Vicariously Experiencing it all without Going Outside:
A Study of Outdoor Livestreaming in China

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Fig. 1. Screenshots of outdoor livestreams on (a) Douyu.tv and (b) Douyin (TikTok). Note that both livestreams have (i) a number of Danmaku comments and display (ii) virtual gifts that have been sent to the streamer alongside Danmaku conversations that are ongoing.

The livestreaming industry in China is gaining greater traction than its European and North American counterparts and has a profound impact on the stakeholders' online and offline lives. An emerging genre of livestreaming that has become increasingly popular in China is outdoor livestreaming. With outdoor livestreams, streamers broadcast outdoor activities, travel, or socialize with passersby in outdoor settings, often for 6 or more hours, and viewers watch such streams for hours each day. However, given that professionally produced content about travel and outdoor activities are not very popular, it is currently unknown what makes this category of livestreams so engaging and how these techniques can be applied to other content or genres. Thus, we conducted a mixed methods study consisting of a survey (N=287) and interviews (N = 20) to understand how viewers watch and engage with outdoor livestreams in China. The data revealed that outdoor livestreams encompass many categories of content, environments and passersby behaviors create challenges and uncertainty for viewers and streamers, and viewers watch livestreams for surprising lengths of time (e.g., sometimes more than 5 continuous hours). We also gained insights into how live commenting and virtual gifting encourage engagement. Lastly, we detail how the behaviors of dedicated fans and casual viewers differ and provide implications for the design of livestreaming services that support outdoor activities.

CCS Concepts: • **Human-centered computing→Human computer interaction (HCI)**; Empirical studies in HCI;

1 INTRODUCTION

The ubiquity of mobile devices with high-definition cameras and more affordable and faster Internet speeds have led to a surge of live video streaming platforms. In Europe and North America, these platforms such as Twitch.tv, Facebook Live, YouTube Live, and Periscope, enable streamers to share their gameplay experiences or personal experiences with a live audience. Although livestreaming in North America and Europe has been gaining traction, it has not become as ubiquitous as livestreaming in China. Because many streamers are employed full time by streaming platforms to create content, livestreaming talent agencies train streamers and help them accumulate viewers, streamers have opportunities to stream a variety of content, and gifting features allow viewers to reward their favorite streamers, livestreaming in China has had a profound impact on both streamers' and viewers' online and offline lives [43].

Outdoor livestreams are livestreams where streamers broadcast themselves engaging with the outdoors in real life, often via travelling or socializing with passersby, and are increasingly popular amongst viewers [43][1]. During these livestreams, a single streamer (or a small team of 2 or 3 people) travels to a far away destination and documents their journey or goes into the wild and performs an outdoor activity such as mountaineering, fishing, or hunting. Livestreams where streamers go outside and interact with random strangers on the street or drive in a Didi (i.e., Uber) are also part of this genre. Given the unpredictability and reality of these environments and the potential risks involved when interacting with strangers or performing extreme activities, this genre of livestreams is gaining immense popularity in China. According to Toubang.tv, i.e., a Chinese website that collects and aggregates streamers' statistical data on daily viewership and gifting income, 14 of the top 100 most popular streamers across all streaming platforms in China in March 2019 were outdoor livestreamers and the remaining 86 streamers were videogaming or live performance streamers [70]. The popularity of outdoor livestreamers in China suggests that livestreaming must have unique affordances that encourage viewers to watch the streaming of such activities and subsequently live vicariously through outdoor livestreamers.

Understanding how users experience outdoor events or activities through live videos has been of interest in HCI and CSCW for several years because live videos can make shared experiences more vivid, by intertwining physical and virtual experiences, while also enabling social interaction [15]. Most investigations have explored the sharing of live videos between close-tie relationships [29,52], live broadcasts from communities of amateurs or spectators [18,19,21,60], or outdoor public live events [25]. Few studies have explored the facets of streaming a broader range of outdoor experiences on streaming platforms that have potentially millions of viewers who watch and engage with the streams.

To better understand the emerging socio-technological phenomenon of outdoor livestreaming in China, a mixed methods study including a survey (N = 287) and interviews (N = 20) was conducted with outdoor livestreaming viewers in China. The survey queried the practices of, and

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[1] Although other terminology may be better suited to describe this growing and diverse category of livestreams, to maintain consistency with the terminology used by prior work and live streaming platforms today, this paper uses the term "outdoor".

the motivations behind, engaging with outdoor livestreams, streamers, and other viewers, how viewers provide support to their favorite streamers, how viewers decide which outdoor livestreamers to watch, and how viewers perceive their relationship with outdoor livestreamers and the community. Our results revealed a diverse range of outdoor activities were being broadcasted by streamers, with the most surprising category being live outdoor shows that involved couples or guest stars on the street. We also found three distinct segments of the viewing audience: one of which watches livestreams for excessive lengths of time and is heavily engaged in in-stream activities in the streamer's community, another who watches for shorter lengths of time and is casually engaged with the streamer's community, and a third group that watches outdoor livestreams for information and to gain knowledge about outdoor activities. We provide an overview of the opportunities and challenges outdoor livestreaming presents to the design of livestreaming services to better support outdoor livestreaming activities.

2   BACKGROUND AND RELATED WORK

Research into the socio-technological phenomenon of livestreaming, sharing outdoor experiences through video-based media, and projects about HCI and outdoors informed the direction of this work. We first give a brief background of livestreaming in China and outdoor livestreaming, and then review the literature related to outdoor experiences and HCI.

2.1   Livestreaming in China and Beyond

Real time video broadcasting services provided by websites and mobile applications enable synchronous and multi-modal (e.g., video, text, and image) interactions between streamers and viewers. Livestreaming began in China in 2014 when Internet users repurposed public video chat room services such as YY [78] for indoor performative live sessions [38]. Thereafter, mobile livestreaming services supported streamers streaming from any location, thus enabling livestreaming to become more popular. By the end of 2018, there were over 397 million livestreaming viewers, accounting for 47.9% of all Chinese Internet users [12]. During this time, professional streamers also began to emerge. These professionals livestream almost every day and are supported by agencies or guilds that provide training, support, and publicity to them [14].

Livestreaming platforms in China have several unique design features, including gamification elements that induce users to pay to support their favorite streamers (e.g., highly customizable virtual gifts and leaderboards of top gift senders [38,43]) and Danmaku, a form of commenting that is overlaid on the live video during the stream [44]. Different from the traditional chat-room style commenting adopted by Twitch, Facebook Live, and YouTube Live, most livestreaming platforms in China adopt Danmaku to display viewers' real time comments. Prior research on Danmaku has been shown to encourage user participation [76], increase user engagement [44], affect user emotions and judgements [11,76], and enhance memory [77], however this research has focused on asynchronous, non-real time Danmaku usage. Viewers can also purchase and send virtual gifts to a streamer during the livestream. These gifts are shown as a special animation overlaid on the live video and are visible to all viewers [43]. Viewers can also pay to subscribe to a streamer and earn special 'fan' badges. These subscriptions and badges allow viewers to gain access to different privileges, for example, sending exclusive virtual gifts or having their Danmaku comments displayed with a higher visibility than other comments. Most streaming platforms in China also host platform-wide competitions or "carnivals" once or twice a year, where streamers compete against each other to obtain the highest value of virtual gifts from viewers [14]. The winning streamers of these competitions will be promoted more by the platform and receive more commercial resources [14].

Although the penetration rate of livestreaming and the numbers of professional streamers in China are incomparable to their North American or European counterparts, livestreaming in China has been less studied in HCI and CSCW. Previous research in HCI and CSCW has investigated how streamers engage with viewer communities and identified the different types of live video that are broadcasted, including game play [26,54], life experiences of celebrities or ordinary people [32,67], knowledge sharing [42], live events [25,39,68], civic engagement [17], live performances [38], intangible cultural heritage [41], or the selling of goods [10]. Streamers from various categories of livestreams also have different motivations for streaming, for example, streaming life experiences on Periscope was motivated by personal branding [67], streaming on Twitch was used for building communities and sharing gameplay skills [26,54], while sharing intangible cultural heritage practices using livestreams was motivated by the sense of social responsibility streamers felt to promote cultural practices [41]. Research into engagement patterns and viewer motivations has found that Twitch viewers are gamers who want to learn gameplay skills and be part of a videogame community [26], whereas viewers engaged in livestreams of intangible cultural heritage, are not game players, are older, are less tech savvy, and are interested in cultural practices [41]. Understanding the needs of different livestreaming user groups can inform the design of livestreaming interfaces that tailor to user needs and make livestreaming more accessible to a broader audience, e.g., non-gamers or older adults.

This work contributes to the broader view of livestreaming research by understanding the viewers who watch outdoor livestreams and engage with outdoor livestreamers' communities and why they do so for such long periods of time. This paper also seeks to understand the gamification elements and effects of live commenting (i.e., Danmaku) during livestreaming and explore the role these elements play during livestreams that are of longer duration and involve more unpredictability and risk than traditional videogame, live performance, or intangible cultural heritage livestreams.

