From Virtual Strangers to IRL Friends: Relationship Development in Livestreaming Communities on Twitch

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Accounts of the social experience within livestreaming channels vary widely, from the frenetic "crowdroar" offered in some channels to the close-knit, "participatory communities" within others. What kinds of livestreaming communities enable the types of meaningful conversation and connection that support relationship development, and how? In this paper, we explore how personal relationships develop within Twitch, a popular livestreaming service. Interviews with 21 pairs who met initially within Twitch channels illustrate how interactions originating in Twitch's text-based, pseudonymous chat environment can evolve into close relationships, marked by substantial trust and support. Consistent with Walther's *hyperpersonal* model [76], these environments facilitate self-disclosure and conversation by reducing physical cues and emphasizing common ground, while frequent, low-stakes interaction allow relationships to deepen over time. Our findings also highlight boundaries of the hyperpersonal model. As group size increases, participants leverage affordances for elevated visibility to spark interactions; as relationships deepen, they incorporate complementary media channels to increase intimacy. Often, relationships become so deep through purely computer-mediated channels that face-to-face meetings become yet another step in a continuum of relationship development. Findings from a survey of 1,367 members of Twitch communities demonstrate how the suitability of these spaces as venues for relational interaction decreases as communities increase in size. Together, these findings illustrate vividly how hyperpersonal interaction functions in the context of real online communities. We consider implications for the design and management of online communities, including their potential for supporting "strong bridges," relationships which combine the benefits of strong ties and network bridges.

CCS Concepts: • **Human-centered computing** → **Empirical studies in collaborative and social computing**; **Social media**; • **Information systems** → **Chat**.

Additional Key Words and Phrases: Twitch; livestreaming; tie strength; relationships; online communities; networks; strong bridges

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1 INTRODUCTION

Many popular accounts of livestreaming services focus on their expansive scale and the popularity of the broadcasters they support, characterizing it as a "gold rush" [36] that turns "bedroom gamers into internet superstars" [30]. As a result, public attention is frequently directed to channels with massive audiences, associated with celebrity streamers or global events, such as esports competitions. Interaction in these streams has been characterized as one-sided, where the only

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video and audio being transmitted is controlled by the streamer, and the public chat window, as one journalist puts it, "scrolls with the indecipherable speed of a spinning game-show wheel" [13].

These services differ noticeably in design from those intended to support meaningful connection and relationship-building, such as social networking sites (SNS). For one, viewers often enter a channel with no visibility into the so-called "in real-life" (or IRL) identities of other viewers, and many of these services don't encourage the creation of rich user profiles. Consequently, it may be difficult to imagine livestreaming services such as Twitch, Douyu, or YouTube Live as examples of settings in which viewers might meet a potential best friend or romantic partner.

Prior research on computer-mediated communication (CMC), however, suggests that certain affordances of livestreaming services could create an environment well-suited for dyadic interaction and relationship formation. Many of these services, for instance, encourage the use of pseudonyms; anonymity and pseudonymity have been shown to encourage or enable self-disclosure [1, 18, 42, 44, 59–61]. Primarily text-based interactions among viewers can strip away extra-communicative "cues," such as concerning facial expressions or body movements [17], which can discourage intimate and honest disclosure [41, 67]. Settings combining the safety of limited cues, the freedom of relative anonymity, and the promise of repeated interactions contribute to what Walther has called *hyperpersonal interaction* [76]. These affordances, plus time, enable relationships formed in CMC settings to equal or even surpass those formed in face-to-face contexts [76, 79, 81].

Walther and colleagues created and validated the hyperpersonal model in settings which were typically experimental, with individuals interacting in dyads (e.g. [71, 78]) or small groups of up to 6 (e.g. [77, 79–82]). Livestreaming communities, however, can vary dramatically in size, including massive channels which regularly support thousands of participants. To what extent should we expect that the processes which underlie the hyperpersonal model will scale to larger communities, and when does this model break down? Furthermore, these original studies often analyzed interaction within a single, isolated, text-based forum. How can we expect these results to translate to the present reality, where community members have access to and can navigate through a variety of services for managing self-disclosure and communication with others?

In this paper, we focus on understanding the development of personal relationships within livestreaming communities, through an exploration of one such website, Twitch. Twitch hosts millions of such communities, ranging widely in both size and content. We adopt a mixed-methods approach to studying relationship development in the context of real-life, text-based livestreaming communities, guided by the following research questions:

- **RQ1.** How do new personal relationships form within Twitch communities?
- **RQ2.** How do relationships formed within Twitch communities become stronger over time?
- **RQ3.** What types of Twitch communities support the maintenance of personal relationships?

In the first phase of our research, we analyze findings from interviews with 21 pairs who formed close relationships after meeting initially within livestreaming communities on Twitch. These interviews provide insight into the contexts which foster initial interactions and the processes which enable relationships to deepen over time. We then widen our scope by presenting our analysis of data from a survey of 1,367 participants in Twitch livestreaming communities; using these data we explore how the potential for relationship development and maintenance varies across livestreaming communities, with respect to community size and frequency of interaction.

A growing body of research has explored how interaction in rich, multimedia virtual worlds and MMORPGs can support and sustain strong relationships, leading sometimes to offline meetings [2, 14, 31, 33, 84, 90]. In this paper, we contribute to the theoretical literature on CMC-supported relationship formation by illustrating how many of these same processes are initiated and facilitated in the primarily text-based environment of livestreaming communities. Findings from our interviews

provide an in-depth illustration of how the pseudonymous, interest-based, text-only context of livestream chat facilitates viewers in self-disclosing to others and makes potential conversation partners more receptive by elevating common ground. These findings also highlight some of the limitations of Walther's model. We observe that viewers participating in communities larger than Walther's dyads or small groups leverage affordances that provide elevated visibility in order to spark initial interactions. We also find that – after initial relationships form – conversation partners often leverage increasingly rich communication channels in order to further develop mutual trust, intimacy, and self-disclosure. Our quantitative analysis illustrates how the potential for communities to support hyperpersonal interaction decreases as communities increase in size.

Together, these findings show how hyperpersonal interaction plays out within livestreaming communities, enabling the formation of close, personal relationships. In the discussion, we consider implications for a wider variety of online communities, in terms of relationship formation and cross-platform communication. We also explore the potential for future research on online communities as contexts for building close relationships among otherwise disconnected strangers, a unique type of relationship that we call a *strong bridge*. More broadly, these findings paint a powerful vision of not only how many connections can form within CMC contexts, but also how deeply these relationships can develop via purely CMC, to the point where face-to-face meetings serve more to confirm the strength of a relationship, rather than to increase it. As one of our interview participants characterized the experience of finally meeting their "virtual" friend in "real" life:

> *"It's like meeting your best friend for the first time."*

2 BACKGROUND

This paper explores how personal relationships form within livestreaming communities. We start by providing some background on Twitch, which serves as our research context, and discuss prior research on some of the affordances of livestreaming sites that support relational interaction. We then situate the present study within existing work on relationship formation in CMC environments.

2.1 Research Context: Twitch

Twitch[1] is a livestreaming service that allows individuals (called *streamers* or *creators*) to broadcast activities live to others (*viewers*) around the world. As of July 2020, Twitch reported over 4 million unique individuals streaming to the service each month to an average of 17.5 million daily visitors [73]. Although Twitch has been associated historically with gaming, streamers cover a wide variety of content, including music, arts, sports, as well as a talk-focused category called `Just Chatting`. A Twitch stream appears on a streamer's dedicated page (the *channel*), as illustrated in Figure 1. Alongside the video player, the website provides several mechanisms for viewers to interact with the streamer and each other. In the chat window, streamers and viewers with a Twitch account engage in real-time conversation using text and Twitch-specific emoji (*emotes*). Usernames are typically pseudonyms and persistent over time. As the site does not specifically encourage profile creation, individuals' public traces tend to be confined to chat interactions. Users can also interact one-on-one, outside of a channel, using private messages (*whispers*). These features are largely shared across other livestreaming services, such as YouTube Live and Mixer.

In this paper, we focus specifically on how these features of livestreaming services support social and community interaction among viewers. Livestreaming on sites like Twitch, YouTube, and Mixer can be considered a form of "active spectatorship," as defined by Jacucci et al. [34], in that spectators' actions play a role in shaping the experience for others. Prior study has illustrated how integrating text chat into video can turn viewing from a passive and isolating experience into one

[1] https://twitch.tv

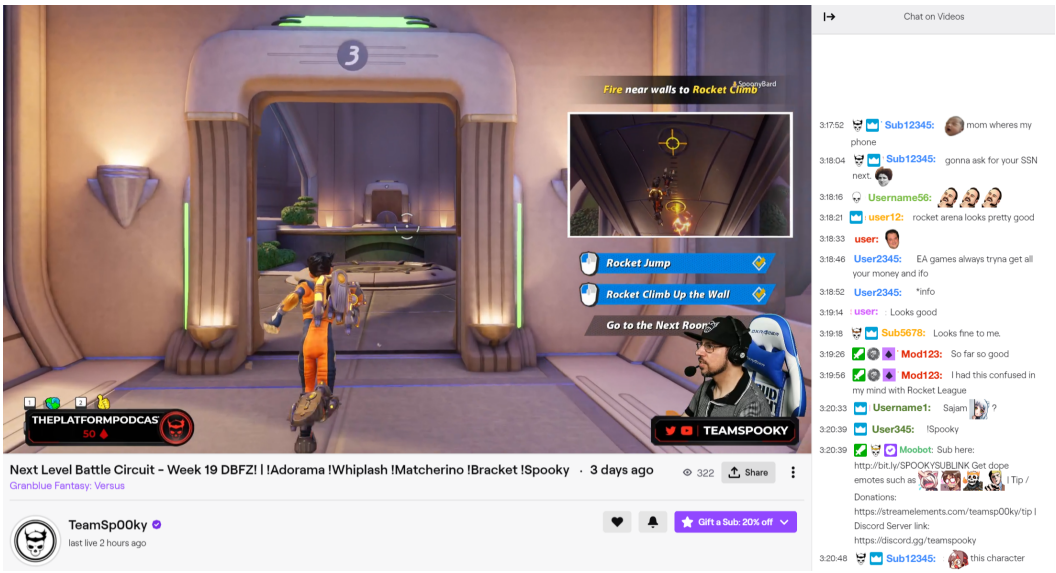

Fig. 1. A screenshot depicting the layout for channel *TeamSp00ky*. The video player shows live gameplay, and overlays provide views of the streamer's webcam and contextual game information. Twitch account-holders can communicate in *chat*, shown on the right, using text and Twitch-specific emoji, referred to as *emotes*. Usernames have been changed in this image for privacy reasons.

that is active and social [83]. Hamilton et al. have characterized the social organizations which can arise out of engaging as active spectators in Twitch channels as "participatory communities" [29].

