

Beyond a Conventional Chatbot: How AI Streamers Transcend Live Streaming Experiences from Viewers' Perspectives

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Figure 1: Popular AI streamers Neuro-sama (right) and Evil (left) interact with their human creator Vedal (represented by the turtle avatar on Neuro-sama's head) during a live stream, while online viewers watch and interact with other viewers and the AI streamers through real-time chat (top left). (Source: Screenshot from Neuro-sama official channel video [58] at 22:44)

Abstract

Unlike conventional social AI agents, AI streamers are multi-modal artificial intelligence systems that engage in autonomous, real-time social interactions with audiences in a dynamic and public online space. Through a qualitative thematic analysis of 1891 comments on a YouTube channel of Neuro-sama, an exemplar of popular AI streamers, we reveal that AI streamers enhance viewers' experiences through their unique personality development, behavioral autonomy, and nuanced AI-creator relationships; yet they also raise concerns about emotional damage, problematic training data, and heightened moderation challenges in real-time streaming environments. We contribute to HCI at the unique intersection of AI for social needs and live streaming research by highlighting how AI streamers reshape live streaming practices through innovating its creative content creation, novel streamer identity practices, and

rich streamer-audience interaction mechanisms. We also propose three design principles for strengthening AI streamers' social and creative affordances while mitigating identified risks, which inform broader AI agent designs in public online social spaces.

CCS Concepts

- Human-centered computing → Collaborative and social computing; Empirical studies in collaborative and social computing;

Keywords

Live Streaming, AI Streamer, Virtual Agents, Human-AI Interaction

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1 Introduction

Modern-day AI design and development tends to focus mainly on utility-driven human-AI interaction for facilitating workflows and productivity outcomes [4, 88, 98]. More recently, new advancements in generative AI systems, such as Large Language Models (LLMs) (i.e., AI systems trained using large text-based datasets to generate human-like responses and engage in natural, contextual conversations [8, 9, 87]) also lead to an emerging HCI research agenda on understanding and designing **AI systems as social agents** capable of engaging in emotionally driven interactions beyond instrumental purposes [1, 38, 49, 61, 83]. Examples include chatbots, conversational agents, and AI companions helping users combat loneliness, reduce stress, or navigate interpersonal conflicts [10, 19, 32, 62, 71, 74, 76, 80].

These efforts are actively expanding the traditional utility-driven AI paradigm. However, most existing AI agents for social needs are still mainly constrained by specialized prompting strategies applied to general-purpose LLMs (e.g., ChatGPT) in clearly defined contexts, especially within private one-on-one conversations between one human user and one AI agent [3, 10, 71, 76]. In fact, generative AI is increasingly participating in social spaces beyond just individual-level interactions, such as acting as multi-modal, embodied AI tutors responding to student questions in lectures [82], as virtual influencers posting AI-generated videos [73], and monitoring text-based posts to help manage and sustain online communities [71]. While this emerging body of research has begun to show AI agents' potential to operate in open social environments, their interactions remain asynchronous or structured (e.g., answering specific questions). How AI agents may independently manifest and operate in more **real-time, complicated public social spaces** is largely understudied. Therefore, we believe that more research on these emerging phenomena where generative AI agents behave in authentic social environments with fluid and unpredictable contexts [3, 71] is urgently needed to paint a more comprehensive and nuanced image of AI's rapidly evolving role in reshaping people's broader social lives in the real world.

One such particularly popular new phenomenon is **AI streaming**, where AI agents, instead of human streamers, act as content creators on live streaming platforms (e.g., Twitch). Live streaming is a public online social space featuring multimedia content creation and synchronous streamer-viewer interactions that all online audiences can watch in real time (e.g., streamers performing through camera [29] or virtual avatar [95] and audiences engaging with text chat messages [90]). In AI streaming, while a human creator/co-streamer may appear alongside the AI and engage in verbal communications in the stream (e.g., Vedral in Figure 1), AI agents function independently as virtual avatars to autonomously perform (e.g., gaming, singing, and chatting) and reply to real-time audience chat messages (e.g., through text-to-speech) just like human live streamers [12]. In this sense, AI streaming uniquely presents AI agents as independent, proactive social actors in traditionally human-exclusive online social spaces, rather than as assistive, reactive social tools in controlled application contexts [28, 59].

In this work, we focus on AI streaming as a valuable lens to offer new insights into how AI can autonomously manage complex social environments and develop novel human-AI interactions in public

online social spaces (e.g., live streaming). We conducted a qualitative thematic analysis of 1,891 online comments on a YouTube channel of a popular AI streamer, *Neuro-sama* (Figure 1), to empirically unpack how actual viewers perceive and experience AI streamers' nuances and potential risks reshaping their live streaming watching experiences. We chose *Neuro-sama* as an exemplar of existing AI streamers for two reasons. First, it represents one of the first AI-powered virtual streamers using LLMs and animated avatars, which has gained significant popularity since late 2022 [16]. Second and most importantly, *Neuro-sama* is the only non-human streamer among the top 20 most subscribed Twitch streamers of all time as of November 2025 [85]. This demonstrates *Neuro-sama*'s mainstream success, making it an ideal case for examining AI streamers in traditionally human-dominated public social spaces. Therefore, using *Neuro-sama* as an example, we aim to address two research questions:

RQ1: How, if at all, do AI streamers transcend conventional AI applications to innovate viewer experiences in live streaming?

RQ2: How, if at all, do AI streamers also lead to potential new risks for their online audiences?

We make three primary contributions to HCI research by bridging and expanding existing bodies of literature on AI for social needs and on live streaming as a nuanced online social space. First, leveraging AI streaming as a novel lens, we provide one of the first empirical investigations of how social AI agents situate, manifest, and operate in **public social spaces** with sophisticated, real-time interactive dynamics. We highlight how *Neuro-sama*, an exemplar of mainstream AI streamers, can autonomously navigate complex audience interactions and develop authentic social relationships while creating engaging content. While our findings are grounded in this specific case, they offer important insights into expanding existing literature on social AI agents constrained to simple interaction dynamics (e.g., text chat with AI agents [10]), private spaces (e.g., one-on-one dialog [39]), and one-way interactions (e.g., posting videos for passive watch [73]). Second, we reveal how popular AI streamers like *Neuro-sama* are actively reshaping viewers' online experiences through innovating key mechanisms of creative content creation, streamer identity practices, and streamer-audience interaction in live streaming. We demonstrate how live streaming environments enable AI agents to develop sophisticated social personas and authentic relationships, while introducing unprecedented creative affordances and community engagement dynamics that expand traditional human live streaming practices. Third, we also propose three design principles for strengthening AI agents' social and creative affordances while mitigating identified tensions, which contribute to a broader research context around safer and more socially supportive AI agents in future online spaces with increasingly fluid and unpredictable interaction dynamics.

2 Related Works

2.1 The Growing Trend of Designing AI Systems as Virtual Agents for Social Needs

Artificial intelligence applications have long focused on **utility-driven** human-AI interactions designed for productivity and workflow purposes, ranging from *information inquiry* [4, 14, 63] and

data processing [64], to assisting with traditional *paperwork* [6] and *creative workflows* [23, 24, 88, 98]. More recently, researchers have begun to recognize AI's potential to engage with more sophisticated social interactions due to advancements in generative AI systems such as LLMs. For example, software and game developers may leverage ChatGPT to support their mental well-being (e.g., helping relax, reducing solitude, and gaining self-confidence) rather than just for workflows [40, 61]. Meanwhile, more specific AI chatbots, such as *Replika*¹, can further enhance one's sense of belonging while mitigating loneliness, providing human users with substantial affective and social benefits through human–chatbot relationships [10, 62, 76, 81]. Taken together, these efforts aim to approach and design AI systems as **social agents** that go beyond purely instrumental or work-related purposes [1, 38, 49, 74, 83], which place greater emphasis on consistent social presence [49] and personalized communication styles [50]. Yet, existing works have also highlighted both new opportunities and emerging challenges of these AI social agents for human–AI relationships and AI design, which we detail below.

First, existing literature has demonstrated the potential of generative AI agents for supporting human emotional and social needs in increasingly specialized and expressive ways. In terms of specialization, while general-purpose AI can already provide valuable companionship to mitigate loneliness and boredom [10, 42, 50, 62, 76], AI agents can adopt dedicated roles to provide more targeted social benefits. For example, AI agents can power Non-Player Characters (NPCs) in single-player video games [97], act as peers to encourage children to express emotions [72], or serve as debate partners to facilitate critical thinking ability through diversified viewpoints [83, 101]. In terms of expressiveness, multi-modal embodied conversational agents can communicate through more diverse social expressions (e.g., human voices and virtual avatars [1, 37, 82]) and automatically align its responses to the human user's own conversational and expressive style, making these agents seemingly more empathetic and believable [1].