2.2 Outdoor and In Real Life (IRL) Livestreaming

Since its introduction as a listed category on livestreaming platforms in China in 2015, "outdoor" livestreams have become increasingly popular [14,43]. The content and form of outdoor livestreams has been evolving since its origin, initially categorizing outdoor activities in the wild, e.g., fishing, hunting, and surviving in the wild. As this work will demonstrate, this category also includes livestreams about backpacking around the world, city life, conversing with strangers, performing in the public, live reality shows, couple live shows, and so on. This category is often used by streamers to differentiate themselves from video game or performance streamers. On Douyu.tv (i.e., the Twitch equivalent in China), for example, three of the top ten most popular streamers in 2018 were streamers who streamed within the "outdoor" category [79]. In 2017, to expand the scope of Twitch.tv beyond videogaming, the IRL (In Real Life) category was introduced. IRL streams enable streamers to share their real-life experiences and includes subcategories such as "Just Chatting" and "Travel and Outdoors". Although IRL streams continue to gain traction on Twitch, such livestreams largely consist of "talking heads" or mundane footage of random excursions – neither of which are engaging to watch [25]. Although other nomenclature may be better suited to describe the ever-evolving "outdoor" category of livestreams, to maintain consistency with the categorizations used by livestreaming platforms in China, the term "outdoor" is used within this paper.

2.3 HCI, the Outdoors, and Rural Computing

In recent years, many HCI projects have sought to fuse nature and outdoor activities with technology. Several studies have explored users' technological needs within specific outdoor application areas, for example, technology preferences of hikers [1], information sharing practices while trail running, climbing and skiing [75], key tensions while on a trail [45], social engagement and experiences while walking [3], the practices of hunters [66], and motivations for amateur runners [34]. Some research prototypes have also been built to support specific outdoor activities using technologies, such as a mobile app to support hiking [55], AR for skiing [20], and haptic communication and wearables for rock climbing [35,46]. Another line of research has investigated the technology use of rural individuals and communities that are often considered as peripheral to mainstream HCI [69]. An urban/rural divide has been found to be an important factor for engagement with social media, for example, Gilbert et al. found that MySpace users in rural areas had fewer friends than those in urban ones [22]. Similar findings reported that rural areas have fewer tweets, check-ins, and geotagged photos per capita than urban areas [27], and that content about rural areas on Wikipedia is of systematically lower quality [30]. This work provides insights into both lines of research by understanding how livestreaming viewers that are interested in watching outdoor or rural livestreams become engaged while also providing design implications that encourage them to engage more with outdoor activities and rural communities.

2.4 Sharing Outdoor Experiences Via Videos

The use of mobile video for sharing outdoor experiences has been of interest in HCI and CSCW for decades. Studies of mobile video use in shopping, restaurants, museums, and touring situations showed that it is difficult to orient and place mobile video cameras appropriately to provide good views for remote viewers [29,31,59]. Remote viewers also often want more control over their view [31], the ability to point to things in the scene [31], more spatial context [31,33], and the ability to see both the environment and the camera handler simultaneously [29]. Privacy concerns for video sharing in the public have also been explored and it has been found that bystanders are more concerned about privacy with wearable cameras than cameras on mobile phones [53,63]. Several prototypes have also explored how mobile or telepresence technology supports parallel experiences over distances via shared outdoor activities, for example, enabling geographically separated joggers to jog together through sharing spatialized audio [49,50], exertion interfaces that share video and audio to support sports activities over distances [48], mobile video conferencing to share outdoor leisure activities (e.g., geocaching and bicycling) with remote family members and friends [52,56], and telepresence robots with 360 degree viewing to share geocaching experiences [28]. Although relevant, most of these projects explored how users share outdoor activities with close-tie or small-scale remote users, i.e., one to one, or one to a few. We aim to understand how larger scale audiences of viewers engage with outdoor livestreamers.

Another line of research investigated live video streaming from outdoor settings between users and the general public. For example, Juhlin et al. found that early adopters of mobile livestreaming services enjoy broadcasting tours, performances, social events, and unexpected situations [32]. Several software prototypes were built to support multiple people livestreaming an event from multiple cameras [18] and allowed viewers to view live events from different camera views [68]. Reeves et al. studied a mixed reality game that supported livestreaming from city streets and identified challenges facing performers such as demands from remote viewers while streaming, situational challenges, and self-presentation desires [60]. These projects focused on content creators and streamers rather than viewers who consume the video, as this work does. Haimson et al., have studied what makes live events engaging for viewers and found that immersion,

immediacy, interaction, and sociality were important for user engagement [25], however they focused on live events, which are a small segment of the outdoor livestreaming category.

3 METHOD

Inspired by the growing popularity of outdoor livestreaming in China and the differences between outdoor livestreaming content and videogame or live performance livestreams, a mixed-methods research methodology was used to better understand the demographic, motivational, and situational contexts of those who watch outdoor livestreams. Although it would also be useful to understand outdoor livestreaming from the perspective of streamers, within this work we focus on understanding the viewer population because previous research has shown that popular streamers are hesitant to participate in research [38]. This can be due to their agencies not allowing them to, them not wanting to lose their competitive advantage, or them not having the time to do so. By focusing on viewers and their motivations and practices, we can also learn about the in-stream and post-stream communities of streamers, a facet of livestreaming that is unique to the Chinese context.

3.1 Data Collection: Online Survey

To understand the viewership, content, and context surrounding outdoor livestream viewers, an online survey was developed with both closed-form and open-ended questions. The survey was modelled after survey methods previously used by Rader et al. [58], Baumer et al. [5], and Lu et al. [43] and was developed in English, then translated into Mandarin by the first author, a native Mandarin speaker. The translation was validated by another member of the research team who is also a native Mandarin speaker. The English version of the questionnaire can be found in the supplementary material. The survey took approximately 10 – 30 minutes to complete, depending on the detail that was provided within the open-ended questions.

Multiple online platforms were used to recruit participants, including wjx.cn (i.e., a firm specializing in recruiting study participants in China, used in previous research such as [43]), outdoor livestreamers' Yuba (i.e., the built-in forums of Douyu.tv), outdoor livestreaming forums on Baidu Tieba (i.e., the built-in forums of Baidu), and outdoor livestreamers' chatgroups on QQ. Only Chinese-speaking adults who had previously watched outdoor livestreams were recruited. Screener questions ensured that all participants met this requirement. Participants were provided with a 15 CNY (~ $2.20 USD) honorarium for their participation in the survey. The survey was active for 2 weeks in February of 2019 and a total of 302 responses were collected, with 220 responses from wjx.cn and 82 responses from the forums. Fifteen responses were removed from the data set because the respondent had not watched outdoor streams, the respondent failed "trap" questions, the time of completion was too short, responses followed a distinct patterned, or gibberish text was provided for the open-ended questions. A total of 287 completed responses were thus used in the analysis.

3.2 Data Collection: Post-Survey Interviews

To garner a deeper understanding of the survey responses and trends that were identified in the data, follow-up interviews were conducted with 20 participants who participated in the survey. The interviews were conducted using video calls in March 2019. Each interview lasted about 45 minutes and participants were provided with a 50 CNY (~ $7.40 USD) honorarium for their time. The interviews were semi-structured, with questions probing participants' experiences watching outdoor livestreams, what they found engaging about outdoor livestreaming, and their concerns about outdoor livestreaming and outdoor livestreamers, among others. Interviews were conducted

in Mandarin, audio-taped, and transcribed by the transcription service iflyrec.cn after removing identifiable information.

3.3 Analysis

Responses to the open-ended questions and interview transcriptions were analyzed using an open coding method [13]. The first author and another Mandarin-speaking member of the research team coded the first 10% of responses or interview transcriptions individually and met to gain consensus on their codes. Then, the first author coded the remaining responses or transcriptions and met with the other Mandarin-speaking member to reach agreement on the codes. The codes, along with relevant quotes, were translated into English by the first author, validated by the other Mandarin-speaking member, and were discussed by the research team to find emerging themes using sub-categorization and constant comparison [65].

4 FINDINGS

Through the analysis of the survey and interview data, many unique facets of outdoor livestreaming emerged. Among other findings, we identified that outdoor livestreams contain a variety of sub-categories of content, some segments of the viewing audience watch livestreams for inordinate durations of time (i.e., over 300 minutes per day), for some, outdoor livestreams seem to replace traditional forms for entertainment (e.g., TV and movies), many livestreams have community curated Danmaku shows (i.e., live commenting) that occur concurrent with the livestream, virtual gifting is shaped by the cultural elements of "paimian", viewers enjoy content that allows them to live vicariously through the streamer, and many viewers transition from videogaming or live performance livestreams to outdoor livestreams as they mature. In what follows, data and findings from the survey and interviews are presented concurrently to improve readability and provide additional context for the survey response and emerging themes.

4.1 Profile of Participants

The online survey was completed by 168 males, 116 females, and 3 people with an unspecified gender (Fig 2). Many respondents were between the ages of 20 and 35 and were largely from developed regions in China (Fig. 2).
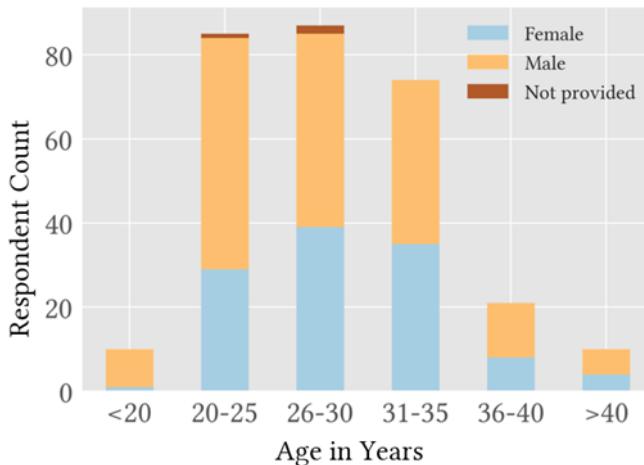

Figure 2. Distribution of the age and gender of the respondents in our survey.
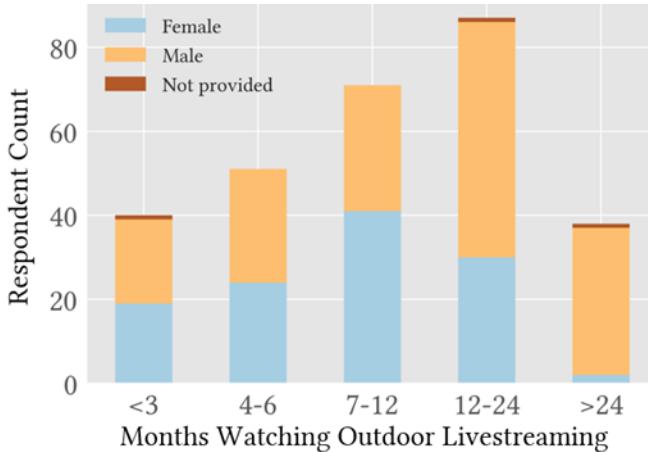
Figure 3. Distribution of the months respondents reported watching outdoor livestreams.

