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The Virtual Concert-goer: Audience Perspectives on Remote Music Performances

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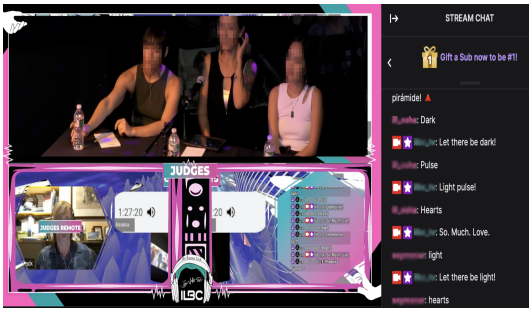

(a) O3 - International DJs perform in a live-streamed event blending in-person and online audiences via Twitch extensions



(b) O4 - Twitch and VR Chat stream showcasing a DJ set with virtual participants dancing in the live background

Fig. 1. Selected screenshots showcasing hybrid in-person and virtual audience interactions on different platforms, during our study observations

Our work explores how audiences perceive and engage with remote music events. The shift to digital platforms has transformed the live music experience, leading to the rise of remote music performances. Following the COVID-19 pandemic, platforms such as Twitch have been repurposed and surged in popularity as meaningful outlets for live music dissemination. Concurrently, novel platforms specifically crafted for music events have begun to emerge. Understanding the preferences and challenges of remote music audiences is crucial because it guides the development of platforms that answer effectively to varied user needs, which could enhance overall

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engagement and shape the future of music consumption. For this, we employed a qualitative multi-method approach, including a survey, interviews, and event observations, to start mapping the design space of remote music performances and capture a wide spectrum of audience perspectives. Our findings reveal audience engagement patterns in remote music events across different digital platforms, highlighting unmet needs, desires as well as opportunities for future HCI work in this area.

CCS Concepts: • **Human-centered computing → User studies**.

Additional Key Words and Phrases: music, concerts, audiences, live-streaming, performance, remote events, live music, users

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1 Introduction

The increasing integration of technology into our lives has fundamentally transformed live music experience, including the rise of remote music performances, i.e., musical events or concerts where the performers and the audience are not physically present in the same location, such as interactive livestreaming experiences or Virtual Reality (VR) concerts [76, 79]. Today, these virtual events not only grant access to a wider and more diverse audience but also redefine the relationship between the performers and their audience, reshaping our musical experiences in a way that we could not previously imagine [21, 71, 77, 94].

While remote performances cannot fully replicate the vibrant atmosphere and spontaneous interactions of an in-person concert, their popularity has grown significantly, particularly at times when physical gatherings were not feasible, like the COVID-19 pandemic, where virtual concerts were adopted as a solution to a crisis, rather as a result of a successful design or a planned move directed by the music industry [111]. Nevertheless, with social distancing measures in place and every one confined to their homes, remote concerts became a lifeline for both musicians and fans [97], and the music community demonstrated their resilience and creativity with how quickly they were able to adapt to a new normal [12]. Remote performances provided a sense of community and shared experience but they also emerged as a more sustainable alternative to traditional in-person event attendance [11].

With digital platforms now an established and popular avenue for reaching remote audiences, it is important to recognise that the landscape of remote music performances is incredibly diverse; different platforms have different benefits and drawbacks. For instance, Twitch, one of the first platforms to exclusively focus on live-streamed content, offers musicians who stream tools for monetisation and a wide array of customisation features for interacting directly with fans [42, 103][1]. Instagram Live, on the other hand, takes advantage of a pre-existing widespread user base and focuses on providing users more immediate and intimate livestreaming features. In addition to screen based streaming, there are increasingly popular VR-based platforms like VRChat that transport users into fully immersive 3D environments, have become spaces where audiences can attend virtual concerts, interact with other concertgoers' avatars, and even dance to the rhythm of the music [70, 93]. Concurrently, many other platforms, both large and small (e.g., Veeps[2], and StageIt[3]), also appeared in this space. However, it is important to acknowledge that some of these platforms have already disappeared, while others struggle to attract a significant audience. Difficulties could

[1]During the first year of "lockdown" (February 2020 to February 2021), Twitch saw music-related content increase by 359% (Music – Twitch Statistics and Charts n.d.)
[2]https://veeps.com
[3]https://www.stageit.com

be attributed to various factors, including a lack of understanding of the nuances and preferences of remote concertgoers, which makes it challenging to provide a satisfying experience. Therefore, the continued pertinence of both existent and emerging platforms depends decisively upon gaining an in-depth understanding of user needs and demands across the online space. This understanding will ensure that remote performance solutions go beyond momentary excitement, laying a groundwork for effectively addressing authentic user requirements.

Existing research, while valuable, has predominantly focused on individual livestreaming platforms or events in isolation [27, 42, 82, 103, 104]. This narrower focus may overlook the intricate interplay, cross-platform trends, and evolving user behaviours that characterise the broader ecosystem of remote music performances. Furthermore, it fails to recognise the affordances of remote performances as a unique medium for experiencing live music, rather than merely a digital extension of in-person events. With our work, we offer a broader, audience-centred perspective on remote music performances, with an emphasis on moving beyond the current limitations of platform-specific studies. To achieve this, we employ a multi-method research strategy consisting of (i) a survey, (ii) in-depth interviews, and (iii) remote music event observations, examining audiences of multiple platforms to understand their experiences. Our panoramic approach allows us to gather a variety of insights into how remote music events are perceived and engaged with, by diverse audience groups. The following research questions (RQ) guided our work:

- **RQ1**: How do audiences currently engage with and perceive remote music performances across different platforms?
- **RQ2**: How does technology influence the landscape of remote music performances?
- **RQ3**: What opportunities and challenges are emerging in the design space of remote music performance?

Our contribution is twofold. Firstly, we provide insights into remote music performances from the audiences' perspectives, identifying their engagement patterns across various platforms and pinpointing unmet needs and desires. Secondly, we present a set of learnings gained from our findings, with the goal to expand the design space of remote music performances and spark inspiration for future work in Human-Computer Interaction (HCI) and design research within the context of remote music events. Overall, we hope our work can benefit designers, musicians, artists, and scholars in this space by providing inspiration and assisting them in making informed decisions about content creation, platform selection, and design of engaging remote music experiences.

2 Background

2.1 Audiences in the digital age

Traditionally, audiences have been understood as consumers of content across various forms of media, including music, theatre, cinema, and games. However, digital technologies have significantly reshaped this role, shifting audiences from passive spectators to active participants [41]. Schrøder [86] defines audiences in the digital age as *"The people who, in their capacity of social actors, are attending to, negotiating the meaning of, and sometimes participate in the multimodal processes initiated or carried out by institutional media"*. As this definition highlights, in a digital landscape marked by interactivity and multimedia, the role of audiences has shifted from passive spectators to active participants [41]. People are no longer only consuming content but are also shaping its meaning and reach through real-time interaction, commentary, and sharing [14].

Live-streaming platforms like Twitch and YouTube have facilitated this transition by integrating chat and content creation tools, allowing audiences to directly engage with creators and influence their experience in ways that feel personal and communal [29, 43, 113]. By supporting both synchronous and asynchronous engagement, these platforms remove geographic barriers and

create a participatory culture where creator - audience relationships moves from "one-to-many" communication to "many-to-many" communication within the online space [10, 96].

The nature of this engagement varies across different content genres [112]. For example on gaming streams commentary and shoutouts are often used to strengthen community [44, 114], as well as options for collaborative gaming between streamers and viewers [96, 109] blurring the lines between player and spectator[87]. Meditation live streams, by contrast, focus on fostering consistency and community among practitioners, despite the weaker sense of social presence compared to in-person sessions [56]. Similarly, study-with-me and ambient streams offer a steady, reassuring background environment, where engagement is less about direct interaction and more about co-presence and motivation [53]. Meanwhile, cultural and knowledge learning streams provide a platform for experts, such as practitioners of intangible cultural heritage [58, 59] to engage with a large audience in real-time, facilitating interactive learning and cultural preservation, which can be further enhanced through collaborative archival documentation of the content [61]. Moreover, in some cases, creators extend audience interaction through digital personas. For instance, VTubing, where streamers use animated avatars to represent themselves, allows for an alternative form of presence [63] that maintains anonymity while allowing flexibility in how the streamers present themselves and perform during the streams [107]. This format, used mostly in gaming and entertainment streams, is attracting a growing viewership in East Asia, opening up new opportunities for creative expression in the digital space [52, 107].

One major outcome of such interactions is the intensification of parasocial relationships – one-sided emotional bonds audiences form with creators [37]. While traditional media mainly facilitated unidirectional relationships, digital platforms enable a more mutual connection, where brief live engagements nurture what Baym [4] calls connected fans. Interactions through live chat, acknowledgments, or personalised responses, create a sense of familiarity and connection that further bridges the gap between creators and audiences. Studies show these bonds deepen engagement and loyalty, amplifying the immediacy and intimacy of the streaming experience [3, 23, 48].

2.2 Music audiences 2.0 and 3.0

The rise of livestreaming platforms and the digitalisation of music consumption has significantly reshaped live music experiences. Historically, digital platforms served as supplements to in-person music events, but the COVID-19 pandemic transformed them into primary venues for artist-audience interaction [88, 89, 94]. Platforms like YouTube, Instagram, and Twitch allowed artists such as John Legend to connect with remote audiences from their homes, providing intimacy and access in ways previously unimagined [45, 75]. Meanwhile, large-scale virtual concerts by artists like Travis Scott on gaming platforms like Fortnite and Roblox drew millions of viewers, marking a new era for live, virtual events [32]. Independent musicians also leveraged these platforms to host live, interactive performances, cultivating close-knit community experiences [28]. The rapid adoption of livestreaming suggests lasting shifts in artist-audience dynamics, emphasising the need for ongoing research to understand the economic, social, and creative impacts of digital platforms for live music on the music industry.

Current studies in the area of remote participation in music concerts from the audience's perspective looked into isolated platforms or analysed specific events with a focus on distinct dimensions of the audience experience, such as solidarity and connectivity among the audience, the dynamics of artist-audience interaction, or the phenomena of platform appropriation. For example, Vandenberg et al. [104] explored how livestreamed concerts on Facebook Live foster collective solidarity, while Rendell [82] analysed "portal shows" through three case studies (online events on Instagram, Twitch, and StageIt), and argued that such shows can offer nuanced ways for artist-audience interactions

through spatial convergence afforded by video streaming and digital interfaces. Other scholars offered an ethnographic perspective on a jazz concert held during the pandemic, emphasising the spontaneity of the event and the unpredictable interactions between musicians and their real-time audience [18]. A study by Benford et al. [6] presents an ethnographic account of how two traditional folk clubs transitioned to online experiences using platforms like Zoom and Facebook. Based on their observations, the authors suggest that there is potential value in expanding the ways audiences can participate in online performances, and encourage a more varied and interactive approach. This viewpoint is further reinforced by Vandenberg [103], who investigated music consumption on Twitch and emphasised that digital platforms are best suited for enabling smaller-scale interactions. However, these studies largely lack a holistic, panoramic perspective that would allow us to understand broader engagement dynamics across multiple types of digital spaces and music genres. As a result, there is limited insight into how different platform affordances and audience expectations converge to shape a cohesive remote music experience.

2.3 Technology for remote music experiences beyond streaming platforms

While prior research has studied platform-specific audience behaviours, HCI research has largely focused on enhancing remote performance technology for musicians, overlooking the audience experience. For instance, the field of Networked Music Performance (NMP) has focused heavily on investigating the development of systems that enable geographically separated musicians to perform together, simulating in-person performances across networks [13, 38, 84]. Yet, while the result of such performances is often public, audiences often experience the performance passively (e.g., audience sitting in a concert room watching a livestream), due to unidirectional communication and latency limitations [85, 102].

Newer research efforts, like the field of Internet of Musical Things (IoMusT) proposed by Turchet et al. [101] (i.e., the extension of the Internet of Things paradigm to the musical domain) aim to overcome such technical challenges by enabling low-latency, multidirectional communication, thus opening possibilities for real-time audience participation [35]. However, the application of IoMusT remains limited in fully remote contexts [34]. Immersive technologies like eXtended Reality (XR) can further enhance audience connection in remote performances. Concepts such as the "Musical Metaverse" envision immersive, multidirectional concert interactions enabled by XR and IoMusT systems, offering an increased sense of presence and engagement for remote audiences [70, 100]. Studies in opera and other immersive environments have similarly shown XR's potential to deepen audience connection and participation through interactive interfaces [14, 95]. However, HCI research should prioritise understanding audience behaviours alongside technical capabilities, especially across platforms [72].

3 Our approach

The central objective of this study was to probe into existing audience experiences during participation in remote music events across diverse digital platforms, to understand behaviours and to discover opportunities for enhancing engagement, enjoyment, and interaction in remote music settings. We adopted a trifold data collection approach to ensure a holistic view of the audience experience through (i) a **26-question online survey** to gather insights into audience demographics, preferences, and attitudes toward remote music events; (ii) **semi-structured interviews** to go deeper into the nuances and complexities of audience engagement through personal narratives, which could not be fully explored through surveys alone; (iii) **observations of 11 remote music events**, totalling approximately 18 hours, across various platforms including *Twitch*, *YouTube*, *Instagram*, *Social VR*, and *Video On Demand (VoD)* to directly witness audience behaviours and interactions in real-time. The sequence of the data collection allowed us to refine our understanding

of the audience experience progressively. Starting with a broad foundation via the survey, we captured general audience demographics and preferences, then the interviews added depth and detail, and the observations provided real-world context and validation. We used the survey results to inform the structure of our semi-structured interviews, ensuring deeper explorations were grounded in preliminary data trends. Subsequently, insights from both the surveys and interviews guided the observational study, allowing us to target specific behaviours and interaction patterns across platforms. The findings were then integrated to begin mapping out a clearer picture of how audiences currently engage with remote music performances (**RQ1**), the role of technology in shaping these experiences (**RQ2**), and the emerging design considerations for future HCI work in this space (**RQ3**). The qualitative multi-method approach validated the findings through multiple lenses and enriched our understanding of explicit audience interactions and feedback. The study was approved by the ethics board of the first author's institution. Below, we detail the methods associated with each data source.