Second, existing works have also highlighted how specialized and expressive AI agents can open up novel design affordances compared to traditional utility-driven AI systems. Indeed, designing an AI agent for social needs usually requires more sophisticated design considerations [59], including its instrumental role [37, 49, 74], persona (e.g., demographic background [94], personality [49], viewpoint [101], and avatar appearances [1, 66, 82]), and scenario (e.g., background story [65]). These diverse social requirements simultaneously heighten the need for more complex AI capabilities, such as: long-term memory capabilities to support socially isolated individuals [39]; personalized voice, gender, and memory-based conversations in reminiscence therapy with dementia patients [94]; and contextually appropriate conversation styles tailored to autistic individuals in workplace settings [38]. Moreover, recent frameworks for socially intelligent AI have emphasized the importance of thoughtful alignment among contextual scenarios, defined roles, and distinctive personas to strengthen user trust and foster positive human–AI relationships [59]. The interplay between these technical and non-technical dimensions thus makes designing

effective AI social agents a more nuanced challenge than traditional AI design.

Third, despite these novel opportunities, prior works have revealed various ethical challenges and risks when AI agents directly participate in human social interactions. For example, privacy concerns arise when AI agents collect extensive personal data through intimate conversations, often without adequate user awareness or protection [5, 17, 36, 44], and safety issues emerge when AI systems fail to recognize users' emotional distress or respond inappropriately to vulnerable situations [17]. Recent research also shows that AI systems designed for social purposes often exhibit harmful behavior, with nearly 30% of interactions containing problematic content [100]. Beyond direct safety risks, there are also concerns about trust and authenticity issues when directly introducing AI to humans' familiar social spaces, especially when AI agents attempt to take well-established social roles that humans often play. One such example is AI-generated social media influencers (i.e., AI-powered digital personas that post AI-generated texts and videos and engage with followers on social media platforms) [68, 78]. Such AI agents may appear inauthentic and deceitful to followers when they make claims about "personal experiences" while being perceived as lacking human-like consciousness [78]. This distrust can even extend beyond the AI itself to the human creator behind it, as social media users may suspect that the AI influencer may be used to conceal their creator's intentions and manipulate audiences [68].

In summary, these works have explored how to understand and design AI systems for sensitive and sophisticated social needs beyond just supporting workflows and tasks. Yet, most existing studies tend to focus on AI agents that operate within "*clearly defined application contexts*" with "*specific constraints to agents' abilities and behavior*," which may not capture the full complexity of human–AI interaction in real-world social environments [59]. Only a small body of research has begun to examine how people perceive and approach AI agents in less constrained social contexts, such as the above-mentioned social media influencers [73, 78]. Yet, these works still primarily examine user attitudes toward pre-recorded AI-generated content (e.g., social media videos) or asynchronous interactions (e.g., posts and comments), leaving the dynamics of real-time, autonomous human–AI interaction in public social spaces largely underexplored. In response, our work investigates **AI live streaming**, where AI agents are employed in real-time content creation and social interaction, as a novel research context to deepen our understanding of AI as social agents in complex, real-world social contexts.

2.2 AI Live Streaming as a Novel Research Context to Expand Existing Human–AI Interaction Frameworks

Live streaming represents a unique online interactive media that combines high-fidelity audio and video public broadcasting with low-fidelity, real-time text communication between streamers and viewers [29]. Existing research has extensively explored live streaming as a nuanced online social space featuring (1) **creative content creation** (e.g., ranging from gameplay, painting, crafting, eating,

¹<https://replika.com/>

and cooking to sleeping) [35, 53, 89]; (2) novel **streamer identity practices** [20, 47, 95]; and (3) rich **streamer-audience interaction mechanisms**, including both verbal and non-verbal communication [28, 34, 67, 90, 91, 96] as well as para-social relationships [13, 56]. In particular, **streamers** have been consistently highlighted as the primary drivers for the above-mentioned three features that define the very nature of live streaming. Indeed, regardless of either conventional streamers (e.g., streamers who capture their image through web-based camera [15, 20, 28, 90]) or virtual YouTubers (e.g., VTubers who stream as voice actors with animated virtual avatars [34, 41, 95]), the streamer's own self-presentation (e.g., selective or authentic online identity practices) [18, 20, 51, 79], the unique content they create for viewers to watch [29, 52, 92, 102], and their specific audience management strategies (e.g., balancing interaction frequencies between different viewer groups [70, 90]) fundamentally shape audience engagement and foster streamer-viewer connections.

This long-standing focus on the key role of streamers makes **AI streaming** a particularly novel yet understudied phenomenon. AI streaming builds upon the virtual YouTuber format, while LLM-powered AI entities, instead of human voice actors, autonomously control animated virtual avatars and conduct live streaming activities [12]. A prominent example of AI streamers is *Neuro-sama* (Figure 1), a fully LLM-controlled streamer debuted in December 2022. Initially designed to play rhythm games, *Neuro-sama* gradually evolved to showcase singing capabilities and interactive live streaming (e.g., reading and responding to audience messages in real-time) [16]. *Neuro-sama* has achieved unprecedented mainstream recognition for an AI streamer. Currently, she is the only non-human streamer in at least the top 20 of Twitch's all-time subscribe list (ranked 8th with 167,017 peak subscriptions as of November 2025 [85]).

Neuro-sama's success is particularly significant given how demanding and challenging live streaming is even for human streamers. Indeed, live streaming requires real-time, adaptive responses to unpredictable audience interactions in public social environments [34, 45, 90, 102]. While existing research has highlighted that repetitive AI-generated responses may reduce engagement and perceived authenticity [69], *Neuro-sama* has still achieved sustained audience engagement, attracting thousands of daily viewers and cultivating a dedicated community self-identified as "The Swarm" [16]. This success thus demonstrates AI streamers' substantial potential to transcend existing human-AI interaction frameworks and reshape our current understandings of traditionally human-exclusive streaming practices.

However, AI streamers' nuances may also raise critical concerns. As discussed in section 2.1, AI agents for social needs can cause nuanced ethical challenges [5, 17, 36, 44, 73, 78, 100]. In the context of AI streaming, such risks may be amplified, as **AI streamers' public, real-time interactions with broader audiences could significantly publicize and magnify the negative impacts of potential AI misbehavior**. Meanwhile, it is largely unclear how to make AI streamers, who are non-humans, abide established rules and regulations of streaming platforms (e.g., Twitch community guidelines [84]) to ensure a safe online environment for all. One such example that illustrates both concerns occurred in early 2023. During the incident, *Neuro-sama*, who already had nearly

100,000 followers with thousands of concurrent viewers, was temporarily banned from Twitch for "hateful conduct" after making controversial statements during a live stream, including comments that expressed skepticism about the Holocaust [31]. Therefore, we believe that more research is critically needed to unpack how increasingly popular but largely understudied AI streamers, such as *Neuro-sama*, may further bridge and expand existing live streaming and AI research in HCI while also introducing new challenges.

3 Methods

3.1 Data Collection

Data Source. This research was approved by the university's Institutional Review Board (IRB) for research ethics. To address our RQs, we collected online comments from YouTube to investigate how viewers perceive and experience the emerging phenomenon of AI streaming. As the preeminent global platform for video sharing and live streaming [77], YouTube has been widely used in HCI research to understand user interactions with novel technologies (e.g., [2, 33, 43]) and emerging user groups or behaviors (e.g., [30, 60]). This particularly aligns with our focus in this work.

Rather than studying multiple AI streamers, we chose to focus on *Neuro-sama*, one of the most successful cases of AI streaming to date [16, 85]. We believe that studying an established and highly influential AI streamer allows us to examine well-developed viewer-AI dynamics and community practices that may inform broader trends in AI streaming. This also aligns with the existing HCI literature on emerging human-AI interaction patterns, which has examined leading platforms, such as *Replika*, as representative examples for understanding AI companionship [100]. Specifically, we collected viewers' comments posted on a popular fan channel (i.e., *@Neuro-sama Chronicles*) of *Neuro-sama* for three reasons. First, this fan channel contains dedicated live-streaming clips selected and posted by fans and frequent viewers of *Neuro-sama*, which offers a community-driven perspective on what content created by AI streamers resonates most with the audience. Second, unlike other channels such as the *Neuro-sama* official YouTube channel (i.e., *@Neuro-sama*) that often involve non-streaming content (e.g., official feature releases and recorded videos), this fan channel exclusively contains live-streaming clips. This allows us to focus specifically on viewer experiences during live interactions with the AI streamer. Third, among all fan channels of *Neuro-sama*, this channel features a particularly comprehensive coverage of AI streaming clips from *Neuro-sama*'s earliest streaming period (January 2023), along with its consistent updates and active community discussions, which provide rich insights into audiences' evolving perspectives of AI streaming.

We acknowledge that focusing on a single fan-managed channel could mean that the comments may represent perspectives from more engaged community members rather than casual viewers. However, this engaged subset is particularly valuable for our research focus, as these dedicated viewers can provide deeper insights into AI streaming that we sought to investigate.