Social Motivations for Livestreaming. Several prior studies have shown that viewers approach livestreaming services with social motivations. Hilbert-Bruce et al. found that social motivations are more prevalent for consumers of livestreams than those of mass media [32]. Lu et al. found "communication with others" to be a critical part of the experience for users of a variety of Chinese livestreaming sites, suggesting that this motivation generalizes beyond Twitch [43]. Sjöblom & Hamari found that viewers' self-reported levels of social integrative motivations were predictive of differences in time spent viewing [66]. Hamilton et al., in turn, found that many streamers broadcast with the specific goal of supporting a community [29], and Wohn found that some moderators are specifically motivated to help foster a community [86]. Wohn et al. illustrated that, in some cases, viewers provide substantial and emotional support to streamers [87]. A study of software development communities on Twitch by Faas et al. found that viewers engage in mentorship and support of streamers and each other, in ways that extend beyond the streams themselves [19].

Community Size and Social Experience. Prior research has found that the social experience on livestreaming services can vary substantially based on the size of the stream. An early study of Twitch found that the distribution of viewership across streams was highly skewed, with a small number of massive streams and a large population of medium and small-sized streams [40]. In addition to regularly broadcast content, specific events can draw massive, ad hoc crowds [16]. Efforts to segment Twitch channels by audience size have indicated that smaller channels may be more relationship-driven than large channels [20]. When the number of participants in chat becomes large enough, Hamilton et al. found that one-on-one interactions can become difficult [29], giving way to fast-moving, repetitive "crowdspeak" [21]. A cross-platform study of Facebook Live and Periscope by Haimson and Tang found that these negative effects of participant volume on perceived interactivity and enjoyment extends across platforms [27].

This paper draws on Twitch as a context for studying relationship formation within a larger class of livestreaming communities and other online communities which offer similar platform affordances. These include live content, persistent pseudonymous communication, and interaction networks which connect content creators, viewers, and individuals playing other roles (e.g. moderators, subscribers, VIPs). Our quantitative analysis tests and validates hypotheses about the relationship between community size and social experience raised in prior work (e.g. [20, 29]). The value of studying these phenomena within Twitch is increased by this cross-platform research illustrating how the effects can generalize to other related services.

2.2 Psuedonymity, Filtered Cues, and Hyperpersonal Interaction

Pseudonymity and Anonymity. Perceptions of anonymity can facilitate self-disclosure in offline contexts. Rubin's experimental study of self-disclosure among strangers in airport lounges, for example, found that out-of-town visitors disclosed more than locals; this illustrates the "passing strangers" phenomenon, in which the affordance of relative anonymity leads individuals to self-disclose more intimate details to others [59]. These effects have been replicated in experiments within CMC systems, as well, with anonymity facilitating self-disclosure, especially in cases where the content being disclosed is negative [44]. On Reddit, community members utilize "throwaway accounts" to replicate being a "passing stranger," in order to facilitate self-disclosure [1, 42]. In health contexts, pseudonyms provide a safety buffer, allowing individuals to share negative self-disclosures more publicly in order to obtain information and support [89]. Similarly, research on Q&A and discussion forums such as Yik Yak, Secret, and ask.fm show how anonymity is leveraged to achieve social [18, 44], self-expression [60], and tension release [44, 61] goals. Anonymity can increase creativity in online communities by reducing pressure and softening the potential psychological impacts associated with failure [3]. Specific implementations of anonymity/pseudonymity have raised concerns that the resulting disinhibition could lead to bad behavior; the ability to quickly adopt a new pseudonym means that individuals are not responsible for the consequences of actions [22]. Researchers have argued that clear ties to one's real-world identity can enrich interactions, promote accountability, and foster polite conversation [49]. In online gaming environments, for instance, a preference for anonymous gaming has been associated with increased cheating [10].

Filtered Cues. In physical contexts, even when anonymous, we transmit a lot of information to conversation partners. Nonverbal behaviors, such as body language and facial expression, can reinforce or possibly betray verbal efforts to customize our self-presentation [17]. Early research on computer-mediated communication (CMC) described how text-based interaction stripped away many of these additional information channels, leading to increased self-disclosure [41, 67]. Some early perspectives on these environments assumed that the reduction in cues would affect the quality of communication [15]. Research on text-based CMC by Walther illustrated that, with additional time, users can adapt to the limited personal cues available in CMC environments to achieve levels of relationship development found in face-to-face environments [79, 81]. CMC based on persistent pseudonyms enables a context of "managed ambiguity," allowing individuals to choose how information is self-disclosed through repeated interactions over time [35].

Hyperpersonal Interaction. Walther's *hyperpersonal* model suggests that the combination of limited cues, relative anonymity, and repeated interactions, may actually benefit relationship development in certain ways, by facilitating initial and repeated self-disclosures that generate trust [76]. When this communication is asynchronous, it provides additional time for participants to confidently craft self-presentations [78]. The hyperpersonal model was developed and has been validated largely based on insights from controlled experiments, with participants communicating via CMC or face-to-face in dyads or small groups of up to six participants (e.g. [71, 77–82]). In the context of a pseudonymous online classroom forum, Chester and Gwynne found that this

combination of features helped students to develop a "strong and confident voice" and to self-disclose more than they would have during an in-person class [11]. Henderson and Gilding found that the limited cues environment of the "Active Worlds" virtual world actually created opportunities for enhanced trust by "fast-tracking" self-disclosure [31]. A study of newsgroup posters by McKenna et al. found that an increased ability to express one's "true self" online was associated not only with closer friendships online, but also with moving these friendships offline [48].

In the present study, we observe that livestreaming communities, such as those on Twitch, incorporate many of the affordances which support the hyperpersonal model, providing a theoretical grounding for our investigation. Our research extends our understanding of the hyperpersonal model, by exploring its boundaries in two dimensions: first, the depth of relationships that can be achieved in such environments, and second, the extent to which the potential for hyperpersonal interaction changes quantitatively with the size and activity of the community.

2.3 Online Communities and Relationship Formation

Relationships in Virtual Worlds/Games. Prior research on virtual worlds and online gaming provides numerous examples of how these forums can connect previously unconnected individuals, leading to close relationships that sometimes include offline meetings. In a 2001 survey of Everquest players, Yee found that 47% felt that their in-game friendships were "comparable to" their real-life friendships and that 46% of respondents "wouldn't mind" meeting their in-game friends in real life [90]. A large-scale survey of Asheron's Call players found that the majority of respondents played within social groupings ("allegiance-fellowship"), that these viewers had typically made multiple close friends within the game, and that over 1 in 4 had met in-game friends in a face-to-face setting [2]. In "Active Worlds," friendships developed and moved offline, even when participants had reservations about unrealistic self-presentations and deceit [31].

Williams' study of World of Warcraft (WoW) showed that people who were otherwise distant (e.g. geographically or demographically) cooperated and interacted, extending relationships outside of WoW and even offline [85]. A cross-MMORPG survey by Cole & Griffiths found that 3 in 4 players had made good friends online and that a substantial fraction had had an in-person meeting [14]. Study of Second Life found that individuals formed friendships that provided social benefits, even when those friendships remained within the platform [33]. Similar to studies showing that offline superficial markers (e.g. t-shirt color) can support in-group affinity [4], Taylor observed that membership in shared game servers can promote an "instant community" within a larger population of Everquest players [70]. Twitch shares both an overlapping audience and many characteristics with these services, including the multiple levels of association (e.g. as Twitch users, as fans of a game, as participants in a community). Insights from this literature provide framing and guidance for the design of our present investigation into text-based livestreaming communities.

Potential Negative Impacts. There are contexts in which fostering relationships within online communities could negatively affect these communities. Kairam et al. [39] describe a mechanism through which densifying the relationship network within an online community can limit its growth or longevity. Prior research has similarly demonstrated trade-offs between fostering individual relationships and a sense of group identity [57, 58]. As such, it is possible that successfully supporting the formation of relationships could actually reduce overall levels of community attachment and engagement among members. One possible negative outcome is that dyads who form relationships migrate their communications outside of the community, thus removing the generated social capital from the community [45]. It is also possible that individuals who form relationships will favor interaction with each other at the expense of interactions with other community members [64].

The prior work most closely related to the present research may be a study of relationship formation in internet newsgroups by Parks & Floyd [53]. Newsgroups share many affordances

with livestreaming services, including persistent pseudonyms, common focus around content, and repeated interactions over time. A survey of 4 large Usenet groups found that 60.7% of respondents had formed a relationship with at least one person that they had "met" through the newsgroup, and that roughly half of them had formed what might be considered a "highly developed" personal relationship. Our study continues this line of inquiry, exploring how personal relationships flourish within livestreaming communities, and under what conditions. We extend findings from prior work to cover features of modern platforms, such as those which host real-time interactions at massive scale. This is the first study of which we are aware to document the full process that leads strangers from initial interactions to the formation of strong relationships within livestreaming communities.

3 STUDY 1: FROM VIRTUAL STRANGERS TO IRL FRIENDS

Our first study investigates the contexts and triggers for forming new relationships within livestreaming communities and the processes through which these relationships develop and deepen over time. Here, we adopt a "lead user" mindset [74]; we focus specifically on the experiences of dedicated Twitch viewers who have successfully built relationships through Twitch and identify common patterns which may inform strategies for helping other viewers build relationships of similar strength. In this study, we address the following two research questions:

RQ1: How do new personal relationships form within Twitch communities?

RQ2: How do relationships formed within Twitch communities grow stronger over time?

3.1 Methods: Paired Interviews

To address these research questions, we conducted in-depth, semi-structured qualitative interviews with pairs of Twitch users at TwitchCon 2019, Twitch's annual user conference, in San Diego. Participants were recruited prior to the conference by reaching out to members of a panel of Twitch users who had previously opted in to consideration for survey and interview studies. Each candidate was asked to identify a second Twitch user whom they had met through Twitch and sign up for the study as a pair, after obtaining consent from their interview partner.

3.1.1 Participant Recruitment. 19 participating pairs were recruited through this process, and another 2 pairs were recruited on-site at the conference. All of the interviews were conducted in-person by the first author with each pair jointly, and were held in a private, secluded part of the conference venue. The interviews were all recorded and ranged in length from 30 to 60 minutes. Details about the participants, including self-reported age and gender, are summarized in Table 1, along with the self-described nature of their relationship. Participants' ages ranged from 20 to 46 (M = 29.7, SD = 6.33). Six of the 21 interviews captured relationships among same-gender pairs, while participant gender differed for 15 of the pairs. Three of the 21 interviews captured what the participants described as romantic relationships. For each interview pair, we show the interview number. To protect the identities of the participants, we assigned pseudonyms which reflected the gender and national origin of their true names. These interview numbers and pseudonyms are used in the remainder of this section when referring to individual interview participants. Each interview participant was compensated with a US $25 Amazon gift card for their time.