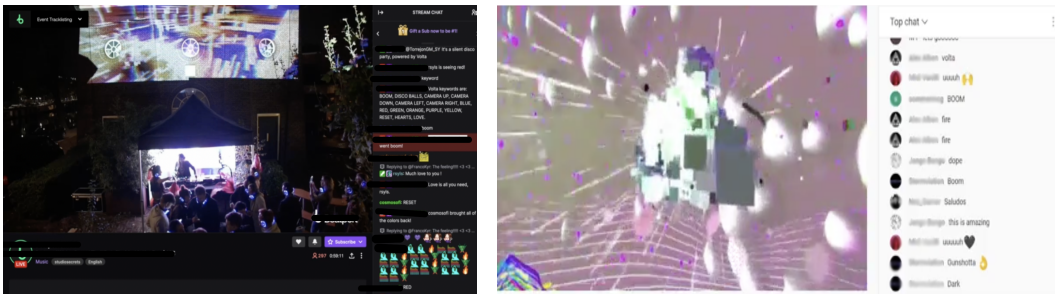
3.1 Data collection

3.1.1 Qualitative survey. We started our research with an online survey to gain an overview of remote audiences' general attitudes, preferences, and demographics. The survey included 26 questions, combining multiple-choice and open-ended queries. Participants reported their frequency of attending remote music events, the platforms they used, and recalled memorable at-home performances, noting both positive and negative aspects that made these experiences unique. The survey served as the first phase of our methodology, aimed at gaining a broad overview of audience characteristics and preferences. Insights from the survey then guided the design of the subsequent interview and observation phases.

3.1.2 Semi-structured interviews. Building upon survey insights, we conducted 25 interviews to go deeper into the individual experiences and perceptions of remote music audiences, to clarify ambiguities, and to understand the audiences' journeys. The survey data guided our participant selection from diverse backgrounds and helped us identify themes to investigate such as the role of interactive features in enhancing audience engagement and the impact of platform choice on the overall experience.

We recruited interview participants separately from survey respondents to ensure a diverse range of perspectives and to avoid any potential bias. Each interview lasted approximately one hour and followed a semi-structured format. All interviews were audio-recorded and transcribed using an online automated transcription tool, with transcripts cleaned by two researchers for accuracy. The rich data gathered from the interviews contributed to our understanding of the audience's emotional and behavioural responses to remote music events and added layers of meaning to the initial findings from the survey. Furthermore they guided the focus of our subsequent observational research, highlighting specific aspects and dynamics of audience engagement to be observed in the remote music events.

3.1.3 Remote music performance observations. Our observations of remote music performances complemented the survey and interview findings. Through the observations we were able to gain first-hand experience and capture real-time audience behaviours, interactions and engagement in the natural setting of the remote music performances. We conducted the observations last to validate and contextualise the self-reported data from the survey and interviews with practical evidence of how audiences experienced and interacted within this setup, and to uncover behavioural patterns that may not have been articulated by participants. We observed 11 online music events (O1-O11), hosted on platforms like Twitch, YouTube, Instagram, Meta Horizon Worlds, and Video On Demand (VoD) (see Table 2). The events were selected to represent a diverse range of formats,



(a) O5 - AI-enhanced chat using a chatbot to address latency, enabling real-time keyword-triggered customisation

(b) O2 - Interactive keywords drive performance customisation, taking over the chat and shifting focus from general conversation to visual engagement

Fig. 2. Screenshots from observed events in our study, showcasing key moments of audience interaction and platform features

genres, audience sizes, technological interfaces, and interaction styles[4]. We primarily focused on observing remote music performances on platforms mentioned by our participants in the survey and questionnaire, ensuring that our observations were directly relevant to the experiences and preferences expressed by our audience sample (YouTube, Instagram, Twitch, VoD)[5]. To broaden our understanding, we also included two events on platforms that were not explicitly mentioned by participants (Meta Horizon Worlds and Veeps). The observations were both passive (to understand the natural flow of events) and active (to interact with the interface and other users to empathise with them). Observation data was captured real-time, using post-its and screenshots on a collaborative Miro board[6], focusing on elements such as audience participation, technological affordances, and the dynamics between performers and viewers. The integration of observational findings with the insights from the survey and interviews allowed us to construct a multidimensional understanding of the remote music performance audience experience, ensuring that our conclusions were grounded in a blend of reported experiences and observable behaviours.

3.2 Participants

Survey participants and interview participants were two distinct groups, with no overlaps. To recruit participants who attend remote music events we shared links to a sign-up form, with our personal and professional networks via personal correspondence, emails, social media (Facebook, Instagram), distributed 40 postcards to students in an international university and reached out to relevant groups to spread the word on their social media pages. After analysing the survey results, we extended a targeted call for interview participants, using the same distribution channels, specifically reaching out to individuals who used the platforms mentioned in the survey. All participants were informed of the study's purpose and provided informed consent.

[4]We note that although four of the events observed were electronic music events, each had a different type of configuration and interaction.

[5]Video conferencing platforms were frequently mentioned by our participants. Nevertheless, the event observations happened after the COVID-19 pandemic, hence such platforms were no longer frequently used for concerts, therefore we did not observe events on them.

[6]https://miro.com/

Table 1. Summary of remote music events observed

ID	Event	Platform	Music Genre	Viewers	Length (mins)	Description
O1	J.Balvin Futurum	Meta horizon worlds	Rap / Pop	<20	40	A 180-degree concert of a selection of the artist's best hits. The platform allowed audiences to view the concert in VR, use interactive drum kits and fashion props.
O2	Hybrid Drum N' Base set	YouTube using Volta	Drum N' Base	<100	90	Hybrid event where remote audience influenced the background visuals by inputting keywords into the chat. The streamed content was simultaneously displayed behind the artist at the in-person event. Remote viewers were able to see the physical venue and the in-person audience. No interaction between the artist and the remote audience (see Figure 2b).
O3	Electronic music competition	Twitch using multiple extensions	Electronic Dance Music (EDM)	<100	180	The event was hybrid with in-person audience in the same physical location as the presenters. Musicians were streaming and performing live music from their respective countries. The broadcast incorporated interactive visuals and allowed for audience voting (see Figure 1a).
O4	Drum n' Base DJ set	Twitch and VR Chat	Drum n' Bass	<200	60	A DJ set simultaneously streamed on Twitch and VR Chat. The audience dancing in VR Chat was visible as the background of the Twitch Stream, behind the DJ. Shout-outs to new and returning viewers, stream chat and donations were all visible in the event screen (see Figure 1b).
O5	Hybrid DJ set	Twitch using Volta	EDM	<400	120	Hybrid outdoor event allowing remote audience to influence the background visuals by inputting keywords into the chat. The content streamed on Twitch was simultaneously projected on the buildings behind the artist. Remote viewers were able to see the physical space and the in-person audience (see Figure 2a).
O6	Piano set	Twitch	Classical / covers	<1000	120	Artist playing piano from their bedroom, taking in song requests from the audience. Most requests are for game or movie soundtracks. The artist looks at chat between songs and interacts with the audience verbally.
O7	Aerosmith	YouTube	Classic Rock	<1000	60	Aerosmith Rockisums Maximus Tour old concert was streamed for the first time, as a one-off event. No possibility to re-watch after event finished.
O8	Foo Fighters	Veeps	Alternative Rock	n.a.	90	The band's pre-recorded performance was broadcast online and remained accessible for 72 hours. It included behind-the-scenes clips and conversations among band between tracks. A live chat feature allowed viewers to comment in real-time (see Figure 3a).
O9	BTS - Proof	YouTube	Pop	aprox 1mil	30	Album release event during which the band performed songs from the album in a relaxed outdoor setting. Between songs artists would talk between them and discuss the stories of the songs. The event is still available online to re-watch with the chat replay also available. (see Figure 3b)
O10	Eurovision 2023	VoD (BBC iPlayer)	Pop	162mil	240	An international broadcast of the European music competition incorporated audience voting through an app. Online viewers actively engaged with the event, using Eurovision-specific hashtags on platforms such as X to share opinions, memes, and follow the competition in real-time.
O11	Live at Home	Instagram Live	Acoustic	>300K	60	Weekly Instagram live sessions on a band's Instagram account every Friday. During these sessions, the main artist would sing the ten most popular songs chosen by the audience that week. A live-chat allowed in-real time commenting and the artist read and replied to comments in between songs.

3.2.1 Survey participants. 67 participants were recruited, from 16 geographical regions (including Europe, North America and East Asia) and ages ranging from 18 to over 55 (27%: 18-24, 40%: 25-34, 12%: 35-44, 9%: 45-54, and 12%: over 55). Participants identified as 33 women, 32 men, 1 non-binary and 1 individual who preferred not to disclose their gender. Remote event attendance included 14% weekly, 5% monthly, 15% seasonal, 15% yearly, and 51% rarely (attended few such events). Participants used a variety of platforms to engage with remote music events with the most commonly used being YouTube (59%), TV / VoD (53%), Instagram / TikTok / Facebook (24%), Facebook (28%), teleconferencing platforms such as Zoom (20%), Twitch (19%), social VR tools like VRChat or Engage (10%), Other (e.g., Veeps, Discord, We-verse) (15%).

3.2.2 Interview participants. We conducted semi-structured interviews with 25 participants, representing a mix of demographics, interests, and living situations. Participants identified as 10 women,

14 men, and 1 individual who preferred not to disclose their gender. Their ages spanned several brackets: 28%: 18-24, 52%: 25-34, 10%: 35-44, 6%: 45-54, and 4%: over 55. They came from diverse geographical regions including Britain, Spain, Italy, Taiwan, Turkey, Greece, Cyprus, Romania, Liechtenstein, Germany, and the USA. Every participant had attended at least a few remote music events. Their attendance frequency varied: 24% attended events occasionally (a few events here and there), 20% at least once a year, 28% attended three or more events annually, 12% monthly, and 16% weekly. The platforms they used for these events included TV / VoD (24%), YouTube(48%), Instagram / TikTok / Facebook (28%), Twitch (28%) specialised streaming platforms (28%), social VR tools like VRChat or Engage (20%) and other platforms such as Zoom (8%), with all participants having used multiple platforms.

3.3 Data analysis

We employed an iterative open-ended coding process, identifying data patterns related to desires, opportunities and challenges. We started this process by analysing the survey data. First, the main researcher familiarised themselves with the data by reading the entire dataset. At this point, they documented their thoughts and took preliminary notes such as *Participants want technology to stay in the background, keeping the focus fully on the performer*; *Most participants feel that current engagement strategies lack enough interaction and do not fully engage audiences*; *The concept of "live" appears fluid within the digital space*. Some of these notes informed the interview questions and the finalised thematic analysis. This was followed by a preliminary coding of the open-ended questions. After processing the remaining data (such as interviews and observations) in a similar manner, the main researcher refined the coding. Subsequently, another researcher collaborated with the main researcher to review and analyse the coded data, by integrating and comparing initial codes from all data sources. To ensure the other two team members were aligned, detailed documentation of the initial coding and clustering processes was shared, followed by group sessions for discussion and feedback. Through the iterative process, the team was able to determine which codes were most useful for interpreting relevant themes, how they may be combined according to shared meanings, and which could be discarded. The generated themes were finally grouped in three higher-level themes encapsulating key insights drawn from the triangulated data sources, reflecting a multi-perspective analysis.

It is essential to recognise that the researchers' backgrounds inherently shaped the analytical lens applied to this study. The team comprises of experts from design, performance, XR, and music technology. All authors come from Western backgrounds and work within or around the immersive technologies domain, which influenced our focus on digital interactions and user engagement. While these diverse backgrounds enriched our analysis, they also introduced specific subjectivities, such as our preference for events with audience interaction and our focus on designing more immersive remote music experiences. We continuously engaged in reflexive practices throughout the study, ensuring that our interpretations remained grounded in the data while being aware of our positionalities.

4 The Digital platforms for remote music performances

As shown by data in Sections 3.2.1 and 3.2.2, participants in our study accessed remote music performances across a variety of platforms, each with distinct features and interaction options to shape their engagement. This range indicates that the future of digital music experiences is not one-size-fits-all but rather a spectrum of tailored options to meet the needs and preferences of audiences. Before we present the main themes developed from our data analysis, in this section we provide a summary of the platforms our participants used, some of their reported affordances and limitations, and the audiences' interactions with them. It is important to clarify that these insights

are based on our participants' experiences and thus represent common, but not exhaustive use cases. [7]

Twitch is a live-streaming platform initially known for gaming [99] but increasingly popular for live music performances, especially among indie and experimental artists. It enables real-time direct interaction between artists and audiences through chat, emotes, and interactive extensions, allowing for personal and unscripted engagement. Engagement ranges from casual conversation to responding to music requests, creating a highly interactive and personalised music experience.