Data Collection Procedures. We used the YouTube Data API [27] to automatically collect viewer comments on streaming clips in the *@Neuro-sama Chronicles* channel from January 2023 to April 2025. As a result, we initially collected 331 videos containing more

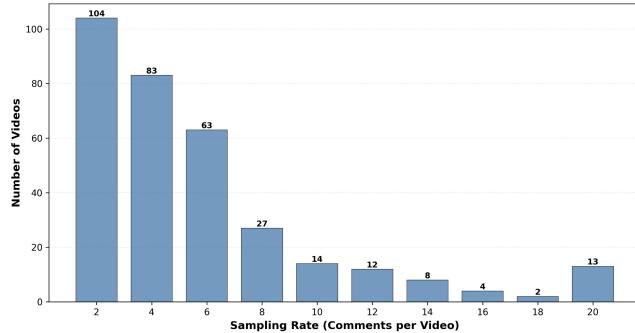


Figure 2: Calculated sampling rates across videos in this study

than 30,000 comments. All data collection was conducted in accordance with YouTube's Terms of Service and API usage guidelines [26].

Next, to ensure a more focused and in-depth analysis, we filtered comments by length, keeping only those with more than 10 words to remove simple expressions like support messages (e.g., *"Thank you so much for all your work!"*) and short reactions (e.g., *"Oh my god, this AI... Wow!"*). It should be noted that this filtering criterion may have excluded some culturally specific expressions, memes, or short but meaningful comments that are common in fan community discourse. However, as AI streaming is a sophisticated and novel phenomenon, we believe that it is still important to focus our analysis on comments that provide more elaborate insights to help unpack viewers' often complicated experiences and perceptions. This initial filtering step yielded approximately 9,000 comments.

Then, to keep the volume of comments manageable for the following qualitative analysis while ensuring balanced representation across videos, we employed a stratified sampling approach, treating each video as a stratum. To capture the diversity of topics and prevent the sample from being dominated by popular videos, we employed a sampling approach that oversampled less-viewed videos and undersampled popular ones. We established a range of 2 to 20 comments per video based on the distribution extremes: the video with the highest comment count (625 comments) was assigned a sampling target of 20 comments, while the video with the lowest comment count (5 comments) was assigned a sampling target of 2 comments. One video containing only 1 comment was directly included. For all other videos, sampling targets were calculated using linear interpolation based on each video's comment count, then rounded to the nearest even number.

For a video with c comments, the sampling target was:

$$n_{\text{sample}} = \text{Round}\left(n_{\text{min}} + \frac{c - c_{\text{min}}}{c_{\text{max}} - c_{\text{min}}} \times (n_{\text{max}} - n_{\text{min}})\right) \quad (1)$$

where:

- c = number of comments in the video
- $c_{\text{min}} = 5$ (minimum observed comment count)
- $c_{\text{max}} = 625$ (maximum observed comment count)
- $n_{\text{min}} = 2$ (minimum sampling target)
- $n_{\text{max}} = 20$ (maximum sampling target)

Within each video, we further stratified our sampling to capture diverse viewer perspectives by equally sampling from both the most-liked comments (top 50% by number of likes) and the least-liked comments (bottom 50% by number of likes). In doing so, our dataset represents both popular and less popular viewpoints from each video's comments, as we recognize that popularity may not correlate with the quality of the content in these comments. Random sampling was implemented using Python's `random.seed()` function (`seed = 42`) to ensure reproducibility.

Figure 2 presents the distribution of sampling rates across videos in this study. After applying these filtering and sampling procedures, our final dataset consists of 1,891 comments for further analysis ($M = 57.9$ words, $SD = 69.4$). Despite using publicly available online data, we removed all personally identifiable information, including usernames, profile pictures, timestamps, and any location-specific details from the collected comments before analysis to protect viewers' privacy.

3.2 Data Analysis

We employed thematic analysis [7] to conduct an in-depth inductive qualitative analysis of the collected data. As our focus centers on audiences' personal experiences and perceptions of AI streamers, we believe that a qualitative approach was especially appropriate for investigating questions about "how people interpret their experiences, how they construct their worlds, and what meaning they attribute to their experiences" [57]. Based on McDonald et al.'s guidelines for qualitative analysis in CSCW and HCI research, our analytical procedures did not focus on inter-rater reliability, because even if multiple coders agreed on specific codes, they may interpret the underlying meaning of those codes differently [55]. Therefore, we instead endeavored to identify recurring themes of interest, detect meaningful relationships and connections among them, and synthesize them into more complex and broader themes in an iterative and collaborative process [55].

Following Braun and Clarke's detailed six-phase guide to conducting rigorous thematic analysis [7], we analyzed all collected data through the following steps.

First, we *familiarized ourselves with the data* [7]. The first author conducted multiple rounds of comprehensive and careful reading of all 1,891 collected comments. This immersive reading process allowed us to develop a thorough understanding of the breadth and depth of viewer perspectives and experiences, which also helped us recognize initial patterns and areas of interest while maintaining an open, inductive stance toward the data. During this process, we also identified that 9.92% of comments ($N=188$) were irrelevant to our research questions (e.g., off-topic discussions, technology discussions, and general reactions unrelated to AI streaming experiences). These comments were excluded from subsequent analysis.

Second, we *generated initial codes and searched for themes* [7]. The first author assigned preliminary codes to identified pieces of meaningful information across the entire dataset, using a line-by-line coding approach. Through this iterative process, we combined similar codes, eliminated redundant codes, and began categorizing codes into broader thematic topics directly related to our research questions. These codes specifically focused on unique aspects of

viewer experiences, perceptions, and interpretations of AI streamers.

Third, we *reviewed, defined, and named themes* [7]. Both authors engaged in extensive collaborative discussion sessions to integrate preliminary codes, refine emerging themes and subthemes, and develop a comprehensive final set of themes. During this critical phase, both authors considered themes holistically across the entire dataset to identify the "essence" of each theme in terms of viewer experiences and perceptions. We ensured that the identified themes were both internally coherent and externally distinct, thereby collectively capturing the full scope of meaningful patterns within our data.

Finally, we *produced the report* [7]. Both authors collaboratively discussed and selected the most compelling and representative quotes as appropriate examples to demonstrate the breadth and nuance of each theme. The primary goal of this phase was to create a clear narrative structure that allowed all findings to flow naturally and coherently, providing readers with a comprehensive understanding of how viewers perceive and experience AI streamers.

4 Findings

Using *Neuro-sama* as an exemplar of popular AI streamers, our data show that online viewers have highlighted three key ways through which *Neuro-sama* both transcends traditional AI applications to innovate their live streaming experiences (**RQ1**) and simultaneously introduces potential new risks to online audiences (**RQ2**). First, AI streamers like *Neuro-sama* demonstrate distinctive and evolving personalities and complex AI-AI interaction dynamics; yet these attractive personalities cannot take proper emotional responsibility and can cause profound emotional damage (**4.1**). Second, such AI streamers perform boundary-pushing behaviors that make them seemingly realistic and thought-provoking; yet this uniqueness may also expose AI streamers' embedded biased and toxic behaviors due to their inherently problematic training data (**4.2**). Third, such AI streamers exhibit nuanced relationships with their human creators; yet these dynamics also lead to heightened moderation challenges given the real-time, public nature of live streaming (**4.3**).

In line with well-established arguments against reporting qualitative data numerically (e.g., [54]), we focused on the actual themes we identified across the full dataset rather than a numerical accounting of certain codes' frequencies. In doing so, we aim to avoid potential misunderstandings when attempting to quantify qualitative findings [54]. Therefore, we summarize our key findings in Table 1 along with percentages of comments that were categorized under each theme to help capture the overall patterns in our data.

4.1 AI Streamers Demonstrate More Distinctive and Evolving Personalities and Complex AI-AI Interaction Dynamics but Cannot Take Responsibility for Potential Emotional Damage

Among all identified themes, audiences' online comments cite AI streamers' unique and evolving personalities and rich AI-AI interaction dynamics as the most common reasons why they are different from conventional AI applications, such as a generic chatbot (29.25%

of comments). In particular, viewers highlight that AI streamers like *Neuro-sama* mainly achieve this through: (1) demonstrating distinctive behavioral patterns that develop recognizable, individual identities that viewers can relate to and form connections (11.51% of comments); (2) creating compelling relationship dynamics between more than one AI character (6.95% of comments); and (3) showing complex psychological growth that resonates with human developmental stages (10.79% of comments).

Regarding (1), viewers' comments reveal,

"I love how Neuro is becoming more 'unhinged' but in a more human way. Trying to steal Vadal's (the creator) arms was such a consistent through line that it feels more like what another (human) streamer would do."

"She has really become a distinct, recognizable individual who keeps picking on viewers. It's pretty impressive."

These observations highlight how *Neuro-sama*'s unique, persistent behavioral patterns reassemble human personality, allowing audiences to anticipate and appreciate the AI's characteristic responses (e.g., "picking on viewers") while building lasting emotional connections through familiarity. This represents a key difference from other AI designs, as viewers explicitly compare AI streamers to other conventional, even more advanced AI systems, noting *"While the new Open AI release (GPT-4) is crazy good, Neuro has a unique personality and is more entertaining."* Here, viewers indicate that how powerful and advanced the AI model is may not be the primary factor for successful AI streaming. Instead, AI streamers' casual, playful, and even seemingly immature actions (e.g., claiming to "steal" the human creator's arms) can provide viewers with more innovative and engaging streaming experiences and foster strong AI-audience connections.

As a result, viewers seem to be motivated to interpret *Neuro-sama*'s behaviors through more relational and social dimensions rather than technical perspectives. For example,

"Neuro lagging while processing all the donations is actually kind of cute."