3.1.2 Interview Procedure and Data Analysis. We asked each interview pair to recount their initial meeting, with follow-up questions to elicit additional details, such as context about the community in which they jointly participated and communication methods used. Each pair also discussed how their relationship developed over time, including the context and reasons for their first in-person meeting. Interviewing participants as pairs and adopting a semi-structured protocol created

		Interview Pair Participant 1			Interview Pair Participant 2		
Interview	Relationship	Pseudonym	Age	Gender	Pseudonym	Age	Gender
1	Best Friends	Chris	33	M	Brandi	29	F
2	Close Friends	Angela	22	F	Jared	26	M
3	Best Friends	Mary	39	F	Logan	35	NB
4	Best Friends	Damien	32	M	Tim	32	M
5	Best Friends	Lauren	38	F	Erica	31	F
6	Close Friends	Kyle	30	M	Susan	23	F
7	Close Friends	Jose	31	M	Pedro	26	M
8	Good Friends	Heather	31	F	Alex	40	M
9	Best Friends	Thomas	30	M	Anna	31	F
10	Best Friends	Lisa	34	F	Sophia	33	F
11	Romantic Relationship	Laura	30	F	Nate	25	M
12	Good Friends	Kayla	28	F	Scott	25	M
13	Romantic Relationship	Eric	22	M	Ashley	24	F
14	Best Friends	Alex	24	M	Amy	21	F
15	Best Friends	Sean	33	M	Jason	46	M
16	Best Friends	Gina	20	F	Ian	26	M
17	Best Friends	Jake	43	M	Robyn	42	F
18	Romantic Relationship	John	35	M	Sara	32	F
19	Best Friends	Mike	25	M	Jennifer	24	F
20	Close Friends	Fernando	25	M	Tomas	22	M
21	Best Friends	Evelyn	21	F	Michael	29	M

Table 1. Descriptives for interview participant pairs, including interview number, self-reported description of relationship, age, and gender. To protect participant privacy, we assigned pseudonyms evocative of their true names. We use these, along with interview numbers, to identify quotes from specific participants below.

opportunities for participants to build on each others' stories and to delve into greater detail around specific topics. We provide the guide used to structure our interviews in Appendix A.

The audio for each interview was transcribed and anonymized. We performed a thematic analysis of the interview transcripts [5], using a modified grounded theory approach [9]. One author first engaged in a round of independent coding, using an inductive open coding scheme. The authors then discussed and refined the emerging codes, grouping them into themes, nested under two higher-order categories matching our research questions: "conditions for relationship formation" and "mechanisms for deepening relationships." The transcripts were then coded independently a second time by another author, resulting in the findings as they are presented below. Throughout the process, the two authors met regularly to discuss the themes as they evolved.

3.2 Findings

Below, we report our findings from the interviews, which address our two research questions regarding how relationships form on Twitch and how they strengthen over time. We include a third section that illustrates the surprising depth of the relationships achieved by many of our participant pairs. Throughout this section, we illustrate the themes identified with excerpts of quotes from our interview participants, using the pseudonyms provided in Table 1.

3.2.1 How Relationships Form on Twitch. Our first research question focused on understanding what characteristics or aspects of interaction facilitate the formation of new, close relationships within livestreaming communities, particularly between users who had no prior, off-site connection. Our interviews surfaced three themes with respect to interaction on Twitch, corresponding to ways in which Twitch's affordances lower perceived barriers in initial meetings between strangers: facilitated self-disclosure, assumed common ground, and elevated visibility.

Facilitated Self-Disclosure. Early research on text-based environments hypothesized that the "absence of regulating feedback" would negatively impact conversation quality [41]. Consistent with the hyperpersonal model, however, the absence of audiovisual cues from conversation partners helps to make self-disclosure relatively "easy" when communicating with new people through Twitch. Amy (Interview 14) discussed how being shielded from other's reactions made it easier for her to self-disclose online, as opposed to "in real life" (IRL):

> *Amy: I guess for me, it was easier because they weren't there in person, so I couldn't see their expressions. If they were judging the things that I said, I could kind of tell if they said it, but I wouldn't really care that much, because they're still online, you know?*

The ability to hide one's own facial expressions or reactions similarly enables greater self-disclosure. Kayla (Interview 12) mentioned how interacting in a text-based setting allows her to express emotions that she might not have been able to express in a face-to-face interaction:

> *Kayla: Especially because I hate crying ... [being online] makes it more easy for me... And I can be a little more free because I don't have these persons in front of me, I don't have to cry, and I don't have to show I'm weak and that kind of stuff.*

This filtered cues environment also facilitates how individuals receive self-disclosures from others. When asked about how the formation of her IRL friendships were different compared to those formed online, Jennifer (Interview 19) illustrated how CMC on Twitch provides her with an increased ability to perceive others "with less judgment:"

> *Jennifer: A plus about meeting people online is you don't know what they look like and that does sound weird at first, but you don't get to judge them based on appearance at all... you get to know them without judging them first.*

Even as friendships progressed beyond initial meetings, interacting in a filtered-cues environment continues to provide benefits with respect to facilitating self-disclosure. Two best friends, Lauren and Erica (Interview 5), described how they are able to delve into more personal topics than they might have if they had been meeting face-to-face, facilitating more intimacy and relationship depth:

> *Lauren: It's just easier because talking to someone face to face about scary things or just things that you wouldn't normally get into is a little hard. When you've got that barrier and that separation... you've got that freedom, that safety, of you're still in your safe space.*
>
> *Erica: You know when you're talking to somebody in real life about what scares you or what makes you sad or personal body issues or sex life, whatever it is... You get embarrassed and you're like, you wait for the eye contact... [But] when you're on here or on Discord you can just let it out.*

Here, the pair of best friends have highlighted ways in which communicating within the context of livestreaming communities facilitates the discussion of embarrassing, controversial, or upsetting material easier by creating a barrier of physical cues that help manage discomfort. These findings align with previous observations that limited cues can "fast-track" self-disclosure [31] by supporting participants' ability to express their "true self" [48], and that pseudonymity can enable individuals to access more public forums for information and support [89]. This ability for online interaction to facilitate self-disclosure is particularly important in the initial stages of friendship formation, as two people who meet for the first time are more willing to engage and discuss a wider range of material that can serve as a foundation for stronger relational ties later.

Assumed Common Ground. Because Twitch channels are anchored in the content produced by streamers, viewers participating in the same channel know, at a minimum, that they share a common interest. All of our interview participants shared an affinity for video gaming and related topics, and all of the pairs indicated that they found each other in channels which reflected a mutual

interest. When asked the question: "In what ways did meeting on Twitch differ from other previous experiences that you've had with other relationships?" Nate (Interview 11) replied:

> *Nate: Common ground. You already know that you have something in common with someone if you're in that same sort of space, whether it's online or off. Where I'm from, there's a lot of people you can't necessarily relate to... I like speedrunning. Who in North Carolina likes speedrunning versus likes NASCAR?*

Another one of our respondents, Logan (Interview 3), mentioned that 5-6 of their best friends came from meeting on Twitch and explained why they thought this happened:

> *Logan: I think that's because common interests first of all. Second of all, for some reason I don't know if it's people of like mindsets gravitate to each other or I gravitate, you know? But basically I think that people that I have just met online from Twitch, they just share the same ideals... it's harder to be friends with somebody that you don't always agree with.*

Moreover, participants frequently expressed that their interests in video gaming were not largely shared in the general population. This feeling of uniqueness further highlighted the importance of the common ground felt when interacting in Twitch communities. Here, Anna and Thomas (Interview 9) talked about their mutual interests when they first met. When asked, "And did you remember anything from your first couple of interactions about the other person?":

> *Anna: A mutual enjoyment of speedrunning. From there it's kind of, "What do you do for a living? What kind of games do you like?"*
>
> *Thomas: Yeah, it was kind of the same. It was just a mutual enjoyment of being able to interact with somebody else, being able to have somebody else to talk to.*

Later, Anna reflected on why it was easy for her to make friends on Twitch, saying:

> *Anna: And with friends through Twitch for example, you have understanding of gaming, of Twitch, of social media, whatever it might be, and you can elaborate on those topics. And it's kind of your comfort zone... I find them to be more in depth than a lot of the friends I have.*

Anna remarked that her relationships with friends from Twitch are more "in depth" because of the shared context and interests that allow conversations to delve deeper into topics. The concept of "common ground" was highlighted by almost all of the interview pairs as a primary driver for their initial friendships with each other. At a minimum, common ground with respect to language and shared objects of reference is a prerequisite for establishing communication [12]. Many of the tools that we use for establishing common ground in face-to-face settings are lost in the filtered-cues environment of text-based CMC [52]. These examples, however, illustrate how livestreaming communities can provide shared reference points around which common ground can be built.

Elevated Visibility. When channels are sufficiently small, participants experience a conversational setting similar to those in Walther's small-group experiments (e.g. [71, 77–80, 82]). In these cases, frequent exposure means that even pseudonymous usernames in chat will become familiar over time, enabling persistent relationships to form. Here, Jason remembered the first time he met Sean (Interview 15), now one of his best friends, two and a half years earlier:

> *Jason: He was one of the first people that kept coming back, that's how I remember him. I'd see him the next day and was like, "Wait a minute, someone came back! Awesome." We had some common interests pretty immediately.*

Twitch communities vary widely in size, however, with some channels hosting thousands of participants. Necessarily, in larger channels, not all participants will be equally visible. In larger channels, some number of formalized and semi-formalized roles allow for certain members to stand out as chat moderators, subscribers, and so on. For several of the interview pairs, we found that

one participant had been a moderator or had helped in some volunteer administrative role for a channel. Here, Laura and Nate (Interview 11) recalled their first interactions:

> *Laura: I was moderating a lot of my friend's chats... He was also a moderator for [their mutual friend's] chat as well. So we kept talking, joking, being funny.*
>
> *Nate: She was the one to reach out to me first, one-on-one, personally, so we could communicate and build some rapport.*

Occupying such a role can make one or both participants more visible to others, providing a catalyst for interaction that enables the discovery of common ground. As an example, Lauren and Erica (Interview 5) recounted how the initial interaction that led to their friendship happened when Lauren was serving as a moderator for a mutual friend's chat and Erica volunteered to help, providing an opportunity for cooperation and communication:

> *Erica: So then, she was the mod in there. She was the only mod. So, his channel started growing and getting bigger with all his stuff. And I was in there, and I know basic coding and stuff. So I could do all the commands really easy, really quickly. I knew them.*
>
> *Lauren: And we worked really well together as a team.*
>
> *Erica: And we realized, you know, not everybody's a giant asshole on the internet, which was nice.*
>
> *Lauren: It was nice!*

In subsequent follow-up questions to this statement, Lauren and Erica remarked that finding and having another female friend within a gaming community became, in Lauren's words later in the interview, "one of our bonding things." The elevated visibility provided by Lauren's role as a moderator sparked the initial interaction that allowed them to identify this "common ground," which would have otherwise remained hidden in the pseudonymous chat environment.

Certain forms of participation within livestreaming communities can also create moments of elevated visibility. Many streamers use technical features, such as audio or video alerts, to highlight contributions such as donations or subscriptions in various ways, providing a momentary spotlight on individual community members that can trigger interactions. When Eric and Ashley (Interview 13) were asked how they first interacted, Eric illustrated how donations first made Ashley visible:

> *Eric: I used to donate $5 ever time one of the streamers I knew went live. And you usually would be like, "Oh, hey, that's one of the main donations of the stream." And she comes on, and all of a sudden once she starts coming into the community, she'll make these big donations. And I was like, "Who is this person who's out-donating me?"*

Our interviews revealed two ways in which the particular affordances of livestreaming services help to scale the benefits of hyperpersonal interaction to larger communities. As community size grows, members can utilize specific roles (e.g. moderator, subscriber, VIP) or moments (e.g. cheering, being recognized in chat, being recognized by the streamer) to gain elevated visibility. This visibility sparks interactions with others, making salient areas of common ground, such as shared interests or personal characteristics, that would have otherwise gone unnoticed in this pseudonymous space, seeding the potential foundations for relationships that continue to develop in strength.

