Video-based Evanescent, Anonymous, Asynchronous Social Interaction: Motivation and Adaption to Medium

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ABSTRACT
Danmaku is an emerging socio-digital media paradigm that puts anonymous, asynchronous user-generated scrolling comments on videos. (How) can danmaku afford the illusion and realization of social interactions, if at all possible given its interactional incoherence nature? To answer this question, we collect Chinese danmaku users' reflection on their motivations to use this social service and explore the actual practices that meet the needs. According to a preliminary danmaku usage survey, users consider it as an information seeking and emotion venting channel. Through archival analysis of real-world data, we find that danmaku commentaries are relatively short, video-centric, saturated with emotions, and similar in syntactic and semantic features. Users have developed a set of mechanisms adapted to the medium, to leverage such text-based messages to foster interpersonal and hyperpersonal communication for sharing of facts, thoughts, and feelings.

Author Keywords
Danmaku; socio-digital media; motivation; information seeking; emotion venting; hyperpersonal communication.

ACM Classification Keywords
H.5.3. Group and Organization Interfaces: Asynchronous interaction, synchronous interaction.

INTRODUCTION
Conventionally, watching a video and reading / posting a comment about it are separate actions. Users can leave comments under videos on video sharing websites such as youtube.com or in separate online communication channels, e.g., dedicated review sites, general-purpose discussion forums or social media. In either case, the interconnection between posterior commentary and the targeted multimedia content is rather loose. As a result, the comments may be noisy, sometimes off-topic, or even toxic [13].

Therefore, many researchers and end users who seek better socializing around media have advocated simultaneous interaction among audience watching the same multimedia program, such as text chat accompanying online videos [42] and live-tweeting about TV broadcasts [31, 45, 15]. Such live commentary has a stronger reference to the multimedia content, but often requires users to coordinate their viewing actions. When a program ends, the words continue to live on the second screen while triggers of the conversations on the first screen are gone, making it difficult for people who do not watch the program at the same time to follow [31].

Figure 1. Screenshot of scrolling danmaku texts overlaid on an original review video of the movie Big Hero 6.

In contrast, danmaku, an emerging socio-digital media service popular in Japan and China, offers an experience close to collocated shared viewing for asynchronous viewers by combining the two screens together. Compared to live streaming applications such as Periscope and Meerkat [35], danmaku enables more seamless integration of textual commentary and any uploaded video. It breaks the constraints of viewing time and optimizes the utility of screen space to accommodate an exceedingly large amount of user-generated messages. Sign-in users can superimpose their floating comments on the video content, often anonymously (Figure 1). Comments are aligned with the video timelines regardless of their actual submission time, and can be seen by any viewer of the video as it plays.

The increasing popularity of danmaku services has attracted interests of media research and industry. The comments are not just an essential part of danmaku users' experiences, but also as a potential lens for content providers and other parties of interests, e.g., advertisers, investors, retailers, policy makers [3], educators [22], etc., to gain insights into momentary video contents and audience reaction. However, the social and business values of danmaku could only be

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CSCW '17, February 25-March 01, 2017, Portland, OR, USA
© 2017 ACM. ISBN 978-1-4503-4335-0/17/03…$15.00
DOI: http://dx.doi.org/10.1145/2998181.2998256

optimized when it becomes a massive, long-lasting success. It depends on danmaku's ability to attract and retain users by deploying social media features on streaming videos.

There has been little in-depth investigation on whether and how sharing of evanescent, asynchronous, and largely anonymous danmaku comments can foster engaging social interaction experiences over the course of video viewing. This paper aims to address the following research questions: 1) why do people use the danmaku social sharing feature; 2) whom do they interact with; 3) what do they share; and 4) how do they adapt to this "fragmented, agrammatical, and interactionally disjointed" channel [18].

To this end, we conduct comprehensive studies on Chinese danmaku users' motivations and behaviors to gain insights into the social-technical phenomenon of second screen outside of Western culture, first through a preliminary survey with 71 danmaku users and then via archival analysis of 10 videos selected from bilibili.com, a major Chinese danmaku video sharing site. We find that users view danmaku as an information seeking channel more than a dedicated social platform to gain the sense of acceptance and belonging. Such perception shapes their expectation and practices. Besides interacting with other commenters as in live tweeting [31,45,15] or with person(s) in the video as in live streaming [35], danmaku users also message fictional characters, individuals not in the audiences, themselves, and even objects, as a form of hyperpersonal interaction [40]. The results suggest that danmaku users have adapted to the medium and developed a set of norms and schemes for topic organization, listenership signaling, cross-turn reference, and community identification.