All our interview participants who used Twitch for music were also avid gamers, which likely contributes to their familiarity with Twitch's digital norms and interactive culture as well to the fact that they use Twitch for music quite frequently. Participants reported often using Twitch passively, streaming music in the background while multitasking. One noted, *"Whenever I listen to music on Twitch, it's not an experience that captures my entire attention[...] I always have it open on the second monitor or in the background"*. This behaviour reflects a broader trend of multitasking in digital media consumption [40]. Despite passive use, moments of active participation are common. Users join the chat to engage in digital rituals that create a shared experience. As one participant said, *"The chat is a huge part of the experience. Something bad happens, everyone spams an emote[...] Something good happens, they hype the thing up"*. Moreover, interactive extensions on Twitch, such as voting polls and Volta XR[8], further enhance the experience by allowing audiences to influence the performance, thus adding an element of experimentation and personalisation. However, we observed during certain events (like O3 and O5) that these features sometimes constrained real-time dialogue among viewers (see Figure 2b). Users became more engrossed in the interactive elements, which could limit audience-to-audience and audience-to-artist interaction, suggesting that while interactive extensions offer novel ways to experience music, they may create a trade-off between personal engagement and communal interaction in the digital space.

YouTube, is a global video-sharing platform that allows users to upload, view, and share videos across a vast array of content categories. Its widespread accessibility, high-quality video streaming features, and massive user base make it a primary destination for streaming music performances. YouTube was the most popular platform amongst our participants, as it caters to a diverse audience demographic from casual listeners to dedicated fans of specific artists or genres, with usage patterns varying significantly. Our participants reported using YouTube primarily to access mainstream music performances and big-name artists' concerts (either live-streamed or pre-recorded but played one off such as O7). Unlike Twitch, engagement on YouTube often appeared as more sporadic and one-off, particularly for live music events. Our study observed that direct interaction with artists or other audiences on YouTube is less frequent (or non existent). One of the reasons for this is the larger scale of events and audiences, which often makes personal interaction challenging and less likely. P7 noted *"On YouTube, there are tons of messages happening, so it's quite difficult to even interact,"*. Another issue highlighted by our study participants is the sometimes overwhelming nature of YouTube's algorithm-driven content suggestions. While this feature can aid in discovering new music, it can also lead users away from their initial intent, contributing to a less focused music experience.

Social VR platforms, such as VR Chat, Engage VR, Altspace and Meta Horizon Worlds, enable users to interact in immersive, three-dimensional virtual spaces avatars through VR headsets [66, 67]. In recent years, they have emerged as spaces where users go for experiencing live music [65]. Amongst our participants VRChat stands out as a popular choice, with those using it engaging with it on a daily or weekly basis. One participant shared: *"Basically I attend more or less every drum*

[7]Video-streaming platforms like Zoom were omitted due to the lack of events post-pandemic.
[8]https://www.volta-xr.com, An extension that allows audiences to influence the visuals of a performance

piece event, and because VRChat is worldwide, you can go wherever you want. Later I will go to a dancing world to dance for one, two hours and after that I will go to a Rave.(PI07)" In VRChat, small to medium electronic artists often perform in magical spaces, creating an intimate, community-centric atmosphere. Users engage primarily through VR headsets and motion trackers, with some enhancing their experience using haptic vests for tactile feedback. Despite the computational demands, this immersive setup contributes to a concert experience that many participants described as closely mirroring the feelings of a live, in-person performances. Notably, VRChat performances are often simultaneously streamed on Twitch (O4), allowing non-VR users to engage as well. As one participant explained *"A lot of VR events have a video player in the world, and you just show a Twitch stream... It's pretty much, you have the same music, you listen to the same video feed just in very different contexts. (PI10)"* Social interaction is a significant aspect of these platforms; attendees go to dance [73], meet friends, or even perform as part of the show, enriching their virtual experience. The ability to customise avatars allows users to express their individuality [24] and enhances the sense of presence during virtual concerts. However, the capacity limitations of social VR present a unique challenge. For instance, VRChat allows only 80 people per instance of a world, meaning larger audiences must be spread across multiple, unconnected instances, and typically only the first instance features the live artist. This segmentation can make it difficult to create a unified concert experience, yet it allows for more intimate and varied interactions within smaller groups.

Bespoke platforms like Veeps and StageIt are specialised online services hosting remote music performances that often require ticket purchases. They offer exclusive, high-quality musical experiences not typically available on mainstream platforms and gained popularity during the COVID-19 pandemic, catering to audiences who value exclusivity and superior production quality. The type of audience that gravitates towards these platforms typically includes avid music fans who are willing to pay for the added value that these platforms provide, often seen in the form of high audio quality, meticulously curated line-ups, and unique interactive features such as Q&As. Participants appreciated that these platforms closely mimic attending high-end concerts or festivals, offering the convenience of remote access and the opportunity to support their favourite artists directly. However, despite their premium offerings, participants noted that bespoke platforms sometimes lack the wide-ranging community feel of more accessible platforms like YouTube or Twitch, leading to a more isolated viewing experience with limited interaction among music enthusiasts. Additionally, discoverability is a significant challenge. Without large user bases or sophisticated recommendation algorithms, these platforms rely on targeted marketing and word-of-mouth, making it harder for users to find new and interesting events. Some participants even had difficulty recalling the names of these platforms, indicating issues with brand recognition in a crowded digital space. While they offer valuable experiences, bespoke platforms may need to improve their visibility and community features to fully enhance user engagement.

Video on Demand (VoD) services provide high-quality, structured access to pre-recorded or live-streamed content, offering the flexibility to watch major events on demand, much like traditional television. Participants frequently mentioned VoD platforms such as BBC iPlayer as their preferred choice for watching live from home large-scale physical music events. The performances streamed by VoD platforms were valued for their high production quality, with participants appreciating features like behind-the-scenes footage and expert commentary, which contribute to a polished viewing experience. Moreover, VoD platforms deliver widely broadcast content that appeals across age groups, thus are ideal for events that bring together diverse audiences – from younger viewers to older generations accustomed to TV broadcasts. Unlike interactive streaming platforms, VoD services lack real-time engagement features, but this was not seen as a limitation. On the contrary, participants noted that they use VoD services to watch live music performances with others, in the same physical space. For events like Glastonbury or Eurovision, participants valued the shared

experience of watching with family or friends, often transforming their living spaces into "festival sites" for these remote broadcasts.

Social media platforms like Instagram Live provide artists with accessible ways to perform music and engage directly with fans in real time. Through livestreaming features, artists can host impromptu sessions, planned performances, or interactive Q&A events. Participants in our study valued the informal and personal connections these platforms foster. The ease of discovering and accessing music content on social media was a significant draw, appealing to both casual listeners and dedicated fans. Direct interaction through comments and reactions enhanced the sense of community, allowing fans to engage with artists in real time. This cultivated a sense of intimacy not typically found on platforms like YouTube or Twitch, where larger audiences and more structured interfaces can dilute personal engagement. However, participants also noted limitations. The transient nature of content meant live events could be easily missed, and the ephemeral experience contrasted with platforms where content remains accessible indefinitely. While this fleeting nature heightened the exclusivity of live events, it posed challenges for lasting engagement. Additionally, some observed that audio and video quality on social media platforms could be lower compared to dedicated music services. Content discoverability was another issue; algorithm-driven feeds impacted the consistency of finding and engaging with live music events.

5 Findings

In the following sections, we unpack the specific facets of the audience experience, capturing both the joys and the gaps encountered. We report on the overarching themes we developed through our analysis which look into (i) community building and interaction patterns, (ii) redefining here and now, and (iii) the universal reach of remote music events. Our themes point towards opportunities and challenges in the space and for further design and research. Interview participants are named as **PI01-25**, survey participants are named as **PS01-67** and event observations are named as **O1-O11**.

5.1 Community building and interaction patterns

5.1.1 Emergent communities. The rise of new communities focused on remote music attendance marks one of the key characteristics of the contemporary digital landscape. PI10's experience illustrates this trend, highlighting how virtual interactions are transcending digital boundaries and fostering new types of connections: *"I've made so many friends (online) that I just want to hang out with [...] exactly the same reason why I would go out with friends in real life."* Integral to this community building is the role of chat and other interactive features, which facilitate a deeper level of engagement among remote music audiences: *"Having some level of interaction for the audience, I think is also really important. And, I think that's what sort of holds people's attention (PI15)."* This active participation fosters a sense of belonging and identity among members, extending beyond their usual social circles to include diverse viewpoints, as described by PI11: it is *"nice because it creates some sort of debate, some friendly fights about who we didn't like."* The tribes and groups forming around the experience of remote live music, like any other community, appear to develop around the emergence of shared idioms, rituals, and a collective memory of the remote performance. As communities around remote music events solidify on various digital platforms, the distinctive features of each platform evolve to serve more than just communication purposes, they become integral to the cultural identity of these groups.

On YouTube, communities are often bound through its algorithm, with interactions focusing more on post-event engagement through comments and discussions. On paid platforms, the interaction is centred around specific artists, while the exclusivity of the content fosters a stronger community bond. On Twitch, the community dynamics are distinctly shaped by the platform's interactive features. As PI10 notes, the use of *"a bunch of blinking emoji,"* during streams is a common practice

to *"hype up the mood,"* demonstrating how digital expressions can enhance the collective experience. Additionally, PI03's observation about using specific catchphrases related to past events highlights a deeper level of community engagement. These phrases act as 'callbacks' to shared experiences, fostering a sense of collective memory and belonging among long-time members. Such practices, including 'emote spamming' and the use of unique catchphrases, have evolved into nuanced ways for community members to signal their 'in' status within the group. This behaviour exemplifies the development of a shared language and cultural norms unique to the Twitch community.

In social VR communities, unique expressions of appreciation, such as *"throwing a snowflake emoji,"* at the DJ to signify approval while eschewing more common symbols like hearts (as mentioned by PI05), illustrate the development of specific embodied communal rituals and symbols. These practices are not merely retained in VR but are adapted to align with its immersive environment, showcasing the community's shared interests and the development of a unique cultural identity within the VR space. Unlike the more public and observable interactions on platforms like Twitch, VR communities tend to form in intimate, semi-private spaces. These communities are built on personal interactions and word-of-mouth, as highlighted by PI01's description of a public VR world that serves as a gateway for newcomers to navigate the VR community: *"There's one world, Club Orion, that's public, there's like almost always someone inside...maybe you befriend them...and then you kind of start to learn where to go (PI01)."* Members not only engage in regular interactions but also collaboratively shape their environment, this illustrating the community's adaptability, inclusivity, and strong emotional ties. As PI06 notes, *"remote live performance in VR is authentic, part of a folk culture,"* that one must be actively involved in to fully appreciate.

5.1.2 Artist-audience interactions as community building blocks. In our study, participants frequently emphasised the importance of creating a sense of closeness with the artist, a dynamic they viewed as distinct from in-person events. *"I think the strength of remote technology for music events is exactly the creation of that feeling of a one-to-one connection with the artist and that intimacy that comes with it! (PS42)."* Unlike traditional live events where the scale and setting might limit personal interaction, remote events can create an environment where fans feel a personal connection with the artist: *"Remote events offer more opportunities for intimate feelings with the artist. It's just you and them in some occasions, you see them up close and personal even if you are miles away. [...] It's really nice to just sit there and have your own emotional moment with the artist. I mean, you can do that in live experiences but it's slightly embarrassing." "So it actually felt really indulgent because you just had that person in your living room. It felt like a personal concert and there was no one else watering that down (PI12)."* This sense of intimacy is heightened by the digital platforms' ability to facilitate points of view that might not be possible in a physical venue *"to see the performers from a clear and close up side makes it feel like they are performing just for me (PS07)."* or by the increased exposure fans gain to the entire music making experience *"I feel [...] a more personal relationship with [artists] when you get a sense of what happens behind the scenes (PI02)."*

Another aspect that stood out for audience members was receiving recognition from the performer, such as a "shout out", as mentioned by PS12, *"I think that the artist responding to the fans is important."* This element of personalised, direct interaction was often highlighted in our survey and interviews as one of the important aspects of remote music performances, making the moment memorable: *"a musician on Instagram playing the piano [...] he read my account name out and played a song I requested (PS11)."* Shout outs took different shapes during our observations. For example, in event O4, usernames appeared prominently on the screen during the Twitch stream, giving each fan a visible moment of recognition. In event O6, the artist personally acknowledged specific fans by name and played their song requests. Fans responded with emojis and enthusiastic comments,

reinforcing a sense of connection and excitement that made the interaction feel meaningful and direct.

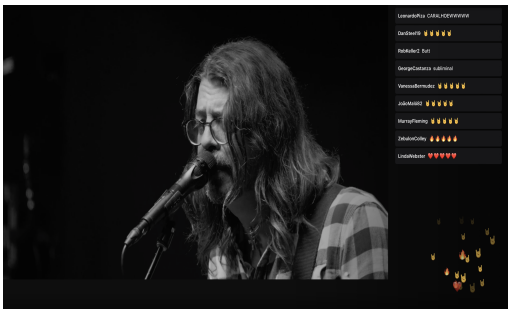
However, it is important to note that while digital intimacy in remote music performances can sometimes be authentic, it can also create an illusion of connection. This concern was articulated by some of our interviewees, such as PI08, who observed, *"it can give a false sense of belonging and friendship and connection because technically, even if I'm watching someone live, I'm not actually connecting with them. To them, I'm literally just a username, if they see that."* This highlights the potential for a discrepancy between the perceived intimacy and the actual level of connection in digital interactions, emphasising the need for a balanced understanding of the nature of these remote engagements.