Table 1. Summary demographics of the viewers interviewed in the follow-up interviews. No. 1-10 were "dedicated" viewers, while No. 11-20 were "light" and "casual". OL denotes Outdoor Livestreams.

ID	Sex	Age	Location	Occupation	Times watching OL per week	Years watching OL	Hours watching OL per stream
1	M	27	Chongqing	Government	14-21	4	3-4
2	M	32	Sichuan	Self-employed	21+	3.5	5-6
3	M	23	Sichuan	Office worker	14	3	4
4	M	22	Zhejiang	Student	7-14	3	3
5	M	21	Jiangsu	Student	14	3.5	3
6	F	22	Shanghai	Student	7-14	2.5	3-4
7	F	31	Zhejiang	Office worker	21+	2	3
8	M	20	Guangdong	Student	14-21	1.5	3-4
9	M	28	Fujian	Factory worker	21+	3.5	4-5
10	M	24	Beijing	Freelancer	14-21	2.5	3-4
11	F	21	Beijing	Student	1-2	<1	<1
12	M	26	Shanghai	Office worker	3-5	2	2
13	F	28	Hunan	Office worker	1-2	1.5	<1
14	M	29	Hubei	Self-employed	3-5	3	1-2
15	M	21	Shandong	Factory worker	7+	3	2
16	M	20	Jilin	Student	1-2	<1	<1
17	F	24	Hebei	Professional	3-5	2	2
18	M	23	Chongqing	Professional	3-5	2	1-2
19	M	27	Guangdong	Self-employed	7+	3.5	1-2
20	M	25	Hunan	Office worker	1-2	1	1-2

All respondents had completed high school with 16% being college graduates, 68% holding a Bachelor's degree, and 8% reported having a Master's degree or higher. Respondents reported that they were students, managers, factory workers, office workers, teachers, working professionals, and so on. The age and education level distributions of survey respondents aligns with those found in previous livestreaming research about China [43].

Respondents were familiar with outdoor livestreams, reporting that they watched outdoor livestreams for an average of 12 months (μ=12 months, σ=8 months; Fig. 3). Thirty-eight

participants (13%) had watched outdoor livestreams for more than 2 years. Although we specifically recruited viewers that watched outdoor livestreams, viewers also reported watching other categories of livestreams, including gaming (90%), live performances (87%), social eating (72%), knowledge sharing (75%), etc.

For the follow-up interviews, 10 survey respondents who reported watching outdoor streams for an average of over 3 hours every day (8 males, 2 females; Range = 21 – 32 years old) and 10 survey respondents who spent less than 3 hours watching outdoor streams every day (7 males, 3 females; Range = 21- 29 years old) were interviewed (Table 1). As the survey data suggested that there were differences between these two populations, interviewing these respondents enabled us to better understand the defining characteristics of these viewership segments.

4.2 Outdoor Livestreaming Technology Practices

Responding viewers used multiple livestreaming platforms to watch outdoor livestreams, with an average of 3 platforms per respondent (μ = 3.5, σ = 2.0; Table 2). Respondents reported using a variety of platforms, some designed specifically for livestreaming and others with minimal livestreaming functionality, if any. The most popular platform was Douyu.tv, which is specifically designed for livestreaming and is one of the most popular livestreaming platforms in China [43].

What is more interesting is that four of the top six most popular platforms were those primarily designed for video sharing, i.e., Douyin (TikTok), Kuai Shou (Kwai), Bilibili, and Huoshan. On these platforms, archived videos of outdoor livestreams and curated travel-related videos shorter than 1 minute are extremely popular and are shared with others [40]. Although these platforms offer limited support for livestreaming (i.e., followers can be notified when their favorite content provider goes live), most viewers tend to watch shared, archived videos. These shared videos are often the gateway for many to enter the world of outdoor livestreaming (i.e., when asked how they initially found outdoor livestreams, 66% of viewers reported finding livestreaming through video sharing apps while 39% found outdoor livestreams on livestreaming platforms). In some cases, viewers continued watching archived videos on these platforms, while others began using livestream-specific platforms to do so.

Table 2. Participants' usage of various livestreaming platforms. (*) denotes that the platform is primarily a video sharing application or website with minimal, if any, livestreaming functionality.

Platform	% of Users	Platform	% of Users
Douyu.tv (see Fig. 1a)	64	Panda.tv	17
Douyin (TikTok; see Fig. 1b) *	58	Hua Jiao	7
Kuai Shou (Kwai) *	41	Momo	6
Huya	35	Zhan Qi	6
Bilibili *	33	QQ Live	5
Huoshan *	29	Inke	5
YY	28	Yi Zhi Bo	5

In terms of the devices used to watch livestreams, most viewers used mobile phones to watch outdoor livestreams (93%). Because video sharing and livestreaming platforms are specifically designed to capture and consume content on-the-go, this is to be expected. Viewers also reported using other devices such as tablets (38%), laptops or desktops (31%), or TV casting devices (16%) to watch livestreams. As these devices have a larger physical footprint, it would be natural for some viewers to turn to them to overcome occlusion issues that occur when typing on mobile phones, the small resolution and physical size of the viewing area, and distractions that occur from other

mobile applications (e.g., notifications). These patterns of device usage may also be explained by looking at the contexts where viewers watched outdoor livestreams. Eighty percent of viewers watched outdoor livestreams in the evening or at night, after they had finished school or work. During these times, they watched outdoor livestreams while commuting (30%), having meals or snacks (55%), playing sports or exercising (21%) or while cooking or working from home (41%). When these viewing activities are coupled with the substantial proportion of viewers who watch livestreams alone (86%) and the lengths of time viewers watch livestreams (detailed in the next section), mobile phones offer the flexibility and mobility that viewers need to consume outdoor livestream content.

4.3 Segments of the Outdoor Livestreaming Viewership Population

Two of the most surprising findings that emerged from the survey data was the length of time that respondents self-reported watching outdoor livestreams and the frequency with which they watched livestreams each week (Table 3). On average, viewers spent 104 minutes (μ = 104 minutes, σ = 107 minutes) watching outdoor livestreams, almost universally watching *one* livestream continuously. Compared to previous findings of Chinese livestreaming viewers who watched livestreams other than outdoor livestreams (i.e., 62 minutes on average while watching live performances, videogaming, and so on [43]), this is surprisingly long. When digging deeper into the surveyed viewership, there appear to be three segments of livestreaming viewership: those livestream viewers that spend less than an hour watching a single livestream (i.e., *light viewers*; N=149), those who spent 1 to 3 hours watching a single livestream (i.e., *casual viewers*; N=101), and those who spent more than 3 hours watching a livestream (i.e., *dedicated viewers*; N=37). Note that as the data is self-reported, participants may have under-reported the actual duration of time they spend watching livestreams per day out of shame or self-preservation, so actual viewing durations may be even higher.

Table 3. Frequency of watching outdoor livestreams from each viewer segment

	Less than one time a week	1 – 2 times a week	3 – 5 times a week	1 – 2 times a day	> 3 times a day
Light viewers (N=149)	15%	28%	26%	21%	9%
Casual viewers (N=101)	7%	11%	34%	34%	15%
Dedicated viewers (N=37)	0%	5%	16%	24%	54%

Dedicated viewers are those who spend an excessive amount of time watching a streamers' outdoor stream and take part in post-stream activities (e.g., making fan videos, curating archive videos, and so on). These viewers are also more likely to spend money on virtual gifts for the streamer and initiate and heavily participate in Danmaku side shows during the livestream. They tend to form attachments to specific streamers and enjoy streamed content that is about inter-personal connections. On average, dedicated viewers spend 344 minutes (μ = 344 minutes, σ = 111 minutes) watching a single livestream per day, and they watch outdoor livestreams more than twice a day (μ = 2 times a day, σ =1 time a day). Some of these viewers have a lot of leisure time in the evening so the livestream replaces traditional media such as TV or movies. Others have a job that allows them to have a livestream on as background noise and help combat loneliness. Because they watch livestreams so often, watching outdoor livestreams have become part of their everyday routine. As noted by P9, "*It just became a habit for me. I got used to watching his livestream every day. I would feel uncomfortable and lost if I don't watch his stream …… I am attracted by the streamers' content and the style, and I feel comfortable watching their streams. I just cannot help*

watching their streams". For this viewer, the habit of watching outdoor livestreams may have turned into an "addiction" that they do not realize that they have. One factor that may contribute to a possible "addiction" is the empathy viewers have for the streamer, which is the result of the lengthy windows of time they have into streamer's lives. These durations allow viewers to develop an understanding of the streamer's behavior, personality, and past experiences which makes them feel more engaged and encourages them to watch for longer periods of time, e.g., "*in outdoor livestreams, I can see how the streamer reacts to different situations in real life, feel her emotions, and understand her reactions. For example, I am impressed by how she deals with those who criticize her, and I appreciate her attitudes. I feel that I know her well and I would like to know more about her and support her if I can*" (P4).

