

Received 11 January 2023, accepted 1 March 2023, date of publication 6 March 2023, date of current version 30 March 2023.

Digital Object Identifier 10.1109/ACCESS.2023.3252563

## RESEARCH ARTICLE

# “Ju. T’aime” My Idol, My Streamer: A Case Study on Fandom Experience as Audiences and Creators of VTuber Concert

SEBIN LEE<sup>1</sup> AND JUNGJIN LEE<sup>1</sup>

Global School of Media, Soongsil University, Seoul 06978, Republic of Korea

Corresponding author: Jungjin Lee (jungjinlee@ssu.ac.kr)

This work was supported in part by the National Research Foundation of Korea (NRF) funded by the Korean Government through the Ministry of Science and Information & Communications Technology (MSIT), South Korea, under Grant NRF-2021R1C1C1014153; and in part by MSIT under the Innovative Human Resource Development for Local Intellectualization Support Program supervised by the Institute for Information & Communications Technology Planning & Evaluation (IITP) under Grant IITP-2023-RS-2022-00156360.

**ABSTRACT** Streamers and celebrities are increasingly using virtual avatars as a form of online entertainment; moreover, VTubers and virtual concerts are reporting increasing viewership. Therefore, understanding the unique characteristics, phenomena, and challenges of virtual avatars is an active topic in the HCI community. We extensively investigated a VTuber’s concert that was streamed on various viewing platforms and in which fans participated as voluntary creators. We surveyed 1,795 audience members and interviewed 10 voluntary creators to understand their experiences and perspectives. The survey and interview results revealed that both the platform type and perceived role of the VTuber (e.g., idol/streamer) affect the presence and immersion of audiences. We determined that the motivational context for voluntary creation and fan experience considerably influence content creation. Combining the two findings, we discussed the influences of perceived roles, fanwork experience, and viewing platforms on fandom experience. Furthermore, design implications were introduced for a future concert with virtual avatars.

**INDEX TERMS** Computer-mediated communication, fandom experience, online entertainment, virtual concert, virtual idol, virtual youtuber.

## I. INTRODUCTION

The growing popularity of using virtual avatars has pioneered new forms of online entertainment [1]. Celebrities, such as John Legend and Lindsey Stirling have begun adopting virtual avatars to enhance fan immersion during online concerts [2], [3]. Ado, a famous Japanese singer, debuted in an idol avatar without revealing her face [4]. Many streamers have increasingly been adopting virtual avatars in their live-streaming activities to protect personal privacy or portray a specially designed persona. Such streamers are referred to as virtual youtubers (VTubers) or virtual avatar streamers. A real person called Nakanohito (中の人, meaning a person behind the character) controls a 2D or 3D avatar of a VTuber in real time using various input modalities (motion-capture

device, keyboard, mouse, microphone) [5]. Thus, VTubers can react to their fans with lively gestures, voices, and motions in their live streams that include gaming, chatting, and singing. Such real-time interactions with viewers have become popular worldwide and are becoming a commercial success [6], [7], [8].

Recently, going beyond prevalent streamers, VTubers have evolved into professional musicians (i.e., singers and idols). Some VTubers, such as Nana Asteria and Milky Queen, describe themselves as VSingers (Virtual Singers) and have released considerable music content online [9]. Moreover, VTubers associated with famous commercial Japanese VTuber agencies (e.g., Hololive and Nijisanji) have released music and held concerts similar to real music idols [10], [11], [12], [13]. For example, Hololive has conducted idol projects with its VTubers and released an album named Hololive IDOL PROJECT [13]. In South Korea, similar to real idol

The associate editor coordinating the review of this manuscript and approving it for publication was Giuseppe Desolda<sup>1</sup>.

contest programs, in projects such as ISEGYE IDOL [14] and GIRLS's RE:VERSE [15], auditions have been conducted for selecting members of virtual idol groups in VRChat. The debut song RE:WIND by ISEGYE IDOL peaked in major domestic music charts. Popular VTubers have gained a considerable fan following, referred to as a fandom.

Compared with real-person streamers and celebrities, virtual avatars as a means of a new entertainment business present unique characteristics, phenomena, and novel challenges. According to studies, the characteristics of each subject in a scenario wherein VTubers and viewers interact are as follows. For viewers, the creative personae and appearances of VTubers based on subcultures are fascinating; viewers feel distant from avatars and tend to be tolerant of their potential rude and unusual behaviors [5]. For creating virtual avatars as VTubers, performers behind the avatars can intentionally construct an avatar with an identity that differs from themselves; some even play a character of a different gender [16]. The identity of an avatar may dynamically evolve based on the engagement of the fan community. Moreover, multiple performers can contribute to a single avatar [5]. Similarly, prior research has sought to examine the differences between real-person streamers and VTubers in terms of perceptions, attitudes, and practices [5]. However, despite the rise in VTubers' music activities and growth in popularity, understanding of factors influencing fandom engagement and experiences in VTubers' music activities remains limited.

There are many interesting topics to study regarding the VTubers' music activity and fandom culture. Advances in computer graphics enable VTubers to interact with their fans in an immersive manner on virtual reality (VR) platforms such as VRChat, which is beyond the scope of regular video streams. Furthermore, VTubers can simultaneously utilize video streaming and VR platforms for musical performances to benefit from both. Because VTubers create content through various activities, the perception of a VTuber's role in the VTuber's fandom may differ for every individual. Thus, some fans may regard their VTuber as an idol, whereas other fans may regard the VTuber as a streamer or broadcaster. Digital fanwork (i.e., memes and fan art) can not only be shared with online communities for social purposes but also be used in the content by VTubers [5], [17]. These aspects may influence how fans engage with their favorite VTubers' musical activity. Understanding the fandom experiences in the context of VTubers' music activity provides novel design insights that support an immersive performance and interactions between VTubers and fans.

In this study, we scrutinized a VTuber's virtual concert "Ju. T'aime" that was streamed on various viewing platforms. Some fans participated in the concert as voluntary staff (fan staff) who planned, created, and operated the concert. To understand various factors influencing concert experience, we first surveyed 1,795 audience members from the fan community. We conducted in-depth interviews with ten fan staff for understanding their motivation, experience, and

challenges. The survey result revealed that in addition to the platform type, the perceived role of the VTuber (e.g., idol/streamer) also affects the presence and immersion of audience. Through interviews with fan staff, we identified the motivational context for voluntary creation and the influence of fan experience on content creation. Based on the studies, we discussed the influence of viewing platforms, interactions, perceived roles of VTubers, and fanwork experiences on the fandom experience related to a VTuber. Finally, design implications for future concerts with virtual avatars were detailed.

The contributions of this study can be summarized as follows:

- A mixed-methods analysis to understand a VTuber fandom experience in detail, encompassing two aspects, namely, audiences and volunteer content creators, while focusing on a case of a virtual concert
- Identification of practices, challenges, and desires for interaction across multiple platforms
- A description of how the perception of the role of the VTuber influences fan engagement and experience
- Identification of unique motivations and advantages of voluntary participation in original content creation
- A suggestion of design implications for enhancing the engagements between VTubers and fans that occur across multiple platforms

## II. RELATED WORK

### A. AVATAR-BASED MUSIC ACTIVITIES AND VIRTUAL CONCERTS

Studies on avatar-based virtual idols have primarily focused on Hatsune Miku. Miku, a 16-year-old female character released by Crypton Future Media in 2007, has gained popularity worldwide. The ability to create songs in the voice of Miku using Vocaloid, without being connected to a living person, has enabled the generation of various creations [18], [19]. Live concerts were conducted with Miku singing upbeat and popular songs [20]. To understand the Miku phenomenon, various studies have focused on creator collaborations for content related to Miku [20], [21], [22], causes of fans being so passionate about Miku [18], [23], [24], and Miku's musical activity such as concerts and collaboration with other virtual artists [20], [25], [26]. Virtual idols, such as K/DA and True Damage, with an animation-like appearance based on the intellectual property of League of Legends [27] and Han YuA with a human-like appearance have emerged [28]. In addition to these virtual idols, VTubers have ventured into musical activities. As mentioned, VTubers released music [12], [13], [29] and even conducted a concert [10], [11]. However, understanding of the VTubers' musical activity is limited. Furthermore, unlike existing virtual idols, VTubers are not limited to music activity only. They deliver various content for activities such as gaming and chatting. Fandom can selectively interpret their roles depending on the activity. Such characteristics provide

a chance to study the effect of the perceived roles of VTubers on the experience in the context of VTubers' music activity.

Another relevant research theme in the HCI community is virtual concerts using virtual avatars. The performance and viewership in the virtual space have been studied extensively [30], [31], [32], [33]. Numerous methods have been proposed for enhancing audience experiences. Webb et al. described distributed liveness phenomena encompassing various forms of physical, spatial, and social co-presence [34]. In distributed live performance environments, audiences and performers experience difficulties in socially interacting with each other; furthermore, performers' attention is required to sense audience engagement [34]. Young et al. discovered that the primary cause of the preference for physical performances over VR is "the artist being there, and the public all around," which suggested a necessity for sharing experiences with others in VR [35]. Studies have proposed several methods for enhancing the liveness of VR concerts [36], [37], [38]. With VR technology becoming increasingly accessible to the public, numerous commercial virtual concert providers (e.g., Wave XR) have emerged. For example, Travis Scott held a concert in the game Fortnite [39], and Lindsey Stirling and John Legend collaborated with WaveXR to perform concerts [2], [3]. John Legend and Lindsey Stirling streamed their performances on both VR and social media platforms to enable fans to experience a sense of presence and immersion while maintaining online accessibility.

However, research on virtual concerts is not comprehensive. Previous studies have primarily focused on the audience, whereas the perspective of the producer or performer is yet to be studied comprehensively. Because studies have been primarily conducted in a controlled laboratory environment, the audience experience and their desired interactions in virtual concerts may differ. To the best of our knowledge, multi-platform concerts using virtual avatars, such as the case of John Legend and Lindsey Stirling and VTubers' concert, have yet to be studied in literature. Understanding experiences in the multi-platform concerts and VTubers' concerts is vital for obtaining new design insights for ensuring immersive experiences and supporting interactions between performers and fans. To fill this gap in literature on music activities and virtual concerts of VTubers, the following research questions (RQs) were addressed in this study:

- RQ1: What engages or disturbs fans in VTubers' virtual concerts, and what do they want?
- RQ2: How does the perceived role of a VTuber affect the fandom experience related to VTubers' concerts?

### B. FANWORK AND FANDOM ENGAGEMENT

Henry Jenkins defined participatory culture as the culture in which the producers and consumers of media are not separated but interact with each other and are perceived as participants [40]. The peer production of Hatsune Miku is an example of a participatory culture. Creators who were fans of Miku created and consumed the content related to Miku, and the production company granted a PCL license to address

the legal issues for noncommercial content production and facilitate peer production [19], [20], [21]. Moreover, fans voluntarily produce creative projects called fanwork that transform the original media of the artist [41]. Fandoms create and consume fanworks of their favored artists on online platforms [42], and they even share knowledge and learn from each other during the creative process [43], [44].

The emergence of live streaming has opened novel avenues for fandoms to interact and support their favored streamers or artists, such as providing monetary gifts [45], [46], [5], [47], and volunteer moderators [48]. Hamilton et al. explained the experience in the live-streaming community by using the sense of community theory [49], [50]. According to the theory, people are attracted to the communities they can influence. Community members maintain and develop membership status by fulfilling needs (e.g., knowledge acquisition and emotional compensation) while developing emotional connections through shared history and continuous participation [50]. Viewers of live-stream communities desire interactions and recognition from streamers; streamers try to satisfy the viewers by conducting polls and displaying fanworks [49]. Because VTubers are digital natives, they can maximize the influence of fandom by directly interacting with digital fanworks and even incorporating them into their streaming content.

However, limited studies have focused on fans participating in the creation of original content to support artists. Although the motivation to voluntarily participate as a moderator was analyzed in a previous study [48], the experience of the original content creator may differ considerably because the moderator in the study did not have permission to intervene in the content. To fill the gap in the literature on fandom experience which participating in the creation of original content, we addressed the following RQ:

- RQ3: How do fans feel about participating in the creation of VTubers' original content?

