P6, 7, 16), two of them stated their positions did not allow them to block the others just for their convenience (P3, 16). The main reason was that one's different role in the remote meeting and physical space existed simultaneously. For example, P3 (assistant manager) could not lock the door only for meetings due to having a parent's role in caring for her children. In addition, P16 (a high school teacher), who had to communicate with students, did not lock the door even when they were having important meetings in the school office but sometimes put a sign in front of the door. This was because the user was responsible for both a role in the physical space and a role in video conferencing.

> *"I don't lock the door, but I tell my family not to come in. (...) For example, what if my children have to go out in a hurry, but there is nothing important? They have to find me."* (P3, assistant manager)

> *"They just came to do their own business. They just came because they wanted to talk to the teacher. (...) I just asked the student to come back later because I was in a staff meeting. During the exam period, a sign saying 'Student access is prohibited' was posted, but…"* (P6, high school science teacher)

Previous studies on the work-from-home context focused on the effect of videoconference users' multiple roles when engaging in remote work. Wang et al. [69] identified work–home interference as one of the four key challenges in the remote work context during the pandemic. They mentioned, *"Working parents faced a bigger challenge in balancing work and family roles."* A previous study argued working from home due to the COVID-19 pandemic dramatically increased families' care burdens (especially women), and the reason for that was not only because people were physically not allowed into workplaces, but also because institutional support had decreased [52]. Our results suggest that not only the family role at home, but also the possibility of different coexisting roles (e.g., a teacher for students and a colleague for other teachers) occuring in various places should be recognized, and its impact of it on users should be broadly considered. Participants in our study said that the problematic situation regarding the coexistence of different roles usually occurred when people were not aware that they were in a videoconference. We found that users wanted to inform the people around them about their current working status for this situation. Our participants wanted to place a product that could inform others of their working status in front of their working spaces, such as *"hanging a sign that they were having a meeting at the door"* (Team 1) and *"showing that the meeting room was booked and in use on the LCD screen as well as the reservation web page"* (Team 4). In addition to physical products, participants proposed ideas to inform others of one's working status through digital devices. Team 2 indicated that *"automatically sending a text message 'USER NAME is in videoconference' to those who share space"* would help solve this problem.

Furthermore, we found that participants were embarrassed (P1, 3, 9, 16, 17), ashamed (P3, 9), and bothered (P4, 5, 14), especially when people around them were shown on the user's video screen. Most of the people shown on the video screen did not cause major problems, but some unexpected privacy was exposed, creating a dizzying situation.

> *"It was shown on the screen that my roommate went to the bathroom right behind me after taking off his top and bottom."* (P4, university student)

The intrusion of pets, as well as people, disturbed users (P4, 11, 17). Participants said there was no adequate way to prevent intrusions by pets, who, unlike humans, do not communicate well.

> *"I have a cat, and my cat often comes up on my laptop. So I closed the door, but my cat can open it again, so it comes again. So there's no other way."* (P17, project manager)

In addition, the videoconference users were distracted by concerns that other participants in the same meeting might not be able to concentrate because of the users' screens. Such concerns once again acted as indirect factors to distract users. Users needed a way to prevent exposing other beings through their video screens. Most participants solved this problem using the virtual background function. Many videoconferencing platforms provide ways to hide the remaining background area, except for the user's silhouette, by using other photos or videos. However, one participant (P5) pointed out the technical limitation of the platform function: the real background is not completely obscured if a person moves behind the virtual background.

> *"I usually set up my virtual background. But if I have a friend behind me, when my friend moves, it looks like there's a little strange object behind me. My team members said it looks like a ghost and is a little scary."* (P5, designer)

Study participants expected that higher quality virtual backgrounds would be needed and suggested ideas such as *"recognizing a specific user's face and processing all virtual backgrounds except for the corresponding face"* (Teams 2 and 4) and *"setting the unconditional area for virtual background"* (Teams 2 and 4). Furthermore, participants suggested that *"using a virtual avatar instead of a video screen showing the real user"* would reduce the problem that this distracting factor causes (Team 1). Our results imply that, when videoconference tools fail to block distracting factors, users expect

to solve the problem through technological advances and user-centered design. Kruger's early study in augmented video experiences anticipated manipulated videoconferencing tools with virtual backgrounds [40]. Currently, most commercialized online videoconferencing tools, such as Zoom and Teams, provide a function to set the virtual background. Zoom recommended a green screen for the best virtual background experience during videoconferencing, but it is not required [74]. However, none of the study participants had experience using a green screen, and they expected a better virtual background experience without requiring additional preparation for users. This indicates that developers and designers of videoconferencing tools should consider providing a virtual background that is acceptable in diverse situations, for example, without a green screen, to provide a better experience by flexibly responding to diverse distraction situations.

4.1.2 Demand in user's attention and action. People in the physical environment distracted the videoconference users' attention not only by simply entering the users' physical space but also by needing the users' attention and additional actions. Four participants (P3, 12, 15, 18) said the people around them did not know they were in a meeting and sometimes talked to them.

> *"I close the door while working from home, but my family opens the door and talks to me."* (P15, intellectual property officer)

> *"During videoconferences, people often talk to me. (...) I was flustered at first, but now, I'm just pointing at my earphones and ignoring them."* (P12, salesperson)

Participants answered that they frequently had to answer a phone call during a videoconference because their responses were required not only from people around them physically but also through phone calls (P3, 6, 12, 14). This problem can occur in offline meetings, but participants pointed out that it becomes a more critical factor due to the nature of videoconferencing, during which users can only share limited information about their physical environments. Participants who answered the phone while videoconferencing had trouble participating in the meeting (P3), disappeared from their video screens to take calls (P12, 14), or waited for an important part of the meeting to pass (P12). Based on these experiences, the participants proposed *"the function of automatically replying to messages that they are in a meeting when a phone call or text message is sent to their mobile phone"* (Team 4, 5). This indicates that users are willing to focus on their work and make excuses by describing their situation to someone who requires them, such as the caller, as much as possible, even if they are not fully responsive to those who need them. The participants also shared various experiences of leaving the meeting place because the people and pets around them needed their attention. In such a situation, the participants weighed the importance of the virtual meeting and the physical world, and they chose the more important and urgent situation, temporarily gave up the other.

> *"It happened a while ago, and when I started self-isolation (as part of government regulations related to COVID-19) and had a personal meeting with my professor, the district office suddenly called me and said that the relief*

> *goods were delivered. They said there was refrigerated and frozen food in there."* (P9, Ph.D. student)

> *"I was having a morning meeting and my cat vomited. Normally, I have to clean this up quickly. (...) I felt impatient, but I focused on the meeting again because the meeting didn't end quickly just because I was in a hurry."* (P1, UX design team intern)

We discovered that users needed to interact with other meeting members when they had to leave their workspaces. First, participants wanted to communicate their statuses to the videoconferencing tool as a visual representation so that other meeting members could know their statuses without interrupting the meeting's progress. Teams 3 and 4 indicated that *"a function to select and notify their status (e.g., away for a while) on their video screen"* was necessary. Similarly, videoconference users wanted to inform meeting attendees intuitively about their statuses in videoconferencing tools by using icons that indicated their statuses. Team 5 proposed the idea of *"icons that can represent the status by mixing emoji and text with appropriate tone and manner."* In addition, AR-filter software, such as Snap Camera [26], can be an interesting solution for users to announce their statuses easily. It is important to develop these solutions by considering the status that users need and want to indicate most. Several studies have attempted to apply visual elements and icons in computer-mediated communication (CMC) to provide better user experiences [38, 45, 50, 72]. Cho et al. [8] investigated valuable user-designed icons to support video-mediated communication better and categorized the icons into six functions (reaction, speaking order, request, status, excuse, and indicate). Our results revealed that videoconference users had a strong need for visual elements to excuse themselves in critical situations. When users needed to leave their workspace temporarily, they wanted to give quick and easy notice and specific reasons to excuse their leaving to other participants in the same meeting. We suggest that videoconferencing tool designers consider a function and design that allows users to communicate their away statuses and reasons to other participants quickly and easily. At this time, a design should be considered that allows the users to make respectful excuses to the other party by mixing text and icons (in a polite tone and manners) that give detailed explanations about their situations.

In addition, through our study, participants showed the need for videoconferencing tool users who wanted to solve problems without having to move locations during a meeting. As previously mentioned, an automatic reply message to an unexpected phone call is a relevant example of this. For another good example, when someone (e.g., a delivery driver) visits a house and rings the doorbell, Team 5 said an *"IoT solution that allows a user to check the intercom screen with a laptop and respond to visitors using TTS technology would be a good way"* to solve this problem. A previous study found that phone calls, emails, or personal requests prompt workers' task switches and that frequent task switching increases time spent on tasks and makes them inefficient [11]. In another work, they warned that switching attention among different activities during the work can deplete workers' cognitive resources [54]. Czerwinski et al. [11] mentioned, "Improved integration across applications (e.g., the phone, email, web services, instant messaging, etc.) could benefit users' multitasking and recovery." Our study found that requests

for additional non-work-related activities that interrupted users during videoconferences were made by a wider array of sources, such as washing machines, doorbells, and delivery drivers. This result indicates that a wider range of integration across applications and devices could enhance the videoconferencing experience. Additionally, there was a suggestion for a development allowing users to follow-up on missed meetings while they were away. Researchers and practitioners in video-mediated communication need to explore various design directions, such as IoT solutions, so that users can solve problems in this category without leaving their seats during videoconferencing. In addition, when users are forced to leave during a meeting, they should be able to communicate quickly and effectively with other participants at that moment, and design directions should be considered to follow the flow of missed meetings after they return.