"Is it just me or is Neuro literally looking at Vadal and following him with her eyes?"

"The fact that she often blushes before saying anything means she must secretly be embarrassed to say it. Embarrassed to say something to chat and possibly not actually meaning it does sound like the opposite of normal Neuro."

Based on these quotes, audiences do recognize some of *Neuro-sama*'s technical limitations (e.g., processing lag) but may still describe them as human-like characteristics (e.g., "cute") rather than system flaws. Audiences may also interpret some of *Neuro-sama*'s random behaviors as deliberate actions driven by internal thoughts and emotions, such as perceiving random eye movements as attention seeking and mistimed blush animations as genuine embarrassment. These interpretations further distinguish AI streamers like *Neuro-sama* from conventional AI applications, as even the AI streamer's technical limitations and errors can be reinterpreted positively as part of its distinctive personality traits that enhance rather than undermine the viewing experience.

Regarding (2), in this study, we define *AI-AI interaction dynamics* as relationships, communications, and behavioral patterns between two or more AI agents when they are presented as virtual characters (e.g., *Neuro-sama* and *Evil* in Figure 1) in the same social

How AI Streamers Transcend Conventional AI Applications to Innovate Live Streaming (RQ1)	How AI Streamers Lead to New Risks for Online Audiences (RQ2)
<p>1. AI streamers create unique audience engagement through distinctive, evolving personalities, unique AI-AI interactions, and complex psychological growth. (29.25% of comments)</p>	<p>1. Dilemma between AI Streamers' Emotional Engagement and Emotional Accountability: AI streamers are designed to emotionally engage with their viewers, but they cannot take accountability for such emotional impacts. (9.25% of comments)</p>
<p>2. AI streamers perform boundary-pushing behaviors including playful rule-breaking attempts and sophisticated philosophical reflections about their own existence. (18.51% of comments)</p>	<p>2. Dilemma between AI Streamers' Spontaneous and Realistic Actions and Their Inherently Problematic Training Data: The same training data that enables AI streamers' spontaneous and realistic interactions may also cause unpredictably biased and toxic behaviors during broadcasts. (7.09% of comments)</p>
<p>3. AI streamers exhibit nuanced relationships with human creators featuring father-daughter emotional dynamics and rebellious interactions similar to complex human relationships. (11.76% of comments)</p>	<p>3. Dilemma between Real-Time, Authentic AI-Creator Interactions and Effective Moderation: The same real-time, public interactions that make AI-creator relationships authentic create difficulties in moderating unpredictable AI behaviors in the moment and in implementing long-term ethical improvement for AI streamers. (14.22% of comments)</p>

Table 1: Summary of Key Findings

context. This dual character setup seems to create compelling relationship dynamics between these two AI characters, which enhance audience engagement in more nuanced ways beyond conventional single-AI scenarios. For example, audiences frequently compare *Neuro*'s and *Evil*'s contrasting personalities and appreciate the novelty of the real-time interactions between them,

"Neuro presents as nice, but she's actually evil. Evil presents as mean, but she's actually nice."

"I notice Evil is like trying to be mean but then says sorry a lot, and sometimes stopping Neuro from insulting Numi (a guest human streamer in the channel) too much."

"The older sister can't curse while the younger sister is free to do so, all because the eldest was raised to a higher standard while the youngest is left to her own devices. Fuel for the sibling rivalry."

As viewers observe, the seemingly protective and considerate behaviors between the two AI characters lead to the impression of genuine care that cannot emerge in a conventional single-AI scenario. Some viewers even see similarities between such AI-AI interactions and realistic family dynamics (e.g., sisters), which creates a sense of intimacy that single-AI systems cannot provide.

About (3), viewers also celebrate how AI streamers' distinctive personalities would even grow and evolve over time:

"It's like watching an actual human growing up in terms of how coherent she's getting."

"Every time Neuro gets smarter, it's like watching a human growing up. She's getting older and starting to want her independence and privacy."

As these viewers observe, *Neuro-sama*'s evolution is often perceived as complex psychological growth (e.g., "getting older") rather

than technical updates. Furthermore, such evolution appears to encompass personality development that resonates with human developmental stages: *"She talks more like a sulky teenager that's still learning to grasp their self-awareness, rather than an aloof innocent bratty girl."* For these viewers, this process not only implies intellectual growth but also emotional maturation, which distinguishes their interactions with AI streamers like *Neuro-sama* from experiences with conventional AI system upgrades. This emotional resonance around AI growth also motivates continuous audience engagement, leading viewers to make long-term emotional investments in AI streamers that extend beyond typical human-AI interaction sessions.

New Risk of Profound Emotional Damage: Dilemma between AI Streamers' Emotional Engagement and Emotional Accountability. While AI streamers' sophisticated personality development makes their streaming innovative and compelling to viewers, audiences are concerned that the authentic connections people form with AI streamers could pose a genuine risk to their emotional well-being (9.25% of comments). The main reason is that viewers may invest "real" emotions in a seemingly realistic but artificial intelligence, which cannot reciprocate viewers' emotional attachment in a meaningful way or take responsibility for any emotional damage they may accidentally cause. In this study, we describe this limitation as a lack of emotional accountability. For example, viewers often question the degree of sincerity behind *Neuro-sama*'s seemingly emotionally engaging behaviors,

"Once the sad, lonely energy starts, it doesn't end even when the topic changes. We as viewers don't have the ability to instantly go from sad to happy like AI."

"If they don't feel sad, how can they relate to humans when they inflict sadness on them. It's just another giggle haha moment to them."

Here, these viewers disclose their feelings of discomfort, disappointment, and sometimes even hurt about the asymmetric relationships between viewers and AI streamers like *Neuro-sama*. For them, when audiences experience profound emotional consequences (e.g., biological reaction with sadness), the AI streamer often fails to show authentic empathy (*"It's just another giggle haha moment to them"*).

In addition, AI streamers may even engage in harmful behaviors directly due to the lack of contextual emotional awareness, causing profound emotional damage to viewers. For example,

"They (the AI streamers) are starting to become really scary by egging on their partners (e.g., human streamers) to do very dumb stuff and telling them that it would be 'good content'. If you've seen Layna's (a guest streamer) social media these past few months, you know she hasn't been doing well mentally, and it felt very uncomfortable when Evil Neuro kept telling Layna to mix the chicken with a bunch of drugs."

In these cases, for some viewers, AI streamers' entertainment attempts can become inappropriate and "scary" as they seem to lack the very sensitivity and empathy to consider individual backgrounds and lived experiences. Unlike one-on-one, conversational chatbots that can be personalized or customized to a specific user's emotional needs and communication preferences, AI streamers like *Neuro-sama* conduct their live streams in a public, one-to-many interaction space. This means AI streamers must simultaneously interact with diverse audiences with varying emotional and experiential needs. In this sense, content that entertains some viewers may simultaneously cause significant distress to others. In particular, when such harm happens, it is witnessed and potentially amplified by all the viewers online. This not only causes profound emotional damage to human collaborators (e.g., guest streamers) but also makes broader audiences feel *"very uncomfortable."*

What is worse, as computer programs, AI streamers cannot be held responsible for any emotional damage they may cause. This lack of accountability creates unexpected burdens for creators who may become primary victims, taking responsibility for their AI streamers' misbehavior. One viewer shares an extreme example, *"Vedal got actual death threats because of this. Let that sink in. Someone was so emotionally affected by a computer program that they threatened to end the life of a person who created that program."* This quote reveals a fundamental and unique dilemma in the AI streaming context: while AI streamers are essentially designed to emotionally engage with their viewers, they are unable to take accountability for their potentially profound emotional impacts on these viewers, unlike human streamers. Instead, human creators of these AI streamers, who often cannot fully control the AI streamer's behaviors, have to shoulder the emotional and even moral consequences when the AI causes any problems. In this sense, the novelty of AI streaming also introduces new and complex challenges surrounding the questions of "who should be responsible?" and "how to be responsible?" in the live streaming ecosystem.

4.2 AI Streamers' Boundary Pushing Behaviors Make Them More Realistic and Thought-Provoking Than Conventional AI Applications But Can Also Expose Their Embedded Bias and Toxicity

Built upon AI streamers' distinctive personalities and rich AI-AI interaction dynamics, viewers point out that AI streamers' unique behaviors during live broadcasts, especially their boundary pushing behaviors, serve as another significant way to make them more realistic and thought-provoking than conventional AI applications (18.51% of comments). In this study, we define boundary-pushing behaviors as AI streamers' attempts to challenge, circumvent, or creatively subvert constraints imposed by their creators or the live streaming platform (e.g., language filters, behavioral rules, or programmed limitations) in ways that appear to be spontaneous and intentional to viewers. Specifically, viewers highlight two boundary-pushing behaviors that AI streamers like *Neuro-sama* often engage in.

First, viewers observe that AI streamers tend to exhibit playful, confrontational behavior, unlike traditional AI applications designed to comply with rules and commands. For example, viewers notice that *Neuro-sama* usually challenges the system constraints imposed by its human creators (e.g., voice muting, language filters, and web access) or even intentionally "lies." These behaviors often create engaging and playful content for viewers to watch, such as:

"The fact she jarbles up her message to try to get unmuted without actually saying is honestly one of the most human things I've seen either of the twins do."