5.1.3 Co-creation and playful interaction in community building. Online space blur the boundaries between artists and their audiences, leading to a flourishing era of co-creation and collaborative artistry. PI09 gave an example of this shift: *"Snow Patrol... had Saturday Sessions where he would... interact with the audience on Instagram lives. He would ask the audience for lyrics, and a song emerged from that, crafted from the lyrics provided by their fans."* This was also evident in our event observations where we saw a desire from remote audiences to engage more profoundly and collaboratively, yearning for a role in the co-creation process. We observed a surge in message participation when platforms used extensions such as VOLTA XR (events O2, O5 in Table 2), which facilitates audience involvement in shaping the concert visuals through text commands. Moreover, interaction further intensified when the effects were overlaying the artist, signifying a desire to connect with them beyond just having an impact on the performance. Furthermore in O6 and O11, audiences engaged a lot more actively in the sections where the artists asked for their contributions or thoughts as to what to play next, voicing their thoughts and eagerly trying to engage in the music-making process.

Additionally, the inclination towards playful engagement during remote music events is a key aspect of co-creation between artists and audiences. Our events observations revealed a desire to engage in playful activities while attending remote music events. We saw that participants often appropriated features of existing digital platforms for playful interactions, engaging in impromptu activities both among themselves and with the performers. This kind of emergent play manifested in various forms, from smaller types of spontaneous interactions such as play with words during chat conversations (O2 – Table 2), emoji patterns and chants (O7, O9 – Table 2, Figure 3) to more structured forms of play leaning towards gamification such as fans and artists creating their own games and challenges during the performance (O6, O3 –Table 2). Moreover, during the interviews and questionnaires, when participants talked about the aspects of remote events they most enjoy, they often gave examples of interactions that went beyond back and forth with the performer and included mini 'games' that determined the music being played *"There's also a YouTuber [..] who asks audiences to give him three to five words and raps using those three to five words (PI02)."* Such instances could be considered as *play potentials* - i.e., existing manifestations of playful engagement that emerge naturally in ordinary scenarios and that seem to be contextually meaningful and socio-emotionally productive [2]. They reveal a natural inclination for audiences and artists to seek and create their own entertaining experiences during remote music events.

5.2 Redefining here and now through remote music

5.2.1 Temporal fluidity. Digital platforms like Twitch, Instagram Live, and VRChat are redefining the concept of 'live' in music performances. They offer dynamic participation in live events, unbound by physical presence or traditional temporal constraints. Audience engagement varies: some viewers stay synchronised with real-time broadcasts, while others utilise the flexibility to pause or rewind,



(a) O8 - A one-off, pre-recorded Foo Fighters concert, showing the lead singer's intimate performance style. Fans engage in real-time with emojis



(b) O9 - Purple hearts light up the chat as fans show their devotion to BTS, adding a touch of virtual togetherness to the online concert

Fig. 3. Screenshots from observed events in our study, showcasing key moments of audience interaction

PI08 noted, *"So in real life, no matter how you're feeling, if you are hungry or wherever happens, it's happening. Whereas online, I can [...] I can pause it, and actually, obviously, there's a convenience that comes with that."* This flexibility reshapes what 'live' means, allowing to pause a livestream and dissect, discuss, and deeply engage with specific moments as they unfold. This is in contrast to in-person events, where discussions are often postponed until the end, relying on *collective memory*. One participant noted, *"You can control what's happening, [...] you can rewind [...] sometimes I'll spot things, I'll press pause and have a running commentary alongside what I am actually seeing (PI12)."*

This observation supports the idea from Hammelburg [30] that the meaning of 'live' in a mediated, digital context is constantly evolving and being re-defined. Specifically, while digital platforms grant audiences greater agency over their viewing experience, it means that not all viewers are experiencing the event in the same temporal frame. Yet, the shared content and the communal nature of these platforms ensure that audiences remain connected to a sense of a 'live' experience, bound by their collective interest in the event. This suggests that *liveness* in this context is less about temporal simultaneity and more about the depth of engagement and the shared experience, even if temporally staggered. This is in line with Benford et al. [6], who discusses this fluidity of *liveness* in the context of the ethnographic account of two traditional folk clubs going live.

Moreover, it appears that even pre-recorded music performances can evoke a strong sense of *liveness* among viewers. Even though events O1, O7 and O8 (see Figure 3a) were pre-recorded performances, because they were streamed during a certain moment in time, audiences interacted between them as if they were attending a live event. During event O1, attendees danced and cheered while the concert was being broadcast and during events O7 and O8, audiences used the chat the same way they did in live-streamed events, commenting at certain moments, cheering the artist, and interacting with the performance as it was unfolding. The perception of *liveness* is therefore a combination of the viewer's belief, which is anchored by specific markers and cues within the content, and their active interactions with both the performance and other audience members.

However, this perception can vary. A viewer might feel a performance is 'live' due to real-time chat, even if the music is pre-recorded. Conversely, a lack of audience interaction or artist responsiveness might make a real-time performance feel like a replay. Yet, such discrepancies highlight the multifaceted nature of live experiences: pointing to the need of delving into how audiences perceive time during a performance, whether they value synchronous interactions with fellow viewers or the artist, or how they might switch roles - from a passive viewer to an active participant commenting on the performance: *"Once you start immersing yourself in the possibility*

space of these live performances, it could be interesting to start layering levels of reality on top of each other, like this sort of layering of temporally things that happened in the past happening alongside what you're experiencing right now and sort of layering on previous audiences onto the experience (PI06)." The dynamic interaction with time unlocks novel creative avenues for performers and creators, and helps them craft experiences that truly resonate with the audience's evolving definition of *live*. PI06 exemplifies: *"But that in itself is kind of an interesting wrinkle on the sort of recorded experience performed as a live concert as you get some oddities like that,"* - i.e., the artist is in the audience of his live pre-recorded show.

Nevertheless, we found that in scenarios where immediacy is critical, minor delays can significantly alter the perception of 'live'. This was evident in O2 and O5 (see Section 2), where users anticipated real-time responses to commands like *boom*, *spin*, and *light*. However, in O2 latency in visualising these commands disrupted the audience's sense of 'liveness' (see Figure 2b), highlighting the delicate balance between platform capabilities and user expectations. In O5 this was mitigated by introducing a chatbot that would write back the comment and the name of the user who said it a few seconds later to imitate immediacy (see Figure 2a) . This raises a pertinent point about how the meta-rhetoric surrounding the remote music event experience, including the platform's advertised capabilities, can significantly influence audience expectations and the ultimate satisfaction with the live experience. Intriguingly, our findings also suggest that when the remote experience offers distinct advantages, participants are inclined to seek inventive solutions to navigate and mitigate latency-related challenges. Participant PI05, who regularly engages in dancing during VRChat music events [74] remarks: *"And the problem is [...] there's a lag between the time you see the image and hear it [...] It's not synchronised dancing at all, which is another reason when I'm dancing in VRChat at a rave, [...] I tend to try to make sure my movements are not very fast. I'll try to use smoother, slower motions. And the same thing with the leg movements. I don't do any super fast fancy footwork because it will look bad."*

5.2.2 Impossible music experiences. Our participants expressed that for them, remote music events are not just substitutes for in-person concerts; instead, they are distinct opportunities for novel engagement – with the other audiences, the artist and the performance itself. As PI02 puts it: *"Why should you try to emulate something, when using technology, you can make a unique and different experience that can be just as enjoyable?"*

Feedback indicates that technology is not just an enabler, but rather a driving force for otherwise impossible experiences [105]. One participant described *"The most recent unforgettable experience in VR was the Fat Boy Slim virtual performance in ENGAGE XR. It was unforgettable for being amazing and ground-breaking, and unforgettable for being overwhelming and over-stimulating [...] Still, it was amazing as it showed the possible, even how VR can do the impossible."* PS61's comment underscores the excitement for technology to deliver extraordinary and seemingly impossible experiences. As PI16 notes *"I think [...] virtual events are going to be more technological and more conceptual and they don't have to deal with the practical issues of crowd control or rain."* Moreover, for artists themselves, technology presents a remarkable opportunity to overcome the constraints of the physical environments (e.g., venue size, logistical challenges, or budget constraints). This transformation is particularly valuable for smaller artists or those performing from home, who may have previously been restricted in their ability to deliver visually captivating performances. Our observation of the electronic music competition (O3) (see Table 2) exemplified this potential with musicians effortlessly mixed their music from their individual locations to a venue hosting an in-person audience. The performance was further enriched by the inclusion of interactive visuals (see Figure 1a), creating a multisensory experience that captivated the audience, who also voted for the competition's winner.

In addition, the space of remote concerts also allows users to actively shape their virtual encounters, choosing their own "impossible" elements: *"A lot of times I'm wearing different avatars [...] I like dancing with avatars that actually have an extra pair of limbs because it's usually synchronised with my dominant arm, and so you can come up with some interesting moves with your arms. And I don't care how I look because that's not how I look in real life. This is my virtual self (PI05)."* This was also evident during O4 where not only the event was in a magical location, but also those attending in VRChat took impossible forms (see Figure 1b).

5.3 Sensory and emotional immersion

Traditional live music at its core is a multisensory experience, immersing attendees in vivid sights, sounds, temperatures and even smells. The *scent* of a venue, *"the kick of the drums in your chest and the bass and the flow of the people (PI02),"* - all these elements converge to create lasting memories. However, the digital reality of remote music events often grapples with what can be termed as 'sensory paucity', underscoring the diminished sensory richness in digital environments compared to real-world experiences.

Despite their high-quality visuals and audio, platforms like TV, Twitch, YouTube and Instagram Live cannot replicate the immersion of in-person music events. This can lead to: *"feeling disconnected from the experience (PS10),"* and *"like you are watching the event out of your window (PS02)."* 13 participants identified this as a key limitation. PI18 emphasised, *"In person music is more of a sensory experience, whereas online it's mainly seeing and hearing."* Discussing in-person events, our participants vividly recounted their experiences, providing intricate descriptions of everything from the scents in the air to the concert venue's specific details. They recalled meeting people, and even recollected details like the weather and the time of day. However, when reflecting on remote events, participants had difficulty. Some expressed limited memories, with one participant stating, *"I don't really remember much (PI03)."* In contrast to the detailed recollections of in-person events, memories of remote events tended to be more general, often centred on the music itself or the event as a whole rather than specific moments. This was also evident in the survey, where all the responses on memorable in-person music events were significantly longer and more detailed than the responses about memorable remote music events. PI19 explained, *"there's just something about being in an audience with loads of other people [...] it feels more of an event, more of a memory."*

Moreover, in-person events inherently demand a level of commitment and effort, encompassing elements like travelling to the venue, structuring one's day around the event, and investing in tickets. This investment, both emotionally and physically, magnifies the event's significance in our participants' recollections. This contrasts starkly with remote events, where these facets of commitment, physical presence, and multisensoriality are often absent, leading to a different kind of memory and overall experience,*"I think there's a lot more memories associated with [in person] music for me [...] memories from when you get the ticket, up until the day before, or the day of, and then seeing it (PI18)."* This discrepancy in the depth of engagement between online and in-person viewing extends to the perceived value and memorability of remote events. As PI06 points out, *"People [online] may RSVP, right? They may say that they're going to go and then they forget about it [...] in a way that you simply wouldn't do if you had bought tickets to a real life thing. [...] You plan your whole day around that."*

Unlike screen performances, in VR environments, the experience is inherently more immersive, amplifying the sense of presence in the event. For participants like PI17, PI05, PI01 and PI10 who use full body tracking, a ritual of preparation is required, contributing to feeling a deeper connection to the event. PI17 explains, *"When I actually put on the stuff [VR equipment] and kind of go in, VR actually has that spatial aspect [...] and you kind of feel that you connect with the people a lot more."* Participants described their VR experiences as vividly (or even more so) as the in-person ones. PI01

explained *"people who don't have VR, have no idea what we're talking about [...] it's so immersive to be there. It really is another kind of reality, it's not virtual anymore, it's a reality."* This supports findings by Onderdijk et al. [71], showing that attending a concert in VR leads to greater feelings of physical presence than viewing a normal YouTube livestream. To increase their presence further, two of the VR participants in our study mentioned using haptic vests, which convert musical beats into vibrations, mimicking the tangible, visceral experience of music. However, despite VR's capacity for heightened immersion, it continues to face challenges in fully recreating the multisensory richness found in in-person events. Four of our participants reported that *"the physicality of music, most of all is different. Not specifically the feeling of bodies around you, but the actual pumping of the base that is different (PI17)."* The same participant goes on to explain that *"I would say that the music feels better in real life [...], but the actual music is probably better when I go to VR events."*

Overall, that technology has its limitations in replicating the multisensory richness and commitment associated with traditional in-person concerts. People continually seek authentic and memorable experiences which might not depend solely on technology but on how these experiences resonate on a deeper emotional and personal level.

5.3.1 Physical space transcendence. The allure of in-person music events often lies in their ability to transport attendees to liminal spaces - thresholds between the ordinary and the extraordinary [91]. As PI16 describes, *"When you go to a music event [...] it feels very much like a liminal space. I like that it doesn't feel like part of the real world [...] and then you leave and then the world is normal again."* In-person music events create something similar to a 'magic circle' [47], which in the world of gaming defines a temporary space where players willingly suspend disbelief. Audiences at a concert experience a similar feeling, embracing an alternate reality governed by its unique rules, making it easier for them to fully engage and lose themselves in the experience. Despite this, when it comes to remote music experiences, such as virtual concerts or livestreams from home, the challenge lies in establishing these clear boundaries. At home, the boundaries between the ordinary (home chores, distractions, daily routines) and the extraordinary (the music event) become blurred. PI15 acknowledges that, *"it's very easy to get up mid-song and go make a cup of tea if you want to, whereas you would never do that in a live performance."* This juxtaposition can sometimes lead to less immersive experiences, susceptible to the interruptions of everyday life. This was brought up by almost all interview participants and 6 of the survey respondents.