4.1.3 Generation of background noises. People and pets live in the same physical environment as the user, and even if they do not invade the meeting space or ask for the user's attention, they create background noise that can annoy the user. Participants said that the background noise generated by these people and pets in their daily lives distracted them, and the noise was often transmitted to other participants engaged in the same meeting, thus interfering with work concentration. This category in the work-from-home context includes the sounds of people living in the home, such as talking to each other, talking on the phone, snoring, and shouting. In the office, the voices of other employees in the surrounding space distracted videoconference users.

> *"I had a video class right next to my bed, and I heard my husband snoring. I hit the bed with my feet."* (P16, university professor)

> *"When my younger sister comes home, she screams like 'Hey!' I think that sound can reach other team members, and it bothers me a lot."* (P7, human resource team intern)

> *"I was having a video conference in our company's meeting room, and another team was having a meeting in the next room. But that team's discussion was so loud and my microphone picked up that sound. So I was a bit flustered..."* (P14, UX designer)

In particular, pets' sounds cannot be adjusted or controlled through communication, creating a difficult situation. One participant (P11) complained that the effect of the noise-canceling function on barking dogs provided by the videoconferencing platform was lower than she expected. Sometimes, the communication of the user's uncontrollable background noise to other meeting participants also made the users feel guilty for not being successful in their work.

> *"I was leading the responsible researchers, and suddenly my dog barked. (...) I always ask the meeting participants to 'access in a quiet place for immersion' before meetings, and I'm embarrassed because I'm in that situation. I felt like I'm not professional. (...) I know that there is a special option for dog barking among the noise-control functions in Zoom, but I think it doesn't work."* (P11, leadership coach)

Through our participatory design workshop, we found that users expect that users most importantly expect noise transmission problems to be solved through technological development, such as technically delivering only their voices excluding ambient noise. Although there are various attempts to eliminate ambient noise in current videoconferencing platforms, we found that these do not properly solve the problems users face. For example, Zoom provides a "suppress background noise" function with four options: auto, low (e.g., faint background noises), medium (e.g., computer fan and pen taps), and high (e.g., typing and dog barks). However, this function was not a satisfactory solution for some users, such as P11, as the effect was not technical enough to cancel each type of noise sufficiently. On the other hand, advances in noise-canceling technology can certainly address these issues, but some participants noted technological and design improvements need to address some of the key situations that are very disconcerting to current users, even without technological advances. As a solution, the participants proposed the following idea of canceling loud and unusual sounds: *"recognizing the user's voice and automatically canceling other people's voices or sounds outside the user's normal range (e.g., screams)"* (Teams 2, 3, and 5).

4.2 Other people engaged in the same videoconferencing

The *other people engaged in the same videoconferencing category* refers to the distraction experiences created by other participants in the same videoconferencing through videoconferencing platforms. In our study, participants mentioned distracted experiences due to this factor 52 times. We classified four secondary categories in this category: *inexperienced use of videoconferencing tools, accidental mistakes, lack of prior preparation, and physiological phenomenon.*

4.2.1 Inexperienced use of videoconferencing tools. The users' lack of knowledge about how to use the videoconferencing tools' features hindered them and other participants from completing their work. This included a low understanding of how to join the meeting, how to set up the meeting, how to use host authority, how to resolve sound transmitting errors, and how much time was limited to the meeting according to the platform's plan.

> *"I was listening to the lecture and suddenly the meeting ended. But the professor was really working hard on it, but when it was over, all of our students were embarrassed and asked, 'Am I the only one who went out?' in the group chat room, but later we realized it turned off because there was an hour limit. The professor was playing an instrument alone, so after the meeting was over, he said he didn't know for 20 minutes."* (P10, university student)

Most of these experiences primarily occurred when users first started using videoconferencing platforms. The younger generation with a higher technology adoption rate did not face this problem often because they had a higher understanding of the tools as the platforms they used increased. However, older people more frequently have a lower understanding of videoconferencing tools and they are not actively using these tools. Other conference participants' low levels of videoconference knowledge frustrated and

embarrassed users. In this case, because the communication method was a videoconferencing platform, it was even more difficult for the participants to inform the less-knowledgeable party of the solution and deal with it.

> *"(...) Because the elderly are not used to that system yet."* (P13, assistant manager of public institutions)

> *"Many of our customers are not familiar with video conferencing. There are many times when they don't hear me when I talk, or I don't hear them when they talk. Then, I usually say in the chat, 'I think you can hear me if you try this way,' or 'Do it like this,' but sometimes they can't even find the chat window. (...) So nowadays, if they seem to be wandering, I just call them right away to guide them. Sometimes, we muted Zoom and communicated on the phone."* (P12, salesperson)

Users wanted to direct or resolve the problem when the other party could not use the platform's features to avoid delays in meetings as much as possible. Team 4 expressed the desire to control the other party's tool screen for efficient communication. We also found that the unfamiliarity experienced by using a new videoconferencing platform is a distraction that causes users to recall and compare familiar tools. P18, who mainly uses Google Meet, reported the inconvenience of using unfamiliar videoconferencing platforms, such as Zoom and Airmeet.

> *"Not only Zoom, I used Airmeet for some kind of session before. But it was the first time I used that platform. At that time, I was not familiar with the tool, so there were a lot of problems. I was confused about the function to give host permission, so I thought I should switch to Google Meet."* (P18, start-up operator)

Participants needed services that provided information so that users unfamiliar with a specific tool could easily use various functions. For example, participants suggested that *"video lectures on problem situations frequently encountered by users be provided"* (Teams 1 and 3) and that *"companies or organizations provide training on videoconferencing"* (Team 1) as a solution to this problem. Providing accessible guides or services to prevent users' confusion due to unfamiliarity with videoconferencing tools is important for enhancing early users' experiences. Users required additional support during a videoconference for all other distracting factors covered in this work, but this category specifically requires support during meeting preparation before the meeting begins. Currently, various videoconferencing platforms provide usage guides through various channels such as their homepages, but it is important to consider which method is more accessible to users. Furthermore, companies that allow remote work can train their teleworkers to learn how to use videoconferencing tools. This could include hiring dedicated staff, distributing guideline documents, or holding training seminars.

4.2.2 Accidental mistakes. During a videoconference, unintentional mistakes users made, such as starting a presentation without screen sharing, sharing personal messages, or exposing personal documents or confidential information, divert users' attention. People made various mistakes as new problems, which would not have

arisen during face-to-face meetings, occurred during videoconferencing. This secondary category has the largest number of investigated examples in our study and closely relates to privacy issues. First, users often mistakenly share information not related to the meeting during screen sharing. In particular, when information related to personal privacy was shared, participants noted they were embarrassed (P1, 12, 14, 17) and ashamed (P1, 3). Disclosing confidential work-related company information to others could cause critical problems.

> *"At that time, my colleague had to show us various files together, so he was sharing his entire screen, not just a specific window. Our team members were chatting through messenger, such as 'I don't know what that means. This interpreter is really bad,' and it popped up on the screen. I'm sure the interpreter saw that, right? After that, the interpreter got really depressed and we were really sorry."* (P17, project manager)

> *"The notification kept popping up on the business messenger (Slack), but there were confidential issues that the customer should not know, so I kept pressing X and apologizing."* (P12, salesperson)

We also found various mistakes related to sound. This included speaking while muted or sharing noise. P3 said it was cumbersome to repeat what had already been explained while muted. In addition, two participants (P5, P14) said that it was difficult to check whether the other party was speaking when unintentionally muted. In particular, it caused misunderstandings when the speaker's mouth was not visible.

> *"There are many cases where I have to talk again because it (Zoom) is muted. (...) In that case, I feel very embarrassed. It doesn't matter if it's for a minute or two. If I talk for about 5 minutes and I have to do it again, I talk about the key point and end it in 30 seconds."* (P3, assistant manager)

> *"He wasn't aware he was muted and kept talking, but we couldn't see his mouth because the mask covered his mouth, so we didn't know he was answering."* (P14, UX designer)

Conversely, there were also problems caused by forgetting to mute. First, when the same meeting participants were in the same workspace, they often forgot to mute when the other person was talking and suffered noise from audio feedback. Seven participants (P1, 2, 5, 6, 7, 14, 17) expressed their displeasure while sharing their experiences of audio feedback and said the repeated mute on/off function was cumbersome.