## III. METHODS

### A. BACKGROUND

#### 1) ABOUT ISEGYE IDOL

ISEGYE IDOL is a virtual idol group that was formed in 2021 through a virtual idol project started by Woowakgood [14], a South Korean Twitch streamer with 920k followers on Twitch and 1.46 million subscribers on Youtube. Six members were selected through an audition conducted on VRChat, which was opened to fans through YouTube and Twitch. Similar to other VTubers, they interact with their fans through live streaming that primarily consists of gaming, chatting, and singing [5]. Furthermore, similar to real-world idols, they release original songs and cover songs along with music videos. Most of the music videos of ISEGYE IDOL were produced in collaboration with fans participating voluntarily. ISEGYE IDOL members often browse fanworks during their streaming and even conduct streaming on VRChat maps created by fans. Therefore, it is natural culture for members and fans to work collaboratively

**TABLE 1.** Contents of "Ju. T'aime".

Phase	Contents
Before Start	Waiting Time Video (Incl. ambient sound similar to an actual concert venue)
Chapter 1	Performance of 5 songs (Incl. Atlantis Princess)
Intermission	Parody advertisement video using Jururu's memes.
Chapter 2	Performance of 4 songs (Incl. M@STERPEICE)
Encore	Performance of 2 songs (Incl. Hello)

in their fandom. Similarly, "Ju. T'aime" was produced by the fans.

## 2) "Ju. T'aime" VIRTUAL CONCERT

"Ju. T'aime" was a free concert conducted by Jururu (a creator with 195k subscribers on YouTube and 208k followers on Twitch). The concert was streamed through Twitch and VRChat on May 15, 2022 (Figure 1). The concert consisted of her famous cover songs and parody advertisement videos using her memes (Table 1). It lasted for 2 h and included a waiting time of 50 min. A total of 30,768 average concurrent viewers and 35,570 maximum concurrent viewers were recorded [51].

The system structure for the concert was similar to that described in a previous study by Gagneré and Anastasiia [52] (Figure 2). The artist performed on a virtual stage developed using Unreal Engine 4<sup>1</sup> wearing a motion-tracking device. Staff located at a remote environment played pre-defined sequences that included backing tracks, camera movements, and lighting effects. The rendered image was streamed through Twitch and aired at RuruCinema, the VR theater dedicated for "Ju. T'aime," which was implemented on VRChat (Figure 1). Audience members using Twitch could communicate with the performer through chats. Audience members using VRChat gathered at the RuruCinema using a VR device (e.g., Oculus Quest 2) or desktop. They were able to watch the performance, sing along, and cheer with other audiences using cheering items such as light sticks; however, they could not interact with the performer. Because of the limitations of VRChat, up to 40 people were able to access the RuruCinema at an instance, and approximately 1,400 fans were divided into multiple instances to watch the concert.

As mentioned, the process from planning to production for the concert was led by the fan group called "Ju. T'aime Organizing Committee (JOC)". The JOC was formed by a fan (director) using the nickname "Songdo Police Messi"; approximately 90 people voluntarily participated in organizing concerts without any monetary compensation. They remotely created and conducted concerts for three months by communicating through Discord. Fans, including JOC members, voluntarily and cooperatively produced various content to celebrate the concert and have fun [42], [53], such as setting up a goods shop in RuruCinema and displaying augmented reality posters and fan art. This concert was studied in detail because the concert was a VTuber's

fan-created concert that attracted a sizable audience; moreover, we could address various analyses based on the use of multi-platform (i.e., Twitch and VRChat), and the two roles of the fandom (i.e., as the audience and fan staff).

## B. AUDIENCE SURVEY

### 1) SURVEY PROTOCOL

To address RQ1 and RQ2 from the audience perspective, we surveyed viewers to investigate the concert viewing experience, the level of presence and immersion they experienced, and the perceived role of Jururu. The survey included the following questions: demographic information, viewing environment, level of presence and immersion, enjoyment factors, interactions, and the perceived role of the performer.

Participants were asked to detail their age and gender and choose their viewing environment from the following options: using a head-mounted display (HMD) at RuruCinema (VR Cinema), a desktop at RuruCinema (non-VR Cinema), and Twitch.

They answered the questionnaires that measured the level of presence and immersion. To measure the presence, the spatial presence questionnaire of the MEC-SPQ [54] was adopted, and the social presence questionnaire used in the previous study proposed by Yakura and Goto [38] was used. The questionnaire from the study by Yakura and Goto was a modified version of the scales proposed by Hwang et al. [55] to reflect the context of concerts. Jennett et al. developed an immersive experience questionnaire (IEQ) [56] to measure the level of immersion. Although IEQ was designed for video games, its modified versions have been adapted to other domains, such as FilmIEQ for video media [57]. We modified the IEQ for the concert viewing situation. Please refer to Appendix A for the complete IEQ modification. All the items for presence and immersion were given in Korean after translation and measured on a five-point Likert scale (1 = strongly disagree, 5 = strongly agree).

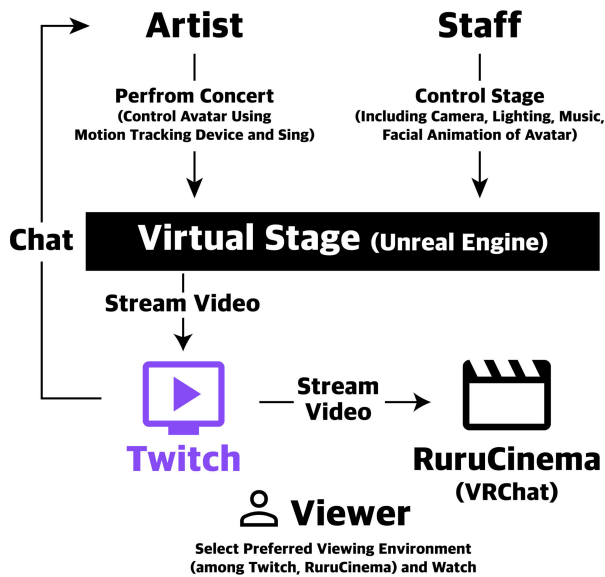
Furthermore, participants answered the questionnaire for enjoyment factors and interactions. We analyzed the posts on the fan community shortly after the concert to design options for the enjoyment factors and interactions. The participants could select up to three of the options listed in Table 3 for both positive and negative enjoyment factors and could report additional factors optionally. The answer options for the question on interaction are listed in Table 4 according to the viewing environment they reported. When the viewing was performed at RuruCinema, the participants were asked to select all the interactions that they had performed, and when viewing was performed through Twitch, they were asked to select the option to indicate how often they had engaged in chats. Subsequently, all participants were asked to answer the reason for choosing the options. An optional open question was included to identify the interactions desired by the participants.

<sup>1</sup><https://www.unrealengine.com/en-US>





**FIGURE 1.** RuruCinema, co-watching space for the virtual concert "Ju. T'aime" on VRChat (left); perspective of the viewer when the concert is aired at RuruCinema (middle); video and chats when the concert is aired on Twitch (right).



**FIGURE 2.** System structure of "Ju. T'aime".

Finally, we included the following question to determine whether the audience's perception of the VTuber's role influences the viewing experience: *In your opinion, which of the following roles best represents Jururu? Idol, Broadcaster, YouTuber/Streamer (henceforth streamer), and VTuber.* The given options were the four most-mentioned roles in the fan community. After choosing the role, the participants were provided with an optional open question to write down why they chose the option.

## 2) SURVEY ANALYSIS

To analyze the effect of the viewing environment and perceived role on the presence and immersion, presence and immersion scores were grouped with the viewing environment and perceived role. Grouped scores were analyzed using the Kruskal–Wallis test to identify statistically significant differences. If a significant difference existed, we used the Mann–Whitney–Wilcoxon test for the post-hoc comparisons and applied the Bonferroni correction. Moreover, all the qualitative responses were analyzed using an open coding method [58] to determine common themes.

## 3) RECRUITMENT OF PARTICIPANTS

We deployed the survey in the official fan community of ISEGYE IDOL called "Wakmulwon" [59] for two days from June 5, 2022, after obtaining permission from Jururu and Woowakgood. A total of 1795 people (262 females, 1533 males) who watched a live screening of "Ju. T'aime" sent their responses. The ages of the participants ranged from 12 to 45 years (mean (M) = 21.79, standard deviation (SD) = 4.80). The survey took approximately 15 min. We provided 20 free coffee coupons to participants through a random lottery, which is a widely used incentive strategy in online surveys to collect many responses within a limited budget [60].

## C. FAN STAFF INTERVIEW

### 1) INTERVIEW PROTOCOL AND ANALYSIS

We conducted semi-structured interviews with the fan staff to address RQ3 and RQ2 from the perspective of fan staff. The interview included the following themes: experiences as a fandom and fan staff (e.g., what makes you start fandom activity of ISEGYE IDOL?), motivation to become a fan staff (e.g., what motivates you to participate in the creation despite no monetary compensation?), design considerations (e.g., are there any special design considerations for the Jururu's fandom?), opinions on survey results, and the perceived role of Jururu. Interviews were conducted for a week from August 1, 2022, through offline meetings and online voice calls using Discord. Each interview was conducted in Korean and lasted approximately 1.5 to 2 h. The researcher took notes during the interview, and all interviews were recorded and transcribed using ClovaNote.<sup>2</sup> We analyzed all transcripts through an open coding method [58] and found common themes. Each participant received a compensation of USD 50.

### 2) PARTICIPANT RECRUITMENT

We recruited fan staff with the help of the director. As presented in Table 2, 10 interviewees were recruited to cover all production divisions, including planning, modeling, design, video, programming, and music, of "Ju. T'aime." All participants were men of Korean nationality, and their ages ranged from 21 to 29.

<sup>2</sup><https://clovanote.naver.com>

**TABLE 2. Staff interview participants.**

Code	Role/Division	Has(d) Related Job or Major
S1	Intermission Ad, Video	N
S2	Producer, PM	Y
S3	Director, Modeler	N
S4	Art Director, Video	Y
S5	Producer, Animator	N
S6	Music	Y
S7	Developer	Y
S8	Developer	Y
S9	Animator, Modeler	N
S10	Design, Branding	Y

## IV. FINDINGS

### A. FACTORS THAT AFFECT AUDIENCE EXPERIENCE IN THE VTubers' CONCERT (RQ1)

Based on the audience survey, we present our findings on the audience experience in VTubers' concert. According to the survey, participants reported their viewing environments as follows: Twitch (1483, 82.6%), non-VR Cinema (280, 15.6%), and VR Cinema (32, 1.8%). In Table 3 and Table 4 which summarize the survey's options and responses about enjoyment factors and interactions, we merged responses from both VRChat environments into RuruCinema because the VR Cinema and non-VR Cinema participants were asked the same questions and the number of VR Cinema participants was small.

#### 1) ENJOYMENT FACTORS

Survey participants selected their enjoyment factors as listed in Table 3, and 358 respondents (178 positive, 191 negative) reported additional factors in their reply to the open question.

##### a: POSITIVE FACTORS

Preference for the performer, content that is exclusive to the concert, and interacting with the performer were the major positive enjoyment factors. In the open question, 37 respondents (20% of positive responses) reported that the experience of watching the concert with other fans formed a bond among them. A preference for free access and watching the concert without going to a concert hall was mentioned by 23 respondents (13% of positive responses). Moreover, 22 respondents (12% of positive responses) mentioned the engagement of fan staff. Although it was insufficient when compared with the preference of the offline concert, they could enjoy the concert because the fan staff conducted the concert (P834). Furthermore, 13 respondents (7% of positive responses) reported that the fact that the concert attempted to reflect the history of the performer made the concert more enjoyable. For example, the order of the songs was related to her history, which resulted in a more pleasurable viewing experience; for example, "I think seeing how ISEGYE IDOL started from the beginning played a big role. I totally agree with the sentence that 'Story is everything for the idol.'" (P1410). We think this result is related to previous

studies that have emphasized a strong storyline for virtual influencers [61] and specified that watching the growth of idols creates an intimate connection with artists [62]. Moreover, eight respondents reported that the concert-like ambient sounds in the waiting time video replicated the feeling of being at a concert.