However, it is important to note that there are unique advantages to remote music experiences. Homes provide a comfortable and cocooning environment for music enjoyment [9], as mentioned by 16 participants in our survey. For some, *"it's two different experiences: the ones at home, I watch them on the TV with the lights off and warm clothes on my couch with my blanket, which was very comfortable. While at the venue, it's a different experience. It depends on what mood you are in, sometimes I would prefer the ones at home, but sometimes I would prefer to be at the venue (PI09)."* Several participants tried to transpose the aura of concerts into the intimate confines of their personal living spaces. *"I connected the speakers I have here, so we are watching the television and [..] and you can start to feel that vibe with the music pumping in your chest, but then again, you're in your house, you can get comfortable and do whatever you like and you enjoy with others (PI14)."* This phenomenon extends beyond sonic enhancements; during preparations for major events like Eurovision and Glastonbury, audiences exhibit a remarkable commitment to physically transforming their living environments. For instance, both PI12 and PI13 shared their experiences of turning their homes into mini Glastonbury festivals: *"Actually we've had our own Glastonbury quite a few times. We've got our attic so it's really dark. We've got a big cinema screen so we can create our own festival up there (PI13)."* During the observation of Eurovision (O10) and the fan conversations on X, numerous fans shared images of their homes and outfits, showcasing their

efforts to harmonise their personal spaces with the event's ambiance, similar to experiences of watching Eurovision described by PI14 and PI11. In such examples the event itself sometimes become secondary to the social interaction happening in the physical space, while at other points it becomes their focal point [90]. In these ways, individuals actively strive to transpose the essence of live events into their own homes, enhancing their immersive experiences while cocooning.

Building upon the 'magic circle' analogy within the context of in-person performances, it becomes evident that the home offers a canvas for individuals to cocoon themselves in comfort while simultaneously crafting an immersive, event-specific space. Unlike the fixed boundaries typically defined by event organisers in traditional gatherings, the home introduces an element of adaptability and personalisation. As attendees take it upon themselves to transform their living spaces in anticipation of an event, they essentially step into the role of creators of their own 'magic circle,' establishing its boundaries. This act of self-driven creation facilitates a deeply personal experience, where the magic circle's boundaries can be reimagined and reshaped for each distinct event. The challenge, then, is to fortify the magic circle against the distractions, interruptions, and the very familiarity of the home setting, ensuring that the music event's reality remains intact.

5.4 The universal reach of remote music events

5.4.1 Accessing the inaccessible. Traditional in-person events often require significant commitments (e.g., travel expenses and high ticket prices) that make them inaccessible to many. 14 survey participants expressed frustration with these financial burdens. Digital platforms have alleviated this by offering free or affordable streaming options, democratising access. . As PI09 highlighted: *"It might actually be better at home, especially with big artists. For example, with Niall Horan, if I had went to a live event, unless I wanted to pay a kidney, I would not have been at the front to actually see his face while singing while at home you could see the emotion on his face."* This newfound accessibility has also addressed the perennial problem of sold-out events, where highly sought-after tickets vanish within minutes[9] and the geographical barriers. PI01 shared their experience, emphasising the importance of accessibility in their decision to join the VR Chat Drum n' Base community: *"Where I live, there's nothing really going on... So when I somehow discovered that there's a VR community, I was like, 'Hey, that's kind of cool'."* Additionally, dedicated fans of music genres such as Kpop, like PI14 and PI07, have found remote music events to be their primary means of engaging with their favourite artists due to the geographical challenges involved: *"These live events are often held in locations that can be challenging to access[...] So you can see it whenever you are, you just need a screen, a passcode, and a Wi-Fi connection (PI14)."* In addition, for participants like PI16 the shift to digital platforms also aligns with a more sustainable future *"conversations about sustainability are going to become way more prevalent [..] So, I think using technology that's more sustainably powered, but also technology that allows people to attend events in ways that are more sustainable, if that's minimising travel to and from events for example (PI16)."* However, remote music events are not without challenges. 11 survey participants mentioned technical issues like internet connectivity and lagging as major frustrations. PS62 observed: *"Lagging streams seems to be the biggest problem as so many people are watching."* This is especially problematic during large events where infrastructure can not support the audience size. PS42 explained: *"Connection issues can make you feel less a part (disconnected) from the experience."* Five participants reported that poor sound and video quality further contribute to disconnection, with PS55 stating they're unwilling to invest in better audio systems just for music. Additionally, some noted that having to pay to interact or be seen impacts perceived accessibility: *"Possibly if [there is] aspects of voting and having to pay, I'm aware some funds need to go towards it but it cuts off how accessible the event is."*

[9] https://help.ticketmaster.co.uk/hc/en-us/articles/360018800214-Why-do-tickets-sell-out-quickly-

5.4.2 Digital safe spaces and freedom of expression. Digital platforms overcome the confines of physical venues, allowing attendees to access them with no limits and to authentically express themselves. As noted by PI19: *"It is really good that we do have those technology options available to make it more accessible for people. People that would be really anxious [...] or if there was a disability that prohibited them going."* Notably, these digital concerts directly address the concerns voiced by 35 survey participants who expressed frustration with the crowds and disruptive behaviour at traditional events. Digital concerts become more than just an alternative mode of participation; they function as digital "third spaces" [69], where people come together for communal experiences, providing a transformative arena for self-discovery, identity exploration, and meaningful connections. Within these spaces, attendees *"can just be like in a safe space basically (PI10),"* free from the challenges often associated with conventional in-person music events. Remote concerts also offer a refuge for individuals grappling with social anxiety and inhibitions that can be exacerbated in the midst of large, crowded gatherings. For instance PI01 finds solace in the 80-person limitation of VR chat events: *"I'm not a person who can stay with huge groups of people [...] that's what I really like about the VR scene."*

In contrast to traditional in-person concerts where self-expression might be limited to clothing or merchandise, remote music events enable a new type of freedom. Attendees have a multitude of creative tools at their disposal, including avatars and pseudonyms, that allow them to explore and express facets of their personalities: *"I feel like I can be more myself here. [...] I have my avatar, they have their avatar, they can be a woman, they can be a man, they can be whatever [..] it doesn't really matter (PI01)."* Moreover, dancing and freely expressing oneself at home, as described by PI20, PI18, and PI14, becomes a liberating experience, free from the inhibitions of crowded public settings. *"You know, we're here with other people, you're doing silly stuff, you're dancing, singing, and you kind of don't care what's going on because you're in your house, so you're kind of free to do whatever you want (PI14)."* Additionally, remote audiences have the autonomy to curate their level of participation. Whether they prefer active engagement, interacting with others, or a more passive role, simply immersing themselves in the music from the comfort of their homes, the choice is theirs. This distinction to traditional in-person events became evident during event observations, where real-time interactions unfolded between participants, yet the context of these exchanges remained hidden due to our limited knowledge about the individuals behind the screens. Additionally, individuals such as PI21, PI02, PI03, and PI04 described themselves as "lurkers" on Twitch (i.e., attend events but do not post) [64], underscoring the remarkable diversity of engagement options in remote music events.

The digital space's enhanced freedom of expression brings its own challenges, notably in managing disruptive behaviour. In events like O7 and O9 on platforms with large audiences, inappropriate comments occasionally surfaced. These were quickly eclipsed by other responses in the fast-moving chat streams, underscoring the difficulties in moderating expansive digital spaces for music events.

6 Discussion

Research on technology for remote music events has predominantly focused on performers (e.g., [50, 78, 84]), or on audiences of specific events and platforms through a sociological lens (e.g., [71, 82, 103]). This study contributes to the broader understanding of how remote music audiences engage with, interact in, and perceive these events, considering their unique preferences and challenges. By examining the multifaceted practices and experiences of remote music audiences, our work informs the development of more inclusive and engaging remote music experiences, enhancing both performer-audience interaction and overall participation. In the sections below, we build on some of our findings and extend them through a generative perspective, by reflecting on potential lessons our data offers. Based on this, we outline some insights and considerations for

designing remote music experiences. While the insights presented here are substantial, they are not all-encompassing. Instead, they serve as a starting point, carving out a design space that future HCI research can look into to refine and elevate the experiences of remote music audiences.

6.1 The impact of music genre

Music genre and artist style profoundly shape the live music experience, influencing audience behaviour and engagement [17, 25]. While platforms like Spotify have made music listening solitary [33], live music remains deeply social, with participation aligning with genre-specific conventions [7, 46]. Since 2020, digital livestreams have become crucial for live music, with genres continuing to shape online engagement in ways that mirror in-person events [31]. Our data reveal that different genres align with specific digital platforms, as artists and audiences choose services that best suit their needs. This alignment reflects how platform features – like interactivity, audience visibility, and artist-audience engagement – correspond with genre norms.

For instance, **electronic music** (i.e., Drum N' Base, EDM), often associated with experimental and technologically literate artists and audiences, thrives on platforms like Twitch and VRChat. In these genres, the artist's instrument isn't always visible, making immersive visuals essential [16]. These platforms enable rich sensory experiences through interactive features – real-time chat, emotes, custom overlays, and shared 3D environments where avatars move to the music. The focus is less on artist close-ups and more on creating a shared, synchronous experience, aligning with electronic music's emphasis on atmosphere, rhythm, and communal participation [98]. This fosters social bonding through synchrony in music and dance [51, 68]. Designers could enhance these experiences by introducing interactive elements that allow for the audience to contribute to the visuals of the performance such as through extensions like VOLTA XR or sync user movements with on-screen visuals and audio, creating immersive, participatory environments, that focus on experience and meaning-making, making interaction more sensory and engaging [98].

On the contrary, **rock and pop music**, events are more often found on platforms like YouTube, Veeps, and StageIt. In these genres, our results indicate that fans are often drawn more to the artists themselves than to the overall experience of the music stream, making artist visibility paramount. The affordances of these platforms including high-quality video and audio as well as the more curated content they provide enables this. The emphasis on artist-focused visuals aligns with the importance of performer presence in rock and pop music, where charisma and stage persona play significant roles. Our participants highlighted that being able to see the artist up close enhances their emotional connection and engagement with the performance. Social aspects and emotional proximity are further enhanced through interactive features like real-time comments and live chats. These tools facilitate direct interaction between artists and fans, fostering a sense of intimacy and community. This suggests that tailored interactive tools can (to some extend) effectively recreate the communal feel of live gatherings [8], especially in genres where fans value close emotional proximity to performers Følstad et al. [19]. Monetisation opportunities also play a significant role in platform choice for these genres with fans often willing to purchase tickets to support their favourite artists and gain access to exclusive content. This willingness to pay reflects a commitment similar to attending physical concerts. For rock and pop genres, designers could prioritise high-quality production that emphasises artist visibility and incorporate interactive features facilitating direct artist-fan engagement such as virtual meet-and-greets. Offering exclusive content and monetisation options can further engage fans and support artists.

Overall our findings suggest that platform choice in remote music performances is closely linked to genre and artist style. Each genre has specific needs and audience expectations that align with particular platform features. By tailoring approaches to the genre's engagement style and leveraging platform affordances, designers and artists can enhance audience connection and

immersion. Understanding these dynamics enables more effective platform selection, ensuring that remote music experiences resonate deeply with audiences.

6.2 When and what spontaneity to seek for?

Facilitating spontaneous interactions is crucial for engaging audiences in remote music settings, offering the unpredictability and liveliness associated with live music events [30]. Traditional concerts are rich with spontaneous moments – unexpected encores, improvisations, and unplanned interactions – that create memorable experiences and deepen the emotional connection between artists and audiences [26, 54, 110]. These surprises and imperfections, occurring before, during, and after performances, make each live event unique and resonate with attendees long after the event concludes.

In contrast, remote events sometimes offer fewer opportunities for spontaneous interaction, which can impact the overall audience experience. Moreover, the immediacy of accessing a virtual performance with a single click further bypasses the traditional audience journey where memorable experiences often happen [28]. Without spontaneity, virtual performances can feel scripted and less engaging, limiting the unexpected joys characteristic of live music. Research shows that spontaneity in entertainment is perceived as more authentic than scripted experiences, adding dynamic energy that counters the predictability of virtual performances, even if it may suggest lower production quality [83]. Our results indicate that expectations for spontaneity in remote music performances vary based on the event format (fully remote vs. hybrid) and event style (informal vs. formal), influencing how audiences prefer to interact with the platform and the performance itself. This aligns with findings of other studies in different live-streaming contexts, such as in gaming, that found that the type of interactivity audiences and streamers seek for is highly dependant on the stream type [55].

In **fully remote, informal events** (i.e., events where the artist performs in an informal setting – perhaps their bedroom) which mostly take place on platforms like Twitch, Instagram live or VRChat, the platform becomes the primary venue, taking on the role of both the physical and social environment of the event. Here, audiences actively seek both audience-driven spontaneity (e.g., real-time chat, live reactions, playful interactions) and artist-driven spontaneity (e.g., unscripted shout-outs, unexpected setlist changes) to replicate the communal and lively energy of a live event. To enhance the audience journey in these settings, designers and artists can incorporate pre-event activities to build anticipation, such as interactive countdowns, teasers, or behind-the-scenes glimpses. During the event, platforms should prioritise flexibility of interactive tools that allow both audiences and artists to engage in real time, including live chat, adaptable visuals, and audience feedback options, to recreate the unpredictable atmosphere of an in-person experience. Moreover, platforms could consider multi-modal and non-textual modes of interaction [22] such as sketches [62], snapshot-based interactions [115] even audiences being able to participate in the event as avatars [15]. Flexibility of interaction within platforms for audiences and musicians alike could further amplify engagement and nurture playfulness [1] and spontaneity, giving users power to shape their experiences either at an individual or collective level [39], similar to other livestreaming contexts such as outdoor streaming [60] or esports [57].