Those classified as light viewers watch outdoor livestreams for less than 1 hour, i.e., approximately 41 minutes (μ = 41 minutes, σ = 7 minutes). They also watch outdoor livestreams about 6 times per week (μ = 6 times a week, σ =6 times a week). This group of viewers tends to not show the excessive or "super fan" behaviors found with the dedicate viewership segment, e.g., "*I don't follow Internet celebrities. I am no longer a kid*" (P13). Although outdoor livestreamers stream for several hours each day (or multiple times a week), these viewers do not feel the need to watch an entire stream – they often only watch a part that interests them or watch other categories of livestreams, e.g., "*I only watch the most interesting parts. I will stop watching if there are too many idle moments*" (P16). These viewers also do not engage in activities outside the livestream (e.g., making fan videos), minimally interact with streamers and the streamers' community during the stream, and tend to not spend as much money on virtual gifting or take part in Danmaku side shows. They prefer content that focuses on extreme environments and outdoor physical activities so that they can learn about the activity or perform or experience it themselves at a later time, e.g., "*the information and skills shared by outdoor livestreamers is what interest me the most*" (P11).

Unlike light viewers, casual viewers spend longer durations of time watching livestreams (μ = 111 minutes, σ = 29 minutes) and watch outdoor livestreams about once per day (μ = 1 time a day, σ =1 time a day). They may treat livestreams as a replacement for traditional media (e.g., TV and movies), but do not exhibit excessive behaviors, e.g., "*I often watch outdoor livestreams when I have time, but not if I am busy*" (P14). Casual viewers often keep up with, and take part in, Danmaku side shows and spend more money on virtual gifting than light viewers do, e.g., "*Although I don't often actively send Danmaku during livestreams, reading others' Danmaku and watching how the streamer react to them is fun*" (P12). They tend to prefer content that is inter-personal and informational, e.g., "*outdoor livestreamers show the beauty of their real life and nature, and sometimes provides valuable information to me in an entertaining way*" (P17). This group of viewers generally lives vicariously through the streamer but does not have a desire to perform an activity themselves or travel to a place shown in a livestream.

More details about light, casual, and dedicated viewers can be found in later sections where discussions of differences between these segments of the viewership are relevant.

4.4 Outdoor Livestreaming Content and Formats

Although other livestream categories such as videogaming and live performances are well defined, the outdoor category contains a variety of streaming content. Some content conforms to traditional definitions of "outdoor", such as traveling to various locations, surviving in the wild, mountaineering, hiking, fishing, and so on. With these livestreams, viewers can often see and experience the unpredictability of the location or learn information about the activity being performed. Other content, however, is more inter-personal in nature, focusing on the

conversations and interactions that streamers have with passersby or occupants of their taxi cabs. We examine each of these content types in more detail next.

4.4.1 Traveling. Similar to findings from [43], viewers like to watch streamers travel and visit places of interest or places with beautiful scenery. Such livestreams usually consist of multiple sessions or episodes that the streamer uses to show different segments of their journey. They often show how they accommodate, commute, what local food they have, how they make plans and interact with local people, the souvenir purchases they make, how they deal with accidents, and so on. Viewers often like to watch streams where streamers travel to destinations that need a large budget, have few transportation choices, cause the streamer to have altitude reactions (e.g., Tibet), involve mountains or seas, or occur in other countries. In addition to guided and self-guided culturally-focused tours, hitchhiking and self-driving tours are also popular.

Viewers who watch travel related livestreams often do so to gain practical information, because such livestreams are perceived as being more transparent about the experiences at hotels and sites and other information critical to traveling, e.g., "*I enjoyed watching traveling streams where the streamers go to various unique bars or places of interest. I would not know those places if I just go to that city without a lot of research*" (P17) and "*Streamers are mostly honest about their experience of the trip. For example, I can easily get to know if the service quality of a hotel or the food quality of a restaurant is good, because a lot of aspects were all streamed in real time, and the streamers are streaming from the perspective of real travellers. This information will be super helpful if I go on a trip to that place. TV shows probably don't show so much information because most parts are edited*" (P14). Viewers enjoy the "reality" and "behind the scenes" views that such streams provide, which due to the length of time that streams occur for, provide a more complete portrait of the travel experience than a documentary or TV show can.

4.4.2 Outdoor Survival. Viewers enjoy watching outdoor livestreams about hunting, fishing, cooking, and eating in the wild. Such streams often take place in rural locations near wild animals, ponds, or lakes with fish, or in cities near ponds for fishing. Interviewees enjoy learning about the processes of foraging for food, preparing materials, cooking, and eating, because they differs from their day to day activities, but still happen in the real world. As noted by P13, a light viewer, "*Nowadays we seldom see how food materials are prepared. In the supermarket we can only see processed meat. Such eating outdoor livestreams give us a chance to see the whole process of how food is prepared, and I am curious about how the streamer can cook very delicious meals out of raw materials. It might be useful for me if I go to the wild for some days.*". While the information that is provided in these streams may not always be relevant to their lives, the enrichment and novelty of these streams appears to be appreciated by both light and casual viewers alike.

4.4.3 Outdoor Adventure Activities. Outdoor adventure livestreams include those which depict mountaineering, rock climbing, hiking, or going to dangerous places, e.g., haunted houses or abandoned locations at night. Light and casual viewers watch these streams to learn outdoor skills and gain information about such activities, though "*they may only be useful in the future*" (P12). The thrills of watching these activities make them highly engaging, e.g., "*I personally do not want go to such [haunted] places by myself, especially during the night. Watching it through livestreaming is thrilling. It feels so real, and I can get scared, but I'm sure I am safe. I can experience this without any potential risks*" (P16). Because many viewers do not get the opportunity to travel outside their city to hike, mountaineer, or rock climb, outdoor livestreaming is an inexpensive yet safe way to experience the thrills that such activities can provide.

Viewers watch outdoor adventure livestreams because they can vicariously feel a sense of accomplishment through the achievements of the livestreamer. P14 and P17, who enjoy watching streams about rock climbing and surviving in the wild, noted that, "*if the streamer successfully*

finished climbing or surviving in the wild, I would get a sense of accomplishment from watching this, too. I felt like I witnessed a skillful streamer succeeded in a challenging task" (P14) and "*When watching the hitchhiking livestream, I feel like I am witnessing a magnificent feat, that the streamer was really working hard for this*" (P17). Although these viewers do not exert physical effort or expose themselves to the danger eminent in such environments, they find it rewarding to watch the physical struggles and emotional stress of the streamer – facets of survival that are often not on display within other genres of livestreaming.

4.4.4 Interpersonal Interactions. A distinct category that emerged was one where the focus of the stream was on spontaneous relationships and interactions between a streamer and their significant other or strangers in real life.

Conversing with strangers on the street. Such streams are akin to social experiments, wherein the streamer goes out on the street and strikes up conversations with passersby, asking questions or making fun of them. Many dedicated viewers enjoyed watching these streams because they were interested in how people communicate and were attracted by the uncertainty of the situations, e.g., "*When streaming in the city, the streamers are communicating with strangers. It is the interaction between real people, and people can change rapidly. Maybe there's nothing special now, but next minute something changes dramatically. This unpredictability about people really engages me.*" (P4). Other streamers perform with dramatic costumes in the public. Viewers enjoy watching such "embarrassing" performances and enjoy the reactions of passersby. As viewers could not see themselves doing such things in the public, they watch them so that they could vicariously experience what it would be like to do the activities themselves, e.g., "*I really enjoy watching those live shows that show a sense of shame in the public, like inviting passersby to join a challenge to do some embarrassing things on the street. I personally could not do that myself in public. I would like to see how the streamer does that, and how other people react to that, which can be super fun. I feel that I become a little bit more resistant to such a shame by watching this as well*" (P10).

Didi (Uber) drivers interacting with passengers. An emerging sub-category are those where Didi drivers stream a live "talk show" with the passengers in their car. The unique setting of their semi-public car, which has two or more strangers, creates an interesting social dynamic that casual and dedicated viewers appreciated, e.g., "*Driving a taxi creates a relatively closed space between the driver and the passenger. The two strangers co-locate in a closed space, where they might be interacting differently than in the public. Besides, because trips can be short, the driver keeps encountering many different people and interacting with them, producing waves of interesting conversations. It is like tens of interesting short talk shows in a two-hour stream, which is super enjoyable*" (P7). The unpredictability of who was going to be in the car next creates more uncertainty than interacting with strangers on the street, and thus created more excitement and engagement in viewers, e.g., "*I enjoy the high uncertainty of the passengers in Didi driving streams. If the streamer goes on the street to find someone to interview, he can easily evaluate if someone is appropriate to be in the stream by observing her behaviors. But when driving Didi, he cannot know much about the passenger until he picks her up. Such uncertainty brings more pleasure.*" (P6).