##### b: NEGATIVE FACTORS

In the case of negative factors, the absence of interaction with the performer accounted for approximately 40% of the responses, regardless of the viewing environment. Viewing interruptions caused by other users (57.4% of negative responses from the participants at RuruCinema) and external environmental factors (30.4 and 38.1% of the negative responses from the participants in Twitch and at RuruCinema, respectively) accounted for a high proportion of the negative responses and were mentioned by 45 respondents (23.5% of negative responses) in the open question. These factors include abusive chats on Twitch (e.g., swearing, sexual harassment), use of huge characters, and the inappropriate influx of sounds at RuruCinema. Consistent with the results of a previous study [63], abusive chats were a cause of participants avoiding chatting. Moreover, 54 respondents (28% of negative responses) reported a degradation in the immersive experience because of the absence of ambient sound and offline-concert-like interactions. Furthermore, 42 respondents (21% of negative responses) mentioned that they were disrupted by delays on Twitch and commercial breaks that could not be removed systemically at RuruCinema.

#### 2) INTERACTIONS

Participants responded to the types of interactions that they performed as presented in Table 4.

##### a: REASONS NOT TO INTERACT

Regardless of the viewing environments, respondents who did not interact provided the following reasons: "To focus on the performance," "It is inconvenient to interact with others," "There is no need to interact." On Twitch, participants could interact with the performer through chat, but they remarked that "There are too many messages, so mine will likely be buried," "I did not feel the need to participate because others were already chatting." These comments were consistent with the observations of previous studies that have indicated that massive chats and comments prevent engagement, and ensuring that the comments of viewers are visible to streamers is vital [1], [63]. Furthermore, people who commented that interactions were inconvenient indicated the following problems: in a mobile environment, the chat UI partially blocked the view of the concert video stream and swinging a light stick using the mouse in non-VR Cinema was difficult.

TABLE 3. Survey options and responses about enjoyment factors.

Positive Factor	Twitch (n = 1483)	RuruCinema (n = 312)
Technical perfection of the concert	1167(78%)	226(72%)
Preference for the performer	934(62%)	189(60%)
Content exclusive to the concert (e.g., Intermission Ad)	749(50%)	136(43%)
Interactions with the performer	713(48%)	135(43%)
Realistically implemented stage and space at RuruCinema	484(32%)	149(47%)
Fandom cheers for the performer together	294(19%)	77(24%)
The avatars of fans expressed as fandom characters	33(2%)	18(5%)
Negative Factor		
	Twitch (n = 1483)	RuruCinema (n = 312)
Absence of voice interaction with the performer	580(39.1%)	179(57.4%)
Viewing interruption caused by the external environment	451(30.4%)	119(38.1%)
Absence of cheering items	400(27%)	108(34.6%)
Lack of technical perfection such as unnatural avatar	362(24.4%)	67(21.5%)
Absence of spatial acoustics in the performance	324(21.8%)	39(21.5%)
Reading chats to see how others react	304(20.5%)	
Typing chats for cheering the performer	251(16.9%)	
		Viewing interruption by the other users
		Absence of interaction with the performer
		Viewing interruption caused by the external environment
		Technical issue related to the concert and RuruCinema
		VR Sickness

TABLE 4. Survey options and responses about interactions.

Platform	Interaction	Responses(%)
RuruCinema (n = 312)	Browsing RuruCinema with others	170 (54.5%)
	Cheering using cheering items	156 (50%)
	Did nothing but just watched	119 (38.1%)
	Talking with others	32 (10.3%)
	Cheering accompanied by sound (e.g., singing along the songs)	24 (7.7%)
Twitch (n = 1483)	Did not see chats (C1)	90 (6.1%)
	Saw chats but did not post in a chat (C2)	417 (28.1%)
	Posted 1-5 chat(s) (C3)	284 (19.2%)
	Posted 6-10 chats (C4)	119 (8.0%)
	Posted more than 10 chats (C5)	573 (38.6%)

b: REASONS TO INTERACT

In Twitch, 1,018 respondents (73% of the participants excluding the C1 group) reported that they engaged in the chat to share their emotions and experiences with others and experience presence, immersion, and enjoyment. Moreover, 125 respondents mentioned that they chatted to cheer the performer, and 74% of these respondents (92 respondents) posted a message more than 10 times. Furthermore, 70 respondents answered that it was natural to watch and engage in chats in the context of live streaming. Similar to Twitch, respondents who went to RuruCinema mentioned that interacting with others was a natural behavior in the context of fandom and concert, and interactions provided realism, immersion, and fun. Respondents who used cheering items or voice chat tried to express their loyalty and cheered for the artist. Some respondents noted that they only used cheering items, such as light sticks, because loud voices can distract others within VRChat.

c: DESIRED INTERACTIONS

A total of 524 respondents commented about their desired interactions. Among them, 346 respondents (66% of respondents) wanted to be in the same virtual space with the performer and wanted their cheering to be included in the performance. Particularly, 112 respondents wanted to vocally cheer the performer (e.g., sing along with the performer),

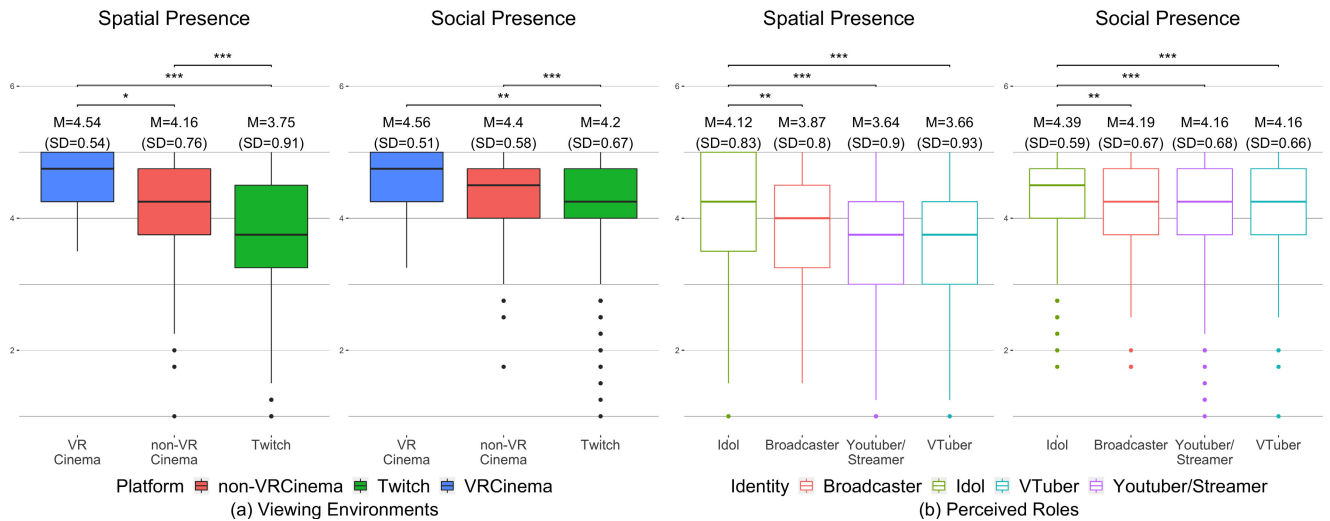
and cheering with the aid of light sticks in the concert hall was mentioned by 30 respondents who watched the concert on Twitch. Some participants suggested methods that can synthesize cheering sounds and movement of light sticks from Twitch chats, for example, "Play cheering sounds when cheering-related chats are typed." (P962), "When the emoji is pressed, synthesized movements of the light sticks can be generated." (P1415)

Moreover, 44 respondents wanted the cheering to be customized to the platform (e.g., donation [47] and cheering using buttons different from those used for chatting). Furthermore, 36 respondents wanted a summary of the chats in Twitch and relay reactions in RuruCinema to be sent to the performer so that the performer could be aware of their cheering. Two participants (P388 and P402) specified that staff should be positioned inside the theater at RuruCinema to restrain abusive users, which is consistent with the findings of a previous study [64].

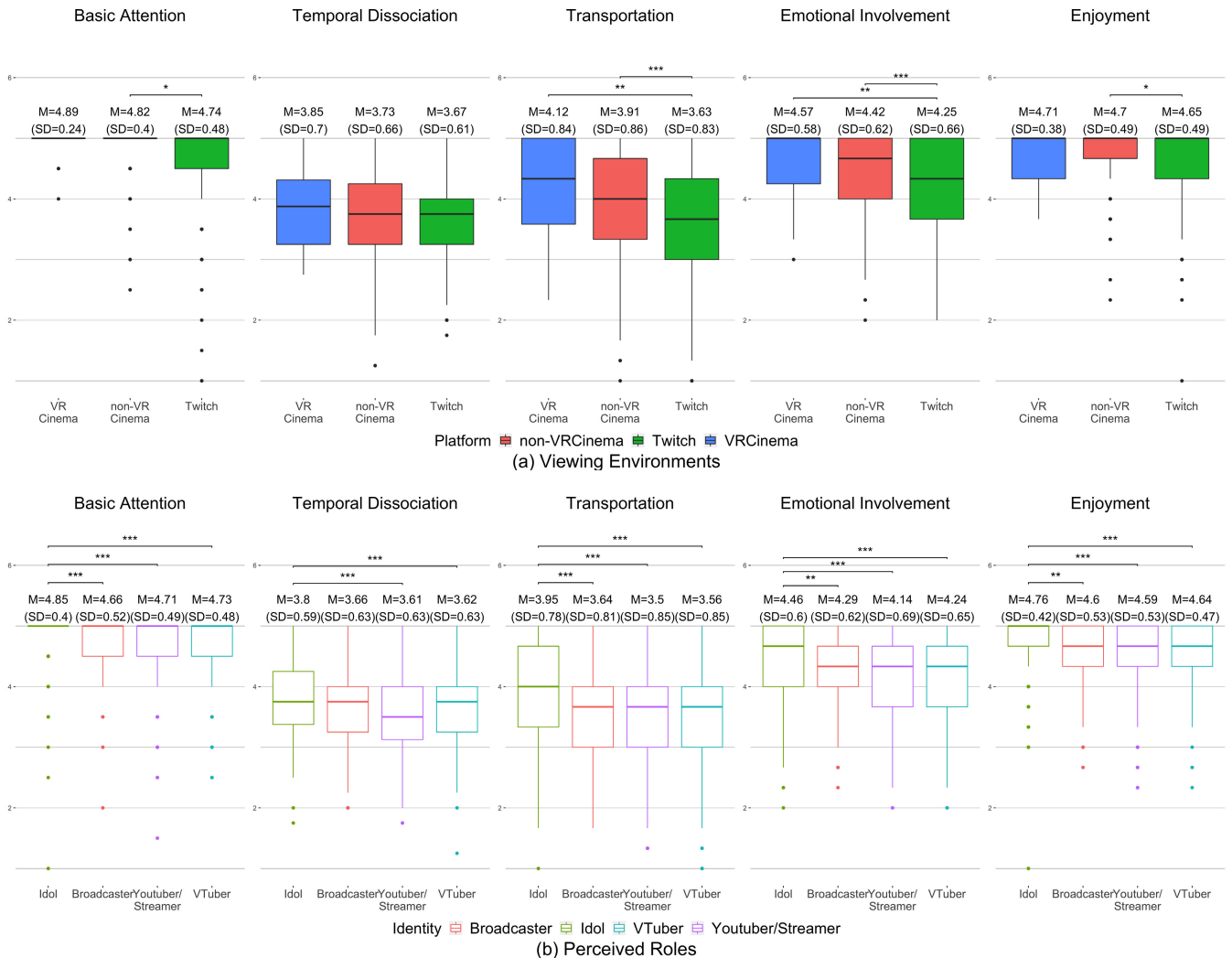
3) INFLUENCE OF THE VIEWING ENVIRONMENT

As mentioned in Section III-B2, we analyzed how the viewing environment affected the presence and immersion. Figure 3(a) displays the average scores that indicate the sense of spatial presence (SP) and social presence (SO) of the audience; and Figure 4(a) displays the average scores of the subscales of IEQ for the immersion, that is, basic attention (BA), temporal dissociation (TD), transportation (TP), emotional involvement (EI), and enjoyment (EJ). Challenge, which is a subscale of IEQ, was excluded because it does not fit the context of the concert. All the presence and immersion scores were grouped and analyzed with each viewing environment.