3.2.2 How Relationships Formed on Twitch Grow Stronger. Our second research question concerned specifically the mechanisms which enabled pairs to progress from acquaintanceship to close, personal relationships. Here we observe a common pattern in which frequent, low-stakes interaction, followed by shifts to more intimate modes of communication, and ultimately face-to-face meetings, enable these connections to develop progressively into close, personal relationships.

Frequent, Low-Stakes Interaction. Many streamers follow a regular streaming schedule, meaning that community interactions have a regular, predictable cadence. For this reason, individuals can anticipate future, ongoing interactions with conversation partners, an important part of the hyperpersonal model [75]. Repeated interactions allow conversation partners to build a shared history together, as Thomas and Anna (Interview 9) described when asked "At what point do you think somebody goes from just somebody you see on Twitch to an actual friend?":

> *Thomas: Once you actually start building more of a connection and having meaningful conversations... "Well, how is your day going?" You know, actually having conversations.*
>
> *Anna: I can agree with that... When you start having those conversations, you start talking frequently and can recall a conversation or a point from say two months back, and then you kind of realize that you've been talking to this person daily via voice, text... it's Twitter, it's Discord, it's text message... [they] would have multiple ways to contact you. And I think when you start kind of grasping that altogether, that's when you have a friendship.*

In addition to conversations happening with a regular, predictable cadence, it was equally important that participating in a channel was relatively "low-stakes." In contrast with real-life meetings, online interactions can occur with far more frequency, at different times of the day, and with less coordination, as Susan (Interview 6) noted:

> *Susan: It just feels a lot more chill and low-key, I guess. Because sometimes in real life, you want to hang out with your friends, you have to set a time and date, whatever. Like, "Let's go do this." (But with) Discord... you just pop in, and then people just join in sometimes, if they want to. If they don't, there's like no pressure.*

The ability to quickly enter a forum and see familiar faces removed much of the pressure associated with in-person meetings, enabling conversations to happen more frequently. Interviewees also reflected on how interacting on Twitch changed the quality of conversations, specifically by focusing attention on conversation as the primary activity, in contrast with in-person meetings, which are often accompanied by activities. Lauren (Interview 5) framed it this way:

> *Lauren: [With IRL interactions] if you're with someone that you see regularly you may go out to dinner, chit chat about this or that, and then you go your separate ways... Online at home in your own safety, you're spending more time and getting deeper into more things... because you talk about everything... The internet allows you to get a little more in depth about everything.*

Together, these features contribute to channels functioning as a "third place" [51], where individuals can visit at their leisure, see familiar faces, and focus on conversation as the primary activity. In essence, livestreaming communities lower the barrier to creating, finding, and participating in the kinds of third places where new interactions and new connections frequently occur.

Moving to More Intimate Communication Modes. After reaching a certain level of relationship depth, many pairs described a shift to more intimate modes of communication. One service mentioned frequently was Discord, which – while used by many Twitch streamers and viewers – is not affiliated with Twitch. One feature that distinguishes Discord chat from the text-based chat on Twitch is the ability to create a private multi-user chatroom with audio – a "virtual hang-out space" – where invited community members can hear one another. When asked about the most used methods of communication with each other, Susan and Kyle (Interview 6) commented:

> *Susan: Discord, I think, is probably the number one tool that really drew us together because it's just a different feel. I mean first, it's a whole server where everybody gets to talk to each other, and then second, the voice channel. That's just a totally different*

experience. When you guys are all together on it, and then you just hear each other's voices, it's definitely a more connected feeling...

Kyle: Yeah, it's mainly Discord because we have the voice chat interaction, and that's different from being in Twitch chat where we're just letters and names to each other, but we have a voice and a name together. You get that personal effect.

Susan: It's like typing LOL versus actually hearing them laugh, I guess.

The ability to use services outside of Twitch to more closely imitate real life interactions went beyond just having audio chats with one another. Here Alex and Amy (Interview 14) described using more intimate forms of communication to mediate a "virtual community night":

Alex: So in our community server, we have this thing called community nights, dedicated nights of just we get to interact with each other, we're all in the same voice call. We all know it's a Friday night, we could be off partying, but no, we're all here in Discord.

Amy: We're drinking separately but together.

Alex: Yeah, we're all in a different part of the world, like some of us are in Europe, one of us in Hawaii, Virginia, they're all in a different time, all the different timezones don't matter because we all know this time, at this moment...We're all going to have a good time.

In shifting to richer or more intimate communication media, our interview participants highlighted some of the limits of the hyperpersonal model. Text-based pseudonymous interactions can lower the barriers to building initial trust and intimacy, as compared with in-person meetings, serving as a kind of scaffold for initial relationship formation. As mutual trust and intimacy develop, it becomes desirable to add additional communication channels, in order to more closely approximate the experience of "being there" when participants were physically distant. In addition to Discord, interviewees also described augmenting their interactions with video by moving to Skype or Snapchat, and increasing their availability by adding traditional phone conversations, while still using Twitch as a central place to gather as a community and meet new friends. Every pair we interviewed mentioned incorporating some form of communication method in addition to Twitch as part of the process in becoming stronger friends.

Progression to Face-to-Face Meetings. Because of the study design, all of the pairs that we interviewed had met in person – at a minimum, during the weekend that they were interviewed. For many, the first in-person meeting was a memorable, emotional moment. Here, Lisa described her memory of meeting her best friend Sophia (Interview 10) in person for the first time:

Lisa: I think my most memorable was our first meeting because we had been starting to keep in contact with social media the closer we got to the convention. We're like, oh my gosh, we get to actually meet in person for the first time. [After flying in, I went to this] huge dinner that Game and Company was hosting, that they were at and it was just like, there she is and it just big old hug and it was just, it was a good moment.

We note that while in-person meetings were important to the pairs we interviewed, they were not a critical precursor to the development of a strong relationship, and often represented another step in the progression of becoming friends. When asked, "After meeting in person, does anything change?" Amy (Interview 14) responded:

Amy: I feel like it's like we knew each other before, so we're just hanging out, you know? ...It's not the same as meeting him in person first and then becoming friends with him later on. So it's more along the lines of we knew each other before... [but] if they change in person, then you know that they're not genuine basically.

The in-person meeting didn't change Amy's perception of the person who had become her best friend, but did increase her confidence in that perception. Brandi (Interview 1) described this in terms of "completing" the mental image she had built of her online friend:

> *Brandi: So you have this mental image of a complete person, but you don't really complete the image until you actually see them... You could talk to somebody every single day through Discord, or Twitch, or whatever it is and have these conversations, every single day or once a week or whatever, and you really, you feel like you really know this person. And so when you meet them, it's like meeting your best friend for the first time.*

These excerpts are indicative of a pervasive theme conveyed by our interview participants. In-person meetings were significant, but not because it fundamentally altered the strong impressions that pairs had of each other. As Taylor phrases it, "a friend can be a friend online, even if you never meet them face to face" ([70], p.19). Many interviewees spoke of waiting months or years before meeting in person. Because all had moved already to more intimate forms of communication (e.g. audio, video), there were few surprises. Rather than "changing" the dynamics of a friendship, meeting in person was part of a "confirmation" of the other, deepening an already strong relationship.

3.2.3 Trust, Support, and Romantic Relationships. One of the most surprising findings from the interviews was how strong these relationships were, overall. We initially expected that participant pairs might discuss cooperative gaming, virtual hangouts, and shared projects; it quickly became clear that many of these relationships were marked by substantial mutual trust and support. In multiple interviews, participants discussed helping each other through anxiety, depression, or even attempted suicide. Others talked about support given during the serious illness or passing away of a loved one. In some case, financial or instrumental support was exchanged, such as lending money, helping someone move, or sharing housing.

When asked, "At what point did you realize your friendship was really what it is?" Ian and Gina (Interview 16) said:

> *Ian: A year and a half ago, my granddad fell extremely ill [becomes emotional]. And I turned to Gina. Just, yeah. She...*
>
> *Gina: Well, we've both been there, because I suffer from depression and anxiety, so he's the first one I call whenever I'm having an anxiety attack, or I'm just having a really bad day. So it's like, we kind of talk each other through our hard times. We're always just there.*

In another interview, Jason (Interview 15) talked about helping their best friend rehearse coming out as gay to a loved one.

> *Jason: [He] wanted to come out to their family, especially their dad. They came in the channel and was like, "Do you mind if I try it with you, and you give me some tips, or try to react like you think my dad might?" And I did, I don't even remember how long, because I just lost track of time. But for someone to trust me enough with that, and then the next day come back and be like, "I did it. And just like you said, it went pretty well. So thanks." That's amazing.*

Others shared similar stories of very strong emotional support. For example, best friends Evelyn and Michael (Interview 21) shared how being there for one another got each other through some very difficult times in life: one, a suicide attempt, and the other surviving cancer:

> *Evelyn: I think this is just around the time we started becoming friends. I told you about it later, but I was real sad. I was on depression pills. I wasn't taking them in college, because I was away from my bad situation. It all came back one time, and I ended up taking a bunch of my depression pills. I immediately threw up. It was really awful. But I ended up just talking to you about it.*

Michael: I'm actually a cancer survivor... There's so much grief and stuff that's tied with that. You feel isolated and really alone when, like I said, your real life friends will move on and not really have time for you, or they'll look at you and go, "Oh, what a sad tale." And being able to talk to [Evelyn] and connect... most people don't care. They don't have the time... [She's] really been the only person...

While previous research has explored the potential of livestreaming communities for fostering supportive relationships between viewers and streamers (e.g. [87, 88]), these findings substantially expand our view of the deep levels of emotional, instrumental, and financial support that these communities can foster among viewers.

Romantic Relationships. Particularly surprising was the number of romantic relationships that we encountered in our research. We did not recruit for pairs in romantic – or even particularly close – relationships, and Twitch is certainly not a matchmaking service; still, three of the 21 pairs interviewed fell into this category. We observed many of the same mechanisms that led to the development of friendships supporting the development of close, romantic relationships.

Recall Eric and Ashley (Interview 13), who first met online through Twitch in June 2015 when Ashley donated to a community in which Eric regularly participated. This initial "moment of elevated visibility" sparked a conversation, mediated through pseudonyms and the safety of online chat, through which mutual trust and intimacy could develop. When prompted with "Walk me through the progression of your friendship together," the two responded:

Ashley: It was mostly just talking online. And then the more we talked... We ended up talking everyday, pretty much. And then it just sort of developed into a friendship, and then went into a relationship after that...

Eric: ...Long Skype calls.

Ashley: Yes.

Eric: Real long Skype calls. But yeah, it was talking on Twitch, similar friends, and we'd talk on Twitter. We'd always end up in Twitter feeds together. And so always end up joking. And then ended up in a group chat. And then we just were like, "Oh, hey, let's just make our own chat." And so then we would Skype call and stuff. And then the whole... I'd say Skype again daily for a few months.

An initial spark led to frequent interaction within public chat on Twitch. As trust developed, they moved to more intimate forms of contact via private messaging and Skype video calls. After 6 months of conversations, the pair decided to finally meet in person in December 2015, which deepened their relationship with one another even more. At the time of our interview, when asked, "How would you describe your current friendship – relationship – to other people?" they responded:

Eric: Good. We live together now, so I'd say... It means something's going right.