Couple (CP) live shows. This sub-category involves two people streaming together while traveling, driving, eating, dating, or engaging in live talk shows in outdoor settings. As most other outdoor livestreams only involve one streamer, these shows enable viewers to enjoy the friendship or romantic relationship that is shown in a spontaneous, unscripted way, e.g., "*CP livestreams involve one of the most essential things in life, friendship, or romantic relationship, which we can easily resonate with. Because the livestreams feel so real, and the streamers are not like acting. From their real-time eye contact or interactions with each other, I can feel the love, which is like a first love when I was young, which makes me feel better and desire such relationship. I think that is what*

pure love should look like" (P4). These "shows" usually occur in a series and often involve the streamer inviting a romantic or platonic partner to appear in several "shows". Some streamers enable fans in chat groups or forums to vote on who should be their streaming partner or invite less popular livestreamer partners to livestream with them to enable the less popular streamer to gain more followers and viewers. Because streaming partners change, viewers prefer it if the personalities and streamers' interactions mesh well, e.g., *"It is important that the guest streamer is talkative and humorous, and their conversations are interesting. They must feel like being together, even if they are not, and they should "match" each other. If so, their livestream seems to be real, and not too scripted like some TV shows"* (P5).

4.4.5 Viewership Trends. Although there are different sub-categories of outdoor livestreams, viewing patterns were consistent across viewer segments and categories (Table 4). Viewers had a similar level of interest in livestreams that were about travelling to familiar (X^2=1.86, p=.395) or unfamiliar (X^2=4.88, p=.087) places. Because these livestreams cover a broad range of interactions, places, and information, they are attractive to all viewer groups. Light viewers, however, were more interested in livestreams that were about surviving in the wild or extreme environments (X^2=14.93, p<0.001) and mountaineering or extreme sports (X^2=12.63, p<.05). Light and casual viewers were also more interested in livestreams about adventuring in a dangerous place (X^2=7.63, p<.05). As these viewers watch for shorter durations than dedicated viewers, they are generally more interested in acquiring knowledge about an activity or learning new skills, tips, or tricks. On the other hand, dedicated and casual viewers were more interested in livestreams involving interaction with strangers on the street (X^2=19.73, p<.001) and in a taxi (X^2=9.53, p<.01). Because these viewers, especially dedicated viewers, enjoy the stream and their community, streams that highlight the personality of the streamer and their social life are of interest to them.

Table 4. Aggregated survey responses about the types of outdoor livestreaming content that viewers watch per viewership segment.

Outdoor livestreaming categories	Viewers from each Viewership Segment		
	Light	Casual	Dedicated
Traveling to an unfamiliar place	79%	67%	81%
Travelling to a familiar place	60%	55%	49%
Surviving in the wild or in an extreme environment	60%	39%	35%
Mountaineering or extreme sports	50%	34%	22%
Hiking	39%	33%	19%
Adventuring in a dangerous place	36%	32%	19%
Striking up conversations with strangers outside	19%	36%	54%
Driving a taxi and interacting with passengers	9%	22%	22%
Fishing	9%	12%	0%
Other (e.g., couple shows, etc.)	1%	4%	19%

4.5 Viewer Motivations for Watching Outdoor Livestreams

Viewers watch outdoor livestreams for several reasons. Overall, they watched outdoor streams because they were fun or interesting (59%), they were interested in traveling or obtaining knowledge about outdoor activities (56%), or because the livestream helped them relax (50%). In terms of the differences between light, casual, and dedicated viewers, dedicated (35%) and casual (38%) viewers reported that outdoor livestreams provided them with a welcomed sense of community more than light viewers thought they did (17%) (X^2=13.97, p<.001). This is likely due to the differing amounts of time these viewers watch outdoor livestreams for and the different levels of engagement they have with the streamer's community. As alluded to previously, light viewers

were more interested in learning about outdoor skills or information about places of interest (49%) than casual viewers (26%) and dedicated viewers (30%) (X^2=15.09, p<.001). Because this category of viewers watches for a shorter period and is more disengaged than casual and dedicated viewers, they watch for personal fulfillment and knowledge rather than to belong to a community. There was no difference amongst viewership groups with respect to viewers' watching outdoor livestreams to relax (50%, 51%, and 46% respectively; X^2=0.34, p=.846). The interview data also uncovered three additional motivations for watching outdoor livestreams.

4.5.1 Nostalgia. Interviewees who grew up in rural or suburban areas enjoy livestreams about rural areas that might be underdeveloped. Such streams served as a reminder of the "old days", their hometown, or people they used to know, e.g., "*I enjoyed watching such livestreams where the streamers are fishing by a small pond. I used to fish like that when I was young. It really resonates with me a lot, and I felt a strong sense of empathy. It reminds me of my old friends.*" (P9). There were also several cases where interviewees mentioned something that might be unpleasant to watch, for example, traveling to abandoned places or underdeveloped regions in the mountains. While it may be difficult to watch unpleasant or depressing content, these viewers appreciated the opportunities for reflection about their life, family, or country that such streams afforded.

4.5.2 Luxurious Lifestyles and Vicariousness. Other interviewees, such as students (e.g., P4) or factory workers (e.g., P9) enjoyed seeing the luxurious life styles of streamers who were rich. These viewers liked watching the streamer having an expensive dinner in a decent restaurant, driving luxurious cars, going to expensive bars, staying at expensive hotels, and so on. For example, P4 noted that watching such livestreams was "*eye-opening and inspiring*", and he "*will set goals for the future to experience such lifestyles in person if possible*". Aside from seeing life experiences that they themselves could not have, they admired and appreciated being able to see the "freedom" that comes with choosing how to spend money. Participant nine noted "*watching someone who is crazy rich spent so much money on traveling is just pleasant*", whereas for participant seven, who was a suburban office worker and could not travel much due to work and family duties, noted "*I enjoy watching some streamers' flashpacking experience, going to travel whenever and wherever they want to go. I think this is a lifestyle a lot of ordinary people dream of in their life*". Although not every viewer may desire or achieve the extravagant lifestyle portrayed by the streamer, these streams enable viewers to see how others in different socioeconomic segments of China live. This could potentially encourage viewers to aspire to achieve their own goals or become more socially mobile within their own lives. None of interviewees commented on the negative effects of watching such streamers, however, it is possible that long term viewing of such content could increase negative feelings about one's own socioeconomic situation.

4.5.3 "Escaping" Other Livestreaming Genres Or Entertainment. Thirteen interviewees reported that they began watching livestreams by watching videogaming livestreams then transitioned to outdoor livestreams. Some reported that they had watched too many videogame livestreams over the years and became bored, e.g., "*Most popular videogames on streaming platforms now are several years' old, and I won't learn much about skills from the streamers. I prefer to watch streamers that are more interesting, and most outdoor livestreamers are really interesting*" (P9). For others, as they matured, switched jobs, or attended university, they did not play videogames as actively and had an increased desire to connect to the real world. This caused them to switch to outdoor livestreams that emphasized interpersonal interactions in the real world, e.g., "*I want to watch outdoor livestreams because they connect me more to the real world. I have been too addicted to the virtual world of videogames when watching gaming livestreams, and I just figured out I should step out a little bit. Outdoor livestreams are perfect because it focuses more on human-human interactions in real world.*" (P5) and "*Game livestreams focus more on content of videogames and interactions with*

gamers, while outdoor livestreams focus more on how to deal with relationship with other people in the society. It is a demonstration of social life." (P8). These viewers thus found value watching face to face or in-person interactions. Because outdoor livestreams can include varying degrees of unpredictability, physical exertion, social dynamics, and individual agency, they demonstrate the physicality and consequences of real-world interactions with others. Such facets of sociality can be difficult to convey or observe in livestreams of singing performances or video game playing.

4.6 Viewer Interactions During and After Livestreams

In addition to watching the live video content that is being streamed, prior research has identified that many viewers partake in different activities during a livestream and after it has concluded [41,43]. For outdoor livestreams, the most prevalent activities that emerged from the survey and interviews related to in-stream virtual gifting, the unique practice of in-stream Danmaku side shows, and post-stream activities such as making super cuts and watching archived videos.

4.6.1 Virtual Gifting. The act of paying for virtual gifts and sending them to streamers is a popular activity during livestreams. When a virtual gift is sent, it appears as text, graphics, or animations during the livestream and the streamer receives a portion of the gift cost (Figure 1ii). On some platforms, the number of gifts a streamer receives contributes to their popularity and leaderboard ranking on the platform. In our population sample, 100% of dedicated viewers had purchased virtual gifts for an outdoor livestreamer at least once, compared to 77% of casual viewers and 61% of light viewers. Dedicated viewers (62%) were more likely to purchase virtual gifts than casual (33%) and light (17%) viewers (X^2= 31.66, *p*<.001), with light viewers spending a statistically significantly lower amount of money per day (7.8 CNY ~$1.16 USD; μ = 7.8 CNY, σ= 13.7 CNY), than casual (15.6 CNY ~$2.32 USD; μ = 15.6 CNY, σ= 25.0 CNY), and dedicated (39.2 CNY ~$5.84 USD; μ = 39.2 CNY, σ= 42.9 CNY) (H(2)= 26.714, *p*<.001) viewers. There were many reasons for these gifting patterns.