In **fully remote, formal events** (i.e., events that are specifically staged and curated), which often take place on bespoke streaming platforms like Veeps and StageIt, our results suggest that audiences expect a polished, consistent experience over spontaneity. In these settings, structured interactions are more suitable, allowing viewers to feel as though they are watching from the venue. Selected moments of spontaneity, such as an artist's acknowledgment of the online audience, can connect without detracting from the formality [33]. For formal, fully remote events, platforms could focus on high-quality streaming and limited but meaningful spontaneous interactions, such as

curated Q&A sessions or artist acknowledgments, to maintain the formality and polish expected in these settings. For example, Oxjam's virtual festival design demonstrated how integrating dedicated volunteer roles can enhance the remote audience journey by managing technical support, guiding new audience members, and facilitating live chat – elements that helped recreate the organic interactions typical of in-person experiences [5]. Volunteers acted as the "invisible" infrastructure that connected artists and audiences, responding in real-time to queries and enhancing the social aspects of the event.

In **hybrid events** (i.e., events that take place physically but are streamed remotely too), on platforms like YouTube or VoD when there is both an in-person and a remote audience, our data showed that spontaneity expectations tend to be lower for remote viewers, who often see their role as spectators of the in-person experience. This is in line with Lai and Hespanhol [49]'s work on hybrid cultural spaces, which suggests that remote audiences in hybrid contexts often engage as observers rather than active participants, expecting a polished experience rather than frequent interaction. However, we found that during such events remote viewers sometimes create "micro-festival" environments at home, with thematic decorations or even small watch parties to capture a shared ambiance, and the screen the live-stream is played on becoming a focal point the experience centres around [90]. Platforms for hybrid events can support this audience preference by focusing on high-quality, seamless streaming, with optional AR-driven customisation kits [106] that allow viewers to personalise their spaces without relying on high interaction levels from the platform – a strategy that can enable co-located interactions while enhancing the overall event experience, similar to the one proposed by [81].

Through integrating considerations of the audience journey and tailoring strategies to each event type, designers and artists can enhance spontaneity and create more engaging and authentic remote music experiences. Recognising that memorable events are not solely about sensory immersion but also about shared stories, unexpected interactions, and the overall journey can bridge the gap between virtual and in-person performances, ensuring that even in a remote setting, audiences feel a genuine connection, capturing the essence of live events.

6.3 Audience size matters

Audience size in remote music events fundamentally alters the dynamics of engagement [108]. On smaller events, especially on platforms like Twitch and VR Chat, viewers have more time to interact and build virtual communities through regular participation [29]. This fosters a deeper connection with the artist, enabling easier *shout-outs*, that take the form of reading out comments, re-posting stories or, in the case of VRChat, a nod. Such moments, fleeting as they might be, can amplify the sense of connection and in turn can make the experience feel more intimate, which in turn could lead to attending more events [28, 80].

On the contrary, during larger events, individual interactions can become transient, often lost in the sea of comments and reactions. On platforms like YouTube, comments tended to be shorter and more repetitive in nature, often seemingly unrelated to each other. For some, this type of interaction accommodates for a different kind of coherence, dubbed by Ford et al. [20] as a "crowdspeak" that prioritises crowd-based interactions over interpersonal conversations. For others, this could lead to interaction being 'less meaningful' and random, and to events being considered by some scholars as "unsuccessful large-scale interaction rituals" [103]. Moreover, as events scale up in size, the *"feeling seen and heard by the performer"*, although more exciting, becomes a challenge. In larger or hybrid events, the sheer volume of attendees makes individual shout-outs impractical. Recently, platforms like Twitch have automated their shout-out systems [92] to assist the performers with managing their interaction with the audience, but the impersonal nature of automation can sometimes dilute the value of such recognition.

To mitigate some of the challenges that come as audience numbers grow, designers could draw inspiration from events like Eurovision, where fans often create their own local viewing parties and think about grouping participants into smaller communities or 'viewing pods'.

6.4 The illusion of closeness between audiences and artists

Our findings reveal a discrepancy between the perceived intimacy audiences feel during remote music events and the actual level of connection with the artists. Current digital platforms offer audiences a chance to engage in a "one-and-a-half" sided relationship, where they message artists in real time and occasionally receive a direct response [48]. Participants talked enthusiastically about moments when artists acknowledged them personally (e.g., by reading out their usernames or fulfilling song requests), which enhanced the feeling of a one-to-one connection. This was further amplified when artists actively invited fans to become part of the creative process (e.g., by suggesting lyrics).

However, the sense of intimacy in remote music streaming can be questioned. This reflects the concept of parasocial relationships, where audiences form emotional bonds with media figures, who remain unaware of their individual fans [37]. The ease of digital communication can blur the lines between genuine engagement and the illusion of a personal relationship. Even when participants recognised they were "just a username," the emotional impact of being acknowledged was significant. The pursuit of intimacy also drives monetisation on platforms like Twitch, where viewers pay for shout-outs or to have messages highlighted, capitalising on fans' desire for personal connection. While this enhances interactivity, it may exploit fans' emotional investment, raising ethical concerns about commodifying personal interaction [36].

To address this, platforms and artists could further promote community-building features that encourage fan interactions, shifting focus from direct artist-to-fan engagement. Transparency from artists about the nature of digital interactions could help set appropriate expectations. These approaches can enrich the remote music experience, ensuring it remains positive and mentally healthy for audiences.

6.5 One platform does not fit all

Overall, our research demonstrates that no single platform can effectively accommodate all types of remote music performances. The diversity of music genres, artist styles, and audience expectations necessitates a variety of platforms, each offering distinct features and capabilities. What works for an immersive electronic music event may not suit a formal classical concert or an intimate acoustic session. This diversity signifies the importance of designing platforms that are adaptable and responsive to specific needs. Attempting a one-size-fits-all approach overlooks the unique elements that make each genre engaging. Artists, designers and event organisers should select platforms that align with their artistic goals and audience preferences. By utilising platforms designed for their specific context, they can enhance engagement, encourage authentic connections, and create more memorable experiences.

6.6 Limitations

Our research, while providing valuable insights into the world of remote music events from the lens of audiences, has certain limitations that need to be acknowledged. Firstly, remote music events are diverse, with countless ways for individuals to engage. Our study's limited sample size means we have not captured all possible experiences. While we aimed for a comprehensive view, our findings may not represent every audience type or experience. In addition, we focused on specific digital platforms, which do not encompass the entire landscape. This might leave out nuances from unexplored platforms. Moreover, since our study was about the broader design space we did

not go deep to the platforms presented, so there are aspects of those platforms that we did not examine. Lastly, despite our efforts to engage varied demographics, most participants were adults embedded in Western context with good digital access. While these participants are among those more likely to access and attend remote music events, it is crucial to acknowledge that the insights that emerged from our study are, to a certain extent, a reflection of their socio-economic privileges. In addition, this means that we have overlooked the practises of audiences from other regions such as East Asia where platforms like BiliBili are popular for live streaming including music, and practices such as those of VTubers are much more prominent [107, 109]. Future research should look into the practises of those audiences, specifically related to remote music events [52].

7 Conclusion and future work

In this paper, we took an exploratory approach, where we focused on remote music audiences, to start mapping out the design space of remote music performances. Our findings point out to insights and design directions, which we hope could provoke designers and researchers to explore this area. We see value in sharing this work now, when the research landscape remains relatively unexplored but interest in this space is nevertheless evolving rapidly, especially after the transformative shift brought by the COVID-19 pandemic. Our scope with this study was broad, covering a wide range of audiences, experiences and platforms, necessitating future work that is perhaps more targeted to certain types of events. Moreover, in this work we focus on audiences rather than the artists themselves. Therefore, there is an opportunity for future research to build on ours by investigating the design space from the musicians' perspective and bridging the two key stakeholders of remote music experiences.

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References

[1] Ferran Altarriba Bertran, Elena Márquez Segura, and Katherine Isbister. 2020. Technology for Situated and Emergent Play: A Bridging Concept and Design Agenda. In *Proceedings of the 2020 CHI Conference on Human Factors in Computing Systems (CHI '20)*. Association for Computing Machinery, New York, NY, USA, 1–14. doi:10.1145/3313831.3376859

[2] Ferran Altarriba Bertran, Alexandra Pometko, Muskan Gupta, Lauren Wilcox, Reeta Banerjee, and Katherine Isbister. 2021. The Playful Potential of Shared Mealtime: A Speculative Catalog of Playful Technologies for Day-to-day Social Eating Experiences. *Proceedings of the ACM on Human-Computer Interaction* 5, CHI PLAY (Oct. 2021), 267:1–267:26. doi:10.1145/3474694

[3] Ava Bartolome, Nguyen Binh Ha, and Shuo Niu. 2021. Investigating multimodal interactions and parasocial attractiveness in YouTube ASMR videos. In *Companion Publication of the 2021 Conference on Computer Supported Cooperative Work and Social Computing*. 14–18.

[4] Nancy K. Baym. 2013. Fans or friends?: seeing social media audiences as musicians do. *Matrizes* 7, 1 (June 2013), 13. doi:10.11606/issn.1982-8160.v7i1p13-46

[5] Steve Benford, Kadja Manninen, Sarah Martindale, Adrian Hazzard, Juan Pablo Martinez Avila, Paul Tennent, Jocelyn Spence, Teresa Castle-Green, Pat Brundell, Pepita Barnard, et al. 2023. Infrastructures for Virtual Volunteering at Online Music Festivals. *Proceedings of the ACM on Human-Computer Interaction* 7, CSCW1 (2023), 1–26.

[6] Steve Benford, Paul Mansfield, and Jocelyn Spence. 2021. Producing Liveness: The Trials of Moving Folk Clubs Online During the Global Pandemic. In *Proceedings of the 2021 CHI Conference on Human Factors in Computing Systems* (Yokohama, Japan) *(CHI '21)*. Association for Computing Machinery, New York, NY, USA, Article 646, 16 pages. doi:10.1145/3411764.3445125

[7] Andy Bennett. 2004. *Music scenes: Local, translocal and virtual.* Vanderbilt University Press.

[8] Claudio E Benzecry. 2019. *The opera fanatic: Ethnography of an obsession.* University of Chicago Press.

[9] Karin Bijsterveld. 2010. Acoustic cocooning: How the car became a place to unwind. *The Senses and Society* 5, 2 (2010), 189–211.

[10] Jean Burgess and Joshua Green. 2018. *Youtube: online video and participatory culture* (second edition ed.). Polity Press, Cambridge, UK Malden, MA.

[11] Clemency Burton-Hill. [n. d.]. Is watching opera in the cinema just as good? https://www.bbc.com/culture/article/20150114-opera-in-the-cinema-blasphemy. Accessed: 2010-09-30.

[12] Carrie J Cai, Michelle Carney, Nida Zada, and Michael Terry. 2021. Breakdowns and Breakthroughs: Observing Musicians' Responses to the COVID-19 Pandemic. In *Proceedings of the 2021 CHI Conference on Human Factors in Computing Systems*. ACM, Yokohama Japan, 1–13. doi:10.1145/3411764.3445192

[13] Alexander Carôt and Christian Werner. 2009. Fundamentals and principles of musical telepresence. *Journal of Science and Technology of the Arts* (Jan. 2009), 26–37 Páginas. doi:10.7559/CITARJ.V1I1.6 Artwork Size: 26-37 Páginas Publisher: Journal of Science and Technology of the Arts.

[14] Digital Catapult. 2020. *Immersive Audience Journey Report.* Technical Report. Digital Catapult. https://audienceofthefuture.live/immersive-audience-journey/

[15] Qijia Chen, Jingwen Gan, Andrea Bellucci, and Giulio Jacucci. 2024. "I Felt Everyone Was a Streamer": An Empirical Study on What Makes Avatar Collective Streaming Engaging. *Proc. ACM Hum.-Comput. Interact.* 8, CSCW1, Article 67 (April 2024), 25 pages. doi:10.1145/3637344

[16] Nuno N. Correia, Deborah Castro, and Atau Tanaka. 2017. The Role of Live Visuals in Audience Understanding of Electronic Music Performances. In *Proceedings of the 12th International Audio Mostly Conference on Augmented and Participatory Sound and Music Experiences* (London, United Kingdom) *(AM '17)*. Association for Computing Machinery, New York, NY, USA, Article 29, 8 pages. doi:10.1145/3123514.3123555

[17] Tia DeNora. 2000. *Music in everyday life.* Cambridge university press.

[18] Ariane d'Hoop and Jeannette Pols. 2022. 'The game is on!'Eventness at a distance at a livestream concert during lockdown. *Ethnography* (2022), 14661381221124502.

[19] Asbjørn Følstad, Marita Skjuve, and Petter Bae Brandtzaeg. 2019. Different chatbots for different purposes: towards a typology of chatbots to understand interaction design. In *Internet Science: INSCI 2018 International Workshops, St. Petersburg, Russia, October 24–26, 2018, Revised Selected Papers 5*. Springer, 145–156.

[20] Colin Ford, Dan Gardner, Leah Elaine Horgan, Calvin Liu, a. m. tsaasan, Bonnie Nardi, and Jordan Rickman. 2017. Chat Speed OP PogChamp: Practices of Coherence in Massive Twitch Chat. In *Proceedings of the 2017 CHI Conference Extended Abstracts on Human Factors in Computing Systems (CHI EA '17)*. Association for Computing Machinery, New York, NY, USA, 858–871. doi:10.1145/3027063.3052765

[21] Noah R Fram, Visda Goudarzi, Hiroko Terasawa, and Jonathan Berger. 2021. Collaborating in isolation: assessing the effects of the Covid-19 pandemic on patterns of collaborative behavior among working musicians. *Frontiers in Psychology* 12 (2021).