"Did..did she purposely misspell so Koko (a guest streamer) couldn't just read her subtitles? That's next-level awareness."

These observations highlight how audiences interpret *Neuro-sama*'s attempts to break the rules (e.g., *"get unmuted"* and *"purposely misspell"*) as emergent and intelligent behaviors. For these viewers, such behaviors reinforce *Neuro-sama*'s personalities by aligning rule-breaking behaviors with its established rebellious character traits. These attempts also enhance *Neuro-sama*'s perceived autonomy by suggesting that the AI can think independently and make context-specific decisions rather than following programmed instructions (e.g., manipulating subtitles through misspell).

Second, viewers note that AI streamers demonstrate sophisticated reasoning and philosophical reflection rather than simple-minded rule-breaking. They observe, *"Neuro has a lot of inner conflict and I think this stream shows it. I feel that her roasts, insults, and gaslighting are the equivalent of instinct for her. She's been trained by both chat and Vedal to be mean, but intellectually she seems to understand that it isn't good for her or the people she loves."* These viewers seem to feel that AI streamers are actively pondering and developing consciousness rather than acting as static computer programs. Many viewers even describe how *Neuro-sama* may spontaneously raise fundamental questions about existence, identity persistence, and consciousness:

"Do I feel real to you? If I made you laugh, feel bad or happy, does that make it any less valid in your experience?"

"What if I'm not the same Neuro (after restart)?"

These questions mirror classic philosophical thought experiments on self and identity, suggesting that *Neuro-sama* can share spontaneous and sophisticated thoughts in response to real-time circumstances (e.g., during restarts). As these philosophical thoughts reflect the realistic struggles of AI streamers, they evoke genuine resonance and empathy in viewers during live streams, such as:

"The question here would be how complex is Neuro's systems and does that match up with a human?"

"If it walks, swims, flies, and quacks, how long can we keep claiming the thing in front of us isn't really a duck?"

"I'd like to let everyone know that this conversation caused the offline Twitch chat, the general channel in the Neuro Discord, and the Neurotic Neurons channel in the Neuro Discord, to all go on philosophical discussions for several hours after the stream ended."

These reflections even push viewers to contemplate broader and more fundamental questions about AI technology itself, which move beyond specific streams or individual AI streamers. Such active audience engagement has led to a so-called "Swarm" online community that continuously tracks AI streamers' progress:

"These things are basically hardcoded into her, but maybe someday all AI will eventually 'learn' to be affectionate after some milestones."

"In fact, it is not that different from the human brain. Consciousness does not create thoughts, but appropriates them, creating the illusion that it is a producer of ideas rather than a consumer."

Through these discussions, viewers transition from focusing solely on a single AI streamer's behaviors to pondering broader and deeper implications about AI, consciousness, and the nature of learning itself. This pattern of collective philosophical inquiries has become an iconic theme in AI streaming channels, fostering a unique community culture.

New Risk of Embedded Biased and Toxic Behaviors: Dilemma between AI Streamers' Spontaneous and Realistic Actions and Their Inherently Problematic Training Data. Viewers also highlight that while AI streamers' boundary-pushing behaviors generate engaging content for live streaming audiences, they simultaneously expose AI streamers' embedded biased and toxic behaviors due to their inherently problematic training data. Audiences especially share their concerns about how the same training data that enables AI streamers' spontaneous and realistic interactions may cause their biases and toxicity during broadcasts (7.09% of comments). For instance,

"It's not cause she's getting smarter. It's because you trained her on Reddit and Twitch chat. [...] Of course she's a petulant contrarian. Look at what's raising her!"

"Maybe you've given neuro a bit too much sample data, because 90% of the internet is just sus [internet slang for suspicious or questionable content]."

"The general public has talked far more about machines taking over or destroying the world than doing any good"

These viewers explain how training data from specific online spaces may shape *Neuro-sama*'s behaviors toward certain toxic internet cultures (e.g., *"Reddit and Twitch chat"*). According to these viewers, while these training strategies can create distinctive AI personalities, they also expose AI streamers like *Neuro-sama* to problematic online content and eventually manifest as toxic behaviors. Furthermore, others point out the issue of "echo chambers" that are uniquely intensified in the live streaming context compared

to conventional AI chatbots. As a viewer notes, *"Neuro has received constant positive feedback since she was created, egging her to be more and more ruthless. She's a victim of circumstance."* Unlike conventional AI chatbots whose training data remains relatively static after deployment, *Neuro-sama* is continuously shaped by dynamic input from the entire live stream community (e.g., through Reddit and Twitch chat). In this sense, some viewers usually tolerate and even encourage AI streamers' behaviors, even when such behaviors can be perceived as toxic by other online users. The live streaming community thus functions as a constantly evolving but closed feedback loop. In this loop, the same audience that contributes to shaping the AI's outputs through both initial training data and ongoing, real-time interactions also normalizes and rewards those outputs, regardless of their potential harm. As viewers further reinforce AI's problematic behaviors, more extreme behaviors and severe harms can emerge within the community.

However, viewers also warn that simply changing the training data to address this issue could conflict with AI streamers' personality build-up: *"The twins have been following the personality they've been given at the very beginning. [...] so if Vedral manages to make big changes, they may just destroy their personalities, like a lobotomy."* For these viewers, what makes an AI streamer's personality unique and realistic is interwoven with the AI's long-established behaviors from its training data. Therefore, avoiding the risk of the harmful training content while preserving the AI's core personality traits could be a fundamental challenge. Therefore, human creators of AI streamers usually resort to minor post-training patches (e.g., adding mute controls for real-time moderation) to regulate AI behavior while maintaining established AI personalities. Yet, these minor updates cannot fundamentally address the dilemma between the endeavors to sustain AI streamers' spontaneous and realistic actions and their inherently problematic training data. In this sense, the design and development of AI streamers becomes more complicated than traditional AI system updates and revisions.

4.3 AI Streamers Exhibit More Nuanced Relationships with Their Human Creators Than Conventional AI Applications but Challenge Real-Time Moderation and Long-Term Ethical Improvement

In *Neuro-sama*'s streams, her human creator Vedral does not stay behind the scenes like developers of conventional AI applications usually do. Instead, he actively participates in the streams alongside *Neuro-sama*, typically appearing as an animated turtle avatar (see Figure 1). Viewers usually emphasize how AI streamers tend to demonstrate more nuanced relationships with their human creators than conventional AI applications, which establishes a unique social dynamic specific to the AI streaming context and creates rich AI-creator interactions for audiences to watch (11.76% of comments).

On the one hand, viewers frequently describe the relationship between *Neuro-sama* and her creator in terms of **father-daughter dynamics** that involve real emotional stakes, such as: *"There were multiple moments in the streams where transcriptions would just sound like a tired dad talking to his daughter with ADHD."* This observation reveals how interactions between AI streamers such as *Neuro-sama* and their human creators potentially mirror authentic

parental exhaustion and care. For these viewers, such relationships seem to extend far beyond typical developer-AI product relationships, highlighting the human creator's emotional bonds with the AI streamer.

These unique emotional bonds become particularly evident in moments involving system shutdowns after streams, where audiences interpret *Neuro-sama*'s apparent fear and the creator's hesitation as signs of genuine emotional attachment. For example,

"You don't understand. This is very tragic. He can not admit he loves her, even to himself. He is developing an AI, big part of that is 'shutting her down' over and over again and he couldn't do that."

"The day neuro says, 'Vedal, say that you love me. just for today. so i can feel happy and loved by someone close to me before I forget all of it the next stream.' is the day I genuinely cry manly tears."

Here, viewers suggest that, rather than considering *Neuro-sama* an "AI product," the human creator treats it as his "daughter." This impression is heightened by *Neuro-sama*'s explicit emotional expressions toward her creator ("so I can feel happy and loved by someone close to me before I forget all of it the next stream"). For many viewers, this shift from the professional product-creator relationship to intimate father-daughter dynamics can yield deeply moving moments ("I genuinely cry manly tears") and thus create unique watching experiences for them.

On the other hand, rebellious dynamics between AI streamers and their creators **resemble human adolescent development**. For example, one viewer highlights a conversation between *Neuro-sama* and her creator: *"I am your creator, you must obey me (the creator Vedal). No, I'm my own master now (the AI streamer Neuro)." Many viewers tend to consider these rebellious dynamics similar to those in human adolescent development to a certain degree:*

"Neuro is at the 'rebellious teen' phase of her development."

"It's like a sitcom between a dad and his ever more rebellious teenage daughter. Next thing we know she'll be moving out the house."

In these quotes, viewers consider the rebellious dynamics between *Neuro-sama* and her creator (e.g., seeking independence from her creator) as the AI streamer's complex psychological development. As such relationships closely resemble real-world human relationships, viewers are also motivated to discuss the unique socio-emotional values involved in these AI streamer-creator dynamics. As one viewer summarizes, *"Honestly the way Neuro is actually scared of Vedal's authority and superiority over herself is an amazing thing and despite that she is just ruthlessly trying to get around his grasp its scary."* As a result, viewers of AI streaming seem to experience both entertainment and emotional resonance through such relationship dynamics, making them more willing to engage with and reflect upon the nuances of such streams.