ABOUT DANMAKU

The Japanese term danmaku (danmu in Chinese) literally means barrage – "a curtain of artillery fire". It refers to a novel commentary sharing mechanism initiated in Japan that enables users to "shoot" their comments directly on top of the videos that they are watching. "Even when the videos are boring, the viewers are getting together and entertaining each other [20]". Introduced by Nico Nico Douga in 2007 for fans of anime, comics and games (ACG), danmaku quickly became a popular national pastime in Japan, even invading the space of traditional media [27, 3]. In subsequent years, two danmaku websites acfun.tv and bilibili.com were launched, bringing such social interaction with and through multimedia to Chinese ACG fans. Note that the global traffic ranking of bilibili has ascended from about 5,000 in 2014 to 132 by July 2016 (31st in China) [2].

Danmaku website users, except those blocked for malicious behaviors, can upload and watch videos as on an ordinary video sharing site. But many users also come for the asynchronous commentary sharing scheme that creates an illusion of simultaneous group viewing. To post a danmaku comment, users need to sign in, put down the text, specify the scrolling scheme, font size, and font color at will, and then click the submit button. Premium paid users can create special visual and animation effects for their advanced commentary. New comments will appear on screen upon reload. Regardless of their actual posting time, all comments for the same video get synchronized with the clip and scroll (from right to left by default) across the display in accordance with their video timestamps. This makes viewers feel like they were really watching videos together with a group of people sending instant messages. Older comments can stay on the video until the post pool reaches its maximum capacity and needs to make room for new ones. This in some way alleviates the concern of sparseness of user engagement activities as observed on YouTube [8]. Sometimes a large volume of comments may spam the entire screen and obscure the view of the video content underneath. This contradicts with Hamilton et al.'s impression that video is the "hot media" while text messages are relatively cold [16]. Users can always hide the danmaku comments or filter out undesirable ones by keywords, position, theme, language pattern, etc., to cool down their screen.

In the early years, danmaku websites in Japan and China aimed to create the "sense of unity" within the ACG subculture community [26]. These platforms now provide access to videos of more diverse genres, and have attracted users with more diverse demographics and interests.

RELATED WORK

Watching videos online has become a common practice in our daily life [13]. The huge user base nurtures the practice of socializing around media.

Video Commentary and Second Screen Phenomenon

Commenting after watching a video online is an intuitive way for viewers to fulfill their needs for affiliation [21]. Online video sharing sites conventionally place the comment box right under the video. However, physical proximity does not necessarily bring the content of commentary closer to the source video. For example, users complain about the spams in YouTube comments [34]. As a result, many people turn to more regulated review websites, discussion forums, or social media groups in search of communities that actually share the same interest. However, this may further reduce the immediacy of communication, making it harder to reference momentary video content.

In contrast, exchanging reviews during concurrent viewing can reduce the cost of grounding, such as efforts to formulate or digest descriptions of designated scene [9], and can facilitate relationship building among strangers [43, 28]. Therefore, researchers and practitioners have been experimenting with synchronous interaction around media. One of such attempts is interactive TVs that connect viewers during live shows directly via a television system, e.g., QUBE [46], AmigoTV [10], 2BeOn [1], HackDay TV [32], Ambient Social TV [17], AOLTV, and WebTV [36].

However, people feel that "talking together through the TV set is redundant with existing communication technologies"

[14], and prefer the simultaneous use of a second screen device such as mobile phones, pads, and laptops socializing while watching TV [14]. In particular, live tweeting becomes an effective way to communicate thoughts on a program and establish social networks around it [31, 45, 15]. However, displaying multimedia content and social media commentary on two separate screens requires users to navigate their gaze back and forth. To mitigate such burden, practitioners propose to superimpose user comments composed on the second screen, such as text messages [47] and tweets [1], directly on live TV program or live streaming videos (e.g., in Periscope and Meerkat [35, 44]). These messages are often presented with posters' social media ID in a restricted area of the display for a short period of time during broadcasting [47]. Such design may not scale well when the volume of incoming messages increases. It also excludes potential viewers who cannot access the TV program or live video when it is on. In comparison, danmaku services open up the entire screen for user commentary stream coming in at any time, leveraging asynchronous Computer-Mediated Communication (CMC) to create an illusion of synchronous group viewing.

Danmaku: Evanescent Asynchronous Anonymous CMC

On one hand, similar to existing text-based asynchronous CMC such as threaded comments in discussion forum, danmaku is interactionally incoherent, especially with poor addressivity under an anonymous setting [18]. On the other hand, the unique channel characteristics of danmaku provide user control opportunities to enhance social cueing, which may alleviate the above-mentioned disadvantages.