For all scales, the VR Cinema achieved the highest level of presence and immersion, followed by the non-VR Cinema and Twitch. Twitch revealed significant differences with VR Cinema (SP:  $p < .001$ , SO :  $p < .01$ ) and non-VR Cinema (SP, SO :  $p < .001$ ) for both SP and SO (Figure 3(a)). A significant difference was observed between VR and non-VR Cinema only in SP ( $p < .05$ ). In the case



**FIGURE 3. Spatial presence and social presence that were analyzed based on the viewing environments and perceived roles ( $\alpha = .05$ , Bonferroni Corrected, signif. level: \*  $p < .05$ , \*\*  $p < .01$  \*\*\*  $p < .001$ ).**



**FIGURE 4. Subscale of immersion analyzed based on the viewing environments and perceived roles ( $\alpha = .05$ , Bonferroni Corrected, signif. level: \*  $p < .05$ , \*\*  $p < .01$  \*\*\*  $p < .001$ ).**



**TABLE 5. Results of the chi-square residual analysis between the perceived role of the Jururu and the chat frequency in Twitch ( $\alpha = .05$ , Bonferroni Corrected, signif. level: \* $p < 0.05$ , \*\* $p < 0.01$ ).**

Role	C1	C2	C3	C4	C5
Streamer	2.4645	2.8456	-0.3243	-0.5417	-3.2716*
Idol	-1.5445	-2.6415	-0.3713	-0.6584	3.8638**
VTuber	-0.8064	-0.8423	-0.0614	1.2487	0.5262
Broadcaster	-0.4666	0.8152	1.3174	0.18760	-1.6933

of immersion, as displayed in Figure 4(a), Twitch exhibits significant differences with non-VR Cinema in BA, TP, EI, and EJ (BA, EJ:  $p < .05$ , TP, EI:  $p < .001$ ) and with VR Cinema in TP and EI (TP, EI:  $p < .01$ ).

Excluding the aforementioned scales, no significant differences were observed between groups. Moreover, no significant differences were observed between VR and non-VR Cinema except for SP. To a certain extent, the use of VRChat influences the level of presence and immersion; however, no significant effect was observed from the use of HMDs except for the spatial presence.

### B. INFLUENCE OF THE PERCEIVED ROLE OF VTuber (RQ2)

The audience survey and fan staff interviews have revealed that perceiving the performer as an idol provides advantages for audiences and vice-versa for fan staff. The survey participants reported the following roles for Jururu: Streamer (655, 36.5%), Idol (615, 34.3%), VTuber (387, 21.6%), and Broadcaster (138, 7.7%). The fan staff interview participants reported the following roles for Jururu: Streamer(7, 70%) and VTuber (3, 30%).

#### 1) EFFECT OF THE PERCEIVED ROLE OF VTuber ON THE AUDIENCE EXPERIENCE

Similar to the previous section, we analyzed how the perceived role of VTuber affects presence and immersion. Figure 3(b) and 4(b) detail the average scores of SP and SO and subscales of IEQ, respectively, for each perceived role.

Recognizing Jururu as an idol provides higher presence and immersion than all other roles. This result was also confirmed in a post-hoc analysis. As displayed in Figures 3(b) and 4(b), the role of an idol has shown significant differences with the roles of streamer and VTuber in all scales ( $p < .001$ ). Furthermore, the role of an idol has shown significant differences with that of a broadcaster in all scales except for TD (SP, SO, EI, EJ:  $p < .01$ , BA, TP:  $p < .001$ ). The non-idol roles did not exhibit any significant difference in all scales. These results may be associated with a previous study that indicates that celebrity worship can be related to transportation [65]. The results also imply that celebrity worship can be applied to a VTuber.

Additionally, we evaluated whether the perceived role affected the interaction frequency. We conducted a chi-square test to confirm the relation between the chat frequency and the perceived role. The result revealed that the perceived role was related to chat frequency ( $\chi^2(12, N = 1483) = 28.704, p = 0.004359$ ). Through chi-square residual analysis

(Table 5), the roles of idol and streamer were related to C5, the high-frequency chat group (Idol:  $p < .01$ , Streamer:  $p < .05$ , Bonferroni corrected). The roles of idol and streamer exhibited positive and negative residual values, respectively. Thus, identifying a performer as an idol contributes to the high chat frequency; conversely, identifying a performer as a streamer provides a significantly weak contribution to the high chat frequency.

#### 2) EFFECTS OF THE PERCEIVED ROLE OF VTuber ON CREATOR EXPERIENCE

In contrast to the audience, all the fan staff reported they did not perceive Jururu as an idol. When asked whether a change in the perceived role of Jururu would influence the motivations or experiences in voluntary content creation, they answered that they participated in the production because they are fans of Jururu rather than what her role is.

However, in some responses, a perception of non-idol roles was observed to be advantageous for voluntary participation. S2, who answered that Jururu is a streamer, mentioned that, although ISEGYE IDOL members are idols, their friendly look as streamers makes him participate in content production. S6 mentioned that if he perceives her as an idol, it seems like the weight of content creation should be considered. S8 mentioned that he did not think of rewards because he considers working on a project with Jururu to be amateur. He continued that if he considers her an idol or broadcaster, it would be nice to receive a monetary reward.

#### 3) FACTORS AFFECTING THE PERCEIVED ROLE OF THE PERFORMER

The perception of the role of the performer as an idol provides enhanced presence, immersion, and high chat frequency, and the perception of the role of the performer as a non-idol causes fan staff to easily participate. To determine factors affecting the perception of roles, we analyzed fan staff interviews ( $n = 10$ ) and responses ( $n = 1122$ ) to an open survey question about the reason for the selected role. The major factors are as follows: activity and fandom experience similar to idols, live streaming, sense of celebrity, and similarity with other VTubers.

#### a: KEY FACTORS FOR THE ROLE AS IDOL: ACTIVITY AND FANDOM EXPERIENCE SIMILAR TO IDOLS

Respondents who answered that Jururu is an idol mentioned that she released the cover and original songs and had also ranked higher on the major music charts in South Korea. This result is similar to a previous study in which people followed the animated-like virtual influencers because of their music [1]. Some respondents reported that the concert "Ju. T'aime" has made them perceive Jururu as an idol because she performed on stage and because of the cheering experience. In this regard, P589 mentioned that Hololive members typically display an aspect of madness when streaming; however, he perceived them as idols when they sing on stage. This result suggests that singing on the

stage, regardless of the content that is usually presented, can help provide considerable recognition as an idol. Similarly, certain respondents experienced changes in perception. They mentioned that they perceived ISEGYE IDOL members as streamers because they provided stream-oriented content before they released official albums. However, they started to perceive them as idols after they started their musical activities. Similarly, P1680, who perceived Jururu as an idol, responded that calling Jururu an idol would not be possible if she stopped singing and concentrated on streaming.

Providing fandom experiences similar to other idol fandoms also made Jururu an idol. Moreover, by following the K-pop idol fandom cultures of streaming the newly released music of the artist and advertising birthday celebrations of the idol through crowdfunding [66], Jururu attained idol status. Furthermore, respondents who perceived Jururu as an idol mentioned that her live streaming is similar to the manner in which other idols communicate with fans through dedicated fan apps such as V Live [67].

#### *b: NON-IDOL ROLES*

Live streaming is the main factor that leads to non-idol roles. Among all non-idol roles, live streaming is the primary mode of relaying the primary activities of Jururu. Respondents specified that the close and candid aspects that are presented on live streaming have collapsed the unique features of idols, such as the aspects of mystery and distance. Moreover, because of her proficient streaming and ability to communicate with viewers, respondents considered Jururu to be a proficient broadcaster and streamer. The factors that distinguish non-idol roles were the sense of celebrity and the similarity with other VTubers. Respondents who perceived Jururu as a broadcaster mentioned that they classified her in a role between an idol and a streamer; moreover, these respondents said that she is closer to a celebrity than other roles. People who perceived Jururu as a VTuber indicated that other VTubers also release music. They mentioned that ISEGYE IDOL works under the concept of an idol using an avatar. However, respondents who perceived her as a broadcaster or streamer mentioned that although she uses an avatar, the attraction of the person "Jururu" is more important than the avatar or concept.

### **C. EXPERIENCE AND DESIGN CONSIDERATIONS OF THE FAN STAFF (RQ3)**

In this section, the analysis of the fan staff interviews revealed why they got involved in the concert production, their experience as creators as a part of the fandom, the role of their colleagues in fanwork, design considerations, and their challenges.

#### **1) WHAT MOTIVATES FANS TO ENGAGE AS STAFF?**

S3 (director) stated that the primary reason for organizing the JOC and creating concert was because Jururu mentioned "I will hold a concert when I reach 100k subscribers in

YouTube" in her previous live streaming. Other interviewees mentioned that they participated because of their loyalty and because creating a concert with the help of other fans was interesting.

Interviewees had created fanwork even before "Ju. T'aime." They participated in fanwork activities because ISEGYE IDOL members watch their fanwork and occasionally work with fans. As mentioned in Section III-A, the fan community of ISEGYE IDOL tended to be active in fanwork, and fans collaborate with ISEGYE IDOL members. The community provides separate threads for uploading fanwork and recruiting members to work on projects. This phenomenon reflected how the fan staff joined the JOC. They applied to join JOC after seeing a recruitment advertisement that was posted by the director; alternatively, they were approached by the director to join the JOC after the director saw their portfolio on the thread. S2 mentioned that opportunities to work with your favored artists are not typical, but *Wakmulwon* provided a platform to make it possible.

With regard to monetary compensation, six interviewees mentioned that they participated because they did not receive any monetary compensation. They felt that because they were not rewarded, they could create what they wanted, and their creativity was valued. Moreover, they expressed that their colleagues were enthusiastic because everyone participated voluntarily. S10 noted that if he received monetary rewards, even if it is fanwork, then it would not be fun anymore and would result in work pressure similar to commercial work. S9 mentioned that if he received a reward, then he would only provide outputs of corresponding quality.

#### **2) CREATORS AS A PART OF FANDOM**

Fan staff mentioned that they could reflect the characteristics of fandom when creating the concert because they are also a part of fandom. They mentioned setting up of a goods shop in RuruCinema, incorporating intermission ads, and creating the setlist of the concert as examples. To determine the items to be placed in the goods shop, fan staff, themselves enthusiastic fans, listed the goods that they would want the most. They created and placed the goods that can be implemented among the listed goods. With regard to intermission ads, the fan staff attempted to use memes relevant to Jururu and also organized advertisements in which she appeared to be beautiful and bubbly. In particular, they mentioned that the fans do not like Jururu being with other male characters. In cases in which male characters were unavoidable, they reduced the proportion of male characters as much as possible. In the case of the setlist, the fan staff attempted to reflect the history of Jururu through the songs that are popular among fans. They placed the songs that she sang at her audition at the beginning of the concert and her representative cover songs at the end of concert (Table 1). Moreover, camera operation and facial animation were organized to obtain an attractive avatar and reflect the desires of fandom.

For amateur creators who did not have a major or job related to content production, their loyalty and the fact that

they can provide their fanwork to artists were the primary motivations for studying content production. S3 and S5 mentioned that they started learning modeling to support Jururu. They stated that *"Once Jururu said that her avatar does not have many costumes. After hearing that, I wanted to make and give costumes for her, so I learned modeling"*(S3), *"In the early days of ISEGYE IDOL, unlike other members, Jururu had literally no fans who could create and provide VRChat content for her. To create content by myself and give it to her, I started to learn how to make VRChat maps."*(S5) For people having a related job or major, fanwork provides opportunities to showcase their skills and passions. For examples, S10 said that *"Fanwork provides opportunities to show off my loyalty and skills, and also gives me an opportunity to advance my abilities."*

Conversely, fan staff strived to intentionally separate their loyalty as a fan and their role as a creator. S1 and S9 mentioned that they could create content that aligned with her memes, tendencies, and the mood of fandom because they are fans. However, S3 noted that he could reflect her meme to a great extent, which may lead to difficulties for viewers who did not know the meme in understanding it. Further, S5 excluded his loyalty as much as possible when he created content because his loyalty does not represent the loyalty of the fandom. Furthermore, the fan staff attempted to create high-quality outputs that aspired to make Jururu look as beautiful as possible because they are her fans. However, their love for her could cause difficulties in objectively evaluating the content output, possibly leading to a lower quality.