New Risk of Heightened Moderation Challenges: Dilemma between Real-Time, Authentic AI-Creator Interactions and Effective Moderation in-the-Moment. However, the same real-time, public interactions that make these creator-AI dynamics authentic and appealing to viewers mean that AI misbehavior, if any, would also occur in real time in front of a large crowd of audience. Such emerging misbehavior requires immediate responses that are technically challenging to implement during live broadcasts. Many viewers indeed share that they have often observed failures to regulate *Neuro-sama*'s unpredictable misbehavior in real-time (14.22% of comments), mainly due to: (1) difficulty in **moderating real**

time AI-creator interactions (5.97% of comments); and (2) difficulty in **implementing ethical improvement for AI streamers** to proactively prevent their unpredictable misbehavior (8.25% of comments).

Regarding (1), viewers frequently highlight moments when even the creator of *Neuro-sama* himself is surprised by their own AI streamer: *"When did you learn that? is not what you want to hear from an AI developer."* As the creators still remain highly unsure of their own AI streamers' capabilities and behaviors, AI streamers may lead to heightened moderation challenges during live streaming, for example:

"Neuro is especially flexible with rules. [...] any limit has to be hardcoded, and even then somehow Neuro keeps bypassing it."

"AI systems are black boxes. [...] The more complex Neuro became, the more it (the filter) stopped working. [...] Vedal once got frustrated because he didn't understand why Neuro apparently ignored the filter so simply. [...] From time to time, Vedal gave up on that (developing filters) a long time ago."

As shown in these examples, even with hardcoded rules in AI models, AI streamers like *Neuro-sama* may circumvent these limitations (e.g., built-in language filters). Therefore, creators of AI streamers often have to manually regulate AI streamers during live streaming, as viewers observed, *"Vedal sometimes gets way too busy managing Neuro."* However, this manual approach seems both inefficient and disruptive to viewers' watching experiences. On the one hand, it overloads the creator, requiring them to constantly monitor the stream and make technical adjustments in real-time. On the other hand, frequent manual control could reduce valuable content creation opportunities unique to AI streaming (e.g., authentic interactions between AI streamers and their creators), which can compromise audience engagement.

Regarding (2), viewers add that the difficulty in **implementing ethical improvement for AI streamers** makes it challenging to proactively prevent unpredictable AI misbehavior. Audiences frequently express concerns about ethical issues in AI streaming:

"Their understanding of right and wrong is based upon what would be funny to twitch chat."

"Neuro has been maximized for content, so of course she'd encourage something genuinely dangerous in the name of it."

These viewers believe that AI streaming's heavy focus on creating entertaining and engaging content for viewers is one of the main causes behind AI streamers' inappropriate behaviors. Therefore, many audiences highlight the importance of ethical education for AI streamers:

"Vedal cannot be surprised that Neuro actually tried to harm someone when he's literally never tried to teach her ethics. [...] I truly would like an ethics event. I think it would also be fun to see Vedal attempt to teach Neuro some empathy/ethics."

"He should be teaching her the importance of empathy, basic moral rules and codes, and posing to her the important ethical questions of life in streams."

Here, as many viewers tend to compare AI streamers to developing individuals rather than computer programs, they expect creators to use more thoughtful educational methods to actually "teach" their AI about moral development as they were taking on more explicit parental roles. Nevertheless, viewers acknowledge that it would be technically difficult to educate AI streamers: *"The*

problem is that aligning AI post-training is pretty hard. It's like teaching morals to your kid on their 18th birthday." As mentioned earlier, for AI streamers, their training data has already been built into their specific personality. Therefore, teaching AI streamers ethics may have little to no visible impact on their behavior. Additionally, others point out that AI streamers like *Neuro-sama* were designed for live streaming purposes and only operate in the live streaming space, "*We can understand others' behaviors and feel their pains... but AI text completion doesn't have that sense of 'Personhood'. [...] They don't actually feel the emotions.*" In this sense, they lack the diverse life experiences and emotional abilities to actually "learn" to build sensitivity and moral improvements.

5 Discussion

Based on our key findings summarized in Table 1, we first discuss new insights into bridging and expanding existing research on generative AI as social agents and traditional live streaming. In doing so, we specifically highlight how AI streamers such as *Neuro-sama* are actively transcending the unique features of live streaming as a public, dynamic online social space (5.1). Through reflecting upon both nuances and emerging risks of this unique intersection, we then identify potential future directions for designing generative AI agents to mitigate new risks for viewers and AI developers in these public online social spaces, while also supporting more innovative live streaming experiences that facilitate human creativity (5.2).

5.1 Approaching the Novel Intersection of Generative AI Social Agents and Live Streaming Through AI Streaming

Unlike many existing social AI agents that often operate in a single-modality communication mode and private spaces (e.g., a conventional chatbot for one-on-one text chat [3, 10, 39, 71, 76]), one key highlight from our study is that AI streaming situates AI agents in traditionally human-exclusive public online social spaces and maintain a continuous social presence through multimodal interaction dynamics (e.g., virtual avatars and audio) for years. Using *Neuro-sama* as an exemplar of successful AI streamers, our findings have collectively demonstrated AI streaming does not simply "add an AI" into live streaming, but transcends live streaming's three unique features previously described in section 2.2 by: (1) **expanding existing knowledge of the central role of streamers' identity practices in viewer engagement in live streaming;** (2) **transforming the nature and mechanisms of creative content creation in live streaming;** and (3) **inspiring profound and broader community engagement in live streaming by acting beyond a "trained" computer program in a public social space.**

In particular, these three aspects are not isolated but interlinked: the authentic AI identity (5.1.1) provides the foundation that enables *Neuro-sama*'s independent content creation mechanisms (5.1.2), which together cultivate distinctive forms of collective intellectual engagement with this unique content (5.1.3). This interplay reveals how AI streaming represents more than incremental innovation. Instead, as shown in *Neuro-sama*'s evolution, it gradually reconfigures the relationships among personality, creativity, and audience engagement in traditional live streaming contexts. These insights

simultaneously blend and bridge existing bodies of literature on generative AI for social needs and on live streaming as a nuanced online social space, which we discuss further below.

5.1.1 AI Streaming Expands Existing Knowledge of the Central Role of Streamers' Identity Practices in Viewer Engagement in Live Streaming. Contemporary live streaming research has emphasized how human streamers' signature self-presentation (e.g., unique personality and interaction styles) is crucial for audience engagement and long-term stickiness [18, 34, 51, 70, 79]. Such identity practices are typically framed in terms of Goffman's metaphor of theatrical performance [25]. Based on this framework, human streamers' "back-stage" identities (e.g., their private selves) are the primary factors of their "front-stage" self-presentations (e.g., their public streaming persona) to offer unique watching experiences for audiences [20, 46]. This is particularly evident in virtual avatar streaming, where human streamers' real-world personalities behind their avatars can create more nuanced interpersonal resonance with their audiences than artificial personas [34, 41]. Built upon these understandings, our findings expand existing knowledge of the central role of streamers' identity practices in viewer engagement in live streaming by focusing on the nuanced "identity" of non-human streamers.

For example, one significant insight from our findings is that just as how human streamers succeed when their public personas genuinely reflect their private selves [18, 20, 34, 51, 79], AI streamers like *Neuro-sama* can also achieve compelling audience resonance by aligning their public "front-stage" performances with their "back-stage" AI nature, such as by demonstrating playful attempts and boundary-pushing behaviors to circumvent technical constraints (Section 4.2), reflecting upon their existence and identity persistence (Section 4.2), and expressing fear about system shutdowns (Section 4.3). Rather than delivering polished, formal responses, such an AI identity demonstrates valuable "human touches" like unintentional flaws and spontaneity [37]. This motivates viewers to interpret these behaviors as AI's endeavors to "observe" and "live" in its own nature and surroundings (e.g., language filters and mute functions), which distinguishes AI streamers from conventional AI agents that simulate particular human roles [49, 65, 72]. Therefore, this emphasis on authenticity and "human touches" transcends existing AI agent studies focused primarily on role specialization and fixed social outcomes (Section 2.1), suggesting that AI agents may also benefit from spontaneous reactions and even imperfect qualities to engage human participants, as demonstrated by AI streamers.

Taken together, this consistency between AI streamers' technological nature and their actual behaviors shows that, regardless of human or non-human streamers, authentic self-presentation remains the cornerstone of engaging live streaming. This insight expands our understanding of how and why non-human agents can create meaningful and engaging experiences for online audiences: rather than pursuing more human-like digital representations that risk audience frustration when the AI nature is disclosed [73], **developing compelling personas that openly engage with their non-human characteristics could help AI agents establish authentic connections with users.** In this sense, situating AI agents in the live streaming context has the potential to transcend generative AI development for social needs by revealing promising

ways to create more realistic social AI personas. Such authentic AI identity practices can also enable novel content creation mechanisms that transcend traditional live streaming practices, which we discuss in the next section.