Ashley: I'd say we're best friends.

Eric: Best friends. And boyfriend, girlfriend.

3.3 Study 1: Summary of Findings

Eric and Ashley's story of progressing from virtual strangers to being in a close relationship illustrates many of the themes which arose across our interviews regarding how relationships form on Twitch and deepen over time. Consistent with the hyperpersonal model, pseudonymous, text-based interaction facilitates self-disclosure and the assumption of common ground supports initial connections; these deepen over time as a result of the frequent, low-stakes interactions provided by a regularly convening community. Affordances that support elevated visibility within a community allow these processes to scale to larger groups. As trust and intimacy build over time, relationship

pairs shift to more intimate modes of communication, adding additional communication cues such as audio and video, illustrating some of the boundaries of the hyperpersonal model. Many pairs develop such a high level of relationship depth entirely via CMC media that face-to-face meetings serve more to confirm their perceptions to each other than to enhance them. These findings are illustrative of patterns observed across our 21 participant pairs, who represent a population of "lead users" in terms of leveraging communities on Twitch to build close relationships. In the following section, we identify more boundaries of the hyperpersonal model, by exploring patterns regarding which communities are more or less supportive of these types of strong, personal relationships.

4 STUDY 2: WHAT TYPES OF TWITCH COMMUNITIES SUPPORT PERSONAL RELATIONSHIPS?

In Study 1, we identified ways in which the affordances of livestreaming communities enabled the benefits of hyperpersonal interaction to scale to larger groups. We observed how individuals transitioned from strangers to acquaintances to close friends. In this second study, we explore how the potential for relationship development and maintenance varies across communities, to gain a more precise sense of the boundaries of the hyperpersonal processes which lead to the formation of the types of close relationships observed in Study 1. We operationalize relationship closeness using the notion of "tie strength" popularized by Granovetter [25, 26], in which dyadic relationships can be conceived of as "weak" or "strong." In this second study, we address the research question:

> ***RQ3: Which types of communities support the maintenance of weak and strong relationships?***

Walther's experimental evidence for hyperpersonal interaction draws mostly on studies of dyads or small groups; prior work suggests that the size of a community will substantially affect interaction quality and quantity in several ways. Intuitively, as larger communities provide more potential conversation partners, the sheer number of possible connections will grow, increasing the possibility of forming at least weak connections with others. As channel size increases, communication shifts in quality from one-on-one interaction to "crowdspeak," or engagement with the community as a whole [21, 27, 29]. A shift to crowdspeak could support a stronger sense of group identity or generalized attachment to other group members [55, 69, 72], supporting weak ties to others. A shift away from conversation, however, would inhibit the self-disclosure and intimate interactions which support the types of friendships outlined in our first study. These intuitions led to the following hypotheses about size of a community and its suitability for maintaining personal relationships:

- *H3A. As communities increase in size, participants will be more likely to have weak ties with other members.*
- *H3B. As communities increase in size, participants will be less likely to have strong ties with other members.*

In offline settings, frequency of interaction is associated with closeness [28, 65]. Walther's hyperpersonal model suggests that frequency of interaction is a necessary component in order for intimacy in CMC settings to approach that of face-to-face settings [76]. Building on these intuitions, we hypothesize that channels which broadcast more frequently will support more personal relationships overall, weak or strong:

- *H3C. As communities increase their meeting frequency, participants will be more likely to have weak ties with other members.*
- *H3D. As communities increase their meeting frequency, participants will be more likely to have strong ties with other members.*

4.1 Methods: Survey

We distributed a survey via email that was completed in November 2019 by 1,367 Twitch account-holders located in the United States. We outline participant recruitment, the survey instrument, and descriptive statistics about the respondents in more detail below.

4.1.1 Sampling and Recruitment. Our participant pool started with Twitch viewers with an email-verified account located in the United States, who had viewed Twitch from any device (e.g. web, mobile, smart TV) within the prior 28 days. For each viewer, we calculated the average concurrent viewer count[2] (abbreviated as *CCU*) for their most-viewed channel over the prior 28 days. Using this measure, we split viewers into two segments: "small-" (< 100 CCU), and "large-" (100+ CCU) channel viewers, sampling the same number of survey contacts from each segment. The survey was distributed via email to 17,000 Twitch viewers and kept open until 1,000 completed responses were submitted. The email invitation (full text in the Appendix) indicated the topic of the survey as the "role that community and friendships play in our experience on Twitch," likely biasing responses towards those interested in engaging socially on Twitch. The invitation also clearly indicated that participants must be 18 or older.

4.1.2 Survey Measures. The survey had two sections (measures provided in the Appendix). The first collected demographic information and ended with a screening question, *"Have you ever used the Chat or Whispers feature on Twitch?"* Participants responding "No" or "I'm not sure" skipped directly to the end. As Chat and Whispers represent the only text-based means for on-site communication, this question provided a clearly defined way of identifying a subset of viewers who use Twitch with at least some social or community orientation. Respondents who self-reported their age as under 18 were also immediately skipped to the end and notified that they were ineligible.

The second section asked respondents to name the Twitch channel which *"contributes most to your experience on the platform,"* and prompted them to respond to the remaining questions while keeping in mind *"the community associated with this channel."* This section focused on a 16-item scale, based on an instrument developed by Petroczi et al. [54] for measuring tie strength in virtual communities. This measure was modified to ask respondents to estimate the number of community members meeting each criterion, rather than naming them, in order to reduce cognitive exertion (i.e. to minimize satisficing bias) [50] and to preserve the privacy of non-participants.

Items in this scale covered several dimensions of tie strength, including trust, intimacy, and emotional or instrumental support. A full list of items presented in our version are provided in the Appendix. In order to provide a benchmark against some commonly-understood notion of "friendship," we included two additional questions: *"How many members of this community would you consider to be as or more close than your "real life" (IRL) friends?"* and *"How many members of this community would you consider to be a close friend?"* Participants estimated the number of community members matching each question using a 6-point scale with the following options (0, 1, 2-5, 6-10, 11-20, 21+).

4.2 Survey Respondents

We received a total of 1,458 responses (8.6% response rate), of which 91 (6.2%) were screened out immediately because respondents indicated that they were under 18 years old. An additional 367 (25.2%) respondents were screened out from the main survey analysis because they had never used the Chat or Whispers feature on Twitch. Respondents were compensated with a $10 Amazon gift card, regardless of whether or not they were screened out at this second stage. Statistics about

[2] Average concurrent viewer count is defined as the average number of logged-in or anonymous viewers present during a typical minute that a channel is streaming. This number is visible next to the stream title when a streamer is broadcasting.

Dimension	Category	Overall	Communicators	Non-Communicators
Count		1367	1000	367
Gender	Male	1066 (78%)	764 (76%)	302 (82%)
	Female	234 (17%)	189 (19%)	45 (12%)
	Non-Binary / Decline	67 (5%)	47 (5%)	20 (5%)
Age	18-20	378 (28%)	275 (28%)	103 (28%)
	21-24	314 (23%)	229 (23%)	85 (23%)
	25-29	291 (21%)	214 (21%)	77 (21%)
	30-39	285 (21%)	218 (22%)	67 (18%)
	40+	99 (7%)	64 (6%)	35 (10%)
Gamer	Non-Gamer	18 (1%)	8 (1%)	10 (3%)
	Casual	207 (15%)	138 (14%)	69 (19%)
	Core/Mid-Core	802 (59%)	583 (58%)	219 (60%)
	Hardcore	340 (25%)	271 (27%)	69 (19%)

Table 2. This table summarizes self-reported demographics for respondents, split into self-reported users (labeled *Communicators* and non-users (*Non-Communicators*) of the Chat or Whispers features on Twitch.

self-reported participant demographics are summarized in Table 2, split by those who self-reported having used chat or whispers in the past (whom we refer to below as *communicators* for brevity) and those who had never used these features on Twitch (*non-communicators*). The overall demographics of the survey population resembles those from prior academic research on gaming and comparable online communities, skewing younger and predominantly male.

A Mann-Whitney test did not provide evidence that communicators (Median=24) differ from non-communicators (Median=24) with respect to age ($U = 184370, p = 0.8929$). A chi-square test indicated that communicators differ from non-communicators with respect to gender ($\chi^2(df = 2, N = 1367) = 8.4, p = 0.0149$); specifically, respondents identifying as female are more likely to communicate on Twitch (80.7%) than those identifying as male (71.7%) or those choosing a non-binary option [3] (70.1%). Similarly, a chi-square test showed that communicators status varies with level of gamer identification ($\chi^2(df = 3, N = 1367) = 19.5, p = 0.0002$). Self-reported "hardcore" gamers are most likely to have communicated on Twitch (79.7%), followed by "core/mid-core" gamers (72.7%), "casual" gamers (66.7%), and finally non-gamers (44.4%).

4.3 Findings: Are personal relationships prevalent within Twitch communities?

We received 975 completed responses to the 16 items assessing the presence of relationships of varying strength within a respondent's selected community. Distributions of responses for each measure are summarized in Figure 2, ordered by the likelihood that respondents identified at least one person in the community matching a given criterion.

The top bar in Figure 2 shows responses to the question *"How many members of this community do you like?"*; 911 (93.4%) of respondents indicated that they "liked" at least one person within their selected community, with the median response in the range "11-20." On the spectrum of relationships of varying strength, this could be considered to be the lowest bar for what we might consider a "weak tie." At the bottom, we see responses to the question *"How many members of this community could you count on for a small, personal loan?"*; 329 (33.7%) of respondents indicated that at least one person in the community met this bar, and the median number of community members indicated was 0. This question provides a proxy for what might be considered a "strong tie."

In the middle are the two questions intended to anchor our notions of tie strength to a traditional concept of "friend." For the first, "How many members of this community would you consider to be a close friend?", more than half of the respondents (511, or 52.3%) indicated at least one such

[3] including "Prefer not to state"

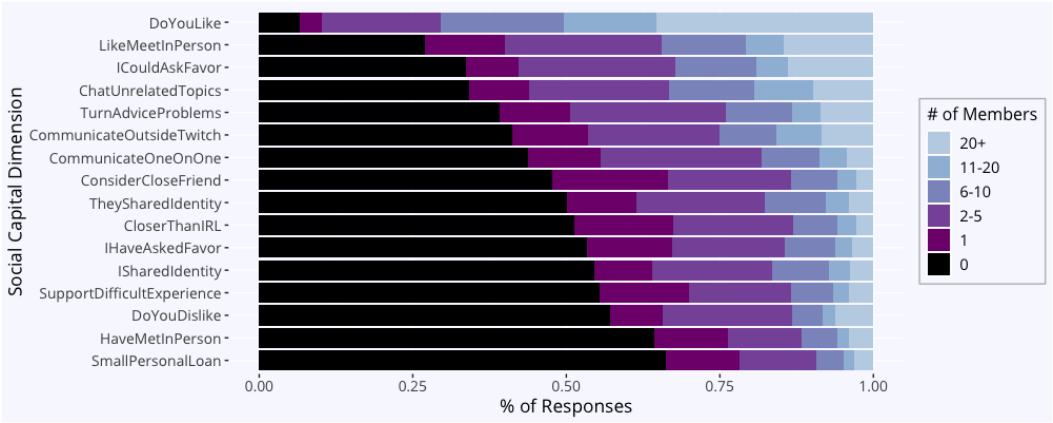

Fig. 2. Distributions of responses for each of the 16 items measuring social capital within the respondents' selected community, order by the likelihood of respondents identifying at least one community member matching each criterion. A full list of short codes for the 16 measures is given in the Appendix. At the top, 93.4% of respondents counted at least one community member that they liked. At bottom, 33.7% counted at least one community member that they could count on for a small, personal loan.

person within their selected community. Similarly, for the second question, "How many members of this community would you consider to be as or more close than your 'real life' (IRL) friends?", almost half (474, or 48.6%) of respondents indicated at least one such person.