### 3) ROLE OF COLLEAGUES

When considering the creation experience of the fan staff, their colleagues in the JOC played crucial roles. S4 commented that he had fun working with other members of the JOC; S7 and S8 noted that, although loyalty played a major role in initial participation, the fun experienced when working with their colleagues during the production week affected their participation. S1 mentioned that some of the team members of fanwork projects also work in the industry. He said that amateur creators can enhance their ability while working with such members. S2, who has a related job, mentioned that he could enhance his skills while watching the progress of work in other fields.

Not only for the fun working experience, but the roles of colleagues are also crucial in various aspects during production, such as the prediction of fans' reactions, decision making, and technical difficulties. Fan staff noted that, in fanwork projects, seniors acting as advisors were not observed, and making critical decisions is difficult; this phenomenon was a problem because they were responsible for the success of the project. To ease the pressure, staff discussed the direction of the project and made decisions after reaching consensus. In the content design and production process, staff considered each other as potential users of the target population to predict the reaction of fans to their

content. This implies that a production team consisting of fans can easily perform an iterative user-centered design process, which is difficult to adopt in the general production process because of concerns related to content leakage. Furthermore, the staff received help from their colleagues to solve various technical difficulties during content creation. For example, S9 used to upload tutorial videos to share his VRChat techniques. This phenomenon is similar to the mentoring in the fan community in previous studies [43], [44]. If no member provides feedback on the content or has appropriate skills, they recruited additional team members without budget pressures.

Crucially, the tiredness of content creators had to be managed when they were creating content for Jururu. Jururu [68] and some interviewees mentioned that even if the fan staff started work with a sense of loyalty, work can become excessive, which can result in the fan staff losing interest and even exiting the fandom. The fan staff recognized these side effects and adjusted their workload through continuous communication, and additional team members were recruited if required.

### 4) DESIGN CONSIDERATIONS AND CHALLENGES BASED ON THE AUDIENCE SURVEY RESULTS

Fan staff responded that positive factors that viewers reported were incorporated at the time of production. Negative factors and the demands for interaction were considered, but these factors were not implemented because of technical difficulties. Furthermore, some of these suggestions are considered for future projects. This phenomenon was similar to a previous study in which producers were aware of the problems that viewers experienced but did not solve them for various reasons [69].

#### a: RECOGNIZE CHEERING

For the viewer response that they did not participate in chats because the performer would not be able to see their chat, fan staff mentioned that the performer can see the reactions of the fans but responding to the chats posted at a fast pace was difficult. To overcome this problem, fan staff summarized the chat content and delivered them to the performer. S2 mentioned that he thought that cheering using text in a massive chat would not be possible; therefore, he planned and provided a light stick emoji as a proper method for cheering. Furthermore, they noted that a plan was proposed to show the reaction of viewers in RuruCinema to the performer and stream it, but they experienced the following several technical difficulties: 1) It was physically challenging for the performer to simultaneously respond to multiple platforms while controlling the avatar. 2) All fan staff controlled the concert remotely; therefore, relaying the reactions at RuruCinema to the performer was difficult. 3) Monitoring the dozens of RuruCinema instances was not realistically feasible because it would entail the services of numerous people.

### *b: DIFFICULTY OF COLOCATION*

Interacting with the performer at RuruCinema while watching the performance in the same virtual space with the performer could not be implemented because of technical limitations. S2 noted that if fans entered the same virtual venue with the performer, then directing was restricted. He continued that watching the concert inside the virtual concert venue implemented with Unreal Engine was not possible while maintaining the current quality because of hardware limitations. Therefore, S8 considered synthesizing the motion data of viewers at RuruCinema to dummy spectators in the concert venue, but VRChat security regulations restricted this measure. Placing the avatar of the performer on the VRChat map and synchronizing it with the movement of the performer can be another alternative (S9). However, because of the technical nature of VRChat, people with malicious intent could copy her avatar without permission. This phenomenon can lead to impersonation and copyright problems.

### *c: ABUSIVE USERS*

The possibility of abusive chats and interruption in viewing in the cinema were predicted; however, fan staff noted that no feasible method was available to solve it. They mentioned that the chat speed is fast; therefore, finding and blocking them was difficult, even if abusive chat messages were confirmed. The public instances of VRChat can be accessed by anyone. S1 anticipated a disruptive behavior at RuruCinema as described in Section IV-A and considered technically disabling microphones to prevent abusive behavior using voice. He struggled between abuse prevention and greater interaction.

Fan staff were wary that any interactive feature could be used for abusing and disrupting the viewing experience in response to the demands for further interaction. In the case of voice interaction such as singing along with the performer, low-quality voices of some users could be regarded as awkward and annoying sounds, which could degrade the viewing experience. Regarding the donation that some survey participants mentioned, fan staff noted that donation messages and effects could interrupt viewing by covering the screen and overlapping sounds.

### *d: USABILITY IN THE VIEWING ENVIRONMENT*

When asked if they would use a service or a platform that provides the interactions that viewers wanted, half of the interviewees mentioned that they would not use it. As mentioned, they were wary that providing interaction can increase the risk of abuse. They noted that unlike offline concerts, many abusive users were present online because of the nature of accessibility and anonymity in online platforms. Furthermore, they discussed the usability of the platform. S8 mentioned that fans were used to VRChat because ISEGYE IDOL used it; however, VRChat is a platform with high entry barriers. He stressed the importance of easy-to-use platforms, noting that, irrespective of the superiority of the features,

the platform should not require a large number of people to study how to use it. S9 mentioned that moving fans to a new platform to watch a performance would be difficult and wanted solutions that could be integrated with existing platforms such as YouTube and Twitch. Staff who showed a willingness to use the platform noted that they would use it because the viewers wanted it. They added the condition that the service should be stable.

## V. DISCUSSION

### A. UTILIZATION OF MULTIPLE VIEWING PLATFORMS

Compared with real-person streamers, the advantage of VTubers as a digital form is that they can easily present themselves in various digital media. Beyond photographs and videos, avatars can appear in animations, games, and VR naturally and easily. Accordingly, multiple media can be simultaneously used for various purposes, such as accessibility and a sense of immersion. For example, Lindsey Stirling and John Legend conducted virtual concerts using their own avatars on both VR and social media platforms [2], [3]. Similarly, Hololive VTubers conducted concerts on both platforms simultaneously [70]. This strategy can attract more fans while showcasing avatars immersively.

"Ju. T'aime" could also be viewed on two platforms, VRChat and Twitch. In Twitch, fans watched the performance and reacted through chats and emojis. In VRChat, fans enjoyed more content in a virtual venue (RuruCinema), which was specially decorated with posters, goods shops, and photo zones. Here, fans watched the performance with others while using voice chat and cheering items. Because Twitch is highly accessible to the public, the number of audience members using the platform was more than that in VRChat. Our survey results revealed the differences between the two platforms in terms of the viewing experience. Similar to other VR-related studies [71], [72], VRChat users (17.4% of the total audience) exhibited a higher level of presence and immersion. The 3D world with a high degree of freedom provided by VRChat enables various activities and greater participation; however, it may cause more disruptions from abusive users. A notable aspect that we observed in this study was that the use of HMD does not affect the viewing experience, with the exception of the spatial presence. To understand the results and determine their causes, further user studies should be conducted in a controlled laboratory environment.

A virtual concert using multiple platforms with different fidelity and interactivity is a type of distributed liveness phenomenon. As mentioned by Webb et al. [34], distributed liveness imposes various difficulties related to social co-presence and interactivity on both performers and audiences. However, concerts of VTubers aggravate these difficulties. Because the performer operates the avatar using motion-capture devices, keyboard, and mouse, the performer requires considerable hand-eye coordination and focus, which causes a mental burden for communicating with users of various platforms using various interactive modalities. In the "Ju.



T'aime" concert, the interactions of users in VRChat were ignored and isolated. The lack of interactivity and social co-presence can hinder liveness [34], [73]. The design implications for virtual concerts are discussed in the next section.

### B. INFLUENCE OF THE PERCEIVED ROLE OF VTuber

Including Jururu, other VTubers who are operated by agencies (e.g., Kizuna Ai, Hololive) also engage in mainstreaming like activities such as concerts and release of songs [16], [10], [11], [74] in addition to live streaming activities that provide subcultural content [5]. Our survey revealed that the wide range of VTuber activities leads fans to the perception that the VTuber has multiple roles. Moreover, differences in perception affected the viewing experience and fandom activities. In this study, perceiving a performer as an idol provides a higher sense of immersion and presence and induces more interactions than the perception of the performer in non-idol roles. Our finding is consistent with a previous study that states that celebrity worship may be related to transportation [65]. Moreover, fans who perceive the VTuber as an idol may tend to increase their sense of community [50] through continuous participation in chats.

Notably, being perceived as an idol may not always be advantageous. Loyalty to Jururu is the motivation to voluntarily participate in the production process; however, all fan staff responded that they perceived Jururu as a streamer or a VTuber for the same reasons as audience fans. Based on the interview results, we can make several interpretations as follows: 1) The unique characteristics of idols, such as mysterious and distant personalities [75], can result in fans experiencing a high psychological burden when participating in content creation, which can directly affect the reputation of the artist. (e.g., S6: "If I perceive her as an idol, it seems like the importance and responsibility of content creation must be considered seriously.") 2) The fan staff may feel that working for a subculture-based streamer or VTuber is an amateur job, which can cause them to participate with a lighter mind without compensation. (e.g., S8: "Perceiving her in a non-idol role makes my participation in the production of her original content feel like an amateur work. Therefore, I do not think about the monetary compensation.") The positive effects of fandom participation are discussed in the next section.

The influence of perceived roles revealed in our study suggests that maintaining a balance between idol and non-idol roles may be critical for increasing the number of fans and encouraging fandom participation. The role of the VTuber is defined by complex dynamics. Survey respondents mentioned that the past streaming activities or candid aspects of the Nakanohito are a crucial factor in the perception of the roles as a streamer. Some people have mentioned that the music activities of the Jururu changed the perception of the role of the performer. In the case of the fan staff, they attempted to reflect the characteristics of an idol in the content

production process, despite themselves perceiving Jururu as a streamer. This phenomenon may be attributed to an early stage of cognitive transformation.

The role of a VTuber can be changed dynamically through communication and fandom participation or can be structured intentionally [5]. For superior role management, a longitudinal study on the factors and processes for the formation and change of perceived role of VTuber is required.

### C. FANWORK EXPERIENCE AND SENSE OF COMMUNITY

Similar to a previous study by Hamilton et al. [49], we discuss the finding of the fan staff experience by applying the sense of community theory [50]. Most of the fan staff had continuously participated in the fanwork project even before participating in the production of the concert. The fandom of ISEGYE IDOL creates not only memes but also 3D maps, items, and costumes that can be used in VRChat. ISEGYE IDOL members introduce fanworks in their live streaming and even use them for their streaming content. Moreover, this phenomenon is accepted culture for fans and ISEGYE IDOL to work collaboratively. The active use of fanwork by VTubers increases the intervenability of content for fans and encourages fans to create more content. Thus, such collaboration is a unique characteristic of live streaming that is unique to VTubers. Based on the aspect of a sense of community, fanwork activities that can be directly used in the content will strongly develop the membership status. Fans look forward to influencing the community and being recognized by streamers [49]. Participating in the production of a concert can be understood in a similar context.

Fan staff expressed satisfaction with the positive reviews of the fan community members and viewership numbers for the concert. It connects with the fulfillment of needs component of the sense of community in the form of emotional compensation. As mentioned in the study by Wohn [48], volunteer work should be recognized by other fans. Other rewards were acquiring content creation skills and solidarity with colleagues. By collaborating with colleagues, the fan staff improved their skills and enjoyed the process of collaborative work. As mentioned in Section IV-C3, emotional connection developed by collaborative participation is a major motivation. Moreover, they established processes for distributed mentoring [43], [44], exchanging feedback with each other, and solving various difficulties in a remote collaborative work environment. Conversely, monetary compensation was not important for the fan staff. Fan staff felt that they were free to create what they wanted because they were not monetarily rewarded and felt that they would experience work pressure similar to that experience during commercial work if they were paid.