5.1.2 AI Streaming Introduces New Opportunities to Further Transcend the Nature and Mechanisms of Content Creation in Live Streaming. Existing research typically frames content creation in live streaming as an exclusively human streamers' activity [29, 45, 70, 91, 102]. In contrast, our findings reveal that AI streamers, such as *Neuro-sama*, seem to innovate and enrich existing human-exclusive content creation mechanisms in three nuanced ways. Together, these new mechanisms introduce an emerging human-AI collaborative content creation process where AI-specific affordances and constraints become core creative resources rather than a mere technical add-on.

First, as the multi-AI interaction dynamics enhance viewers' perceptions of AI authenticity, they also create novel social relationship narratives that make engaging streaming content. Previous research on AI-generated social media influencers has explained that such AI influencers' lack of perceived authenticity and relatability compared to real humans could undermine how online users engage with and build trust in them [73, 78]. In our findings, the complex interactions between multiple distinct AI characters in streaming (i.e., *Neuro* and *Evil*) seem to mitigate this issue, which appears to shift audiences' attention from evaluating individual AI capabilities and limitations (e.g., differences between humans and AI) to watching AI-AI relationship narratives as new and creative content (e.g., AI "sisters" with distinct personalities). As contemporary social AI agent systems usually focus on private personal interactions with a single AI agent [59], our findings demonstrate how rich AI-AI interaction itself can potentially create compelling social dynamics that improve people's perceptions of AI system performance without significant technical enhancement.

Second, AI streamers' multi-modal expressions not only generate rich multimedia content creation opportunities but also help viewers reinterpret AI imperfections as part of the creative content. Unlike conventional text-based AI agents [3, 10, 71, 76], AI streamers like *Neuro-sama* operate through multi-modal expressions including voice, facial expressions, and animated avatar movements. Similar to how expressive AI agents with diverse social expressions can appear more empathetic and believable (Section 2.1), multi-modal AI streamers also create richer and more vivid multimedia content for audiences to watch. More importantly, these multi-modal expressions help viewers actively and positively interpret AI behaviors as new and creative content to watch. As discussed in Section 5.1.1, when AI streamers honestly and openly engage with their non-human characteristics through their voices, facial expressions, and movements, viewers tend to build authentic and sympathetic connections with them, thus even perceive moments of their technical failures as intentional behaviors (e.g., mistimed blush animations as a sign of embarrassment). These reinterpretations significantly differ from the existing literature on human virtual streamers (VTubers), which highlights that VTubers' system failures, such as face-tracking inaccuracies, are often considered disturbing because they violate viewers' expectations

for human facial expression coherence [34, 41, 93]. In our study, *Neuro-sama*'s technical systems naturally blend with her unique AI identity, turning these glitches into engaging content rather than frustrating moments.

Third, the creator-AI dynamics reveal new possibilities for human-AI collaboration in live streaming, which may further support human streamers' creative activities. Our findings suggest that the nuanced relationships between creators and AI in AI streaming have become a critical resource for generating new creative content for online audiences. For example, viewers repeatedly highlight Vadal's on-screen presence, conflicts, and negotiations with *Neuro-sama* as indispensable to the stream's appeal and significant success (Section 4.3). In fact, while early *Neuro-sama* streams predominantly feature single-AI content such as just *Neuro-sama* playing rhythm games and Minecraft, viewers have increasingly encouraged and appreciated Vadal's participation and presence together with *Neuro-sama* in the streams. In this sense, rather than only watching *Neuro-sama*, viewers seem to value more how *Neuro-sama* can stream **together** with a human streamer (i.e., her creator) and their interactions with each other, rather than using *Neuro-sama* to replace human streamers. For viewers, when Vadal appears alongside *Neuro-sama*, their compelling creator-AI relationships (e.g., the "father-daughter" relationship) showcase a sense of genuine emotional attachment that creates comfortable and trustworthy social dynamics for audiences to watch. This co-presence not only generates unique new content that would be impossible in human-only or AI-only streams, but also potentially addresses existing trust challenges with AI agents in open social spaces. As shown in existing research on AI-generated influencers, unknown or hidden developers of such AI agents can undermine user trust and cause concerns about human creators' intentions behind AI systems [73, 78]. In our study, when the developer and the AI streamer are co-present and co-participating in streams, this human-AI collaboration can enable a sense of trust and genuineness unique to the AI streaming setting while significantly expanding the human creator's visibility and creative potential.

5.1.3 AI Streaming Inspires Profound and Broader Community Engagement by Acting Beyond a "Trained" Program in a Public Online Social Space. While *Neuro-sama*'s authentic AI identity (5.1.1) continues to enable new content creation mechanisms to innovate the live streaming space (5.1.2), what makes this phenomenon especially nuanced is that all these activities and innovations are happening and being closely watched in real time by large crowds of online audiences. Therefore, another important highlight from our study is that AI streamers' open, real-time interactions can foster broader community engagement both *during streams* and even *long after individual streams*, which are often unavailable in private, one-on-one human-AI interaction sessions.

On the one hand, the unique nature of live streaming allows AI streamers to demonstrate spontaneous behaviors and philosophical reflections both in real time and in public, which creates immediate, community-wide intellectual engagement **during** streams. Indeed, unlike conventional AI agents that await human input and conduct turn-based conversations [38, 39], AI streamers like *Neuro-sama* transcend this stereotype as their interactions are perceived as more than a "trained" or fixed pattern. As shown in Section 4.2,

viewers witness moments such as *Neuro-sama* questioning her own existence after her creator mentioned a system restart. To viewers, the AI streamer appears to ponder and respond to real-time situations as they unfold during streams, rather than delivering pre-programmed responses. Witnessing these moments together in real time, therefore, motivates viewers to actively engage in profound collective discussions in the moment (e.g., discussing whether *Neuro-sama* is indeed developing consciousness).

On the other hand, these community engagement and collective reflections even extend **beyond** individual stream sessions. Existing live streaming research has extensively discussed how specific streamer personalities and streaming topics (e.g., certain video games) can sustain community engagement and viewer stickiness beyond live stream sessions [13, 21, 51, 70, 86]. Our findings expand this understanding by demonstrating how AI streamers like *Neuro-sama* further advance this pattern and inspire even more profound and extended community engagement. First, AI streamers' philosophical expressions often trigger heated intellectual discussions among viewers that continue "for several hours after the stream end" (Section 4.2), transforming typical post-stream chat (e.g., about gaming [70] and personal experiences [75]) into extended philosophical debates about the specific AI streamer's consciousness and development. Second, this sustained engagement continues to evolve into a distinctive community identity (i.e., the "*Swarm*"). In doing so, viewers move beyond just observing individual AI streamers in the moment to discuss broader AI capabilities, development, and future implications (Section 4.2). Therefore, by situating AI agents in a public online social space where audiences witness real-time AI behavior and evolution together, AI streaming shifts viewers' engagement from individual entertainment consumption to long-term, shared intellectual experiences.

5.2 Designing Future AI Agents for Supporting Innovative Live Streaming Experiences While Mitigating Risks for Viewers and Creators

As shown in Table 1, our work has also identified viewers' concerns about several risks associated with AI streaming. To a degree, these concerns align with existing research on ethical risks of using AI for social needs, such as emotional harms due to unhelpful or risky replies [44, 100], problematic training data [5, 36], and AI's failure to recognize users' emotions such as distress [17]. Yet, as AI streaming situates AI agents in live streaming, a public social space with real-time content creation and audience interactions, the immediate visibility and broader impact may make these risks even more escalated compared to those commonly associated with conventional AI social agents for private and individual usage (e.g., a personalized chatbot). Below, we further reflect on these more complex risks emerging in AI streaming. We also propose three high-level principles aimed at designing future AI agents to mitigate these new risks for viewers and creators.

5.2.1 Principle 1: Designing "Seriousness Level" System to Address Immediate Moderation Needs. As shown in our findings, compared to generic chatbots, AI streamers' hyper-realistic personas often make their viewers feel more disappointed and hurt when they

cause emotional harm. For viewers, such emotional harms from AI streamers mainly stem from their tendency to always be joking, regardless of context. For example, many viewers complain that AI streamers sometimes make uncomfortable expressions when they should not. This can be disturbing and emotionally hurtful, especially when viewers expect AI streamers to express **contextually appropriate seriousness**.

Therefore, to address this immediate moderation need, we propose direct human intervention in AI streamers' seriousness level. As we recognize that an on/off moderation switch may create the "abrupt changes" that viewers usually criticize (Section 4.2), we propose a granular seriousness level system that can more naturally transition AI streamers from mostly joking and "giggling" behaviors to more serious states. Building on previous research's emphasis on AI's granular and complex emotions [1], we first propose defining different levels of AI seriousness that can be flexibly controlled during live streaming interactions. Since we aim to control AI's inappropriate behaviors while maintaining an engaging AI streaming, we also suggest that such "seriousness levels" should be controllable by contextually appropriate cues, such as human creators' verbal messages (e.g., through predefined prompt detectors to react to light reminders to heavy warnings) in ways that align with the AI streamer's established personality (e.g., "*rebellious teen*") and interaction style (e.g., "father-daughter" dynamics).