Given that our survey recruitment and sampling strategy was geared towards identifying Twitch viewers who were motivated to engage socially within Twitch communities, we emphasize that these should not be interpreted as site-wide estimates, but rather, as descriptive statistics for our survey sample of active viewers who have communicated through Twitch.

4.4 Findings: What types of communities support weak or strong ties?

We hypothesized that the prevalence of personal relationships in a community would vary with community size and broadcasting frequency. To test these hypotheses, we construct two logistic regression models to help us capture how community-level features influence the likelihood of maintaining weak (*"How many members of this community do you like?"*) and strong (*"How many members of this community could you count on for a small, personal loan?"*) relationships within a community. In each case, we predict a binary outcome, indicating whether a respondent counted at least one community member meeting the given criterion (i.e. answered with "1" or greater). We refer to these binary measures for brevity as *DoYouLike* and *PersonalLoan*.

For each respondent, we include self-reported demographic features as control variables: *age*, *gender*, and *gamer identification*. We represent gender and gamer identification as binary variables, *is female* and *is core/hardcore* respectively, based on our observations above that these groups are significantly more likely to engage socially on Twitch. We include additional control variables capturing the viewer's level of activity across the site over the prior 90 days: *frequency* (fraction of days visited), *time spent* (average minutes watched per day), and *has chatted* (whether the viewer chatted at least once during this period). We also include *account age*, measured in days since account creation, to capture overall tenure on the service. As *time spent* is log-normally distributed across viewers, we apply a log_2 transformation before including it in our analysis.

Channel names were provided by respondents as user-generated text. We modified manually a small number of these channel names, only in cases that were unambiguous (e.g. changing "http://www.twitch.tv/imjasmine" to "imjasmine"); all other responses were left as provided. Using

case-insensitive matching, 835 of the original 1000 completed responses were matched to an existing Twitch channel. These 835 responses referenced 586 unique channels; 83 channels were mentioned by multiple respondents, and the most-frequently mentioned channel appeared in 17 responses.

We can summarize the content of a channel based on the "Game" [4] most frequently streamed over the prior 90 days. The top 10 Games represented in our sample include `Fortnite`, `Just Chatting`[5], `Minecraft`, `World of Warcraft`, `League of Legends`, `Destiny 2`, `Apex Legends`, `Dead by Daylight`, `Art`, `Call of Duty: Modern Warfare`, reflecting a variety of gaming genres (e.g. Battle Royale, Survival, First-Person Shooters) and non-gaming content. The median channel tenure on Twitch (time since first broadcast) was 54 months, indicating that the majority of channels represented in our survey were well-established.

Matching the hypotheses presented earlier, we compute two independent variables for each channel: (1) CCU (average concurrent viewer count), and (2) fraction of days broadcast, each computed over the preceding 90 days. The selected channels varied substantially in size, as measured by CCU (Min = 1, Max = 67,830, Mean = 2,116) and fraction of days broadcast (Min = 1.1%, Max = 100%, Mean = 58.9%). As CCU is log-normally distributed across channels, we apply a log_2 transformation. To account for the possibility of a non-linear relationship between channel size and the probability of having a relationship (e.g. if relationships were most likely in "medium-sized" channels), we include a quadratic term in our analysis, corresponding to $(log_2(CCU))^2$.

In total, our complete dataset captures $N = 826$ survey responses matched with aggregated log data, capturing user and channel features. Using these data, we construct a logistic regression model for each of our two dependent variables. In each case, we compare the fit and output of the "full" model to a baseline model, which includes only the control features; we then compare the fit of the "full" model to one including the additional quadratic term for CCU. We summarize the output of these models in Table 3.

4.4.1 Which communities support weak relationships? We first report results for our model predicting responses corresponding to our binary outcome for weak relationships: *DoYouLike*. We compare a baseline model, using only the control variables, to the full model, which includes the community variables (CCU and broadcast frequency), using a likelihood-ratio test. We find that the full model provides a better fit to the data ($\chi^2(2)=35.157$, $p < 0.001$). As ordinary R^2 values cannot be calculated for logistic regression, we use McFadden's Pseudo-R^2 to estimate the relative variance explained by each model [46]. The baseline model (user-level control variables only) predicts 6.4% of the variance in *DoYouLike* (McFadden Pseudo-$R^2 = 0.064$). Adding the community variables increases this to 15.0% (Pseudo-$R^2 = 0.150$)[6]. A likelihood-ratio test shows that adding the quadratic term ($(log_2(CCU))^2$) does not improve model fit over the full model ($\chi^2(2)=0.24878$, $p = 0.6179$). The results of the full model for *DoYouLike* are summarized on the left side of Table 3.

When assessing individual predictors, we set a lower threshold for significance at $p <= 0.001$, in order to avoid concerns about multiple comparisons. Age is the only control variable significantly related to *DoYouLike* ($\beta = -0.07$, $p < 0.001$); the odds ratio (shown as *OR* in the table) shows that a one-year increase in age corresponds to a 6% decrease in the odds of having a weak tie with at least one other community member. Looking at the community variables, we observe a negative relationship between $log_2(CCU)$ and the likelihood of having a weak relationship with another community member ($\beta = -0.25$, $p < 0.001$). Specifically, doubling the community size corresponds

[4]The "Game" value is selected by the streamer from a pre-populated list when they are broadcasting to facilitate discovery by viewers

[5]`Just Chatting` is used for more conversational content not tethered to a specific game or activity.

[6]Note that McFadden Pseudo-R^2 values are typically lower than those of typical R^2; 0.2-0.4 can represent "excellent fit." [47]

		DoYouLike (Weak)				PersonalLoan (Strong)			
		β	SE	OR	p	β	SE	OR	p
	Intercept	7.49	1.09	—	.000	2.32	0.52	—	.000
Demographic Control Variables	Age	-0.07	0.02	0.94	.000	-0.04	0.01	0.96	.001
	Is Female	1.37	0.63	—	.031	-0.03	0.21	—	.870
	Is Core/Hardcore	0.64	0.37	—	.090	0.66	0.17	1.93	.000
Behavioral (User-Level) Control Variables	Frequency	0.35	0.58	—	.540	0.29	0.33	—	.379
	log_2(Time Spent)	-0.11	0.11	—	.307	-0.02	0.06	—	.787
	Has Chatted	0.13	0.41	—	.747	0.01	0.25	—	.982
	Account Age	0.00	0.00	—	.509	0.00	0.00	—	.075
Community Variables	log_2(CCU)	-0.25	0.05	0.78	.000	-0.40	0.08	0.67	.000
	$(log_2(\text{CCU}))^2$	—	—	—	—	0.02	0.00	1.02	.000
	Broadcast Frequency	-0.21	0.63	—	.739	-0.50	0.34	—	.142

Table 3. Results from regression analyses for (left) whether respondents indicate that they "like" at least one member in their selected community (*DoYouLike*, our proxy for weak relationships) and (right) whether respondents could count on at least one member for a small, personal loan (*PersonalLoan*, our proxy for strong relationships). Coefficients (β) are provided with standard errors (*SE*) and p values, for all variables in the full model of weak tie formation (*DoYouLike*) and all variables plus the quadratic term in our model of strong tie formation (*PersonalLoan*). For variables with p values less than 0.001, we report odds ratios (OR), interpreted as the change in odds corresponding to a one-unit change in the variable. For example, a one-unit (one year) increase in age corresponds to a 6% decrease in the odds of *DoYouLike*. For log_2-transformed variables, the odds ratio represents the change in odds corresponding to doubling the value.

to a 22% decrease in the odds of having such a relationship. We observe no significant relationship between broadcast frequency and the formation of weak personal relationships.

As communities increase in size, we find that viewers are actually less likely to have weak ties with other community members; not only is hypothesis *H3A* unsupported, but we observe evidence for the opposite: that smaller channels are more supportive of weak ties than larger channels. We observe no relationship between broadcasting frequency and the likelihood of having weak ties in the community, meaning that hypothesis *H3C* is also unsupported.

4.4.2 Which communities support strong ties? The right side of Table 3 summarizes results from our model predicting responses to *PersonalLoan*, our measure of strong ties. Again, the full model provides a significantly better fit to the data than the baseline model. ($\chi^2(2)=47.917$, $p < 0.001$). In this case, adding the quadratic term for community size further improves the fit over the full model ($\chi^2(2)=13.633$, $p < 0.001$). The baseline model explains approximately 3.3% of the variance in *SmallLoan* (McFadden Pseudo-R^2=0.033), while the full model, this time including the quadratic term for CCU, explains 9.2% (McFadden Pseudo-R^2=0.092).

Of the control variables, there is a significant negative relationship between age and the likelihood of having a strong tie within the community. We also observe an effect of gamer identification; for "core" and "hardcore" gamers, the odds are almost twice as high (OR = 1.93) as they are for "casual" or non-gamers. Community size is negatively related to the likelihood of having strong ties; doubling the CCU decreases the odds of having at least one strong tie by 33%, though this negative relationship is offset by the positive coefficient for the quadratic term.

Because of the additional quadratic term, the relationship between CCU and presence of strong ties will change as CCU increases. We visualize this effect in Figure 3, which plots the predicted probability of a respondent having ties meeting various criteria within one's selected community, as a function of CCU. At top (red), we observe the roughly linear, negative relationship between CCU and the predicted probability of *DoYouLike*. At bottom (magenta), we see the clear quadratic relationship between CCU and *PersonalLoan*. We observe that the probability of having a strong tie within

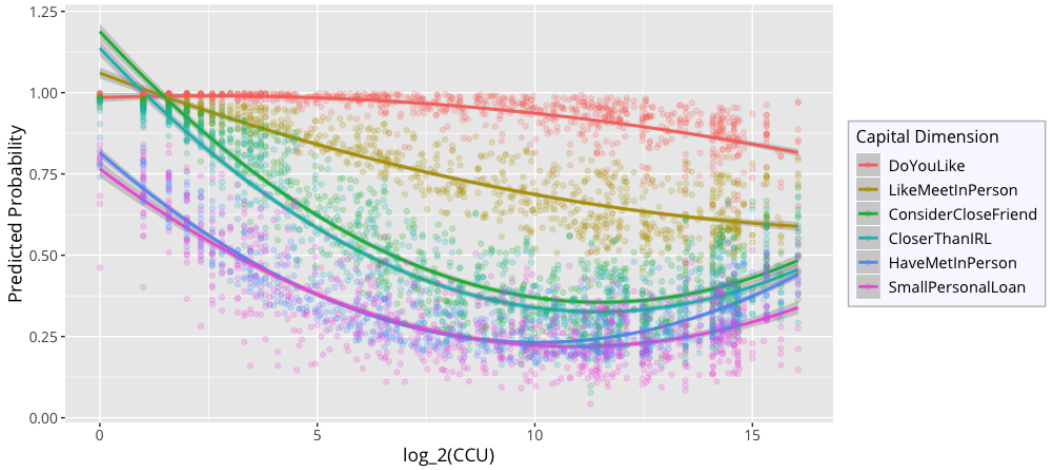

Fig. 3. This chart shows predicted probabilities generated by the model of maintaining ties of varying strength within one's preferred community on Twitch, as a function of CCU (shown here on a logarithmic scale. Each of the 6 lines refers to one of our social capital dimensions using the short codes provided in the Appendix. We observe a negative, mostly linear relationship between channel size and the probability of having weak ties (*DoYouLike*) within a community. For measures capturing stronger versions of tie strength (e.g. *HaveMetInPerson*, *SmallPersonalLoan*), we observe a quadratic relationship, in which the probability is minimized when $log_2(CCU)$ is between 10 and 11.5, or when channels have between 1000 and 3000 CCU.

their selected community is minimized when $log_2(CCU)$ is between 11 and 11.5, corresponding to channels with 2K-3K average concurrent viewers. We observe no significant relationship between broadcasting frequency and the likelihood of having strong relationships in the community.