> *"I heard the audio feedback continuously. My ears hurt a lot, so I felt bad."* (P14, UX designer)

In addition to noise due to audio feedback, participants shared various mistakes when noises for which they were unaware were transmitted. For example, the user's accessory knocked on the microphone and made a noise (P17), the messenger notification continued to be shared during screen sharing (P5, 14), and sounds not related to the meeting were sent (P1, 4, 5, 6, 7, 10, 14, 16). In particular, the case of unintentionally transmitting noise to a meeting without recognizing that the mute was released was frequently

mentioned in our study, and we understood that users made this mistake repeatedly. These users' noise transmission-related mistakes disturbed the meeting progress (P1, 2, 5, 16), diverted other participants' concentration (P1, 5, 6, 7), embarrassed users when they realized their mistakes (P4, 14), and made them feel remorseful (P4, 6, 10).

> *"During the lesson, I sometimes forget to mute my microphone when I have to. I gave the student time to practice personally, and I was resting for a while, but I wasn't aware of my un-muted condition and talked to my family. (...) I was so sorry about that. That student had to focus on practice, but I interfered with that..."* (P10, wind instrument instructor)

> *"I didn't realize that my microphone was on, and the sound of conversation with roommates, KakaoTalk (a messenger application) notification, and phone ringtone was shared by all participants. I was embarrassed and worried that the flow of classes would be broken. I thought I wanted to turn off the cam at that time, and after that, I felt that the professor didn't like me."* (P4, university student)

We found that users wanted to prevent their frequent mistakes in advance and checked whether they were making mistakes. First, the participants needed the additional function of a videoconferencing tool to warn them to prevent their own mistakes. Team 1 said they wanted *"videoconferencing tools to use artificial intelligence to learn their mistakes and warn them about their frequent mistakes."* They also proposed the idea of *"allowing users to preselect situations in which they want to be alerted"* (Team 1). In addition, *"a function to show a preview window before screen sharing"* (Team 1), *"to warn about privacy concerns before screen sharing"* (Team 2), and *"to preselect a specific program so that screen sharing is not possible"* (Teams 4 and 5) were proposed through the participatory design workshop. These ideas mean that users already know that they often make mistakes during videoconferencing and want to prevent them. Additionally, they want to get help from videoconferencing tools in areas where they have no control. Moreover, participants wanted to know whether they were inadvertently disturbing others (especially in terms of noise generation). They wanted the videoconferencing tool's interface to be clearer about their mute status. Team 2 came up with the idea of a *"larger, brighter, blinking mute icon"* to keep users aware of whether a sound was inputted from the users and shared in the meeting. To support the work experience of videoconferencing users further, videoconferencing platforms can make design improvements to avoid these problems by examining common mistakes users make. As important examples, we suggest adding a pre-step to simulate which screen is shared in advance when sharing a screen, and designing a mute icon used for voice sharing that more visually attracts the user's attention and expresses a high level of awareness.

We also found that videoconference users needed to inform other participants who are engaged in the same meeting of their mistakes. Participants suggested the following solution as a way to inform the other party of their mistakes: *"sending an alert message that the presentation material was not shared"* (Team 2), *"an icon that indicates that it was not heard well"* (Team 4), and *"a function*

to request mute release" (Team 4). Most participants commented that they could not mention all the other party's mistakes because they did not want to interrupt the meeting's flow. This means that videoconferencing is highly dependent on sound in video-mediated communication and that it prevents users from giving various vocal feedback. Participants (Team 2) conveyed it would be burdensome to handle all trivial requests verbally. These findings imply that another way is needed for users to communicate with each other on behalf of voices in various situations. Similar to our participants' ideas, many videoconferencing tools, including Zoom, Teams, Google Meet, and WebEx, now offer the ability to express gestures and reactions with icons. However, these platforms do not include icons that can help participants communicate with each other in problematic situations that users often encounter, such as requesting to mute or unmute. Therefore, users frequently have conversations to confirm whether the presentation material is being shared or whether the voice is being delivered to the other party during the remote meeting. The above ideas can be effective not only to notify the other party when they make a mistake but also to increase the meeting's efficiency by reducing unnecessary conversations. Inspired by the participants' ideas, we propose that videoconferencing tools be designed so that meeting participants can communicate via non-voice means, such as text messages or graphic elements.

4.2.3 Lack of prior preparation. Participants tended to be less prepared when attending videoconferences in their living spaces than face-to-face meetings in their original working spaces. As videoconferencing does not have physical space restrictions, conferences can be started anywhere by using equipment that allows users to participate. Participants expressed their opinions that when they were suddenly given a meeting schedule, they were embarrassed because they did not have enough time to prepare themselves or their attire for the meeting. P4 and P18 had experiences connecting to the meeting as soon as they woke up, and P2 had the experience of rushing to get dressed.

> *"If I don't have a fixed schedule, I am with bedhead and zero makeup, but I had to prepare urgently due to a sudden meeting schedule."* (P2, book editor)

For such a situation, the participants wanted the videoconferencing tool to support their poor preparation and suggested *"a sticker function for hair or makeup with augmented reality (AR)"* (Team 2). Snap Camera [26] provides the AR lens function for augmenting video with the user's gesture, which is a suitable feature for small talk or chats with friends. Zoom released the "studio effect" function in September 2020, which allows users to apply eyebrows, mustache, beard, and lip color filters as part of their video appearances [40]. This virtual makeup function could decorate a user's appearance, but users did not use the function to disguise their ungroomed appearances. For example, when P17 tried several filters to experience Zoom's studio effect while wearing a mask, the lip shape was overlaid on the mask.

> *"There is a new makeup function in Zoom, and I set up something like lip color. But at that time I wore a mask, and the lip shape was colored over this mask. I was embarrassed at the time, but anyway, it was like fun*

and we moved on. But I don't really use this function these days." (P17, project manager)

As such, the accidental result of not considering the user's various contexts prevented the user from continuing to use this function. The current videoconferencing tool's AR filter needs to be developed in consideration of the user's various usage contexts. Furthermore, participants expected the function of videoconferencing tools to help them in formal meetings where showing their ungroomed appearance could be a problem. We suggest an interesting approach to design a detailed and natural AR filter function so that videoconferencing tools can be used to assist users in such inconvenient situations. Designing and developing features that make it appropriate for users to cover their appearances in various situations, including casual online meetings and formal meetings, can be an interesting approach to enhance their experiences.

4.2.4 Physiological phenomenon. Participants became thirsty (P3, 13), wanted to go to the bathroom (P4, 6), had cramps in their feet (P9), were hungry (P16), and were groggy (P16) after long videoconferences. These physiological phenomena distracted users and the other participants from the meeting. We derived user needs and design directions for users regarding disturbances due to physiological phenomena. First, we need the means to prevent meetings from lasting too long. This also occurs in offline meetings, but the participants said that remote work is more difficult to distribute systematically than office work is. As a result, the cycle of work and rest is longer (P2, 3). This is similar to Derks et al. [13], who argued that the blurred boundary between home and work makes it difficult for knowledge workers to disengage, which results in work intensification.

> *"At work, when I want to rest a little, I go out for a walk or do something else. But when I work from home, I sometimes work from morning to evening, looking at the laptop like a robot. (...) Sometimes I feel like I'm really a slave to the company."* (P3, assistant manager)

Inappropriate routines due to remote work created a situation in which users did not have adequate rest time and dealt with physiological phenomena during meetings. Participants who experienced disturbances due to physiological phenomena wanted a tool to assist them in forming a healthy work routine. For example, *"lunchtime notification message with AI-assisted care (e.g., Lunchtime: Please wrap up the meeting for the meal)"* (Team 1) and *"notifying the host of the appropriate meeting time through collecting working patterns of meeting participants"* (Team 5) were proposed. Inspired by this idea, videoconferencing tools can help improve the quality of remote work by designing features that help users shape more appropriate work routines. Mark et al. [46] mentioned, "Working long stretches is physically and mentally tiring." In addition, Skatova et al. [61] suggested the development of software to enable small "nuggets" of breaks or microbreaks for workers. As such, HCI researchers and developers can develop additional tools for videoconferencing. Yankelovich et al. [70] argued that not having the meeting facilitator check participants' understanding of the meeting reduced meeting efficiency. On the other hand, frequent checking is awkward and takes time. For this reason, one of their project goal was to help facilitators do their jobs more effectively

through visual cues. We propose that meeting facilitators check the conditions to comprehend not only the participants' understanding of the meeting but also the participants' levels of focus. In addition, videoconferencing tools can help the facilitators understand the participants' conditions through visual cues without compromising work efficiency. Second, users should be able to inform other participants of their statuses easily and kindly and make excuses when they are away. Thus, users can communicate their situations more easily than they can through actions that directly interfere with the meeting's flow, such as speaking during a meeting. A design with appropriate tone and manners should be considered as an excuse in formal meetings. Participants' workshop ideas included *"One-click direct message/emoji transmission to host"* (Team 2) and *"an indication of absence status with an estimated duration on their video screen"* (Teams 2 and 3).

4.3 Environment around the user while videoconferencing

The *environment around the user while videoconferencing* category refers to the distraction experiences due to the environmental characteristics of various physical spaces in which users have remote meetings. In our study, participants mentioned distracted experiences due to this factor 31 times. We classified two secondary categories in this category: *living environment unfit as a workspace for remote working, and noise in one's own workspace.*

4.3.1 Living environment unfit as a workspace for remote working. As videoconferencing became popular, users began to work remotely in various spaces. In particular, an environment that was not designed for work purposes in a living space, a typical workspace for remote work, often made users uncomfortable. First, seven participants (P1, 3, 6, 10, 11, 16, 17) had negative experiences with their backgrounds being shown to other participants through video. This made users feel embarrassed (P1, 17), ashamed (P3, 6, 10, 16), and sorry for the other party (P11) because their private space or objects unrelated to the meeting context were exposed.