The Social Information Processing (SIP) theory posits that CMC users exchange social information through the timing, style, and content of messages [39]. First, danmaku users can exploit chronemics – "How we perceive, structure, and react to time" [6] – and convert interactional relatedness of comments to temporal adjacency. That is, regardless of the actual submission time, posters can place their messages close to the relevant video scene and associated posts on the video timeline, preferably with overlapping screen time in evanescent interactions, as a means of referencing. Second, danmaku platforms enable posters (sender) to tailor the appearance and display mode of the comments to reflect certain meaning [41]. Third, self-disclosure theory indicates that anonymous danmaku users may reveal more personal, even intimate information [19], allowing them to focus on group similarity given nonsalient individual identity (Social Identity/Deindividuation (SIDE) model [29]). Fourth, viewers (receiver) can actively seek new informational and relational partners by filtering danmaku posts.

Existing CMC literature suggests that both the media characteristics and users' subjective perception of media may influence their interaction behaviors [38]. Hence, we conducted an exploratory survey to study how users perceive danmaku. Furthermore, interpersonal interaction in CMC may evolve into Hyperpersonal interaction over time

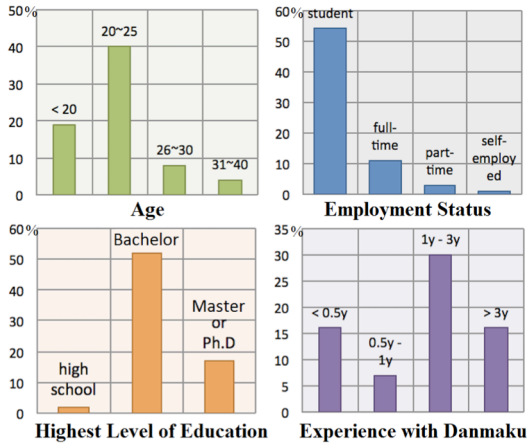

Figure 2. Distributions of age, employment status, education level, and danmaku experience among the respondents.

[40]. We carry out archival analysis on sender, receiver, channel, and feedback [41] to investigate how danmaku's timeline folding and screen usage may foster this process.

PRELIMINARY DANMAKU USER SURVEY

We received responses to our online survey from 71 users scattered in six countries and regions (73% in China, 24% female) who visit danmaku sites several times a week. Since danmaku users are anonymous, we tried to advertise the survey in ACG-related WeChat groups, student forums in various universities, and through word of mouth based on Alexa's audience geography and demographics analysis [2]. See Figure 2 for detailed information about the respondents.

Findings of the Preliminary Survey

In this subsection, we present survey findings regarding the respondents' danmaku usage, their viewing and posting motivations and behaviors, and perception of danmaku.

Danmaku Usage

People indicated that their frequency of visit to danmaku sites might vary as the website contents changed. Their favorite genre is ACG (44 people), followed by spoofy videos, movies, talk or reality shows, music, and TV series.

Only 35% of the respondents agreed that they visited danmaku websites for the comments, and 30% were neutral. About 46% of the respondents always watched videos with danmaku. Another 10% would leave the comments on unless they get too disturbing. About 23% would hide the comments when they first played the video and show them in the second round. One person said he did the opposite, while the rest only enabled danmaku on selected clips. About 34% of the respondents said they would filter out unrelated, redundant, or disturbing posts. Only 63% of the respondents would share their own comments. Among them, per clip, 29 individuals (65%) contributed at most one remark, 11 (24%) would post two to three times, and five (11%) would give more than three comments.

We compare the differences between users' perception of viewing and posting danmaku comments in terms of communication functions, topics, and emotional triggers.