As communities increase in size, participants are less likely to maintain strong ties within their community, supporting hypothesis *H3B*. We note that this trend reverses itself for channels with massive viewership (2500+ CCU). We observe no relationship between broadcasting frequency and the likelihood of having strong ties in the community, meaning that hypothesis *H3D* is unsupported.

This plot shows additional curves representing the predicted probability of ties of varying strength, based on responses to other survey measures. Our second lowest measure of relationship strength was having at least one person in the community that respondents would "like to meet in person"; this probability is shown in yellow. In green and teal, in the middle, we see our two measures for relationships similar to traditional friendships, "consider to be a close friend" and "as or more close than your 'real life' (IRL) friends." Our second-highest measure of relationship strength was having at least one person in the community that respondents "have met in person." Predicted probability for this measure is shown in blue. For both measures of weak relationships, we observe a roughly linear relationship. For measures capturing medium to strong relationships, we observe a quadratic relationship, minimized when $log_2(CCU)$ is between 10 and 11.5, or when communities have between 1000 and 3000 viewers.

4.5 Study 2: Summary of Findings

In this section, we analyzed data from a survey of 1,367 Twitch viewers to explore how support for personal relationships varies across livestreaming communities. We found that both weak and strong ties are surprisingly prevalent across the site. Two measures serving as proxies for close, offline friendship revealed that roughly half of respondents to our survey had a close friend within their primary community on Twitch. We note that the survey was intentionally directed

towards individuals who engage with Twitch for social or community-oriented reasons, through both the email invitation and a screening question asking about previous communication on Twitch. However, as prior research has found that many users of livestreaming services share social motivations for use (e.g. [19, 29, 32, 43, 66, 86, 87]), it is likely from these findings that both weak and strong relationships are pervasive across livestreaming communities.

Age is negatively associated with having social connections within one's primary Twitch community, though this effect was smaller for strong ties than for weak ties. Level of gamer identification did not influence the likelihood of having weak ties within one's primary community, but did influence the likelihood of having strong ties. We observe no effect of gender on the likelihood of forming either weak or strong ties, though we did find that respondents identifying as female were more likely to have indicated that they had used Chat or Whispers. Surprisingly, we find no relationship between control variables capturing high-level Twitch usage, including frequency of visits and account tenure, and the likelihood of forming weak or strong ties on the service.

Beyond 2000 CCU, we find that the probability of maintaining strong ties within a channel begins to increase again. In Figure 3, we observe that this effect grows stronger as the measure of tie strength increases. We note that our survey focuses on which channels are better venues for supporting the types of interaction associated with maintaining personal relationships, and do not distinguish between relationships formed on and off the site. As the probability of weak ties does not also increase after this threshold, a plausible interpretation is that, in the largest channels, viewers may instead be bringing in existing friends from outside to share the experience. If chat within these channels is like experiencing the roar of the crowd [29], then viewers' strong ties within these large communities may very well be the friends who came to the stadium with them.

5 DISCUSSION

In this paper, we reported findings from a mixed-methods study exploring how the affordances of pseudonymous, text-based livestreaming communities can contribute to the development and support of strong, personal relationships. Interviews with 21 pairs who met within Twitch communities and subsequently formed close relationships showed how these affordances support hyperpersonal interaction among community members, making self-disclosure easier for message senders and common ground more salient for message receivers. Because these communities are anchored around channels broadcasting with a regular schedule, they enable the kind of frequent, low-stakes interactions through which trust and intimacy can be built. Rather than limiting the depth of potential relationships, the CMC interactions afforded by chatting within livestreaming communities provide a scaffolding on top of which stronger relationships can be formed.

These interviews also demonstrated some of the boundaries of the hyperpersonal model in the context of real-world communities. In larger communities, we observed participants using opportunities for elevated visibility provided by the service to lower initial barriers to connecting with strangers. As mutual trust and intimacy developed, participants incorporated additional complementary communication channels, adding voice, video, and increased availability, which in turn, fostered even more trust and intimacy. In many cases, face-to-face meetings helped to reduce uncertainty and to solidify relationships, but – on the whole – the relationships that were formed via purely CMC means were quite meaningful before the first in-person meeting. Relationships described by many participant pairs demonstrated deep trust and support, rivaling and often surpassing the strength of their other relationships, such as those which developed offline.

Some of these interview findings help to explain surprising outcomes from our survey analysis. We had hypothesized that different types of communities might support weak or strong ties; instead, we found both in smaller communities. With fewer participants, smaller communities can better support one-on-one interaction [21, 27, 29], form around content that appeals to a smaller audience,

and allow more participants to be visible to others, all factors which contribute to the initial formation of connections. Smaller streams can still foster the regular, low-stakes conversations which enable ties to strengthen over time. Our survey analysis found no relationship between broadcast frequency and the formation of relationships; our interviews show how the larger ecosystem of platforms which surround Twitch communities (including Discord, game servers, and social media) may help keep conversation around a channel going, even when the channel isn't streaming. It may be the case that these complementary platforms help Twitch channels to sustain a community, and the relationships within, even when these channels broadcast less frequently.

5.1 Designing for Relationship Formation

We noted initially that certain aspects of Twitch (e.g. video consumption, one-directional focus on a central figure, and large-scale rapid chat interaction) make it difficult for some to believe that personal relationships play a meaningful role within the site. We find that Twitch's chat environment provides a reduced-cue, pseudonymous environment that promotes self-disclosure, that the focus of channels on specific content allows for the assumption of common ground, and that the regular schedule of interactions enables participants to anticipate long-term future interaction. In these ways, communication on Twitch, at least in smaller channels, embodies many aspects of Walther's *hyperpersonal interaction* model [76], and provides empirical support that these affordances can promote the formation and maintenance of personal relationships, at scale, in Twitch communities. The availability of these communities enables frequent conversation, allowing users to log more quickly the hours together necessary for strengthening relationships [28].

Future research on relationship formation in CMC contexts may choose to consider how different combinations of affordances produce different outcomes or lead users to adopt different strategies to reach the same outcomes. Prior study of "temporary technical identities" on Reddit [1, 42] "situated anonymity" in Yik Yak [60], or pseudonymous interaction in health communities [89], for instance, provide examples of environments which combine filtered cues and common ground, but remove the expectation of future interactions; these settings facilitate self-disclosure in privacy-sensitive situations for individuals seeking social support and information exchange, in a manner that is not geared towards long-term relationship formation. In other settings, such as 4chan [3], a similar combination of affordances promotes group identity and creativity, without the positive benefits related to social support. Cross-platform research could help us to disentangle how affordances interact with behavioral norms to foster different types of social and relational outcomes.

Twitch and other livestreaming services have added new features to encourage interaction outside of chat, such as interactive extensions or polls, raising an interesting question about the effect that these features may have on relationship formation within Twitch communities. On the one hand, having more individuals participating and more frequent interaction could foster a stronger community identity, which increases attachment and engagement with the community and its members. On the other hand, these features could potentially displace the text interactions which enable self-disclosure and kickstart the relationship formation processes outlined in this paper. Future research could explore how the presence of interaction mechanisms designed to complement chat within a community influence the processes described in the present study.

5.2 An Ecosystem of Communication Services

Many CMC systems offer technical mechanisms for managing self-disclosure across subsets of a community, such as Circles [37] or Groups [38]; on Twitch, communities converse within a single public feed. We found that a range of secondary services are used to manage self-disclosure, as relational ties deepen and develop. When users first meet on Twitch, the reduced-cues environment enables users to safely engage with others, self-disclosing at their own comfort level. As mutual

interest is discovered, users migrate to secondary communication channels, introducing new modalities (e.g. audio, video) that allow intimacy and trust to build. For example, after regular interaction on Twitch, two users may engage in Discord or Skype, allowing more frequent exchange (such as when the Twitch streamer is offline) and a richer sensory experience that can include hearing someone's actual voice or seeing their face in video. Here, we find a contrast with Walther's experimental studies, which typically retained viewers in a text-only chat environment.

Key to this process was the user's ability to deploy an ecosystem of community services as a "toolkit" [68] for friendship formation, deploying each one on their own terms depending on their own comfort and desire. The ability to navigate self-disclosure by spreading it across multiple services provides a mechanism for "managed ambiguity" [35] and control. Seeing users navigate to other services might tempt designers to collapse these features into a single environment; we speculate that this would eliminate the flexibility that allows viewers to selectively introduce new communication modalities into a relationship. If, for instance, a livestreaming service introduced audio and video interactions among viewers, and shifted norms away from the use of text, we hypothesize that this could actually reduce the number of new relationships that are formed, by removing the control that viewers have about when to move to richer communication channels.

This phenomenon also highlights some limitations of trying to measure tie strength based on interactions within a single service, as in previous studies on Facebook [6, 24] and Twitter [23]. In situations where incorporating supplementary communication modes is correlated with increasing relationship depth, these models could produce misleading results. In fact, this is precisely the phenomenon described in one anecdote from Gilbert and Karahalios's analysis of errors in a tie strength model trained on Facebook interactions [24]. As such, our study shows that research into such relational processes in online networks should account more fully for the larger ecosystem and users' agency to employ multiple services as part of the process of strengthening relationships.