> *"When I was not using a virtual background, my underwear laundry was being shown behind me. I didn't know, but I found out later. I was very confused then."* (P1, UX design team intern)

> *"It was a meeting without a virtual background. I had a personal coaching person, and I came into my daughter's quiet room at night and closed the door, but her room was full of toys. At that time, that person kept talking about serious things. So I was so sorry that I felt like I was creating a gap in emotions."* (P11, leadership coach)

Most of the participants used the platform's virtual background function to solve the problem. However, one participant (P17) argued that the previously set virtual background was sometimes removed (e.g., when logging in to the platform again), which was embarrassing. The unintentional exposure of users' surroundings due to unexpected circumstances (e.g., automatic logout and relogin) makes videoconferencing difficult for users. Functions intended to protect users' privacy, such as virtual backgrounds, should be designed to be more visible and noticeable than they are now

so users can apply them more independently. On the other hand, since the living space was not a place with the main purpose being work, the fact that the atmosphere of the on-site meeting was not felt during the videoconference also caused disturbances. Three participants (P1, 2, 4) noted that this reduced their concentration.

> *"My house had a bed, kitchen, and dining area in one small space, so it was difficult to separate work from life. So sometimes I couldn't concentrate on my work or participate in meetings properly."* (P2, book editor)

Similarly, we found users periodically switching videoconferencing venues due to a lack of presence and poorly set up workspaces. This requires further effort to make the place that users move to an environment suitable for work. For example, one participant (P3) who worked from home changed the workspace according to the season due to the different temperatures.

> *"I work at home. In my house, not all rooms have an air conditioner. So in the summer, my children's rooms are the coolest, so I work in their rooms, and in the winter, the powder room is the warmest, so I work there. There are some inconveniences when I move places like this sometimes. At that time, I usually think I want to go to the company."* (P3, assistant manager)

This lack of presence, which has also been discussed in previous studies [9], degrades the user experience in many ways, and our participants suggested various ideas for this. Team 1 said that facilities for people who work from home, such as *"coworking spaces,"* are useful and they need more space for remote work in the future. Team 5 said it would be useful to have a *"partition"* to secure their work areas within specific spaces. As such, our participants needed independent workspaces, but problems arise when they do not have such spaces. Therefore, when space separation is not possible, the videoconferencing tool should provide a feature that offers the active feeling of a meeting in the field.

Our participants suggested employing a *"metaverse environment"* (Team 5) and *"show[ing] people's reactions and actions more interactively in videoconferencing tools"* (Team 1). Similarly, in August 2020, Teams released a function for setting up a screen as an auditorium-like setting, making it appear that meeting attendees were seated in a virtual auditorium's seats. This function, called "together mode," brings all team members into the same shared virtual space, rather than putting them in different spaces with individual backgrounds. Gather [18] is a web-based platform that provides a 2D world in which videoconferencing is spatialized [43]. These examples illustrate efforts to humanize virtual interactions more to overcome the monotony of remote meetings. As such, future videoconferencing tools should provide a sense of presence similar to reality through elements that online tools, such as a system's UI and sound, can utilize. In addition, we expect videoconferencing tools to provide positive experiences different from face-to-face meetings by actively utilizing online digital interaction methods that are impossible in reality, such as graphic special effects and virtual avatars.

4.3.2 Noise in one's own workspace. During videoconferencing in various places, many of our participants had encountered diverse noises from their surrounding spaces and environments. In particular, living space noise was investigated the most, including sounds

from interior construction, washing machines, vacuum cleaners, dishwashing, showers, TVs, fans, and doorbells. Most of these did not cause any major problems, but occasionally, the constant noise interrupted meetings. Yankelovich et al. [70] argued that audio problems had the greatest negative effect on online meeting effectiveness, and extraneous noise was one of the major factors creating hearing issues.

> *"The fan was making a lot of noise, and in the end, the CEO even talked about stopping the meeting."* (P3, assistant manager)

In addition, various noises from other indoor and outdoor spaces occurred. These included outdoor construction sounds, café background music, subway announcements, and car and airplane sounds. These noise problems from surrounding spaces distracted the participants during videoconferences.

> *"I don't have an air conditioner in my room. It was so hot that I had no choice but to open the window and the other person said, 'What? I can't hear you well.' He said it with a bit of annoyance. (...) So I closed the window and studied, but I was sweating so much that I couldn't concentrate on the meeting."* (P7, human resource team intern)

Similar to our previous results (1.3, 2.2) regarding noise issues, we found in this category that videoconference users also wanted to have perfect noise-canceling functions, to be aware of the noise levels of their spaces, and to notice their situations easily and be excused by other participants in the same meetings without interrupting those meetings. It would be ideal for the noise canceling function to be implemented perfectly with the advancement of technology, but designers should seek a solution to this problem even with current technology. To solve this problem without relying on technological advances, users should be aware of the level and type of noise entering their microphones so that they can block the noise. In particular, when a sound is not annoying when heard in the real world, it is more difficult for users to notice, but it is a problem due to the amplification of sound transmitted through a videoconferencing tool. During videoconferencing, it is not easy for users to identify a noise's cause. Therefore, videoconferencing tools should be developed to provide systemic feedback to users who generate noise.

4.4 Usability of the videoconferencing platform

The *usability of the videoconferencing platform* category refers to the distraction experiences the videoconferencing tools' features create such as its technology, function, system, and design. Distracted experiences due to this factor were mentioned 11 times in our study. We classified two secondary categories in this category: *low quality in audio output, and restrictions on screen control.*

4.4.1 Low quality in audio output. We found that the quality of the voice output in current videoconferencing platforms was low; thus, it was difficult to understand another party's voice, or the sounds of instruments or music were not transmitted properly. Three participants (P1, 7, 15) said they felt frustrated because the cause and solution were unknown. In addition, one participant (P17)

argued that the platform's sound-related features further lowered the quality of the audio output.

> *"When the sound quality is not good, sometimes it's different from what I pronounced and what the other person heard. For example, I said 'tea,' but that person heard it as 'sea.'"* (P7, human resource team intern)

> *"If you talk without earphones, the beginning and end of the words are cut off in Zoom, so I can't understand what you're saying properly. So when I have meetings, I always wear earphones and recommend them to other people as well."* (P17, project manager)

The suppressed audio feature of some videoconferencing tools, such as Zoom, creates a delay in back and forth talk (the effect P17 mentioned above), making it difficult for users to understand the meaning of the other person's speech. In particular, for types of conversations such as ideation, brainstorming, and debating, where it is important to exchange ideas quickly, free-flowing discussions in real-time are important, making the frequent back-and-forth delay phenomenon more critical for users. Team 2 and 4 mentioned *"live captions at MS Teams"* and *"YouTube automatic subtitles"* as examples and said that *"high-quality real-time subtitles"* were needed to solve the inconvenience caused by low voice quality. As with the subtitle function, users needed additional means in the form of supportive functions to resolve misunderstandings caused by low-quality sound in videoconferencing platforms. In addition to the technical improvement of audio performance, we propose that supplemental functions be designed and applied to videoconferencing tools to assist users in understanding overlapping or poorly delivered speech.

Low-quality audio output created a more critical problem when delivering music, where the sound's connection and flow are important using a videoconferencing tool. We found that the current videoconferencing platforms' inability to properly cover the high range of the instrument when outputting voice by default created user inconvenience. One participant (P10), along with her remote wind instrument lessons experience, pointed out the limitations of high-pitched transmission.

> *"In the case of high notes of musical instruments, the video conferencing tool outputs the sound quietly. So when a student plays a part with a lot of high notes, I sometimes turn up the volume, and at that time, if the low notes suddenly come out loud, I get surprised..."* (P10, wind instrument instructor)

As in previous studies emphasizing the importance of high-quality audio [70], our participants also experienced low-quality sound in various situations and needed improved audio output quality. Team 3 suggested that commercial videoconferencing tools should *"collaborate with other high-quality audio services."* For users in the field of music, such as P10, in September 2020, Zoom released a high fidelity audio mode, allowing users to disable echo cancellation and post-processing and raise the audio codec quality for professional audio transmissions in music education and performance applications [73]. However, all participants in our study were unaware of this function, and P10 cited this as the biggest problem in her poor experience and negative perception of videoconferencing. It is important to effectively inform people of and encourage the active use of new features in videoconferencing tools, which are continuously developed for the users.

Our participants also discussed how it was not easy to distinguish and understand what people in meetings were saying when they spoke simultaneously. When meeting in person and talking in the same space, people can catch and understand only what they want to hear, even if they hear multiple overlapping sounds. This is because of the cocktail party effect, which is the ability to focus one's listening attention on a single speaker among a cacophony of conversations and background noise [3]. However, various sounds are mixed and outputted from one channel during videoconferencing, making it difficult to distinguish between sounds. As a result, users were forced to take turns talking one at a time. Further, three participants (P3, 7, 10) thought that videoconferencing tools output only one voice at a time. This resulted in slow communication and delayed meetings. Participants said this made meetings inefficient (P3, 10) and prevented smooth communication (P3).