Gifting for Engagement. Because outdoor livestreamers can stream for upwards of 10 hours a day, many outdoor livestreamers use specific strategies to induce viewers to purchase gifts for them such as "fundraisers". For example, P6 mentioned that while watching a livestream where the streamer was hitchhiking, the streamer started a live "fundraising" campaign at different times while hitchhiking. Viewers could then buy virtual gifts for the streamer through the streaming platform and the streamer would use the amount "donated" to dictate their hitchhiking "budget". Using this mechanism, viewers were more likely to "donate" to the streamer because they could see how the "donations" were being spent and often made suggestions about how to spend the "donations" e.g., "*The streamer was really hard-working, and it was hard to go hitchhiking in winter. I think with even a small amount of money I sent to him, he could at least save some energy by taking a bus or a taxi for a while*" (P6). Dedicated viewers saw little problem with donating to such campaigns, however, casual viewers did not like streamers asking for virtual gifts, which is a practise carried over from professional videogaming or live performance streamers [38], e.g., "*I think it is too commercial, too utilitarian, to ask for viewers to purchase virtual gifts*" (P19).

Collective Sense of Honor. For dedicated viewers who engaged with a streamer's community, gifting serves as a way to contribute to the community and the popularity of the streamer, e.g., "*I sometimes follow other fans to send virtual gifts when watching livestreams. It gives me a sense of honor as a member in the community, because other viewers and I all care about and support the streamer, and we want him and his stream to become better. I feel honored because I make a contribution to improving the atmosphere of the channel through actively sending virtual gifts*" (P5). Viewers were even more motivated to send virtual gifts during the annual streamer carnival competitions hosted by the streaming platform. If the streamer ranks high, viewers feel a

collective sense of honor in the ranking, e.g., "*Most of the time I don't give virtual gifts, or I just give a few small gifts. But last time when he [the streamer] was competing in the annual streamer competition of the platform, a lot of viewers and I paid for a lot of expensive gifts for the streamer to help him get the No. 1 in outdoor category. We would like him to be awarded the No. 1 for his hard work. We thought that it was just once in a year, and we should unite when we needed to.*" (P9). Although dedicated viewers are essentially paying the platform to provide a sense of belonging, they see virtual gifting as a collective action that helps the streamer rather than as a way to improve their own feelings of self-worth and acceptance.

    External Recognition. In addition to the streamer leaderboard, viewers who send many gifts are ranked on the gift-sender leaderboard. While this mechanism is used by platforms to create competition amongst viewers, surprisingly, dedicated viewers do not care about their placement on the leaderboard. More often, they care about the "atmosphere" of the streamer's channel, i.e., they want a larger proportion of the streamer's audience to send small gifts. The support of the streamer in this way creates a positive impression for newcomers as it suggests that the streamer is supported and beloved by many loyal viewers. As noted by P2, "*There may be some rich people who can give very expensive gifts to the streamer, but it is highly likely that they stop giving gifts someday. As loyal viewers we prefer to send many small gifts to the streamer more constantly, to make the atmosphere of the channel better. It is also a more sustainable way for us to support the streamer*". P7 also shared this view, "*I think it is important for the streamers to attract more and more new fans, if they really want to scale up and be more successful. We, as old fans, cannot always purchase virtual gifts time and time again. We are not super rich people. The streamer should not live off his past gains. New fans can bring more gifts to him and sustain his popularity on the platform*". Although they do not gain fulfillment from the leaderboard, dedicated viewer interviewees reported that they had paid for a "badge" to be displayed on their profile to show that they were a member of the streamer's community. As noted by P6, "*In the streamer's channel, if there are many viewers who have the badges of loyal fans on their titles, it will give others an impression that the streamer is popular …. This will attract more people to come to the channel*".

    4.6.2 Danmaku 'Side' Shows. Unlike other livestreams, which are produced by, and focus on, one livestreamer, the nature of outdoor livestreams requires them to be produced by a small team, often one person to be on camera and another holding the mobile phone or recruiting passersby. In other cases, the livestreamer may wear their mobile phone, use a selfie stick, or be in a situation where they cannot look at their phone or type comments. In these cases, the streamer is unable to read and respond to real-time Danmaku left by viewers. Thus, many outdoor livestream viewers repurpose Danmaku to create a simultaneous side show with inside jokes, running commentaries, and virtual 'fights' (Figure 1i). As noted by P2, "*I send Danmaku sometimes not for the streamer to see and respond, but for peer viewers to see and respond. The conversations between peer viewers are another big show, aside from the streamers.*"

    Dedicated viewers engage with Danmaku a lot because there are many opportunities for questions, critiques, or debates that encourage inspiration or deeper thoughts. Although the streamer themselves is interesting, for some viewers, the Danmaku side show can be even more engaging and is the primary reason they continue to watch the livestream. As mentioned by P10, "*I think 50% of enjoyment comes from the content of the streamer, and the remaining 50% comes mainly from interacting with other viewers through Danmaku. Sometimes even over 50% of enjoyment comes from Danmaku, especially when the streamer is commuting to the site before his real content.*" Light and some casual viewers, however, do not engage with Danmaku very much. This is often because they perceive the Danmaku side show to be distracting and irrelevant. As noted by P16, "*some comments are very shallow and not very informative. I would like to see some*

summaries instead of all the comments during the stream." Because these viewers watch the stream for the information from the streamer rather than the community, many light viewers turn off the Danmaku so they can filter out the "noise" from the community.

4.6.3 Post-Stream Activities. A by-product of outdoor livestreamers not engaging with their audience is that when viewers want to communicate with the streamer, they do so via post-stream activities. Some dedicated viewers voluntarily make super cuts, i.e., summary reels of a livestream, and upload them on social media on behalf of the streamer. These videos help the streamer increase their audience, draw additional viewers to the streamer's community, and will often be recognized during a stream by the streamer. Some viewers also write posts in forums to summarize the main points in the stream, punctuating them with memes, gifs, salient images, or even poetry, e.g., as P3 noted, "*We do this voluntarily, during our spare time. We are willing to do this, because the videos can potentially make more people interested in the streamer.*" Dedicated viewers are also more likely to post encouraging comments for the streamer (70%) than casual viewers (54%) and light viewers (34%) (X^2= 19.36, *p*<.001). They also give more suggestions to the streamer (49%) than casual (40%) and light viewers (20%) (X^2= 17.20, *p*<.001). Although these "extra" activities occur after the stream has concluded and requires even more of the viewer's time, the benefits of them to the streamer and their community make them worthwhile in the eyes of dedicated viewers.

After the livestream concludes, viewers can watch archived videos of the stream. Some viewers, especially dedicated ones, watch archive videos to catch up with what they missed, e.g., "*It is like watching a TV series. I don't want to miss any episode, so if I missed one I will watch an archived video to keep up*" (P4). Those who find value in Danmaku side shows seldom or never watch such videos because they do not offer the same level of community engagement, e.g., "*If it is an archived video it is about the past, then I am not into it. Why not just watch a TV show or a movie which can be better produced?*" (P13). For these viewers, the ability to have Danmaku conversations while watching an archived livestream would be a welcome feature.

Interestingly, the largest difference between the engagement of dedicated viewers and casual or light viewers was that casual viewers were much less engaged in their favorite streamer's communities. Seven of the interviewed casual viewers did not interact with other fans and were less engaged in chat groups or forums, citing that they did not follow "celebrities". This may be because casual viewers watch more amateur or semi-professional streamers who do not have dedicated communities. Light and casual viewers engage in personally fulfilling post-stream activities such as planning a trip to the place where the streamer was (52%), searching for content about the outdoor activities or places mentioned in the stream (51%), and so on. Light viewers were much more likely to plan a trip to the location shown in the livestream (62%) than casual (46%) and dedicated users (32%) (X^2= 13.03, *p*<.01). As these activities occur outside the platforms, they require viewers to exert more time and effort to gain value because the viewer must leave the platform. It is interesting that viewers who were not inspired to join community activities during the livestream were so motivated and inspired by the content of the stream that they decided to seek out additional information and did this moreso than those who were heavily engaged during the stream itself.

4.7 Viewer Social Interactions Shaped by Paimian

One unique and novel theme that emerged was the notion of maintaining "*paimian*" as a viewer and within a streamer's community. Paimian is a Chinese cultural concept that influences how Chinese people present themselves to others. It is composed of two facets: "*miànzi*", i.e., the outside 'face' that people put on to use to show their reputation, pride, or self-respect to the world

in social contexts [57], and "*pái chang*", i.e., the use of elements of luxury and wealth to impress others or attract attention. The notion of miànzi has been shown to influence how Chinese people present themselves to others both in real life and online [74]. Paichang, on the other hand, has been demonstrated to be prevalent in Chinese culture (e.g., [36]). Thus, "*paimian*" is the notion that it is important and commonplace to demonstrate and flaunt one's worthiness, pride, honor, and self-respect in social contexts through forms of ostentation and extravagance. In some sense, paimian is similar to the English idiom "keeping up with the Joneses" [72], however, with paimian, less emphasis is placed on living beyond one's means. With respect to outdoor livestreaming, one can increase or maintain their paimian by buying subscriptions to a streamer's livestream and having a visible badge on their profile, giving gifts to the streamer during the livestream (either free, paid, or from subscription perks), being endorsed to be a community moderator, or being a well-known viewer who has purchased expensive virtual gifts.

Most dedicated viewers enjoyed pursuing paimian, because outdoor livestreaming "*is more real and closer to social life, where we all care about miànzi*" (P2). The desire to have miànzi and increase their own paimian encourages individual users to send virtual gifts, e.g., "*I am used to sending small gifts to my favorite streamer. I always send him small gifts when I am watching his stream. If I do not send gifts any more, I will feel like 'losing face (miànzi)' in front of the streamer and other viewers*" (P10). Dedicated viewers were also more engaged in the community because active communities are demonstrative of paimian, e.g., "*The outdoor livestreaming community has a stronger sense of community and deeper engagement with the community, compared to the game livestreams I used to watch. I gradually got used to watching outdoor streams. Even if sometimes the content is not that interesting, I still enjoy it, because the community feels like a family. In this family, we all want our streamer to become better and better*" (P8).