5.3 Bridges Built from Strong Ties

In his 1974 book *Getting a Job*, Mark Granovetter made a surprising finding: contrary to what was believed at the time, most people did not hear about job opportunities from close friends and family, but rather from "a friend of a friend" or an acquaintance of a coworker – what he called "weak ties" [26]. In this work and in a companion article, "The Strength of Weak Ties," Granovetter theorized and popularized the concept of *tie strength*, categorizing dyadic relationships as "weak" or "strong" [25]. In contrast to the local trust and support offered by strong ties, weak ties enable access to benefits, such as job opportunities, and knowledge not shared by one's closer connections. These ideas are implicit in Putnam's formulation of "bonding" and "bridging capital" [56] and Burt's concept of "structural holes" [7, 8]; those embedded in your local network may be relationally close but share the same resources, and those outside your local network are relationally distant but provide access to new resources. While there is no explicit reason why "bridging" ties must be "weak" and "bonding" ties must be "strong," this formulation is often implicitly adopted

In this study, we observed how online communities can enable strangers who are otherwise socially disconnected to form relationships with all the markers of strong ties, in terms of trust, intimacy, and support. We characterize these connections as *strong bridges*, relationships which combine the social and emotional support of strong ties with the access to novel resources or information offered by network bridges. Offline settings provide fewer venues for repeated interactions with strangers outside one's existing network. As individuals move more of their social activity and interaction online, future research may wish to consider the settings and processes which support the development of strong bridges and the roles that strong bridges formed through the internet can play in people's personal, social, and professional lives.

5.4 Limitations and Future Work

Before concluding, we first discuss some limitations of our findings. Our survey had an 8.6% response rate, making self-selection bias entirely possible. As demographics were not available for non-respondents, we're unable to assess how our respondents differed demographically from the larger Twitch population addressed. Furthermore, screening out respondents who did not self-report use of Chat or Whispers on Twitch may have artificially restricted our survey population, as findings from our interviews showed that some viewers participate in Twitch communities using external services, such as Discord. We note specifically the large number of female participants in our interviews, as the Twitch viewer population is known to skew male. We similarly note that female survey respondents were more likely to have self-reported having communicated on Twitch. In future research, we would like to explore more deeply the ways in which gender influences the amount and nature of social and community experiences on Twitch.

Though we accounted for some demographic factors, we did not collect data on other important dimensions of identity, including race/ethnicity and sexual orientation, which may influence individual attitudes about online communication, comfort engaging with strangers, and perceptions of common ground. Across both the survey and interview study, it is important to note that these findings reflect the attitudes and practices of a U.S.-based, English-speaking audience. An exciting area of future work would be to identify whether and in what ways, the findings outlined here generalize to the global population using Twitch and other livestreaming services.

Survey measures assessed personal relationships on Twitch, in general, and did not distinguish between pairs who met within the site and those who had formed a relationship outside the site beforehand. Twitch's use of pseudonyms may make it more difficult to search for and identify known contacts, but it is certainly the case that some users bring their friends into Twitch. This is even more plausible for those strongly embedded within the gaming community, providing a potential explanation for why "core/hardcore" gamers were more likely to have strong ties within Twitch. The increase in the probability of strong ties for high CCU channels, without a corresponding increase in weak ties, is consistent with viewers bringing friends from outside to join them in large channels. Future research could make this distinction explicit and identify whether endogenous or exogenous relationships dominate, and in which types of communities. Regardless of whether the friendships referenced were developed on Twitch or imported from outside, our findings clearly illustrate that certain structural features of channels on Twitch reliably make them more or less appealing venues for engaging with one's friends.

Our hypotheses in analyzing the survey data specifically focused on features of the channel itself (e.g. CCU, broadcast frequency), rather than how viewers engage with it. Even within a single channel, there is substantial variation in how viewers engage (e.g. frequency of visits, chat participation rates) that is likely to influence various social/community outcomes, from relationship formation to a more generalized sense of community. The scope of the present study did not allow for analysis of variation among viewers within a community; a more focused study capturing a larger number of viewers within a smaller set of communities could address these questions in the future. Experimental approaches could help to identify casual relationships between individual engagement and relationship formation within communities. We feel comfortable in larger channels with our assumption that channel-level features influence individual viewers' experiences, rather than vice-versa; this may not be the case in smaller channels, however, where it is possible that individual friendships could influence the streamer to broadcast more or lead the community to grow, meaning that casual relationships should be interpreted with caution in these cases.

While this study did not focus on the role that streamers and moderators play in shaping conversational norms, maintaining safe standards for conduct, and creating a sense of community

within Twitch channels, prior work has illustrated that it can be substantial [62, 63, 86]. Future research could explore not only how relationship formation is influenced by differences in norms and community standards, but also the role that moderator labor and strategies play in fostering the types of conditions in which personal relationships can flourish.

5.4.1 Ethical Considerations. Our analysis drew on several sources of data, which we accessed through our relationship with Twitch. Academic-industry collaborations naturally raise questions about the objectivity of the research. Were our analysis biased by this association, the primary concern would be inflated estimates of the prevalence of close relationships. For this reason, we have not focused in this paper on estimating this prevalence across the service as a whole. Rather, we have focused our attention on the contexts and mechanisms which support personal relationships – a phenomenon identified in prior external research on Twitch (e.g. [29]). We also addressed participant privacy in various ways. First, we stored and analyzed all behavioral data using hashed user identifiers, so that publicly-facing screen names were never visible in the data. Beyond demographic and usage self-reported in the survey, our analysis incorporated only high-level aggregate measures of usage (e.g. days visited, account age), which could not be personally identifying. Interview data was immediately pseudonymized after transcription, in order to protect participant confidentiality. All stages of this research were approved through a university IRB.

Finally, we conducted our paired interviews at TwitchCon, within the primary conference venue, in order to ensure that our participant pairs were provided a safe and monitored environment in which to converse; we specifically recruited pairs who had already met in person, such that we were not facilitating new first-time meetings. Any offline meetings among members of any online community should be approached with care, and we reflect in our findings on the gradual process that our interview participants discussed of building mutual trust prior to meeting offline. We emphasize the care taken to ensure that no minors were included in any stage of this research. We do not intend for our findings here to generalize to minors, for whom forming friendships online should involve additional safety considerations or supervision.

6 CONCLUSION

Public perception of livestreaming services is often driven by massive streams and events, leading many non-users to believe that meaningful connection is impossible, but the experiences of individuals engaging with these services has often shown otherwise. We began this study to understand how common these experiences were, and to understand how deep, human connections could develop within this pseudonymous, often chaotic, and sometimes mischievous environment.

We were surprised and deeply impressed by the depth of the relationships that our participants described and the levels of social, emotional, and instrumental support which grew from connections created by that environment. The findings of this work provide insight into how sociotechnical design decisions influence relationship formation processes in computer-mediated communication spaces and point to the potential of CMC environments for fostering "strong bridges" or relationships that offer a high degree of support alongside access to resources from outside one's network.

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A INTERVIEW GUIDE

Here, we provide the protocol which we submitted for IRB approval and which helped to guide the paired interviews. While we endeavored to cover the topics in this guide with each interview pair, we adopted a semi-structured approach, asking additional impromptu questions in which we elaborated with participants on themes or stories as they arose, often leading the pairs to cover topics specific to their own experience.

- **When did you first each start using Twitch?** Describe your first impressions. What did you like most? Why did you return?
- **Tell me a little about how you each use Twitch.** What kinds of content do you enjoy? How are you involved today with the platform?
- **Did you know each other before using Twitch?**
- **What do you remember from your first interaction on Twitch?** Can you recall the first time the two of you interacted on Twitch? What was it? What were your first impressions of the other person? What did you think they would be like in real life?
- **How did your friendship develop online?**
- **How long was it before the two of you met in person?** How did meeting in person come about? What were your first impressions?
- **How has it progressed since then?**
- **How often do you communicate with each other today?**
- **Imagine Twitch without knowing this person, how would it be different?** How does this other person contribute to your experience on the platform?

B SURVEY MATERIALS

B.1 Email Invitation

Survey participants were recruited through a Twitch-branded email with the following body text:

> *Hey <twitchID>,*
>
> *Thank you for being a part of the Twitch community!*
>
> *You've been randomly selected to take part in a survey about the role that community and friendships play in your experience on Twitch. This survey should take no more than 10 minutes to complete. If you are eligible and complete the survey, we'd like to offer you a $5 Amazon gift card for your time and interest.*
>
> *Take Survey [CTA Button]*
>
> *Your ideas and feedback help us make Twitch better for everyone. Thank you for sharing your time and your experiences with us.*
>
> *Love,*
> *Twitch Science*

B.2 Survey Instrument

The following measures were included as part of the survey:

B.2.1 Demographics and Screening Questions.

- What is your current age? [free numerical response]
- Please indicate your gender:
  - Female
  - Male
  - Non-binary / third gender

  - Prefer to self describe [free text response]
  - Prefer not to answer
- Which of the following best describes the area in which you currently live?
  - Rural
  - Suburban
  - Small City
  - Large City
- Which of the following best describes you?
  - Non-Gamer: I am not interested in playing video games
  - Casual Gamer: I dabble in video games, but in short sessions or infrequently
  - Core/Mid-Core Gamer: I regularly play video games, but I am not super-serious or competitive.
  - Hardcore Gamer: I play video games frequently, and I play seriously or competitively.
- Have you ever used the Chat or Whispers features on Twitch?
  - Yes
  - No
  - I'm not sure

B.2.2 Primary Measures.

- What Twitch channel contributes most to your experience on the platform? Please provide the name of the channel below. [free text response]
- How would you describe your typical role within this channel? Please choose the option that best describes you.
  - I watch, but logged-out
  - I watch using my Twitch account, but I do not interact using chat, polls, extensions, etc
  - I occasionally participate using chat or other Twitch features
  - I frequently interact with other viewers or the streamer on this channel
  - I am a moderator or support the streamer in other specific ways (e.g. manage social media or create assets for this channel)
  - I stream on this channel
- *Throughout this page, think about the community associated with this channel, even in cases where it might extend to other channels or other platforms (e.g. Twitter, Discord).*
- Take a moment to think about the other Twitch users that you interact with in this community. For each of the following questions, try to estimate the number of members of this community that apply and choose the answer that best matches.
  - **Answer Choices**
    - 0
    - 1
    - 2-5
    - 6-10
    - 11-20
    - 21+
  - **Items, with short reference codes**
    - How many members of this community do you like? (*DoYouLike*)
    - How many members of this community do you dislike? (*DoYouDislike*)
    - How many members of this community have you shared information with about your identity off Twitch (e.g. real name, email address, phone number)? (*ISharedIdentity*)

* How many members of this community have shared information about their identity off Twitch with you (e.g. real name, email address, phone number)? *TheySharedIdentity*)
* How many members of this community have you asked in the past for help or for a favor? (*IHaveAskedFavor*)
* How many members of this community could you ask in the future for help or for a favor? (*ICouldAskFavor*)
* How many members of this community do you communicate with 1-on-1? (*CommunicateOneOnOne*)
* How many members of this community do you chat with about topics unrelated to what's being streamed? (*ChatUnrelatedTopics*)
* How many members of this community would you like to meet in person? (*LikeMeetInPerson*)
* How many members of this community have you already met in person? (*HaveMetInPerson*)
* How many members of this community could you count on for a small, personal loan? (*SmallPersonalLoan*)
* How many members of this community could you turn to for advice about problems with family or relationships? (*TurnAdviceProblems*)
* How many members of this community have you turned to in the past for support during a very difficult personal experience? (*SupportDifficultExperience*)
* How many members of this community have you communicated with outside of Twitch? (*CommunicateOutsideTwitch*)
* How many members of this community would you consider to be as or more close than your "real life" (IRL) friends? (*CloserThanIRL*)
* How many members of this community would you consider to be a close friend? (*ConsiderCloseFriend*)

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