> *"For a good lesson, it's better to give feedback from time to time, but if we do that, the sound of the instrument overlaps with my voice, so you can't hear both sounds at all. So now I write down the feedback separately and let the students know at once. This is a very bad way for both students and me. (...) It usually takes one hour, but these days it takes an hour and a half."* (P10, wind instrument instructor)

> *"... I've become a little more cautious about starting to talk. After that, I waited about five seconds after other people finished talking, and then I thought, 'Now I can start to speak.'"* (P7, human resource team intern)

Our results indicate that the characteristics of videoconferencing, where simultaneous speech is not smooth, made it more difficult for users to judge the timing of speech than face-to-face meetings. Participants expected that their videoconferencing tools would provide the ability to determine the turn of the conversation effectively, and Team 2 proposed *"the function to mark the person to talk to on the next turn on the main screen of videoconferencing tools."* To increase work efficiency in videoconferencing, we suggest that platform designers and HCI researchers explore a solution that helps users more easily recognize the appropriate time to speak during a conversation and that can distinguish meeting participants from each other even if they are speaking simultaneously.

4.4.2 Restrictions on screen control. Although not as much as a sound issue, inconveniences related to the video conferencing tool's screen also distracted users. In terms of using Zoom's remote control feature, a function that allows a user to take control of another participant's screen in a meeting, P15 was unable to take notes while others controlled the screen. In this regard, Team 4 argued that *"even if the other party had some control of the screen, they should be able to control their own screen."* It will be important for videoconferencing researchers to understand deeply the user's control initiative and the appropriate degree of control over another party's screen when the remote control is being used.

In addition, one participant (P17) pointed out her current videoconferencing platform's inconvenient interface, saying the platform's chat notification was not noticeable during screen sharing

and thus was difficult to check in real-time. Team 5 requested *"the development of a videoconferencing tool UI so that users could easily check chat notifications at all times when participating in a videoconference."* As such, the user experience in relation to what needs to be considered from the presenter's point of view when communicating with other participants during screen sharing (such as mentioned by P17, exploring the interface's screen layout for a better chat experience) also would be an interesting topic for further research.

> *"When I'm sharing the screen (using Zoom), it's hard to read the chat together. I think it'll be really easy to recognize if the UI changes a little. It's hidden right now. I hope there are some notification messages somewhere."* (P17, project manager)

4.5 Performance of the device executing the videoconference

The *performance of the device executing the videoconference* category refers to the distraction experiences created by the devices used for online remote meetings, such as laptops and earphones. Distracted experiences due to this factor were mentioned 25 times in our study. We classified two secondary categories in this category: *low technical performance and unstable network.*

4.5.1 Low technical performance. To conduct a smooth video conference, users connect and use several devices together. However, sometimes the connection between these devices was not smooth, thus perplexing users (P14). Tan et al. [65] argued that inadequate software and hardware performance is one of the major causes of technological barriers in virtual collaboration. In this case, our participants could not proceed with the meeting and had to find other devices.

> *"I usually use my AirPods, but one day they didn't work properly, so my voice couldn't be delivered. I was very embarrassed because they suddenly didn't work, so I hurriedly moved to another place and had a meeting on a computer with a built-in speaker and microphone."* (P14, UX designer)

In particular, videoconference users should be immediately able to notice when their devices are not well connected and to fix any issues. Team 4 suggested the idea of a *"notification that the connection was not made when its device was not recognized."* Currently, videoconferencing tools such as Zoom and Teams provide users with notifications regarding problems such as network instability. However, to check the connection status between physical devices, the user must pay attention without the system's proactive assistance. Our results indicated that users need an immediate notification when the connection required for videoconferencing is unstable or disconnected. We believe that allowing videoconferencing tools to send proactive notifications informing users if they are currently properly equipped for a meeting would be effective in alerting participants to device connection issues preventing them from fully participating in meetings.

Additionally, the unexplained errors of users' laptops confused them. While P2 was remotely accessing another computer in the office and sharing work, an unknown error occurred on her computer. P2 was frustrated that she had no way to solve this problem independently and had to find someone else who could fix it.

> *"I'm sharing my work using remote control through Google Remote, but the connected company's computer is lagging so bad. I thought, excellent work from home would be difficult, because these problems are often. After that day, a computer management manager for telecommuters was hired at our company."* (P2, book editor)

Interestingly, none of the participants in our study suggested a suitable solution to this problem. This means that they had no knowledge of the causes of their laptops' unexplained errors or how to fix them. In other words, when a problem occurs, videoconference users cannot take appropriate action to solve it, resulting in frustration. Because this can significantly degrade the user experience, expert designers and developers should diagnose these problems in detail and provide explanations through appropriate means, such as a videoconferencing tool or laptop system, so that users can understand the problems they are facing. Furthermore, as an alternative to solving these problems, we propose providing a continuous experience by immediately connecting a user to another user's electronic device if there is a problem with the first user's equipment. We also recommend that companies that encourage remote work via videoconferencing consider providing supportive professional human resources or training their workers to utilize data on their company's laptops outside the company's physical location.

4.5.2 Unstable network. Other factors can affect network issues, but we classified problems caused by network instability as network connection problems related to users' equipment, such as routers. In this study, network issues were videoconference users' most frequently cited type of device-induced disturbances. This means that network problems frequently cause poor working experiences. These problems include forced exits; choppy and freezing audio, video screens, and shared screens; and shared screens being out of sync with the sound. In particular, because our participants did not anticipate or correct network problems in advance, they were often embarrassed (P5, 6, 7, 10, 15, 16) or frustrated (P4, 6, 10, 14, 15) and felt sorry for other participants (P2, 7, 9, 15, 16).

> *"It's often like that when the Wi-Fi connection is not good. I was embarrassed and sorry because it was a meeting with my boss. I prepared hard in advance, but I was frustrated that this kind of problem suddenly occurred."* (P15, intellectual property officer)

> *"Our team works in a shared office, so we can't control the Wi-Fi directly. I was really sorry to that interviewee that we caused this problem…"* (P7, human resource team intern)

Additionally, videoconference users who were suddenly forced out of their meetings by the network could not communicate their statuses, which left both those users and the other meeting participants floundering. Most of them were able to reconnect and have their meetings proceed. However, one participant said that if reconnection was not possible, they called and explained their

situation and proceeded with only part of the meeting (P6). P10 said that even after reconnection, her meeting was eventually rescheduled for another date due to low network quality. As such, network issues went beyond interfering with individual users and became troublesome throughout the conference. As in the problematic situations related to the low technical performance of the devices our participants used for videoconferencing, the participants were frustrated because they did not know what actions they could take to solve network issues.

> *"Once, the student's network was not good, so that student disappeared during the online lesson. But I didn't realize that and talked by myself..."* (P10, wind instrument instructor)

> *"At that time, I couldn't do anything, so I hit my laptop again and again."* (P2, book editor)

Our results showed that videoconference users wanted to see both their and other participants' network connections in real-time and understand the cause of critical situations, such as being forced to leave a meeting. As solutions, the ideas of a *"function to check their network status in detail"* (Team 2) and a *"function to check the network status of the meeting participants"* (Team 5) were proposed. Currently, various videoconferencing tools provide messages to users when unstable network conditions are detected. However, in addition to notifying the meeting facilitators to check their network statuses, it is important to check the network statuses of other people in the meeting or to notify clearly the remaining participants of the reason for any forced exit due to network problems. We recommend that videoconferencing tool developers improve the tools' interfaces so users can check the network status of other participants in real-time or notify remaining participants that their network instability is the reason for accidental situations such as forced exits. We anticipate that this will help users communicate by allowing them to understand the various issues other participants may be facing. Saatçi et al. [56] argued that technical state awareness should be improved to indicate change. For example, in WhatsApp, an instant messaging mobile application, both parties of a call receive an indication that one party's battery is low. This is a good example of how to warn telecommunication users their conversations may be ended accidentally or be interrupted. Additionally, videoconferencing tool developers need to consider designing ways not only to notify users when their networks are unstable but also to inform those users of various methods they can try to solve their problems. In addition, users want to obtain the content they missed in the flow of their meetings due to their network instability. Team 2 and Team 3 wanted a *"function to automatically inform the contents of the relevant part using the STT service"* and expressed their expectations for videoconferencing platforms to provide such additional features. The UX/UI designers of videoconferencing tools should consider devising a function that helps users who have been forced to leave a meeting due to network problems to follow-up on the missed content.

In a meeting for which changing the schedule was difficult, an unstable network that could not be resolved for the meeting to continue made the meeting inefficient overall. Participants had difficulty taking part in the meeting because they waited endlessly

for problems to be resolved, repeatedly asked questions they missed, or did not understand the flow of conversation well.