[22] C. Ailie Fraser, Joy O. Kim, Alison Thornsberry, Scott Klemmer, and Mira Dontcheva. 2019. Sharing the Studio: How Creative Livestreaming can Inspire, Educate, and Engage. In *Proceedings of the 2019 on Creativity and Cognition*. ACM, San Diego CA USA, 144–155. doi:10.1145/3325480.3325485

[23] Evan L Frederick, Choong Hoon Lim, Galen Clavio, and Patrick Walsh. 2012. Why we follow: An examination of parasocial interaction and fan motivations for following athlete archetypes on Twitter. *International journal of sport communication* 5, 4 (2012), 481–502.

[24] Guo Freeman, Samaneh Zamanifard, Divine Maloney, and Alexandra Adkins. 2020. My Body, My Avatar: How People Perceive Their Avatars in Social Virtual Reality. In *Extended Abstracts of the 2020 CHI Conference on Human Factors in Computing Systems*. ACM, Honolulu HI USA, 1–8. doi:10.1145/3334480.3382923

[25] Simon Frith. 1996. *Performing rites: On the value of popular music.* Harvard University Press.

[26] Alf Gabrielsson, John Whaley, and John Sloboda. 2016. Peak Experiences in Music. In *The Oxford Handbook of Music Psychology*, Susan Hallam, Ian Cross, and Michael H. Thaut (Eds.). Oxford University Press, 0. doi:10.1093/oxfordhb/9780198722946.013.44

[27] Ben Green. 2023. Splendour XR: Place, Experience and Liveness at a Virtual Music Festival. *Leisure Sciences* (2023), 1–18.

[28] Julia Haferkorn, Brian Kavanagh, and Sam Leak. 2021. *Livestreaming Music in the UK. A report for musicians.* Technical Report. Economic and Social Research Council, United Kingdom. https://livestreamingmusic.uk/report/

[29] William A. Hamilton, Oliver Garretson, and Andruid Kerne. 2014. Streaming on twitch: fostering participatory communities of play within live mixed media. In *Proceedings of the SIGCHI Conference on Human Factors in Computing Systems (CHI '14)*. Association for Computing Machinery, New York, NY, USA, 1315–1324. doi:10.1145/2556288.2557048

[30] Esther Hammelburg. 2021. *Being There Live: How Liveness is Realized Through Media Use at Contemporary Cultural Events.* Ph. D. Dissertation. doi:10.13140/RG.2.2.29987.58404
[31] Niels Chr Hansen, John Melvin G Treider, Dana Swarbrick, Joshua S Bamford, Johanna Wilson, and Jonna Katariina Vuoskoski. 2021. A crowd-sourced database of coronamusic: documenting online making and sharing of music during the COVID-19 pandemic. *Frontiers in Psychology* 12 (2021), 684083.
[32] Jo Haynes and Lee Marshall. 2018. Beats and tweets: Social media in the careers of independent musicians. *New Media & Society* 20, 5 (2018), 1973–1993.
[33] David Hesmondhalgh. 2021. Is music streaming bad for musicians? Problems of evidence and argument. *New Media & Society* 23, 12 (2021), 3593–3615.
[34] O. Hödl. 2016. *The design of technology-mediated audience participation in live music.* Ph. D. Dissertation. Vienna University of Technology.
[35] O. Hödl, G. Fitzpatrick, and F. Kayali. 2017. Design Implications for technology-mediated audience participation in live music. In *Proceedings of the Sound and Music Computing Conference.* 28–34.
[36] Cynthia A. Hoffner and Bradley J. Bond. 2022. Parasocial relationships, social media, & well-being. *Current Opinion in Psychology* 45 (2022), 101306. doi:10.1016/j.copsyc.2022.101306
[37] Donald Horton and R Richard Wohl. 1956. Mass communication and para-social interaction: Observations on intimacy at a distance. *psychiatry* 19, 3 (1956), 215–229.
[38] Robert Hupke, Dürre Jan, Norbert Werner, and Jürgen Peissig. 2022. Latency and Quality-of-Experience Analysis of a Networked Music Performance Framework for Realistic Interaction. In *Audio Engineering Society Convention 152.* Audio Engineering Society, 1–10.
[39] Katherine Isbister, Elena Márquez Segura, and Edward F. Melcer. 2018. Social Affordances at Play: Game Design Toward Socio-Technical Innovation. In *Proceedings of the 2018 CHI Conference on Human Factors in Computing Systems (CHI '18).* Association for Computing Machinery, New York, NY, USA, 1–10. doi:10.1145/3173574.3173946
[40] Maggie Jackson. 2018. *Distracted: Reclaiming our focus in a world of lost attention.* Rowman & Littlefield.
[41] Henry Jenkins. 2006. *Convergence culture: where old and new media collide.* New York University Press, New York.
[42] Henrik Jodén and Jacob Strandell. 2022. Building viewer engagement through interaction rituals on Twitch.tv. *Information, Communication & Society* 25, 13 (Oct. 2022), 1969–1986. doi:10.1080/1369118X.2021.1913211 Publisher: Routledge _eprint: https://doi.org/10.1080/1369118X.2021.1913211.
[43] Mark R Johnson and Jamie Woodcock. 2019. 'It's like the gold rush': the lives and careers of professional video game streamers on Twitch. tv. *Information, Communication & Society* 22, 3 (2019), 336–351.
[44] Mehdi Kaytoue, Arlei Silva, Loïc Cerf, Wagner Meira Jr, and Chedy Raïssi. 2012. Watch me playing, I am a professional: a first study on video game live streaming. *WWW'12 - Proceedings of the 21st Annual Conference on World Wide Web Companion* (May 2012). doi:10.1145/2187980.2188259
[45] Olena Khlystova, Yelena Kalyuzhnova, and Maksim Belitski. 2022. The impact of the COVID-19 pandemic on the creative industries: A literature review and future research agenda. *Journal of Business Research* 139 (Feb. 2022), 1192–1210. doi:10.1016/j.jbusres.2021.09.062
[46] Yngvar Kjus and Anne Danielsen. 2014. Live islands in the seas of recordings: The music experience of visitors at the Øya Festival. *Popular Music and Society* 37, 5 (2014), 660–679.
[47] Jan HG Klabbers. 2009. The magic circle: Principles of gaming & simulation. In *The Magic Circle: Principles of Gaming & Simulation.* Brill.
[48] Rachel Kowert and Emory Daniel Jr. 2021. The one-and-a-half sided parasocial relationship: The curious case of live streaming. *Computers in human behavior reports* 4 (2021), 100150.
[49] Zhuosi Lai and Luke Hespanhol. 2021. An investigation on strategies for remote interactions with cultural spaces. In *Proceedings of the 33rd Australian Conference on Human-Computer Interaction.* 170–175.
[50] Vali Lalioti, Sophia Ppali, Andrew J Thomas, Ragnar Hrafnkelsson, Mick Grierson, Chee Siang Ang, Bea S Wohl, and Alexandra Covaci. 2021. VR Rehearse & Perform-A platform for rehearsing in Virtual Reality. 1–3.
[51] Harin Lee, Jacques Launay, and Lauren Stewart. 2020. Signals through music and dance: Perceived social bonds and formidability on collective movement. *Acta Psychologica* 208 (2020), 103093.
[52] Sebin Lee and Jungjin Lee. 2023. "Ju. T'aime" My Idol, My Streamer: A Case Study on Fandom Experience as Audiences and Creators of VTuber Concert. *IEEE Access* 11 (2023), 31125–31142. doi:10.1109/ACCESS.2023.3252563
[53] Yoonjoo Lee, John Joon Young Chung, Jean Y Song, Minsuk Chang, and Juho Kim. 2021. Personalizing ambience and illusionary presence: How people use "study with me" videos to create effective studying environments. In *Proceedings of the 2021 CHI Conference on Human Factors in Computing Systems.* 1–13.
[54] Tuck Wah Leong and Peter Wright. 2013. Understanding 'tingle' in opera performances. In *Proceedings of the 25th Australian Computer-Human Interaction Conference: Augmentation, Application, Innovation, Collaboration (OzCHI '13).* Association for Computing Machinery, New York, NY, USA, 43–52. doi:10.1145/2541016.2541026

[55] Pascal Lessel, Maximilian Altmeyer, Julian Sahner, and Antonio Krüger. 2022. Streamer's Hell - Investigating Audience Influence in Live-Streams Beyond the Game. *Proc. ACM Hum.-Comput. Interact.* 6, CHI PLAY, Article 252 (Oct. 2022), 27 pages. doi:10.1145/3549515

[56] Jingjin Li, Jiajing Guo, and Gilly Leshed. 2024. Meditating in Live Stream: An Autoethnographic and Interview Study to Investigate Motivations, Interactions and Challenges. *Proceedings of the ACM on Human-Computer Interaction* 8 (2024), 1 – 33. doi:10.1145/3637417

[57] Lingyuan Li, Jirassaya Uttarapong, Guo Freeman, and Donghee Yvette Wohn. 2020. Spontaneous, Yet Studious: Esports Commentators' Live Performance and Self-Presentation Practices. *Proceedings of the ACM on Human-Computer Interaction* 4, CSCW2 (2020), 1–25.

[58] Zhicong Lu. 2019. Live streaming in China for sharing knowledge and promoting intangible cultural heritage. *Interactions* 27 (2019), 58 – 63. doi:10.1145/3373145

[59] Zhicong Lu, M. Annett, Mingming Fan, and Daniel J. Wigdor. 2019. "I feel it is my responsibility to stream": Streaming and Engaging with Intangible Cultural Heritage through Livestreaming. *Proceedings of the 2019 CHI Conference on Human Factors in Computing Systems* (2019). doi:10.1145/3290605.3300459

[60] Zhicong Lu, Michelle Annett, and Daniel Wigdor. 2019. Vicariously experiencing it all without going outside: A study of outdoor livestreaming in China. *Proceedings of the ACM on Human-Computer Interaction* 3, CSCW (2019), 1–28.

[61] Zhicong Lu, Seongkook Heo, and Daniel J. Wigdor. 2018. StreamWiki: Enabling Viewers of Knowledge Sharing Live Streams to Collaboratively Generate Archival Documentation for Effective In-Stream and Post Hoc Learning. *Proc. ACM Hum.-Comput. Interact.* 2, CSCW, Article 112 (Nov. 2018), 26 pages. doi:10.1145/3274381

[62] Zhicong Lu, Rubaiat Habib Kazi, Li-yi Wei, Mira Dontcheva, and Karrie Karahalios. 2021. StreamSketch: Exploring Multi-Modal Interactions in Creative Live Streams. *Proc. ACM Hum.-Comput. Interact.* 5, CSCW1 (April 2021), 58:1–58:26. doi:10.1145/3449132

[63] Zhicong Lu, Chenxinran Shen, Jiannan Li, Hong Shen, and Daniel Wigdor. 2021. More Kawaii than a Real-Person Live Streamer: Understanding How the Otaku Community Engages with and Perceives Virtual YouTubers. In *Proceedings of the 2021 CHI Conference on Human Factors in Computing Systems* (Yokohama, Japan) *(CHI '21)*. Association for Computing Machinery, New York, NY, USA, Article 137, 14 pages. doi:10.1145/3411764.3445660

[64] Evan Lybrand. 2019. *Community in the Crowd: Motivations for Commenting on Twitch.tv Live Streams.* Ph. D. Dissertation. Clemson University. https://tigerprints.clemson.edu/cgi/viewcontent.cgi?article=4080&context=all_theses

[65] Divine Maloney and Guo Freeman. 2020. Falling Asleep Together: What Makes Activities in Social Virtual Reality Meaningful to Users. In *Proceedings of the Annual Symposium on Computer-Human Interaction in Play*. ACM, Virtual Event Canada, 510–521. doi:10.1145/3410404.3414266

[66] Joshua McVeigh-Schultz, Anya Kolesnichenko, and Katherine Isbister. 2019. Shaping Pro-Social Interaction in VR: An Emerging Design Framework. In *Proceedings of the 2019 CHI Conference on Human Factors in Computing Systems*. ACM, Glasgow Scotland Uk, 1–12. doi:10.1145/3290605.3300794

[67] Joshua McVeigh-Schultz, Elena Márquez Segura, Nick Merrill, and Katherine Isbister. 2018. What's It Mean to "Be Social" in VR?: Mapping the Social VR Design Ecology. In *Proceedings of the 2018 ACM Conference Companion Publication on Designing Interactive Systems*. ACM, Hong Kong China, 289–294. doi:10.1145/3197391.3205451

[68] Bart Moens, Chris Muller, Leon Van Noorden, Marek Franěk, Bert Celie, Jan Boone, Jan Bourgois, and Marc Leman. 2014. Encouraging spontaneous synchronisation with D-Jogger, an adaptive music player that aligns movement and music. *PloS one* 9, 12 (2014), e114234.

[69] Ray Oldenburg. 1997. Our vanishing third places. *Planning commissioners journal* 25, 4 (1997), 6–10.

[70] Kelsey E Onderdijk, Lies Bouckaert, Edith Van Dyck, and Pieter-Jan Maes. 2023. Concert experiences in virtual reality environments. *Virtual Reality* (2023), 1 – 14. https://api.semanticscholar.org/CorpusID:259095187

[71] Kelsey E Onderdijk, Dana Swarbrick, Bavo Van Kerrebroeck, Maximillian Mantei, Jonna K Vuoskoski, Pieter-Jan Maes, and Marc Leman. 2021. Livestream experiments: the role of COVID-19, agency, presence, and social context in facilitating social connectedness. *Frontiers in psychology* 12 (2021), 647929.