Several dedicated viewers also reported that their favorite streamers "*are largely pursuing paimian. They regard it more important to pursue paimian than streamers of other categories like gaming. They tell us explicitly that paimian is important for them in the stream*" (P1). Outdoor livestreamers embed paimian in the offline and online worlds. For example, they demonstrate paimian in the real world by explicitly showing that they are traveling to places that require a large budget, staying at an expensive hotel, driving luxurious cars, inviting other popular streamers or celebrities to stream together, or using expensive and professional equipment (e.g., drones, stabilizers, and water-proof devices). In the digital world, they demonstrate paimian by having a lively and active livestream with many subscribed viewers who have loyal fan badges, sent Danmaku comments, and purchased virtual gifts. Thus, they actively solicit viewers' participation to "gain" more paimian online. Because streamers value paimian more than the face value of money, some streamers prefer viewers to send virtual gifts on the streaming platform rather than transfer money to them through external channels, e.g., "*The streamer said he preferred to receive virtual gifts even if the platform took a portion of it. He said that receiving more gifts could make the stream livelier, and his stream could be promoted more by the platform*" (P6). Because virtual gifts are shown publicly, in real-time, they enable streamers to indirectly accrue paimian using the built-in mechanics of the streaming platform.

Although streamers express interest in garnering paimian to viewers, not all viewers long for paimian online. Some, especially casual and light viewers, thought that streamers who were too paimian-driven may cause viewers to lose interest, e.g., "*It feels like all the streams of professional streamers are about gaining popularity, paimian, and money. I don't like it very much*" (P17). Because the motivation and goals of non-dedicated viewers are more focused on self-improvement and knowledge acquisition, outdoor livestreams appear to be viewed as more of a contextually

situated teaching or information service. For these viewers, community building and one's external presentation within the community is less important.

5 DISCUSSION

The survey and interview findings uncovered many novel facets of outdoor livestreaming and broadened our understanding of this emerging cultural phenomenon. In what follows, we reflect and highlight the opportunities and challenges that outdoor livestreaming presents, situate our results within other livestreaming research, and discuss insights and future avenues of research.

5.1 Elements of Engaging Outdoor Livestreams

Although the survey and interviews revealed a diverse range of livestreams fall under the outdoor livestream banner, several similar elements were found to encourage viewer engagement. Viewers were mostly attracted to livestreams based on the realness and unpredictability of the situations streamed. Outdoor livestreams occur in more complicated real-life environments than those found in videogame or live performance streams and often contain many factors that are outside the control of the streamer and viewers. The richness of real life enables streamers to have more material, situations, environments, and freedom in terms of how they perform in livestreams. Unexpected accidents or encounters with interesting passersby can be leveraged to show creativity in how a streamer interacts with people in real life. Most interviewees thought that the unpredictability was a source of intrigue and piqued their curiosity. Even when what was being streamed was mundane, viewers still wanted to watch because "*no one knows what is coming next, but if something comes up, it would be interesting*" (P9). Interviewees also noted that the ways streamers deal with emergent situations in the stream was engaging, because it showed "*how a real person is reacting to an emergency and how they make decisions to deal with it quickly, in the pressure of being watched by others*" (P6). For these viewers, the *anticipation* of what could come next and how the streamer may react, solve, or escape the situation encouraged their viewership.

On the other hand, interviewees also noted that there were some performative elements of outdoor livestreams used by streamers to prevent streams from being mundane and losing viewers, especially in livestreams that focus on interpersonal interactions, e.g., passersby may be invited actors or conversations may be scripted. Although aware of scripted content, interviewees still value the realness of outdoor livestreams, e.g., "*at least outdoor livestreams happen in the real world and involve real people. Even if scripted, something unpredictable will still happen, and the streamers' reactions to such situation will be authentic*" (P7). Most dedicated viewers did not care if outdoor streams were scripted, as long as the streams were interesting, inspiring, and the streamer reacted to the emergent situations or interacted with strangers in a "real" way. Light and casual viewers, however, seemed to value the realness of outdoor livestreams more, e.g., "*I think some streamers are too fake. They are acting like they are in a drama. I prefer streamers who share information without too much drama*" (P16). For outdoor streamers, there seems to be a tension between providing hours and hours of engaging (possibly scripted) content for dedicated viewers and keeping the reality of the stream to engage light and casual viewers. This complements prior research on the tensions of streamers when streaming outdoors [60].

The novelty and creativity of content, which has been shown to be important for livestreaming engagement [26,41,43], is even more important during outdoor livestreams. Unlike videogames or live performance livestreams, which have predefined content, e.g., a specific game to play or song(s) to sing, outdoor livestreamers must find their own content to stream. They need to constantly innovate to find new scenarios or angles. As the evolution of outdoor livestreams

continues, streamers will need to find even more innovative ways to engage viewers to stay relevant and meet the needs of their viewership.

Empathy is also important for viewers. Interviewees noted that because outdoor livestreams feel real, and the streamer's life experiences are exposed to them for extended periods of time, viewers understand and share in the feelings of the streamer. For example, P4's favorite livestreamer is controversial because of her 'slacker-like' streaming attitude, which garners her many trolls and critiques on the platform, however, P4 seems to understand and unconditionally support her relaxed and informal approach to streaming. Because empathy can encourage helping behaviors and improve the quality of social interactions [4], this may be why empathy makes viewers feel more engaged with the streamer. The down side to viewers having empathy for streamers is that it may cause some viewers to become addicted to outdoor livestreams because they become accustomed to vicariously watching others live, i.e., the streamer becomes less of a 'person' and more of a 'character' or 'idol'. As videogames have been shown to influence empathy and schadenfreude (i.e., pleasure at another's misfortune) [24], future research should explore livestreaming's effects on empathy to better understand how watching livestreaming, especially for such long durations, can positively and negatively impact viewers' lives.

5.2 Social Interactions within Outdoor Livestreaming

In line with previous research on how and why viewers support streamers [41,73] and how streamers and viewers interact within livestreaming [25,26,41,68], this work revealed a more nuanced understanding of viewer socialization within livestreaming. Cultural elements such as paimian play an important role in shaping social interactions of viewers and streamers and the prevalence of gamification elements like viewer badges and virtual gifts naturally mesh with paimian. Because outdoor livestreams emphasize realness, such cultural elements mirror viewers' real social lives within their virtual social lives. Popular outdoor livestreamers successfully embed paimian into their livestreams by explicitly emphasizing paimian in livestreams (e.g., showing that they are using expensive equipment and they have many loyal followers during livestreams) and making paimian as a collective goal of viewer communities.

These practices make dedicated viewers eager to engage more with the community, watch livestreams more often, buy more virtual gifts for streamers, and help streamers gain more popularity because these activities reward the viewer, the streamer, and the whole community. It is surprising to see that paimian, commonly pursued for a person's own self-esteem or for the honor of their family [57], is sought after in the virtual world by dedicated viewers. This might be explained by the family-like feel of some streamers' communities, however, a deeper understanding of how paimian is pursued within the context of livestreaming is needed. Although paimian is largely a Chinese cultural concept, Goeffman has shown that cultural elements like miànzi may also exist in other cultures [23]. Future research is therefore needed to understand the generalizability of paimian or other cultural elements as possible a motivational and engagement tools for viewers on livestreaming platforms in other countries.

5.3 Outdoor Livestreaming Challenges and Design Implications

Our findings also revealed several challenges associated with streaming outdoor, unpredictable live content, e.g., different needs for professional and amateur streamers, problems with information overload, and techniques and mechanisms for dealing with unpredictability.

5.3.1 Engaging Viewers for Hours. One element that must be considered when designing software and platforms that will be used to record and view content for long periods of time, is the quality and professionalism of the stream. Viewers have standards about the quality of the content

they will watch: for example, dedicated viewers want livestreams with higher production values and better cinematography, which makes sense given the length of time that they watch livestreams for. Watching handheld livestreams that do not maintain a stabilized video viewpoint can be difficult, especially if the streamer is on a long hike in a mountainous area. It may be useful for streaming platforms to introduce additional computer vision techniques to smooth out stream content or reward streamers with awards or badges when they make use of gimbals or tripods.

Aside from cinematography, outdoor livestreamers must ensure that there is always interesting content to attract the viewers. Some streamers have made use of techniques such as switching from videogame to outdoor content from stream to stream, frequently changing the locations where they stream, or inviting other guest stars into their stream. While these techniques may encourage more long-term viewership and help to build their audience, platforms and streamers need other forms of dynamic content to engage viewers in the short term. "Fundraising" campaigns can encourage short-term viewership, however such campaigns must work within the gifting constraints of the platform and require additional streamer effort. Providing streamers and viewers with other methods of interacting may help viewers contribute and increase their sense of paimian, while also decreasing the burdens currently placed on streamers to manage such campaigns, e.g., integrating automatic budget calculations based on the value of virtual gifts.

More recently, some streamers have arranged "unexpected encounters" with guests to entertain viewers, created stories to make the stream flow better, or even purposefully added "conflict" to make the narrative in the stream more dramatic. These strategies have been borrowed from reality television and can create short term spikes in viewership, but do so at the cost of decreasing the realism of a stream and authenticity of a streamer. Rather than using narrative elements that dilute the unpredictable nature of a stream, it would be better if streamers had access to tools that could allow them to integrate spontaneity, for example, 'nearby' notifications to alert them of interesting places, landmarks, or other streamers in their vicinity. Platforms could also enable more viewer interactivity such as introducing voting and polls about the next location to travel to, enabling viewers to become guests, or allowing Danmaku sideshows to become temporary focal points during mundane times (e.g., while the streamer is on a long train ride).