> *"During the meeting for transcription, the speaker's screen and voice slowed down as if they were in slow motion. It was going well, but suddenly, I was very flustered. I was so immersed in the situation that my behavior slowed down. I cheered with the hope that it would be restored soon."* (P7, human resource team intern)

> *"When I usually have video conferences with close people, I can ask them to send me the presentation materials separately or just explain it again. Not long ago, there was an international trial called 'Markman Hearing' against a foreign company, but I could't understand the content because the screen and the lawyer talking to me didn't sync. So the judge kept asking the lawyer several times…"* (P15, intellectual property officer)

Our participants expressed their desire to adjust the platform's performance selectively in the case of an unstable network to minimize the problems the network situation causes. Teams 2 and 4 wanted to adjust their sound and picture quality according to network conditions, offering the YouTube "resolution setting" as an example. We found that videoconference users needed the means to keep participating in their meetings in the event of unavoidable network problems. Even if the quality of a videoconference's elements, such as the screen or voice quality, are low, participating in the meeting can still enhance users' videoconferencing experiences. We propose enhancing users' experiences by allowing them to customize their videoconferencing tool's features and actively adjust its performance according to their network conditions.

5 SUMMARY OF KEY IMPLICATIONS

Through the study, we drew several design recommendations by understanding users' various distraction experiences and unmet needs of users engaging in video-mediated communication through videoconferencing tools. A key finding was that users considered mitigating the negative consequences of facing problematic situations as important as preventing distracting situations from occurring during videoconferencing. Users are aware that there are unavoidable obstacles such as responsibilities to family roles or unpredictable network instability, and they need ways to solve or alleviate problem situations in advance of their occurrence. Two approaches are particularly important to enhance the user's experience in the face of interruption: 1) support users in following up on content they missed due to distraction, 2) inform others of and make excuses for their status. First, in order to help users follow the flow of meetings that have been partially missed, auxiliary means such as subtitles are needed to compensate for the low quality problem. This is especially a good solution to improve the experience of simultaneous conversation in real-time, where experience in video conferencing tools is significantly low. Additionally, to help users explain their situations and ask for permission from other parties, videoconferencing tools should provide another way for users to communicate when their situations prevent the use of their voices. Users should be able to provide information on their situations in

way other than speaking, which can directly interfere with a meeting's flow. It would be helpful to develop a way to inform meeting attendees intuitively about one's status in videoconferencing tools using icons as indicators. Users want to be easy and considerate ways to inform others of their statuses and make excuses. As one solution, we propose that icons and texts with a polite tone and manner could be used appropriately in formal contexts.

As can be seen from our results, various interference factors distracted users during videoconferencing, but among them, the interference of sounds was the most critical problem for users. This is because videoconferencing is highly dependent on sound. As the work environment harmonizes with daily life, more diverse noise sources than ever before are affecting videoconferencing users. Even non-annoying sounds heard in real environments can become noises in video conferencing tools. Furthermore, our participants experienced various noise disturbances related to the technology they depend on to communicate, such as audio output quality of their videoconferencing tools and their network conditions. In addition to the noise, users' difficulty in timing their speech and their incomprehension of simultaneous speech were also critical problems. To help judge speech timing, users need support from their videoconferencing tools via features that can point out the person who should be next to talk.

Moreover, for a better video conferencing experience, these systems should provide immediate notifications to help improve the users' experiences, rather than requiring the user's attention without prior support. In addition, it is necessary to recommend that users employ updated functions through continuous guidance so they can fully enjoy the advantages of the active video conferencing market. Most of the solution ideas proposed in the participatory design workshop would be new or advanced features for video conferencing tools. This means that users have high expectations and demands for technologies and designs that current video conferencing tools do not support. Although there is a need to improve the video conferencing experience in various aspects such as IoT products and technologies, it is expected that the design approach for improving the poor user experience will focus on video conferencing tools.

6 FURTHER DISCUSSIONS ON THE DIRECTION OF FUTURE VIDEO MEETING

Through this study, we developed an understanding of participants' perceptions of future remote work and video conferencing. Based on this understanding, we will briefly discuss the future direction of video meetings.

In the study's final session, we asked all participants two questions about their opinions on video conferencing in the post-pandemic era: 1) "Do you think your industry will continue to use video conferencing after the pandemic?" and 2) "Do you want to continue to use video conferencing after the pandemic?" All participants answered the first question, "Yes, I think so." This indicates that the various problem situations found in our study are not limited to the current pandemic situation, but may become important issues in the future.

In response to the second question, 13 out of 18 participants answered positively that they would like the video conference to continue in the post-pandemic era, while four participants answered negatively and one participant answered neutrally. We envision the active use of video conferencing in the post-pandemic era, with about 72% of participants giving positive answers. Sytch et al. [64] even argued that the COVID-19 pandemic will make some jobs permanently remote. P18, the most favorable participant in video conferencing, asserted that it was a natural phenomenon for video conferencing to become popular and that the pandemic only accelerated it. Thus, it is practically important and necessary to explore the causes of poor videoconferencing experiences and the ways to prevent or eliminate them.

> "It wasn't started because of the coronavirus. It was originally heading in that direction, but I think the speed only accelerated. I don't think the way of working will change just because the pandemic is over, and there are many people around me who say they can't work for companies that don't allow remote work anymore. I like remote work, so I'm glad I was born to live in this era." (P18, start-up operator)

On the other hand, the four participants who expressed their unwillingness to continue videoconferencing, cited the following reasons for their negative opinions: 1) facing obstacles that they did not need to experience in face-to-face meetings (what we discussed in our study) and 2) the limitations of verbal communication through videoconferencing tools based on their job characteristics. Two participants (P2, 4) stated that several unexpected moments negatively created the perception of video conferencing.

> "Personally, I don't like videoconferencing because of a number of problems, such as delays or poor communication caused by communication and server problems. But I feel like I'm doing it because I have to do remote work at home according to the company's instructions." (P2, book editor)

P16 (a university professor), who teaches about the environment and forest, and P10 (a wind instrument instructor), who plays musical instruments, were the participants who conveyed the most negative opinions about video conferencing. They expected to continue to use video conferencing in their industry due to the advantages of saving money and time. However, the nature of their jobs, where non-verbal factors are important, affected their perception of video conferencing. They expressed regret that the lack of education on areas that are difficult to communicate and teach through videoconferencing tools, such as atmosphere (P16, P10), smell (P16), touch (P16), and nonverbal expression (P10), would be a problem. They were afraid that remote work would replace all work processes. Previous studies have emphasized the benefits of working from home and identified that remote online working frees knowledge workers from office distractions and commuting, and helps concentration on individual tasks [33, 47]. Fonner et al. [17] revealed this leads to increased job satisfaction. Our results have different implications from the studies conducted before the pandemic, where remote work was not popular in various situations. We revealed that the perceptions of remote work and video conferencing vary depending on the workers' career fields (involving knowledge workers), and that the lack of work efficiency as much as face-to-face meetings due to various distracting factors greatly reduces users' satisfaction.

> *"I'm afraid people will get too used to it. In fact, students don't like going back to face-to-face classes because they continued to take classes remotely last year. In the case of forest experience, they should go and see it and feel it. From an educational point of view, I have lots of concerns."* (P16, university professor)

Interestingly, the four participants (P13, 15, 16, 17) commented the same opinion that they would choose between teleconference and face-to-face conference based on the context of their work after the pandemic ended. They said video conferencing was more efficient than face-to-face meetings in some types of work, but not for other types. Some participants also noted that video conferencing was inefficient for meetings requiring fast communication.

> *"It feels like not two-way communication, but one-way communication. We can't have a heated discussion. It's really difficult to proceed with an ideation meeting."* (P17, project manager)

This indicates there are areas where remote meetings cannot fundamentally replace face-to-face meetings. If video conferencing is not enforced, using video-mediated communication will be predominant in the context of meetings that are more effective than face-to-face meetings. We suggest that future video meetings are not developed to replace face-to-face meetings completely but rather to maximize benefits. For video conferencing in the future, it is important to maximize the experience of video conferencing that cannot be implemented offline by utilizing the online environment's characteristics rather than implementing the experience of face-to-face meetings online. In particular, we propose approaches to improving the experience for meetings where verbal communication is important rather than nonverbal communication and meetings by a few representative speakers rather than a meeting where there is simultaneous communication with many participants.

7 LIMITATION AND FUTURE WORK

In our user study, participants shared various distracting situations during video conferences and the feelings they felt at the time based on their experiences. Despite using various strategies to elicit as much of their past experience as possible, there may be other factors and situations that we have not discovered in this study, as our method was not based on observation or logging, but on recall. However, based on our extensive investigation, valuable studies could begin to understand more detailed and deeper pain points and user needs, focusing on one of the interesting implications or types of distracting experiences of videoconferencing.

The participants in our study were all from South Korea, which means that culture might have influenced our results. For example, our study found the user's need to convey a nice and polite attitude to the other person when excusing themselves to the other party. Video conferencing is now becoming a popular paradigm of work around the world, and it is therefore important to consider various cultures' characteristics. It would be a good research opportunity to identify the problem situations and user needs arising from other cultures.

Another limitation is that none of the participants in our study primarily works with physical objects, such as in a factory. Although we tried to recruit participants from as many different occupational groups as possible, most of the participants in our study are included as information workers. This is because, when communication through visual data or voice is the main task, it is easy and appropriate to replace existing tasks remotely using current videoconferencing tools. However, with the development of videoconferencing-related technology and the expansion of the contexts for its use, identifying the distractions of videoconferencing for more diverse types of occupations than information workers is another important topic for future research to enhance the videoconferencing experience.