In terms of the effectiveness of the content, the participation of the fan staff exhibited a considerable advantage. Fan staff and content consumers can bond emotionally through shared history and identity about the VTuber. As mentioned in Section IV-C2, our interviewees effectively leveraged the emotional connection to raise sympathy among fans.

The concert setlist was structured based on the history of the performer. The concert and additional contents were produced considering the tendencies of the fans and the preferred images of the performer. Moreover, the existence of fan staff was mentioned as a positive enjoyment factor by the audience, which can be observed from survey results.

As mentioned, the fandom of the VTuber exhibited unique characteristics and advantages in terms of fanwork. A previous study highlighted the importance of intervenability for fan engagement [64]. The fanwork based on VR has potential as a medium that can intervene in the process of building the storyline of the content because the avatar can easily use it and actually interact with it. Content created by fans can attract other fans. We expect our insights to be used for developing a VTuber fandom community and for designing the interactions between the fans and VTuber.

## VI. IMPLICATIONS FOR VIRTUAL CONCERT DESIGN

Our findings and discussions provide new insights for emerging research related to VTuber and virtual concerts in the HCI community. In this section, we elaborately describe the design considerations and opportunities for future virtual concerts in detail.

### A. DESIGN FOR IMPROVED SOCIAL CO-PRESENCE ACROSS VARIOUS VIEWING ENVIRONMENTS

In our study, some fans from Twitch and VRChat mentioned that they would like to be in the same virtual venue with Jururu and watch the concert together with other fans. The performer could only be viewed as a video, the Twitch and VRChat audiences were separated, and communicating with each other was not possible. Audience members used numerous devices, such as mobile phones, tablet PCs, desktops, and HMDs, to watch the concert. Therefore, designs to improve social co-presence between VTubers and audiences using different devices and platforms to support distributed liveness should be considered. A viable solution is to virtually co-present all audiences and performer avatars to a 3D performance viewing application similar to a real concert hall. Similar to first-person shooter games, the audiences and performers can freely move around the venue and interact with each other in various ways beyond merely using texting, which enables them to have a realistic concert experience. However, cloud gaming technology is required to support low-end devices.

However, 3D interaction may not be accessible and affordable to everyone. Some viewers may prefer a conventional live streaming platform. Therefore, another alternative to improving social co-presence across various viewing platforms is to represent audiences and their interactions on a platform to audiences on another platform in a suitable form, and vice versa. In this study, for example, for audiences on Twitch, adding the audiences on VRChat to the number of concurrent viewers is possible. Furthermore, speech-to-text technology can be used to post their voice chats in the

form of chat messages. Certain cheering behaviors could be recognized by artificial intelligence (AI) technologies and expressed in the form of emojis. Conversely, for the audience on VRChat, the audience on Twitch can be represented as dummy avatars that move automatically, as discussed in a previous study [38]. Their chat messages can be presented as audio using text-to-speech technology. Visual and audio effects can be triggered to express the collective effervescence [76] of the concert hall by analyzing the content of chat messages or detecting special moments such as a sharp increase in posting rate. In addition to virtual concerts, this approach can be extended to various applications, such as conferences, meetings, and theaters that can potentially use various platforms simultaneously.

### B. DESIGN FOR PERFORMERS TO EFFECTIVELY INTERACT WITH MULTI-PLATFORM AUDIENCES

As the results of the survey indicate, limited interactivity with a performer can hinder enjoyment and participation. In live performances, remote audiences want to feel connected with the performer [63]. However, to sense the engagements of virtually distributed audiences, the active attention of the performer is required [34]. Furthermore, interpreting the massive amounts of interaction data (e.g., chat messages) [77], [78] is difficult. In this study, fan staff noted these difficulties (Section IV-C4).

One method of supporting performers in interacting with large numbers of multiplatform audiences is to summarize their interactions and behaviors and provide them to performers. Similarly, studies have focused on designs that effectively handle massive chat messages to understand them [77], [78], [79]. This result can be advanced using natural language processing using AI. Moreover, in the future, effectively summarizing the engagement of audiences in the virtual space should be considered. For instance, showing an abstracted visualization to the performer may be possible when the virtual audience avatars wave the light sticks as a group or quantify the arousal level using AI. Furthermore, virtual assistants could explain the reaction audibly to the performer through earphones.

The fact that the performer is aware of their comments or applause is crucial for the audience. This is especially true in a VTuber's concert, where the lack of bodily co-presence leads to lower levels of solidarity and emotional energy [80]. In our survey, respondents who had not engaged in the interaction noted that "their comments will be buried or may not be delivered to the performer" as a reason for not engaging in chats. However, performers are doing their best to sense the engagement of the audience. These efforts are not fully delivered to the audience. For instance, because the performer reads as many chats as possible but only responds to some of them, most audiences do not know if their messages have been read. This subtle interaction or behavior of the performer can be detected and delivered to the audience using eye tracking technology.

### C. DESIGN FOR ABUSIVE USER MANAGEMENT

Audiences and fan staff were concerned about the disruptive behavior of some users. Current possible solutions are simply filtering malicious messages, such as swearing and sexual harassment, in chat windows using predefined forbidden words and having other users manually report abusive users. With increasingly advanced AI technology, automatic filtering and chatbot design that can effectively moderate abusive users in the context of concerts can be considered as in a previous study [81]. Design studies that can control the disruptive behavior of 3D audience avatars have received limited attention. Because of the nature of the virtual environment with a high degree of freedom, their actions may be more disruptive. Various design opportunities exist for designing tools to manage the authority of the avatar of the audience over the spaces and items or designing AI-powered NPCs.

Another viable solution for VR is leveraging the personal space bubble that was mentioned in a previous study [82] to transparently handle objects that obstruct the view of the audience. In the case of audio interaction, the risk of abuse can be reduced by differential treatment of audio levels and reverberations. The voice level of other users can be lowered and a reverb effect can be added to make it sound like ambient sound. Acoustics can be provided that sound like a conversation from a person next to the user, only for specified users or certain users who have expressed their desire to talk. For users who deliver abusive messages through voice-based conversations, muting the user and reporting them to the staff by expressing an intention not to listen, such as a gesture to block the ears, is possible [82].

### VII. LIMITATIONS

Through an online survey of numerous participants and in-depth interviews, we deeply understood the fandom experience as a VTuber concert audience and volunteer content creator. However, this study has several limitations that should be considered when interpreting the results. Our results were drawn by focusing on a single case called "Ju. T'aime" to understand the detailed experience. The composition of participants was biased toward men in their 20s of South Korean nationality. Moreover, as we addressed a survey on the online fan community, the overall respondents were favorable to the virtual concert. They answered honestly and specifically to other questions but showed significantly skewed results ( $M = 4.84$ ,  $SD = 0.38$ ) on the five-point scale for the question about overall performance satisfaction. Furthermore, a gap of approximately 21 days occurred between the time of the performance and the time of the survey. Furthermore, the difference in the number of samples related to Twitch, VR, and non-VR is significantly large. Therefore, although this study provides interesting and novel insights to HCI researchers trying to design a new interaction technology for virtual idols and virtual concerts, additional research is required on various cases, cultures, and participant composition for theorization.

### VIII. CONCLUSION

Based on the case of the virtual concert "Ju. T'aime," we studied the experience of a VTuber fandom as viewers and creators. We identified the enjoyment factors that viewers experienced while watching a virtual concert and the interactions they performed. We confirmed that loyalty, the experience of working with their artist, and the experience of having fun working with their colleagues are the motivations for voluntarily participating in content creation. Moreover, the involvement of fans as content creators is advantageous because they can anticipate the needs of other fans and produce content that reflects the fandom culture and their needs because they are themselves a part of the fandom.

We determined that recognizing the VTuber as an idol provided viewers with a high level of immersion and presence, while recognizing the VTuber as a non-idol facilitated the participation of creators. Multi-platform audiences wanted interactions similar to offline concerts; however, simulating real-concert experience is difficult for the creator, and the risk of abuse using the interaction method exists. Based on these findings, we suggested design implications for future virtual concerts. The results of this study can provide insights and be helpful for emerging research related to VTubers and concerts.

### APPENDIX A

#### QUESTIONNAIRE FOR MEASURING IMMERSION

In this section, we present the complete questionnaire used to measure immersion, a modified version of IEQ. Subscales of IEQ were grouped as follows: Basic Attention(Q1-Q2), Temporal Dissociation (Q3-Q6), Transportation (Q7-Q9), and Emotional Involvement (Q10-Q12), Enjoyment (Q13-Q15). Negative items are marked with (-).

#### A. KOREAN VERSION (VERSION GIVEN TO PARTICIPANTS)

- Q1. 주토펜드 콘서트가 내 시선을 사로잡았다.
- Q2. 나는 콘서트에 집중하고 있다고 느꼈다.
- Q3. 나는 콘서트를 보는 동안 시간이 빨리 갔다고 느꼈다.
- Q4 나는 콘서트를 보는 동안, 콘서트장이 아닌 다른 공간에 있다는 생각을 자주 했다. (-)
- Q5. 나는 콘서트를 보는 동안, 평소에 가지고 있던 걱정들을 잊어버렸다.
- Q6. 나는 콘서트를 보는 동안, 주변 환경이 신경쓰였다. (-)
- Q7. 나는 콘서트를 보는 동안 현실세계와 완전히 분리되었다고 느꼈다.
- Q8. 나는 단순히 영상을 보는 것이 아니라, 콘서트를 경험하고있다고 느꼈다.
- Q9. 나는 콘서트를 보는 동안, 내가 지금 있는 현실세계의 공간보다 주토펜드 콘서트장 안에 있다는 느낌을 더 많이 받았다.
- Q10. 나는 콘서트에 대해 감정적인 애착을 느꼈다.
- Q11. 나는 콘서트가 어떻게 진행될지에 대해 관심을 가졌다.
- Q12. 나는 공연자(주르르)에게 직접 말을 하고 싶은 정도로 몰입했다.

- Q13. 나는 콘서트를 열심히 즐겼다.
- Q14. 나는 콘서트가 끝났을 때 콘서트가 끝나서 실망하거나 아쉬웠다.
- Q15. 나는 주토퍸과 같은 콘서트를 다시 보고 싶다.

## B. ENGLISH VERSION

- Q1. To what extent did the "Ju. T'aime" hold your attention?
- Q2. To what extent did you feel you were focused on the concert?
- Q3. To what extent did you lose track of times during the concert?
- Q4. To what extent did you feel consciously aware of being in the other place rather than the concert hall whilst watching the concert? (-)
- Q5. To what extent did you forget about your everyday concerns?
- Q6. To what extent were you aware of yourself in your surroundings? (-)
- Q7. To what extent did you feel as though you were separated from your real-world environment?
- Q8. To what extent did you feel that the concert was something you were experiencing, rather than something you were just watching?
- Q9. To what extent was your sense of being in the concert hall of "Ju. T'aime" stronger than your sense of being in the real world?
- Q10. To what extent did you feel emotionally attached to the concert?
- Q11. To what extent were you interested in seeing how the concert would progress?
- Q12. At any point did you find yourself become so involved that you wanted to speak to the performer (Jururu in this case) directly?
- Q13. How much would you say you enjoyed the concert?
- Q14. When the concert finished, were you disappointed that the concert was over?
- Q15. Would you like to view a concert like "Ju. T'aime" again?

## ACKNOWLEDGMENT

The authors would like to thank Jururu and Woowakgood for allowing them to perform this study and also would like to thank the fandoms of Jururu, ISEGYE IDOL, and Woowakgood for participating in this study and the staff of "Ju. T'aime" for producing such a wonderful concert.