As it is difficult for a single streamer to satisfy the viewing desires of all their viewers, especially when they are in unpredictable or potentially dangerous environments, platforms need to develop techniques that would enable streamers to target and tailor the content they provide to different viewers based on their viewing interests.

5.3.2 Designing for Collaborative Streaming in Outdoor Environments. Outdoor livestreams largely consist of one streamer, but we found that viewers enjoy livestreams about interpersonal interactions. There is great potential for outdoor livestreaming to include more than one on-screen streamer at a time. Current livestreaming techniques, however, do not support multiple streamers streaming together physically or support the notion of "supporting" streaming roles.

When it comes to supporting multiple streamers together, current co-stream mechanisms are mostly enabling remote collaboration between two streamers, such as showing the juxtaposition of two streamers' videos. This limits the interactivity of streamers while collaborating in a co-located manner. For example, inviting guests (e.g., CP livestreams) is one form of collaboration, however, the communication channel between both streamers' communities are confined to the live commenting of each streamer's individual channel. Viewers should be able to have more direct channels to interact with the guests who are streaming with the streamer and other streamer communities. Future livestreaming applications should have better mechanisms to merge the Danmaku of different streamers, and support maintaining paimian of different streamers' viewer communities. For example, merged Danmaku should clearly visualize the activeness of

each streamer's viewer group. Viewers from different streamers should also be able to specify which streamer their comments were targeted to or enable the platform to automatically classify comments based on contextual information. Information about different streamers' streaming history should also be aggregated, e.g., the places they have been to or plan to go to, and interactive maps showing streamers' status should also be available.

As noted by our interviewees, some outdoor livestreamers have a team of assistants coordinating content behind the camera. Most current collaborations, however, happen offline and in the background because there are few tools available to support real-time, live teamwork in outdoor environments. Some dedicated viewers expressed that they would like to have more interactions with supporting team members and because they are already active in post-stream activities, such as making video clips or summaries, they wanted to help the teams in real-time. Streaming platforms could design interfaces to enable supporting teams to offload certain tasks that can be done remotely to viewers who are willing to help, and enable them to collaborate and ideate on the tasks e.g., searching for interesting places to visit or crafting a story for streamers to tell in the stream,. The support teams should also be provided with viewers' real-time data about their interests and sentiment analysis visualizations from comment data to help support better decision making and streaming strategies.

5.3.3 Information Overload. As shown in previous work, the number of comments or Danmaku found in livestreams is one of the major problems with livestreaming services [42,47]. Our work shows that gamification elements like gifting, Danmaku, fan badges, and rankings also overwhelm casual or light viewers, but are important for building engagement and increasing paimian with dedicated viewers. As these types of engagement strategies will continue to be important to viewers, livestreaming services need to integrate more customizable user interface elements that can be tailored to the needs and paimian desires of different segments of the viewing audience. For example, having the ability to summarize comments or visualize an aggregation of popular terms would help with information overloading, as would the ability to filter topics or categories of Danmaku. Summarizing or aggregating the virtual gifts that are sent to a streamer could prevent those who do not favor paimian from feeling overwhelmed by gifting, while maintain the overall atmosphere of the stream. Further, to satisfy viewers who seek information (e.g., light viewers) and those who enjoy Danmaku side shows (e.g., dedicated viewers), livestreaming platforms should use natural language processing techniques to classify comments, showing informative comments to information seekers and entertaining information to those who enjoy Danmaku side shows.

Although comments and viewer generated content are one of the main contributors to information overload, archive videos also contribute to the problem. Because outdoor livestreams tend to be long, archived videos of the streams are similarly long, often with many mundane sections of video, similar to life-logging videos. Even though viewers want to catch up on the streaming content they missed, several dedicated viewers were unwilling to watch archived videos of outdoor livestreams because the length could be over 5 hours and the platforms have no live commenting functionality. Livestreaming platforms should adopt tools developed for organizing and reducing redundancy of life-logging data, for example, detecting important objects, concepts, or locations and using them for event identification, labelling, or segmentation [7–9,16,62,64,71]. However, because livestreams have video data, Danmaku comments, and virtual gifts, future research should explore how to integrate these multiple video streams with other multimodal data to provide a more representative archive of the highlights and interesting segments of the stream.

Although there are many techniques that could be used to create better archive videos, several interviewees were unwilling to watch edited videos because they felt that the videos might miss

some points that they, but not others, find interesting. Therefore, it is important that resources are devoted to developing visualization and tagging techniques that summarize the events in streams and support interaction methods that enable viewers to quickly compile their own 'Choose [their] own adventure' narrative [2] or montage. By supporting post hoc interaction, viewing, and engagement using techniques similar to the user interface mechanisms in StreamWiki [42], post-stream paimian may motivate viewers to support streamers in alternative ways that could benefit the streamer's community as a whole.

5.3.4 Dealing with Unpredictability and Privacy. For outdoor livestreaming, unpredictability can be beneficial and harmful. In some cases, streamers have been banned from a platform because they encountered situations that caused inappropriate content to be livestreamed (e.g., gambling). Because it is difficult to moderate live videos, outdoor livestreamers need better tools to be able to identify potential risks in their content. AR-based overlays or computer vision detection algorithms could be useful, as could the ability to temporarily introduce 5 or 10 second delays if the streamer is in a dangerous place. Moderators, who have been shown to be active in helping streamers [61], or dedicated viewers, should have access to real-time reporting or delay tools.

Privacy is also an important challenge for livestreaming [37]. Because outdoor livestreamers livestream longer than other genres and often show their journey from place to place, they create large digital footprints and opportunity to be targeted by trolls or followed by infatuated fans in real life. In addition, for those who stream travel, the likelihood of accidently displaying sensitive personal information such as passport numbers, credit card numbers, vehicle licence plates, and so on is increased. Computer vision algorithms could be integrated within live streaming platforms to pixelize or block such information to protect the streamer or their guests.

In addition to the streamer's privacy, there are also concerns about the privacy of the strangers who the streamer interacts with. As most streams occur in public spaces, it could be easy for guests or passersby to forget that their actions and behaviors are being streamed in a form that could be archived, remixed, and reviewed for years to come. While using a temporary delay or blurring of some actions may be a short term solution [51], platforms should develop video and audio comparison techniques that can notify guests or passersby if they are behaving in ways that differ their own social media postings. Because passersby or guests could become a meme, virally famous, or stalked online or in person, livestreaming platforms must introduce better mechanisms to alter video content that contains identifiable information when necessary, replace the background of an environment, or modify the visual appearance of guests if desired.

5.3.5 Bridging the Urban/Rural Divide through Outdoor Livestreaming. Most of the survey and interview participants lived in urban areas, however, they were interested in livestreams about more rural locations where activities such as survival, fishing, or hunting occur, and they were interested in food from the wild and outdoor skills. Some even wanted to purchase food or crafts from streamers in rural areas, similar to the e-commerce activities found during livestreams of intangible cultural heritage practices such as dough figurine or Chinese calligraphy [41]. Outdoor livestreams involving inter-personal interactions and conversations with strangers in cities are also becoming more prevalent, with viewers from suburban areas enjoying living vicariously through livestreams that showcase luxurious city lifestyles or life in foreign countries. There thus appears to be an opportunity to use livestreaming to inform rural viewers about current urban trends and urban people about rural life to bridge these two geographic and socio-economic locations. For example, livestreaming platforms should enable viewers to easily get necessary contextual information about the content being shown in livestreams, enable them to express their interest in purchasing physical objects showcased in the video, and enable streamers to sell them with ease. Platforms should thus introduce new leaderboards and badge or gifting types, add

additional sub-categories to the outdoor livestreaming category, promote streamers outside streaming platforms, and offer functionality to connect streamers to cultural or community groups. One potential challenge to this may be that streamers' communities might not be inclusive and there may be cultural or language challenges that discourage viewers from the other groups from participating in the community. There should thus be better tools to enable a welcoming environment within a livestream so that the two groups can interact with each other, perhaps including real-time translation services, volunteer moderators from community groups or non-profit agencies, automatic captioning [6], and mapping and summarization widgets to provide geographic-based context or historical information.

6 CONCLUSION

This work examined viewers' experiences when watching outdoor livestreams and engaging with outdoor livestreamers' communities within the context of China. The results from the survey and interviews revealed that a diverse range of outdoor activities are streamed on popular livestreaming platforms in China and that different categories of outdoor livestreams engage different segments of the viewing audience (i.e., dedicated, casual, and light viewers). Dedicated viewers watch an outdoor livestream for excessive periods of time in one sitting (e.g., 5 hours), and are vicariously engaged with streamers' content and communities, while casual and light viewers are less engaged, and watched more for information and personal fulfilment. We also found that, for dedicated viewers, Danmaku is used to create a concurrent side show during a livestream, and it can sometimes be more engaging than the livestream itself. Gifting behaviors were also found to be deeply rooted in the Chinese cultural element of "*paimian*". By identifying unique challenges that viewers and streamers encounter within the realm of outdoor livestreaming, e.g., contextual unpredictability and privacy concerns, the results of this work should help improve the design of livestreaming platforms and enable the community to better understand the influence and effects of such livestreaming content on viewing audiences, both inside and outside of China.

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