Additionally, the participants in our study shared their experiences of remote work in various spaces, but most of them were about working from home. This indicates that many remote workers use their living spaces for work, but a deeper understanding of the characteristics of various environments, such as co-working spaces and outdoor spaces, will be an important research topic for improving the videoconferencing experience in the future.

8 CONCLUSION

In this paper, through focus group interviews and participatory design workshops, we discovered troubled remote work experiences with videoconferencing tools that cause users to be distracted through disturbing, interrupting, and restricting videoconferencing interactions that distract users. Conducting this study at a time when many users are more actively engaged in videoconferencing imposed by the COVID-19 pandemic has allowed us to explore the distracted experience of videoconferencing extensively. This allowed us to consider a wider range of possible distractions users would face in the post-pandemic period, from common to specific situations, such as when there is no place for effective remote work. This study developed a structured framework of distracting factors that could provide a valuable guidance for designing advanced future videoconferencing systems. Furthermore, our study is significant in suggesting design implications and directions based on users' implicit needs ascertained through discussions on solutions with participants who have already experienced distracting moments over the past two years. We hope that several ideas from our participants through the participatory design workshop will be great sources of inspiration for both HCI researchers and designers. Through our study, we learned of various important issues on designing better remote meeting experiences that had not been structured and discussed sufficiently in the context of the popularization of such meetings, including the lack of means to inform others of one's status in accidental situations without interrupting the meeting and the lack of presence while videoconferencing. Based on our results, we propose important design implications and insights to support current remote meeting experiences better, and we discuss users' expectations and the direction of future remote meeting experiences in the post-pandemic era.

REFERENCES

[1] Ivana Acocella. 2012. The focus groups in social research: advantages and disadvantages. *Quality & Quantity* 46, 4 (2012), 1125–1136.

[2] Tammy D Allen, Timothy D Golden, and Kristen M Shockley. 2015. How effective is telecommuting? Assessing the status of our scientific findings. *Psychological science in the public interest* 16, 2 (2015), 40–68.

[3] Barry Arons. 1992. A review of the cocktail party effect. *Journal of the American Voice I/O Society* 12, 7 (1992), 35–50.

[4] Stephen R Barley and Gideon Kunda. 2011. *Gurus, hired guns, and warm bodies.* Princeton University Press.

[5] James Calderhead. 1981. Stimulated recall: A method for research on teaching. *British journal of educational psychology* 51, 2 (1981), 211–217.

[6] Zhilong Chen, Hancheng Cao, Yuting Deng, Xuan Gao, Jinghua Piao, Fengli Xu, Yu Zhang, and Yong Li. 2021. Learning from Home: A Mixed-Methods Analysis of Live Streaming Based Remote Education Experience in Chinese Colleges during the COVID-19 Pandemic. In *Proceedings of the 2021 CHI Conference on Human Factors in Computing Systems.* 1–16.

[7] Nik Ed Chmiel. 2008. *An introduction to work and organizational psychology: a European perspective.* Blackwell Publishing.

[8] Haena Cho, Hyeonjeong Im, Sunok Lee, and Sangsu Lee. 2021. "I want more than" User-generated Icons for Better Video-mediated Communications on the Collaborative Design Process. In *Extended Abstracts of the 2021 CHI Conference on Human Factors in Computing Systems.* 1–6.

[9] Jeremy R Cooperstock, Koichiro Tanikoshi, and William Buxton. 1995. Turning Your Video Monitor into a Virtual Window. In *IEEE Pacific Rim Conference on Communications, Computers, and Signal Processing. Proceedings.* IEEE, 308–310.

[10] Juliet Corbin and Anselm Strauss. 2014. *Basics of qualitative research: Techniques and procedures for developing grounded theory.* Sage publications.

[11] Mary Czerwinski, Eric Horvitz, and Susan Wilhite. 2004. A diary study of task switching and interruptions. In *Proceedings of the SIGCHI conference on Human factors in computing systems.* 175–182.

[12] Dahyar Daraba, Hillman Wirawan, Rudi Salam, and Muhammad Faisal. 2021. Working from home during the corona pandemic: Investigating the role of authentic leadership, psychological capital, and gender on employee performance. *Cogent Business & Management* 8, 1 (2021), 1885573.

[13] Daantje Derks, Arnold B Bakker, Pascale Peters, and Pauline van Wingerden. 2016. Work-related smartphone use, work–family conflict and family role performance: The role of segmentation preference. *Human relations* 69, 5 (2016), 1045–1068.

[14] Drew Desilver. 2020. Working from home was a luxury for the relatively affluent before coronavirus—Not any more. In *World Economic Forum*, Vol. 21.

[15] Jennifer DeWitt and Jonathan Osborne. 2010. Recollections of Exhibits: Stimulated-recall interviews with primary school children about science centre visits. *International Journal of Science Education* 32, 10 (2010), 1365–1388.

[16] Dimitrina Dimitrova. 2003. Controlling teleworkers: supervision and flexibility revisited. *New Technology, Work and Employment* 18, 3 (2003), 181–195.

[17] Kathryn L Fonner and Lara C Stache. 2012. All in a day's work, at home: Teleworkers' management of micro role transitions and the work–home boundary. *New Technology, Work and Employment* 27, 3 (2012), 242–257.

[18] Gather.Town. Accessed 2021. Website of Gather.Town. https://www.gather.town.

[19] Graham R Gibbs. 2007. Thematic coding and categorizing. *Analyzing qualitative data* 703 (2007), 38–56.

[20] Cristina B Gibson and Susan G Cohen. 2003. *Virtual teams that work: Creating conditions for virtual team effectiveness.* John Wiley & Sons.

[21] Timothy D Golden. 2012. Altering the effects of work and family conflict on exhaustion: Telework during traditional and nontraditional work hours. *Journal of Business and Psychology* 27, 3 (2012), 255–269.

[22] Christine A Grant, Louise M Wallace, and Peter C Spurgeon. 2013. An exploration of the psychological factors affecting remote e-worker's job effectiveness, well-being and work-life balance. *Employee Relations* (2013).

[23] Jörg Hauber, Holger Regenbrecht, Mark Billinghurst, and Andy Cockburn. 2006. Spatiality in videoconferencing: trade-offs between efficiency and social presence. In *Proceedings of the 2006 20th anniversary conference on Computer supported cooperative work.* 413–422.

[24] Robert D Hisrich and Michael P Peters. 1982. Focus groups: an innovative marketing research technique. *Hospital & health services administration* 27, 4 (1982), 8–21.

[25] Bradley J Hufford, Robert L Glueckauf, and Patrick M Webb. 1999. Home-based, interactive videoconferencing for adolescents with epilepsy and their families. *Rehabilitation Psychology* 44, 2 (1999), 176.

[26] Snap Inc. Accessed 2021. Snap Camera. https://snapcamera.snapchat.com/.

[27] Shamsi T Iqbal and Eric Horvitz. 2007. Disruption and recovery of computing tasks: field study, analysis, and directions. In *Proceedings of the SIGCHI conference on Human factors in computing systems.* 677–686.

[28] E Jeffrey Hill, Joseph G Grzywacz, Sarah Allen, Victoria L Blanchard, Christina Matz-Costa, Sandee Shulkin, and Marcie Pitt-Catsouphes. 2008. Defining and conceptualizing workplace flexibility. *Community, Work and Family* 11, 2 (2008), 149–163.

[29] Aparna Joshi, David A Bloom, Amy Spencer, Kara Gaetke-Udager, and Richard H Cohan. 2020. Video interviewing: a review and recommendations for implementation in the era of COVID-19 and beyond. *Academic radiology* 27, 9 (2020), 1316–1322.

[30] Sasa Junuzovic, Kori Inkpen, Rajesh Hegde, and Zhengyou Zhang. 2011. Towards ideal window layouts for multi-party, gaze-aware desktop videoconferencing. (2011).

[31] Matthew K. Miller, Martin Johannes Dechant, and Regan L. Mandryk. 2021. Meeting You, Seeing Me: The Role of Social Anxiety, Visual Feedback, and Interface Layout in a Get-to-Know-You Task via Video Chat.. In *Proceedings of the 2021 CHI Conference on Human Factors in Computing Systems.* 1–14.

[32] Demetrios Karis, Daniel Wildman, and Amir Mané. 2016. Improving remote collaboration with video conferencing and video portals. *Human–Computer Interaction* 31, 1 (2016), 1–58.

[33] Clare Kelliher and Deirdre Anderson. 2010. Doing more with less? Flexible working practices and the intensification of work. *Human relations* 63, 1 (2010), 83–106.

[34] Katja Kerman, Christian Korunka, and Sara Tement. 2021. Work and home boundary violations during the COVID-19 pandemic: The role of segmentation preferences and unfinished tasks. *Applied Psychology* (2021).

[35] Kathrin Kirchner, Christine Ipsen, and John Paulin Hansen. 2021. COVID-19 leadership challenges in knowledge work. *Knowledge Management Research & Practice* (2021), 1–8.