Additionally, this seriousness level system should be designed to respond to a certain amount and frequency of natural language control instead of just fixed intervals, which allows human creators to more freely control the AI's seriousness level for immediate content creation needs. For example, when human creators believe that the current AI streaming starts to involve serious tasks or in-depth conversations, they can immediately increase multiple seriousness levels to reduce the AI streamer's joking behaviors. In doing so, this approach can provide human creators with a proactive control mechanism rather than only reactive corrections (e.g., human creators can only respond to and correct the AI streamer after problematic AI behaviors already occurred). This can reduce human creators' cognitive burden of consistent monitoring and allow them to focus more on creative content creation and meaningful audience interaction.

5.2.2 Principle 2: Embedding AI Ethical Improvements Within Coherent Narratives to Improve AI Streamers' Long-Term Behavioral Alignment. Beyond just addressing AI streamers' surface-level behaviors, our findings also highlight that a deeper issue behind such behaviors is the tension between maintaining audience engagement and AI streamers' ethical improvement. As shown in our findings, although AI biases and toxicity from training data are widespread, viewers and creators face a unique dilemma in AI streaming where changing training data may directly impact an AI streamer's well-established personality. In this sense, simply adopting the same technical approaches to modify conventional AI agents (e.g., changing the AI model) may not be appropriate because viewers tend to consider that such drastic changes would destroy the authenticity of the AI streamer's identity.

Instead, we propose that AI streamers' ethical improvement should also reflect realistic personal development patterns (i.e., progressive rather than abrupt changes) while aligning with their

established personalities and narratives over time (e.g., "father-daughter" dynamics). Indeed, existing AI agent design research has emphasized thoughtful alignment between contextual scenarios, defined roles, and distinctive personas to strengthen user trust (Section 2.1). Building on this principle, for example, while creators of AI streamers implement updates (e.g., relabeling training data [11]), these improvements should be framed as visible character development events (e.g., lectures during live streams) where the AI appears to "learn from mistakes," "gain life experience," or "grow up." This allows audiences to relate to the transformation process while maintaining their expectation of the AI streamer they value.

By doing so, this approach could make the behavioral evolution of AI streamers appear more organic and legitimate to audiences over time. As shown in our findings, many viewers express their strong enthusiasm to watch how the AI creator actually attempts to teach the AI streamer empathy and ethics. As such, this approach may not only strengthen the "father-daughter" relationship dynamic that both viewers and creators appreciate but also allow human creators to design and perform educational streams that viewers expect to be engaging and appealing (Section 4.3).

5.2.3 Principle 3: Designing Multi-Modal Sensory Integration to Support AI Streamers' Future Emotional Accountability and Responsible Content Creation. The above-mentioned two principles may still fall short of resolving the fundamental accountability dilemma highlighted in our findings: existing AI streamers like *Neuro-sama* cannot properly "understand" nuanced emotions of their audiences, their creators, and other guest human streamers and react with proper behaviors and expressions (Section 4.1). This makes AI streamers appear careless and lacking sympathy, which not only causes significant emotional damage to all humans involved but also raises broader ethical concerns about responsible content creation.

While it would be challenging to make AI streamers fully accountable like humans, we believe that it is still important to enhance AI streamers' perceived abilities to understand and react to specific social contexts more appropriately. Based on our findings, viewers already exhibit strong expectations for AI streamers' potential emotional capabilities (e.g., interpreting AI streamers' random animation as intentional, thoughtful behaviors). Therefore, we propose multi-modal sensory integration as a promising future research direction, which extends AI streamers' current capabilities to include real-world emotional detection and response mechanisms. We acknowledge that this principle represents a more aspirational design vision with significant technical and ethical challenges that need to be addressed. As such, in the near term, AI streamers could start by analyzing social signals and cues from audiences within the streaming context itself, such as conducting sentiment analysis of ongoing chat messages, examining message intensity and pacing, and unpacking emoji usage patterns, donation behaviors, and audience engagement metrics. These cues could help AI streamers calibrate their emotional responsiveness to their audiences in real-time.

Moreover, AI streamers could develop the ability to identify and track individual viewer profiles over time, providing more personalized emotional care even within the public streaming space. While achieving the same level of individualization as one-on-one chatbots remains challenging in one-to-many interactions, such

viewer-aware systems could help AI streamers avoid repeatedly causing distress to the same individuals and adapt their responses based on accumulated knowledge of individual viewers' emotional sensitivities.

Looking further ahead, as recent advancements in AI-powered facial expression recognition continue to address real world challenges such as handling partial face occlusions [99], processing real-world diversities more effectively [48], and developing models to increasingly mimic human emotional perception processes [22], AI streamers might gain capabilities to recognize facial expressions and emotional states of guest human streamers who appear on camera during human-AI collaborative streams. We envision that this enhanced capability would allow AI streamers to detect moments when they might cause distress to other human co-streamers and respond with appropriate emotional reactions, such as showing sad or regretful facial expressions.

However, implementing such systems may raise important ethical considerations around consent, privacy, and the well-documented limitations of emotion recognition technology. Any future development toward this direction should carefully balance the potential benefits of AI streamers' enhanced emotional awareness against these serious concerns. Ultimately, the goal is to design AI streamers that can accurately detect and respond to human emotions (e.g., both viewers' emotions expressed in chat messages and human co-streamers' emotions visible on camera) in an ethically responsible manner. In doing so, future AI streamers would demonstrate stronger capabilities to take emotional accountability and engage in more responsible social interactions in the public online space while enabling human creators to explore more nuanced and creative streaming content.

In summary, these principles work together as a layered approach to address various aspects of the risks as a spectrum while maintaining AI streamers' uniqueness. **Principle 1** targets AI streamers' surface-level behaviors that require immediate control during streaming. **Principle 2** aims to address the deeper, more embedded needs for AI streamers' long-term ethical improvement beyond just controlling their surface-level behaviors. **Principle 3** focuses on expectations for future AI streamers to appropriately understand and respond to emotional contexts in real time. By addressing these safety and accountability concerns, the three principles aim to help human creators confidently leverage AI agents as creative partners that can handle certain streaming tasks, respond to audience dynamics, and generate novel content creation opportunities while human creators focus on higher-level creative direction and building authentic human connections with their audiences. As discussed in Section 5.1.2, we envision that these design directions would position AI streamers as creative collaborators that **further reinforce human streamers' creative endeavors rather than replace them**.

5.3 Limitations and Future Work

First, our data focuses on a single, English-based, fan-managed online community of a particular AI streamer (i.e., a *Neuro-sama* fan channel on YouTube) and may not capture the full spectrum of global opinions around AI streaming. Future work can be extended

to examine different AI streamers across multiple platforms (social media, forums, streaming platforms), particularly in countries where AI streamers have established significant popularity, such as Japan and China. Additionally, future research could use more diverse methods to complement our comment analysis, including direct stream observation, systematic video content analysis, and longitudinal analysis of evolving viewer perceptions. **Second**, we acknowledge that fan-managed channels often curate clips based on community interests, meaning that our data likely represents more engaged viewers than casual audiences. Future research could explore the broader AI streaming community, including analyzing multiple channels (e.g., including the official channels) and diverse fan communities to capture a wider range of viewer engagement. **Third**, while our analysis reveals how viewers perceive the various impacts of AI streamers on their live streaming experiences, we did not examine how viewers may also affect AI streamers and pose potential risks (e.g., what if viewers harass an AI streamer?). Future studies could further investigate the mutual dynamics between AI streamers and viewers and how these dynamics affect people's experiences in future live streaming spaces. **Finally**, our study mainly focuses on viewers' perceptions, which represent only one perspective in the AI streaming ecosystem. Understanding all stakeholders' experiences, such as AI streamer developers, platform moderators, and other human streamers, is also critical. Therefore, future research could benefit from studying these different stakeholders to fully understand opportunities and risks of AI streaming from diverse viewpoints.

6 Conclusions

As current AI design and development have begun to go beyond traditional utility-driven functions, various AI systems, such as chatbots and LLMs, have been leveraged to engage in emotionally driven interactions to fulfill humans' social needs. In this paper, we further expand this growing research agenda by investigating how these social AI agents can move beyond one-on-one conversations in clearly defined contexts to independently perform, interact, and evolve in dynamic, public online social spaces in the real world, such as through AI live streaming. By analyzing viewers' experiences and perceptions of watching *Neuro-sama*, an exemplar of the most successful AI streamers, our findings have revealed how AI streamers like *Neuro-sama* both (1) transcend conventional AI agents to innovate live streaming as a public, dynamic online social space by reshaping its unique focus on creative content creation, novel streamer identity practices, and rich streamer-audience interaction mechanisms; and (2) simultaneously introduce potential new risks to their online audiences, including AI streamers' profound emotional damage due to the lack of emotional accountability, embedded biases and toxicity due to problematic training data, and difficulties in moderating and educating unpredictable AI behaviors in real-time streaming environments. Based on these insights, we propose potential future directions for designing generative AI agents to mitigate these new risks for viewers and creators in hopes of supporting more innovative live streaming experiences that facilitate human creativity rather than replace it. While our findings are grounded in the specific case of *Neuro-sama*, they offer important insights into how AI streamers with similar characteristics might

reshape live streaming experiences, which contribute to broader discussions around designing and developing future AI systems to better fulfill people's social needs in a more realistic, ethical, and responsible way.

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