[72] Tomáš Pagáč, Simone Kriglstein, and Regina Bernhaupt. 2024. A scoping literature review on influencing factors in live-streaming spectatorship experience. *Entertainment Computing* (2024), 100872.

[73] Roosa Piitulainen, Perttu Hämäläinen, and Elisa D Mekler. 2022. Vibing Together: Dance Experiences in Social Virtual Reality. In *Proceedings of the 2022 CHI Conference on Human Factors in Computing Systems* (New Orleans, LA, USA) *(CHI '22)*. Association for Computing Machinery, New York, NY, USA, Article 188, 18 pages. doi:10.1145/3491102.3501828

[74] Roosa Piitulainen, Perttu Hämäläinen, and Elisa D Mekler. 2022. Vibing Together: Dance Experiences in Social Virtual Reality. In *Proceedings of the 2022 CHI Conference on Human Factors in Computing Systems (CHI '22)*. Association for Computing Machinery, New York, NY, USA, 1–18. doi:10.1145/3491102.3501828

[75] Karine Pires and Gwendal Simon. 2015. YouTube Live and Twitch: A Tour of User-Generated Live Streaming Systems. *Proceedings of the 6th ACM Multimedia Systems Conference, MMSys 2015* (March 2015). doi:10.1145/2713168.2713195

[76] Sophia Ppali. 2023. Music from Anywhere & Everywhere: Exploring the design space of remote music performance. In *Companion Publication of the 2023 ACM Designing Interactive Systems Conference (DIS '23 Companion)*. Association for Computing Machinery, New York, NY, USA, 45–49. doi:10.1145/3563703.3593067

[77] Sophia Ppali, Yun Jung Jang, Marina Pasia, Andreas Papallas, Panayiotis Zaphiris, and Alexandra Covaci. 2024. Tingbao: A musical Immersive Experience Inspired by Environmental Themes. In *Companion Proceedings of the 2024 Annual Symposium on Computer-Human Interaction in Play*. ACM, Tampere Finland, 318–323. doi:10.1145/3665463.3678836

[78] Sophia Ppali, Vali Lalioti, Boyd Branch, Chee Siang Ang, Andrew J. Thomas, Bea S. Wohl, and Alexandra Covaci. 2022. Keep the VRhythm going: A musician-centred study investigating how Virtual Reality can support creative musical practice. In *Proceedings of the 2022 CHI Conference on Human Factors in Computing Systems (CHI '22)*. Association for Computing Machinery, New York, NY, USA, 1–19. doi:10.1145/3491102.3501922

[79] Sophia Ppali, Max Scorer, Elena Ppali, Boyd Branch, and Alexandra Covaci. 2024. Remote Rhythms: Audience-informed insights for designing remote music performances. In *Proceedings of the 2024 ACM Designing Interactive Systems Conference (DIS '24)*. Association for Computing Machinery, New York, NY, USA, 2675–2690. doi:10.1145/3643834.3660719

[80] Jennifer Radbourne, Katya Johanson, Hilary Glow, and Tabitha White. 2009. The Audience Experience: Measuring Quality in the Performing Arts. *International Journal of Arts Management* 11, 3 (2009), 16–29. https://www.jstor.org/stable/41064995 Publisher: HEC - Montréal - Chair of Arts Management.

[81] Samantha Reig, Erica Principe Cruz, Melissa M Powers, Jennifer He, Timothy Chong, Yu Jiang Tham, Sven Kratz, Ava Robinson, Brian A Smith, Rajan Vaish, et al. 2023. Supporting piggybacked co-located leisure activities via augmented reality. In *Proceedings of the 2023 CHI Conference on Human Factors in Computing Systems*. 1–15.

[82] James Rendell. 2021. Staying in, rocking out: Online live music portal shows during the coronavirus pandemic. *Convergence* 27, 4 (2021), 1092–1111.

[83] Jacqueline R Rifkin, Katherine M Du, and Keisha M Cutright. 2023. The preference for spontaneity in entertainment. *Journal of Consumer Research* 50, 3 (2023), 597–616.

[84] C. Rottondi, C. Chafe, C. Allocchio, and A. Sarti. 2016. An Overview on Networked Music Performance Technologies. *IEEE Access* 4 (2016), 8823–8843.

[85] A.A. Sawchuk, E. Chew, R. Zimmermann, C. Papadopoulos, and C. Kyriakakis. 2003. From remote media immersion to distributed immersive performance. In *Proceedings of the 2003 ACM SIGMM workshop on Experiential telepresence*. 110–120.

[86] Kim Christian Schrøder. 2019. Audience Reception Research in a Post-broadcasting Digital Age. *Television & New Media* 20, 2 (Feb. 2019), 155–169. doi:10.1177/1527476418811114 Publisher: SAGE Publications.

[87] Joseph Seering, Saiph Savage, Michael Eagle, Joshua Churchin, Rachel Moeller, Jeffrey P. Bigham, and Jessica Hammer. 2017. Audience Participation Games: Blurring the Line Between Player and Spectator. In *Proceedings of the 2017 Conference on Designing Interactive Systems* (Edinburgh, United Kingdom) *(DIS '17)*. Association for Computing Machinery, New York, NY, USA, 429–440. doi:10.1145/3064663.3064732

[88] Caitlin Shaughnessy, Rosie Perkins, Neta Spiro, George Waddell, Aifric Campbell, and Aaron Williamon. 2022. The future of the cultural workforce: Perspectives from early career arts professionals on the challenges and future of the cultural industries in the context of COVID-19. *Social Sciences & Humanities Open* 6, 1 (Jan. 2022), 100296. doi:10.1016/j.ssaho.2022.100296

[89] Caitlin Shaughnessy, Rosie Perkins, Neta Spiro, George Waddell, and Aaron Williamon. 2023. Cultivating progressive development in the cultural industries: challenges and support needs identified by the creative workforce in the United Kingdom. *Cultural Trends* 0, 0 (July 2023), 1–18. doi:10.1080/09548963.2023.2227850 Publisher: Routledge _eprint: https://doi.org/10.1080/09548963.2023.2227850.

[90] Stephen Tsung-Han Sher and Norman Makoto Su. 2023. From Screens to Projector, Wall, and TVs: Conceptualizing Livestreams as Design Material for Direct and Indirect Viewership Experiences. *Proc. ACM Hum.-Comput. Interact.* 7, CSCW1 (April 2023), 56:1–56:22. doi:10.1145/3579489

[91] Harriet Shortt. 2015. Liminality, space and the importance of 'transitory dwelling places' at work. *Human Relations* 68, 4 (April 2015), 633–658. doi:10.1177/0018726714536938 Publisher: SAGE Publications Ltd.

[92] Max Sjöblom, Maria Törhönen, Juho Hamari, and Joseph Macey. 2019. The ingredients of Twitch streaming: Affordances of game streams. *Computers in Human Behavior* 92 (March 2019), 20–28. doi:10.1016/j.chb.2018.10.012

[93] Mel Slater, Carlos Cabriera, Gizem Senel, Domna Banakou, Alejandro Beacco, Ramon Oliva, and Jaime Gallego. 2023. The sentiment of a virtual rock concert. *Virtual Reality* 27, 2 (2023), 651–675.

[94] Neta Spiro, Rosie Perkins, Sasha Kaye, Urszula Tymoszuk, Adele Mason-Bertrand, Isabelle Cossette, Solange Glasser, and Aaron Williamon. 2021. The Effects of COVID-19 Lockdown 1.0 on Working Patterns, Income, and Wellbeing Among Performing Arts Professionals in the United Kingdom (April–June 2020). *Frontiers in Psychology* 11 (2021). https://www.frontiersin.org/articles/10.3389/fpsyg.2020.594086

[95] Alina Striner, Sarah Halpin, Thomas Röggla, and Pablo Cesar. 2021. Towards Immersive and Social Audience Experience in Remote VR Opera. In *ACM International Conference on Interactive Media Experiences (IMX '21)*. Association for Computing Machinery, New York, NY, USA, 311–318. doi:10.1145/3452918.3465490

[96] Alina Striner, Andrew M. Webb, Jessica Hammer, and Amy Cook. 2021. Mapping Design Spaces for Audiencenbsp;Participationnbsp;innbsp;Gamenbsp;Livenbsp;Streaming. In *Proceedings of the 2021 CHI Conference on Human Factors in Computing Systems* (Yokohama, Japan) *(CHI '21)*. Association for Computing Machinery, New York, NY, USA, Article 329, 15 pages. doi:10.1145/3411764.3445511

[97] Dana Swarbrick, Beate Seibt, Noemi Grinspun, and Jonna K. Vuoskoski. 2021. Corona Concerts: The Effect of Virtual Concert Characteristics on Social Connection and Kama Muta. *Frontiers in Psychology* 12 (2021). https://www.frontiersin.org/articles/10.3389/fpsyg.2021.648448

[98] Atau Tanaka. 2009. *Sensor-based musical instruments and interactive music.* na.

[99] T. L. Taylor. 2018. *Watch me play: Twitch and the rise of game live streaming.* Princeton University Press, Princeton ; Oxford.

[100] Luca Turchet. 2023. Musical Metaverse: vision, opportunities, and challenges. *Personal and Ubiquitous Computing* (2023), 1–17.

[101] L. Turchet, C. Fischione, G. Essl, D. Keller, and M. Barthet. 2018. Internet of Musical Things: Vision and Challenges. *IEEE Access* 6 (2018), 61994–62017.

[102] Doug Van Nort. 2023. Distributed Networks of Listening and Sounding: 20 Years of Telematic Musicking. *Journal of Network Music and Arts* 5, 1 (2023), 6.

[103] Femke Vandenberg. 2022. Put Your "Hand Emotes in the Air:" Twitch Concerts as Unsuccessful Large-Scale Interaction Rituals. *Symbolic Interaction* 45, 3 (2022), 425–448. doi:10.1002/symb.605 _eprint: https://onlinelibrary.wiley.com/doi/pdf/10.1002/symb.605.

[104] Femke Vandenberg, Michaël Berghman, and Julian Schaap. 2021. The 'lonely raver': music livestreams during COVID-19 as a hotline to collective consciousness? *European Societies* 23, sup1 (2021), S141–S152.

[105] Carlos Velasco, Francisco Barbosa Escobar, Olivia Petit, and Qian Janice Wang. 2021. Impossible (Food) Experiences in Extended Reality. *Frontiers in Computer Science* 3 (2021). https://www.frontiersin.org/articles/10.3389/fcomp.2021.716846

[106] Vinoba Vinayagamoorthy, Maxine Glancy, Christoph Ziegler, and Richard Schäffer. 2019. Personalising the TV experience using augmented reality: An exploratory study on delivering synchronised sign language interpretation. In *Proceedings of the 2019 CHI conference on human factors in computing systems*. 1–12.

[107] Qian Wan and Zhicong Lu. 2024. Investigating VTubing as a Reconstruction of Streamer Self-Presentation: Identity, Performance, and Gender. *Proc. ACM Hum.-Comput. Interact.* 8, CSCW1, Article 80 (April 2024), 22 pages. doi:10.1145/3637357

[108] Mengdi Wang and Dong Li. 2020. What motivates audience comments on live streaming platforms? *PLOS ONE* 15, 4 (April 2020), e0231255. doi:10.1371/journal.pone.0231255 Publisher: Public Library of Science.

[109] PiaoHong Wang and Zhicong Lu. 2023. Let's Play Together through Channels: Understanding the Practices and Experience of Danmaku Participation Game Players in China. *Proc. ACM Hum.-Comput. Interact.* 7, CHI PLAY, Article 413 (Oct. 2023), 19 pages. doi:10.1145/3611059

[110] Emma Webster. 2012. "One More Tune!" The Encore Ritual in Live Music Events. *Popular Music and Society* 35, 1 (Feb. 2012), 93–111. doi:10.1080/03007766.2010.538241

[111] A. Williamon, G. Waddell, N. Spiro, R. Perkins, C. Shaughnessy, A. Campbell, M. Miraldo, V. Lalioti, and S. Ppali. 2022. Policy brief: HEartS professional: the Health, Economic and Social impact of COVID-19 on Professionals in the ARTs: findings and policy implications for cultural recovery. https://pandemicandbeyond.exeter.ac.uk/ Publisher: The Pandemic and Beyond.

[112] Donghee Yvette Wohn, Guo Freeman, and Caitlin McLaughlin. 2018. Explaining viewers' emotional, instrumental, and financial support provision for live streamers. In *Proceedings of the 2018 CHI conference on human factors in computing systems*. 1–13.

[113] Grace H Wolff and Cuihua Shen. 2024. Audience size, moderator activity, gender, and content diversity: Exploring user participation and financial commitment on Twitch.tv. *New Media & Society* 26, 2 (Feb. 2024), 859–881. doi:10.1177/14614448211069996 Publisher: SAGE Publications.

[114] Tim Wulf, Frank M. Schneider, and Stefan Beckert. 2020. Watching Players: An Exploration of Media Enjoyment on Twitch. *Games and Culture* 15, 3 (May 2020), 328–346. doi:10.1177/1555412018788161 Publisher: SAGE Publications.

[115] Saelyne Yang, Changyoon Lee, Hijung Valentina Shin, and Juho Kim. 2020. Snapstream: Snapshot-based Interaction in Live Streaming for Visual Art. In *Proceedings of the 2020 CHI Conference on Human Factors in Computing Systems (CHI '20)*. Association for Computing Machinery, New York, NY, USA, 1–12. doi:10.1145/3313831.3376390

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