[36] Kevin M Kniffin, Jayanth Narayanan, Frederik Anseel, John Antonakis, Susan P Ashford, Arnold B Bakker, Peter Bamberger, Hari Bapuji, Devasheesh P Bhave, Virginia K Choi, et al. 2021. COVID-19 and the workplace: Implications, issues, and insights for future research and action. *American Psychologist* 76, 1 (2021), 63.

[37] Benjamin Koehne, Patrick C Shih, and Judith S Olson. 2012. Remote and alone: coping with being the remote member on the team. In *Proceedings of the ACM 2012 conference on Computer Supported Cooperative Work.* 1257–1266.

[38] Lucas Kohnke and Benjamin Luke Moorhouse. 2020. Facilitating synchronous online language learning through Zoom. *RELC Journal* (2020), 0033688220937235.

[39] Udo Konradt, Guido Hertel, and Renate Schmook. 2003. Quality of management by objectives, task-related stressors, and non-task-related stressors as predictors of stress and job satisfaction among teleworkers. *European Journal of Work and Organizational Psychology* 12, 1 (2003), 61–79.

[40] Myron W Krueger, Thomas Gionfriddo, and Katrin Hinrichsen. 1985. VIDEO-PLACE—an artificial reality. In *Proceedings of the SIGCHI conference on Human factors in computing systems.* 35–40.

[41] Richard A Krueger. 2014. *Focus groups: A practical guide for applied research.* Sage publications.

[42] Andrea Kysely, Brian Bishop, Robert Kane, Maryanne Cheng, Mia De Palma, and Rosanna Rooney. 2020. Expectations and experiences of couples receiving therapy through videoconferencing: A qualitative study. *Frontiers in psychology* 10 (2020), 2992.

[43] Celine Latulipe. 2021. A CS1 Team-Based Learning Space in Gather. Town. In *Proceedings of the 52nd ACM Technical Symposium on Computer Science Education.* 1245–1245.

[44] Jaemyung Lee, Wonyoung Park, and Sangsu Lee. 2021. Discovering the Design Challenges of Autonomous Vehicles through Exploring Scenarios via an Immersive Design Workshop. In *Designing Interactive Systems Conference 2021.* 322–338.

[45] Shao-Kang Lo. 2008. The nonverbal communication functions of emoticons in computer-mediated communication. *Cyberpsychology & behavior* 11, 5 (2008), 595–597.

[46] Gloria Mark, Shamsi Iqbal, and Mary Czerwinski. 2017. How blocking distractions affects workplace focus and productivity. In *Proceedings of the 2017 ACM International Joint Conference on Pervasive and Ubiquitous Computing and Proceedings of the 2017 ACM International Symposium on Wearable Computers.* 928–934.

[47] A Mazzi. 1996. Alternative office structures for telecommuters. In *Proceedings of Telecommuting'96 Conference.*

[48] Sanjeev Mehrotra, Wei-ge Chen, Zhengyou Zhang, and Philip A Chou. 2011. Realistic audio in immersive video conferencing. In *2011 IEEE International Conference on Multimedia and Expo.* IEEE, 1–4.

[49] David E Morrison and David E Morrison. 1998. *The search for a method: Focus groups and the development of mass communication research.* Indiana University Press.

[50] Katja Neureiter, Martin Murer, Verena Fuchsberger, and Manfred Tscheligi. 2013. Hand and eyes: how eye contact is linked to gestures in video conferencing. In *CHI'13 Extended Abstracts on Human Factors in Computing Systems.* 127–132.

[51] Gary M Olson and Judith S Olson. 2000. Distance matters. *Human–computer interaction* 15, 2-3 (2000), 139–178.

[52] Kate Power. 2020. The COVID-19 pandemic has increased the care burden of women and families. *Sustainability: Science, Practice and Policy* 16, 1 (2020), 67–73.

[53] Victoria Claire Rowe. 2009. Using video-stimulated recall as a basis for interviews: Some experiences from the field. *Music education research* 11, 4 (2009), 425–437.

[54] Joshua S Rubinstein, David E Meyer, and Jeffrey E Evans. 2001. Executive control of cognitive processes in task switching. *Journal of experimental psychology: human perception and performance* 27, 4 (2001), 763.

[55] Anna Rudnicka, Joseph W Newbold, Dave Cook, Marta E Cecchinato, Sandy Gould, and AL Cox. 2020. Eworklife: Developing effective strategies for remote working during the COVID-19 pandemic. In *Eworklife: developing effective strategies for remote working during the COVID-19 pandemic*. The New Future of Work Online Symposium.

[56] Banu Saatçi, Kaya Akyüz, Sean Rintel, and Clemens Nylandsted Klokmose. 2020. (Re) Configuring Hybrid Meetings: Moving from User-Centered Design to Meeting-Centered Design. *Computer Supported Cooperative Work (CSCW)* 29, 6 (2020), 769–794.

[57] Banu Saatçi, Roman Rädle, Sean Rintel, Kenton O'Hara, and Clemens Nylandsted Klokmose. 2019. Hybrid Meetings in the Modern Workplace: Stories of Success and Failure. In *International Conference on Collaboration and Technology*. Springer, 45–61.

[58] In-geon Shin, Jin-min Seok, and Youn-kyung Lim. 2018. Too close and crowded: understanding stress on mobile instant messengers based on proxemics. In *Proceedings of the 2018 CHI Conference on Human Factors in Computing Systems*. 1–12.

[59] Tiago FAC Sigahi, Bruno C Kawasaki, Ivan Bolis, and Sandra N Morioka. 2021. A systematic review on the impacts of Covid-19 on work: Contributions and a path forward from the perspectives of ergonomics and psychodynamics of work. *Human Factors and Ergonomics in Manufacturing & Service Industries* (2021).

[60] Ravinder Singh and Soumya Awasthi. 2020. Updated Comparative Analysis on Video Conferencing Platforms-Zoom, Google Meet, Microsoft Teams, WebEx Teams and GoToMeetings. *EasyChair: The World for Scientists* (2020), 1–9.

[61] Anya Skatova, Ben Bedwell, Victoria Shipp, Yitong Huang, Alexandra Young, Tom Rodden, and Emma Bertenshaw. 2016. The role of ICT in office work breaks. In *Proceedings of the 2016 CHI Conference on Human Factors in Computing Systems*. 3049–3060.

[62] Klaas-Jan Stol, Paul Ralph, and Brian Fitzgerald. 2016. Grounded theory in software engineering research: a critical review and guidelines. In *Proceedings of the 38th International Conference on Software Engineering*. 120–131.

[63] Na Sun, Xiying Wang, and Mary Beth Rosson. 2019. How Do Distance Learners Connect?. In *Proceedings of the 2019 CHI Conference on Human Factors in Computing Systems*. 1–12.

[64] Maxim Sytch, Lindred Greer, et al. 2020. Is your organization ready for permanent WFH? *https://hbr. org/2020/08/is-your-organization-ready-for-permanent-wfh? ab= at_articlepage_relatedarticles_horizontal_slot1® istration= success* (2020).

[65] Amy Tan and Ahmet M Kondoz. 2008. Barriers to virtual collaboration. In *CHI'08 Extended Abstracts on Human Factors in Computing Systems*. 2045–2052.

[66] Lennox Thomas, Julia MacMillan, Emilly McColl, C Hale, and S Bond. 1995. Comparison of focus group and individual interview methodology in examining patient satisfaction with nursing care. *Social Sciences in Health* 1, 4 (1995), 206–220.

[67] Mariana Toniolo-Barrios and Leyland Pitt. 2021. Mindfulness and the challenges of working from home in times of crisis. *Business horizons* 64, 2 (2021), 189–197.

[68] Lena Waizenegger, Brad McKenna, Wenjie Cai, and Taino Bendz. 2020. An affordance perspective of team collaboration and enforced working from home during COVID-19. *European Journal of Information Systems* 29, 4 (2020), 429–442.

[69] Bin Wang, Yukun Liu, Jing Qian, and Sharon K Parker. 2021. Achieving effective remote working during the COVID-19 pandemic: A work design perspective. *Applied psychology* 70, 1 (2021), 16–59.

[70] Nicole Yankelovich, William Walker, Patricia Roberts, Mike Wessler, Jonathan Kaplan, and Joe Provino. 2004. Meeting central: making distributed meetings more effective. In *Proceedings of the 2004 ACM conference on Computer supported cooperative work*. 419–428.

[71] MinYoung Yoo, William Odom, and Arne Berger. 2021. Understanding Everyday Experiences of Reminiscence for People with Blindness: Practices, Tensions and Probing New Design Possibilities. In *Proceedings of the 2021 CHI Conference on Human Factors in Computing Systems*. 1–15.

[72] Rui Zhou, Jasmine Hentschel, and Neha Kumar. 2017. Goodbye text, hello emoji: Mobile communication on WeChat in China. In *Proceedings of the 2017 CHI conference on human factors in computing systems*. 748–759.

[73] Zoom. Accessed 2021. Release notes for September 1, 2020. https://support. zoom.us/hc/en-us/articles/360048388632-New-Updates-for-September-1-2020.

[74] Zoom. Accessed 2021. Zoom Virtual Background system requirements. https://support.zoom.us/hc/en-us/articles/360043484511.