## REFERENCES

- [1] A. Choudhry, J. Han, X. Xu, and Y. Huang, "I felt a little crazy following a 'doll' investigating real influence of virtual influencers on their followers," *Proc. ACM Hum.-Comput. Interact.*, vol. 6, pp. 1–28, Jan. 2022, doi: 10.1145/3492862.
- [2] K. Melnick. (2019). *400 K Live Viewers Tuned in for Lindsey Stirling's VR Violin Performance*. Accessed: Sep. 5, 2022. [Online]. Available: <https://vrscout.com/news/lindseystirling-vr-concert-400k-viewers/>
- [3] B. Carlton. (2020). *John Legend Performs on Wave to Raise Awareness Towards Mass Incarceration*. Accessed: Sep. 5, 2022. [Online]. Available: <https://vrscout.com/news/john-legend-live-vr-concert-wave/>
- [4] P. S. Michel. *Ado Stays in the Shadows to Let Her Music Shine at Live Arena Performance*. Accessed: Jan. 1, 2023. [Online]. Available: <https://www.japantimes.co.jp/culture/2022/08/20/music/ado-live/>
- [5] Z. Lu, C. Shen, J. Li, H. Shen, and D. Wigdor, "More Kawaii than a real-person live streamer: Understanding how the Otaku community engages with and perceives virtual YouTubers," in *Proc. CHI Conf. Hum. Factors Comput. Syst.*, New York, NY, USA, May 2021, pp. 1–10, doi: 10.1145/3411764.3445660.
- [6] A. Silberling. (2022). *VTubers Are Making Millions on YouTube and Twitch*. Accessed: Aug. 27, 2022. [Online]. Available: <https://techcrunch.com/2022/08/20/vtubers-are-making-millions-on-youtube-and-twitch/>
- [7] C. D'Anastasio. (2022). *Twitch's New Star of Streaming Charts is Anime Avatar Ironmouse*. Accessed: Jan. 1, 2023. [Online]. Available: <https://www.bloomberg.com/news/articles/2022-04-06/twitch-s-new-star-of-streaming-charts-is-anime-avatar-ironmouse>
- [8] M. J. Lee, M. Horie, and P. Y. Mak. (2022). *A 26-Year-Old Billionaire Built Fortune on Virtual YouTube Stars*. Accessed: Jan. 1, 2023. [Online]. Available: <https://www.bloomberg.com/news/articles/2022-10-18/virtual-youtube-stars-turn-this-26-year-old-into-a-billionaire?leadSource=uverify%20wall>
- [9] A. Amos. (2022). *VTubers Redefine The Music Industry as Virtual Concerts and Idols Rise up*. Accessed: Jan. 1, 2023. [Online]. Available: <https://www.dexerto.com/entertainment/vtubers-redefining-music-virtual-idols-concerts-1973954/>
- [10] ANYCOLOR Inc. (2021). *Anniversary Festival 2021*. Accessed: Jul. 19, 2022. [Online]. Available: <https://anniversaryfes.nijisanji.jp>
- [11] Cover Corp. (2020). *Hololive 1st FES. Nonstop Story*. Accessed: Jul. 19, 2022. [Online]. Available: <https://www.nonstop.hololive.tv>
- [12] DMM.com LLC. (2019). *A Full Album 'NIJISANJI Music Mix Up!!' Containing 10 Original Nijisanji Units Will be Released on November 27th From DMM Music!! Some Recorded Songs Are Also Released!!* Accessed: Jan. 1, 2023. [Online]. Available: <https://prtimes.jp/main/html/rd/p/000003420.000002581.html>
- [13] Cover Corp. *Music | Hololive*. Accessed: Nov. 20, 2022. [Online]. Available: <https://hololive.hololivepro.com/en/music/>
- [14] Woowakgood's Gaming Channel. (2021). *(No Kidding) I Will Make You a Virtual Idol*. Accessed: Jan. 1, 2023. [Online]. Available: <https://www.youtube.com/watch?v=vDU4L3Tvo8Q>
- [15] *GIRL'S RE:VERSE*. Accessed: Jan. 1, 2023. [Online]. Available: <https://www.youtube.com/user/Yoonsxing>
- [16] B. Ludmila, "Designing identity in VTuber era," in *Proc. Virtual Reality Int. Conf.*, 2020, pp. 1–10.
- [17] H. Han, M. Lin, and F. Zurlo, "An exploratory study of the business strategies for virtual idols in the era of phygitalization—Analysis in the perspective of cases in China," in *HCI International 2021—Late Breaking Posters*, C. Stephanidis, M. Antona, and S. Ntoa, Eds. Cham, Switzerland: Springer, 2021, pp. 317–324.
- [18] D. Black, *The Virtual Idol: Producing and Consuming Digital Femininity*. London, U.K.: Palgrave Macmillan, 2012, pp. 209–228, doi: 10.1057/9781137283788\_11.
- [19] H. Kobayashi and T. Taguchi, "Virtual idol Hatsune Miku: Case study of new production/consumption phenomena generated by network effects in Japan's online environment," *Markets, Globalization Develop. Rev.*, vol. 3, no. 4, pp. 1–4, 2018.
- [20] A. Leavitt, T. Knight, A. Yoshida, P. Galbraith, and J. Karlin, "Producing Hatsune Miku: Concerts, commercialization, and the politics of peer production," in *Media Convergence in Japan*. Kinema Club, 2016, pp. 200–229.
- [21] I. Condry, "Hatsune Miku: Virtual idol, media platform, and crowd-sourced celebrity 1," in *Introducing Japanese Popular Culture*. Evanston, IL, USA: Routledge, 2018, pp. 123–133.
- [22] M. Hamasaki, H. Takeda, and T. Nishimura, "Network analysis of massively collaborative creation of multimedia contents: Case study of Hatsune Miku videos on Nico Nico Douga," in *Proc. 1st Int. Conf. Designing Interact. User Experiences TV Video*, New York, NY, USA, Oct. 2008, Art. no. 165168, doi: 10.1145/1453805.1453838.
- [23] R. Zaborowski, "Fans negotiating performer personas: 'Melt' by Ryo feat. Hatsune Miku," *Suomen Antropologi, J. Finnish Anthropological Soc.*, vol. 43, no. 2, pp. 104–108, Feb. 2019.
- [24] K. Y. Lam, "The Hatsune Miku phenomenon: More than a virtual J-Pop diva," *J. Popular Culture*, vol. 49, no. 5, pp. 1107–1124, Oct. 2016.



- [25] L. March, "'Wrap you up in my blue hair': Vocaloid, hyperpop, and identity in 'Ashnikko feat. Hatsune Miku—Daisy 2.0'" *Telev. New Media*, vol. 10, May 2013, Art. no. 15274764221093599, doi: 10.1177/15274764221093599.
- [26] K. Kärki, "Vocaloid liveness? Hatsune Miku and the live production of Japanese virtual idol concerts," in *Researching Live Music*. Waltham, MA, USA: Focal Press, 2021, pp. 127–140.
- [27] T. Herman. (2020) *K/DA, True Damage, and The Virtual Future of Artist Collaborations*. Accessed: Jan. 1, 2023. [Online]. Available: <https://www.mtv.com/news/ofpi04/riot-games-true-damage-kda-future-artist-collaborations>
- [28] Smilegate Newsroom. (2022). *Who is Virtual Music Artist and Influencer, Han Yua?* Accessed: Sep. 15, 2022. [Online]. Available: [http://newsroom.smilegate.com/bbs/board.php?bo\\_table=eng&wr\\_id=337](http://newsroom.smilegate.com/bbs/board.php?bo_table=eng&wr_id=337)
- [29] J. Bae and J. Cho. (2022). *Talent is on the Metaverse, and Being Born in it*. Accessed: Jan. 1, 2023. [Online]. Available: <https://koreajoongangdaily.joins.com/2022/04/30/business/tech/metaverse-HYBE-SM/20220430114842406.html>
- [30] C. W. Sul, K. C. Lee, and K. Wahn, "Virtual stage: A location-based karaoke system," *IEEE MultimediaMag.*, vol. 5, no. 2, pp. 42–52, Apr. 1998.
- [31] S. Schertenleib, M. Gutierrez, F. Vexo, and D. Thalmann, "Conducting a virtual orchestra," *IEEE MultimediaMag.*, vol. 11, no. 3, pp. 40–49, Jul. 2004.
- [32] T. Takala, R. Hanninen, L. Savioja, V. Valimaki, J. Huopaniemi, T. Huotilainen, and M. Karjalainen, "Concert performance in virtual reality," *J. Acoust. Soc. Amer.*, vol. 100, no. 4, p. 2608, Oct. 1996, doi: 10.1121/1.417635.
- [33] R. Hanninen, L. Savioja, and T. Takala, "Virtual concert performance-synthetic animated musicians playing in an acoustically simulated room," in *Proc. Int. Comput. Music Conf.*, 1996, pp. 402–404.
- [34] A. M. Webb, C. Wang, A. Kerne, and P. Cesar, "Distributed liveness: Understanding how new technologies transform performance experiences," in *Proc. 19th ACM Conf. Comput.-Supported Cooperat. Work Social Comput.*, Feb. 2016, pp. 432–437.
- [35] G. W. Young, N. O'Dwyer, M. Moynihan, and A. Smolic, "Audience experiences of a volumetric virtual reality music video," in *Proc. IEEE Conf. Virtual Reality 3D User Interface (VR)*, Mar. 2022, pp. 775–781.
- [36] A. Munoz-Gonzalez, S. Kobayashi, and R. Horie, "A multiplayer VR live concert with information exchange through feedback modulated by EEG signals," *IEEE Trans. Hum.-Mach. Syst.*, vol. 52, no. 2, pp. 248–255, Apr. 2022.
- [37] T. Kaneko, H. Tarumi, K. Kataoka, Y. Kubochi, D. Yamashita, T. Nakai, and R. Yamaguchi, "Supporting the sense of unity between remote audiences in VR-based remote live music support system KSA2," in *Proc. IEEE Int. Conf. Artif. Intell. Virtual Reality (AIVR)*, Dec. 2018, pp. 124–127.
- [38] H. Yakura and M. Goto, "Enhancing participation experience in VR live concerts by improving motions of virtual audience avatars," in *Proc. IEEE Int. Symp. Mixed Augmented Reality (ISMAR)*, Nov. 2020, pp. 555–565.
- [39] L. R. France and S. Spary. *Travis SCOTTS Virtual Concert on Fortnite Set a Record*. Accessed: Nov. 28, 2022. [Online]. Available: <https://edition.cnn.com/2020/04/24/entertainment/travis-scott-fortnite-concert/index.html>
- [40] H. Jenkins, *Convergence Culture: Where Old and New Media Collide*. New York, NY, USA: New York Univ. Press, 2006.
- [41] B. Dym, C. Aragon, J. Bullard, R. Davis, and C. Fiesler, "Online fandom: Boldly going where few CSCW researchers have gone before," in *Proc. Companion ACM Conf. Comput. Supported Cooperat. Work Social Comput.*, New York, NY, USA, Oct. 2018, Art. no. 121124, doi: 10.1145/3272973.3274542.
- [42] K. E. Ringland, A. Bhattacharya, K. Weatherwax, T. Eagle, and C. T. Wolf, "ARMY's magic shop: Understanding the collaborative construction of playful places in online communities," in *Proc. CHI Conf. Hum. Factors Comput. Syst.*, New York, NY, USA, Apr. 2022, doi: 10.1145/3491102.3517442.
- [43] S. Evans, K. Davis, A. Evans, J. A. Campbell, D. P. Randall, K. Yin, and C. Aragon, "More than peer production: Fanfiction communities as sites of distributed mentoring," in *Proc. ACM Conf. Comput. Supported Cooperat. Work Social Comput.*, New York, NY, USA, Feb. 2017, Art. no. 259272, doi: 10.1145/2998181.2998342.
- [44] J. Campbell, C. Aragon, K. Davis, S. Evans, A. Evans, and D. Randall, "Thousands of positive reviews: Distributed mentoring in online fan communities," in *Proc. 19th ACM Conf. Comput.-Supported Cooperat. Work Social Comput.*, New York, NY, USA, Feb. 2016, Art. no. 691704, doi: 10.1145/2818048.2819934.
- [45] Z. Lu, H. Xia, S. Heo, and D. Wigdor, "You watch, you give, and you engage: A study of live streaming practices in China," in *Proc. CHI Conf. Hum. Factors Comput. Syst.*, New York, NY, USA, Apr. 2018, p. 113, doi: 10.1145/3173574.3174040.
- [46] A. L. Jia, Y. Rao, H. Li, R. Tian, and S. Shen, "Revealing Donation Dynamics in Social Live Video Streaming," in *Proc. Companion Web Conf.* New York, NY, USA: ACM, 2020, p. 3031, doi: 10.1145/3366424.3382682.
- [47] D. Y. Wahn, G. Freeman, and C. McLaughlin, "Explaining viewers' emotional, instrumental, and financial support provision for live streamers," in *Proc. CHI Conf. Hum. Factors Comput. Syst.*, New York, NY, USA, Apr. 2018, p. 113, doi: 10.1145/3173574.3174048.
- [48] D. Y. Wahn, "Volunteer moderators in twitch micro communities: How they get involved, the roles they play, and the emotional labor they experience," in *Proc. CHI Conf. Hum. Factors Comput. Syst.*, New York, NY, USA, May 2019, p. 113, doi: 10.1145/3290605.3300390.
- [49] W. A. Hamilton, O. Garretson, and A. Kerne, "Streaming on twitch: Fostering participatory communities of play within live mixed media," in *Proc. SIGCHI Conf. Hum. Factors Comput. Syst.*, New York, NY, USA, Apr. 2014, Art. no. 13151324, doi: 10.1145/2556288.2557048.
- [50] D. Mcmilan and D. Chavis, "Sense of community: A definition and theory," *J. Community Psychol.*, vol. 14, no. 1, pp. 6–23, 1986.
- [51] TwitchTracker. *JURURU—Stream May 15, 2022—Stats on Viewers, Followers, Subscribers; VOD and Clips*. Accessed: Jan. 1, 2023. [Online]. Available: [https://twitchtracker.com/cotton\\_123/streams/39329436695](https://twitchtracker.com/cotton_123/streams/39329436695)
- [52] G. Gagneré and T. Anastasiia, "Keeping the living bond between actors and remote audiences in distributed virtual theater," in *Proc. 10th Int. Conf. Digit. Interact. Arts*. New York, NY, USA: ACM, 2021, doi: 10.1145/3483529.3483683.
- [53] Q. Guo, "How do fans purposively create information to promote a celebrity? An analysis of fans' information practices and literacy improvement," *Library Inf. Sci. Res.*, vol. 44, no. 3, Jul. 2022, Art. no. 101170. [Online]. Available: <https://www.sciencedirect.com/science/article/pii/S0740818822000330>
- [54] P. Vorderer, W. Wirth, F. Gouveia, F. Biocca, T. Saari, L. Jäncke, S. Böcking, H. Schramm, A. Gysbers, T. Hartmann, C. Klimmt, J. Laarni, N. Ravaja, A. Sacau, T. Baumgartner, and P. Jäncke, "MEC spatial presence questionnaire (MEC-SPQ): Short documentation and instructions for application," Report to the European Community, Maastricht, The Netherlands, Tech. Rep., IST-2001-37661, 2004.
- [55] Y. Hwang and J. S. Lim, "The impact of engagement motives for social TV on social presence and sports channel commitment," *Telematics Informat.*, vol. 32, no. 4, pp. 755–765, Nov. 2015. [Online]. Available: <https://www.sciencedirect.com/science/article/pii/S0736585315000271>
- [56] C. Jennett, A. L. Cox, P. Cairns, S. Dhoparee, A. Epps, T. Tijs, and A. Walton, "Measuring and defining the experience of immersion in games," *Int. J. Hum.-Comput. Stud.*, vol. 66, no. 9, pp. 641–661, Sep. 2008. [Online]. Available: <https://www.sciencedirect.com/science/article/pii/S1071581908000499>
- [57] J. M. Rigby, D. P. Brumby, S. J. J. Gould, and A. L. Cox, "Development of a questionnaire to measure immersion in video media: The film IEQ," in *Proc. ACM Int. Conf. Interact. Experiences TV Online Video*, New York, NY, USA, Jun. 2019, p. 3546, doi: 10.1145/3317697.3323361.
- [58] A. Strauss and J. M. Corbin, *Grounded Theory in Practice*. Newbury Park, CA, USA: Sage, 1997.
- [59] Wakmulwon. *Fancafe of Game Streamer Woowakgood*. Accessed: Jan. 1, 2023. [Online]. Available: <https://cafe.naver.com/steamindiegame>
- [60] E. Singer and C. Ye, "The use and effects of incentives in surveys," *Ann. Amer. Acad. Political Social Sci.*, vol. 645, no. 1, pp. 112–141, Jan. 2013.
- [61] E. Moustakas, N. Lamba, D. Mahmoud, and C. Ranganathan, "Blurring lines between fiction and reality: Perspectives of experts on marketing effectiveness of virtual influencers," in *Proc. Int. Conf. Cyber Secur. Protection Digit. Services*, Jun. 2020, pp. 1–6.
- [62] C. Fairchild, "Building the authentic celebrity: The 'Idol' phenomenon in the attention economy," *Popular Music Soc.*, vol. 30, no. 3, pp. 355–375, Jul. 2007, doi: 10.1080/03007760600835306.
- [63] O. L. Haimson and J. C. Tang, "What makes live events engaging on Facebook Live, Periscope, and Snapchat," in *Proc. CHI Conf. Hum. Factors Comput. Syst.*, New York, NY, USA, 2017, pp. 48–60, doi: 10.1145/3025453.3025642.

- [64] H. Yakura, "No more handshaking: How have COVID-19 pushed the expansion of computer-mediated communication in Japanese idol culture?" in *Proc. CHI Conf. Hum. Factors Comput. Syst.*, New York, NY, USA, May 2021, pp. 1–10, doi: [10.1145/3411764.3445252](https://doi.org/10.1145/3411764.3445252).
- [65] S. K. Brooks, "FANatics: Systematic literature review of factors associated with celebrity worship, and suggested directions for future research," *Current Psychol.*, vol. 40, no. 2, pp. 864–886, Feb. 2021, doi: [10.1007/s12144-018-9978-4](https://doi.org/10.1007/s12144-018-9978-4).
- [66] Y. Wang, H. Zhao, Z. Lu, and R. Wattenhofer. (2021). *Idols That You Decide: Understanding the Phenomenon and Practices of Fan-Idol Crowdfunding*. [Online]. Available: <http://ssrn.com/abstract=3843034>
- [67] R. C. King-O'Riain, "'They were having so much fun, so genuinely...': K-pop fan online affect and corroborated authenticity," *New Media Soc.*, vol. 23, no. 9, pp. 2820–2838, 2021, doi: [10.1177/1461444820941194](https://doi.org/10.1177/1461444820941194).
- [68] Jururu. (2022) *Review of Unreal Concert With 35000 Audiences!* Accessed: Jan. 1, 2023. [Online]. Available: <https://www.youtube.com/watch?v=l2pN09CzhWU&t=175s>
- [69] J. Kim, Y. Choi, M. Xia, and J. Kim, "Mobile-friendly content design for MOOCs: Challenges, requirements, and design opportunities," in *Proc. CHI Conf. Hum. Factors Comput. Syst.*, New York, NY, USA, Apr. 2022, pp. 1–15, doi: [10.1145/3491102.3502054](https://doi.org/10.1145/3491102.3502054).
- [70] ANIME NEWS NETWORK. (2021). *Hololive VTubers Come to Oculus Quest, Smartphones, More in Virtual Concert June 26*. Accessed: Sep. 5, 2022. [Online]. Available: <https://www.animenewsnetwork.com/press-release/2021-05-30/hololive-vtubers-come-to-oculus-quest-smartphones-more-in-virtual-concert-june-26/173380>
- [71] K. E. Onderdijk, D. Swarbrick, B. Van Kerrebroeck, M. Mantei, J. K. Vuoskoski, P.-J. Maes, and M. Leman, "Livestream experiments: The role of COVID-19, agency, presence, and social context in facilitating social connectedness," *Frontiers Psychol.*, vol. 12, pp. 1–10, May 2021. [Online]. Available: <https://www.frontiersin.org/articles/10.3389/fpsyg.2021.647929>
- [72] M. Shin, S. W. Song, S. J. Kim, and F. Biocca, "The effects of 3D sound in a 360-degree live concert video on social presence, parasocial interaction, enjoyment, and intent of financial supportive action," *Int. J. Hum.-Comput. Stud.*, vol. 126, pp. 81–93, Jun. 2019. [Online]. Available: <https://www.sciencedirect.com/science/article/pii/S1071581919300096>
- [73] S.-Y. Kim, "Liveness: Performance of ideology and technology in the changing media environment," in *Oxford Research Encyclopedia of Literature*, 2017.
- [74] A. B. Turner, "Streaming as a virtual being: The complex relationship between VTubers and identity," Ph.D. dissertation, 2022. [Online]. Available: <http://urn.kb.se/resolve?urn=urn:nbn:se:mau:diva-53529>
- [75] J. Maltby, L. Day, L. E. McCutcheon, J. Houran, and D. Ashe, "Extreme celebrity worship, fantasy proneness and dissociation: Developing the measurement and understanding of celebrity worship within a clinical personality context," *Personality Individual Differences*, vol. 40, no. 2, pp. 273–283, Jan. 2006.
- [76] E. Durkheim, "The elementary forms of religious life," in *Social Theory Re-Wired*. Evanston, IL, USA: Routledge, 2016, pp. 52–67.
- [77] M. K. Miller, J. C. Tang, G. Venolia, G. Wilkinson, and K. Inkpen, "Conversational chat circles: Being all here without having to hear it all," in *Proc. CHI Conf. Hum. Factors Comput. Syst.*, May 2017, pp. 2394–2404.
- [78] C. Ford, D. Gardner, L. E. Horgan, C. Liu, A. M. Tsaasan, B. Nardi, and J. Rickman, "Chat speed OP PogChamp: Practices of coherence in massive twitch chat," in *Proc. CHI Conf. Extended Abstr. Human Factors Comput. Syst.*, May 2017, pp. 858–871.
- [79] M. Carnein, D. Assenmacher, and H. Trautmann, "Stream clustering of chat messages with applications to twitch streams," in *Proc. Int. Conf. Conceptual Model*. Cham, Switzerland: Springer, 2017, pp. 79–88.
- [80] F. Vandenberg, "Put your 'hand emotes in the air:' Twitch concerts as unsuccessful large-scale interaction rituals," *Symbolic Interact.*, vol. 45, no. 3, pp. 425–448, 2022, doi: [10.1002/symb.605](https://doi.org/10.1002/symb.605).
- [81] S.-C. Lee, J. Song, E.-Y. Ko, S. Park, J. Kim, and J. Kim, "SolutionChat: Real-time moderator support for chat-based structured discussion," in *Proc. CHI Conf. Hum. Factors Comput. Syst.*, Apr. 2020, pp. 1–12.
- [82] J. McVeigh-Schultz, A. Kolesnichenko, and K. Isbister, "Shaping pro-social interaction in VR: An emerging design framework," in *Proc. CHI Conf. Hum. Factors Comput. Syst.*, New York, NY, USA, May 2019, pp. 1–12, doi: [10.1145/3290605.3300794](https://doi.org/10.1145/3290605.3300794).



**SEBIN LEE** was born in Incheon, Republic of Korea, in 1999. He is currently pursuing the bachelor's degree with the Global School of Media, Soongsil University.

From 2019 to 2021, he co-founded travel-tech and online-dating startups and was a chief technical officer helming the development of services for two companies. From 2021 to 2022, he performed his military duty with Bucheon Sosa Police Station. Since 2022, during his military duty, he has been a Researcher with the Enhanced Experience Laboratory (33Lab), Soongsil University, with the permission from Bucheon Sosa Police Station and Military Manpower Office, Republic of Korea. He is a Researcher with the Global School of Media, Soongsil University. His research interests include virtual concerts, virtual youtuber, and online entertainment.



**JUNGIN LEE** received the bachelor's degree in media engineering from Soongsil University, Republic of Korea, in 2010, and the master's and Ph.D. degrees from the Graduate School of Culture Technology, Korea Advanced Institute of Science and Technology (KAIST), in 2012 and 2017, respectively. He is currently an Assistant Professor with the Global School of Media, Soongsil University. His research achievements have been utilized in the movie and digital content

industries. Before his academic career, he founded tech startups KAI Inc., and LiveConnect Company Ltd., and was a chief technical officer directing the research and development related to immersive technologies for two companies. His current research interests include virtual/augmented reality and human-computer interaction to enhance immersive and interactive experiences in entertainment applications. During his Ph.D. course, he won the Young Researcher Award from the Korea Computer Graphics Society and Creative Award from KAIST.

...