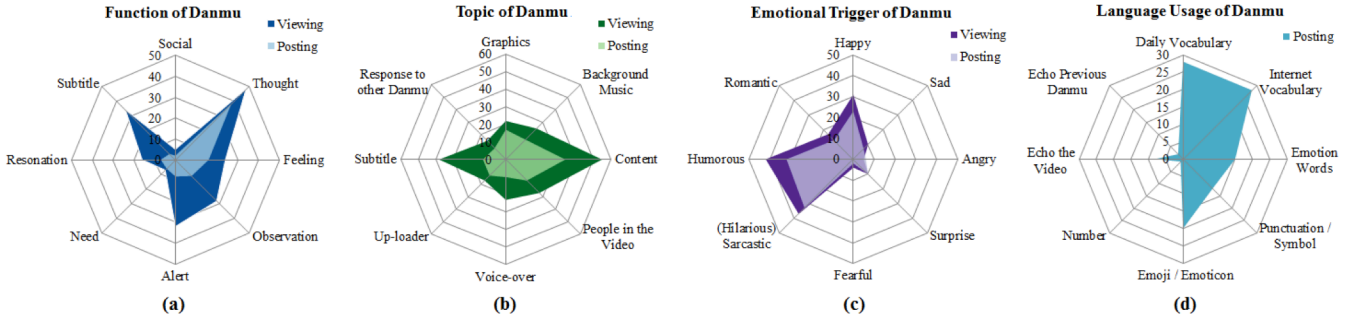

Figure 3. Number of responses in regards to (a) the communication function, (b) topic, (c) emotional trigger, and (d) language usage; the former three consist of responses for viewing and posting, respectively.

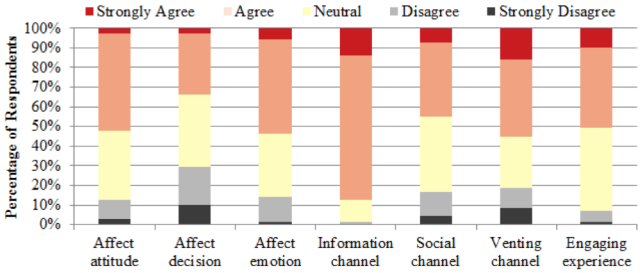

Figure 4. Respondents' level of agreement on statements of their motivation to use danmaku services.

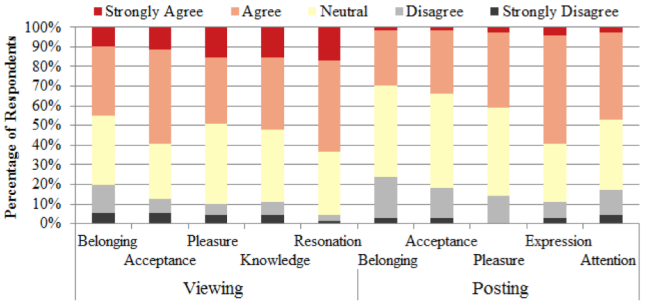

Figure 5. Respondents' level of agreement on statements of their perceptions of viewing and posting danmaku messages.

As shown in Figure 3a, 68% of viewers paid attention to thought-related comments, followed by subtitle (48%), alert on an upcoming uncomfortable scene or danmaku exposure (45%), observation about the video or in real life (39%), feeling (34%), and resonation – repeating lines in the video or previous danmaku posts (26%). Only a couple of people would be attracted to social- or need-related remarks, e.g., "Checking-in" and "Who is this" In comparison, 84% of the commenters would talk about their opinions, 36% would share feelings, 24% would stress observations, 18% might signal alerts, 16% would echo the others, and 13% would ask questions or demand certain actions (need).

There is a higher consistency regarding the topics that people like to read versus to write about (Figure 3b). The respondents were interested the most in the contents (plot, scene, etc.) and people (look, clothing, etc.) in the videos. About the same number of people were likely to attend to posts concerning the quality of graphics, background music, voice-over, up-loader, subtitle, and response to previous comments. Slightly fewer respondents would comment on the visual and sound effects of the videos themselves.

We also asked about what emotions might evoke resonance and even the impulse to comment (Figure 3c). Humors, (hilarious) sarcasms, and happiness were intriguing for both viewers (59%, 52%, and 44% respectively) and posters (71%, 73%, and 51%), similar to findings in other CMC systems [4]. Other emotions were relatively less impactful. In addition, we collected information on the commenters' language usage (Figure 3d). About 62% of people would use everyday vocabularies as well as Internet slang, 44% would add emoji/emoticons, a fair number of posters would compose comments with emotion words e.g., onomatopoeia (33%) and with punctuations e.g., exclamation (27%), and 18% simply repeat phrases from the videos or others' posts.

Motivation and Perception of Participating in Danmaku

We further asked respondents to indicate their level of agreement on various statements of motivation and perception of danmaku using a 5-point Likert scale.

Overall, as shown in Figure 4, people felt that they leverage danmaku mainly as an information exchange channel (87% agreement), sometimes for emotion venting (54%) or social purposes (45%). People also suggested that the danmaku commentary could affect their emotion (53%), opinions and attitudes (52%), decisions (34%), and engagement with the videos (51%). More specifically (see Figure 4), viewing comments leads to a stronger sense of belonging (45%) and acceptance (59%) compared to posting (30% and 34% respectively). It may be because the former allows danmaku users to better discover other people with similar ideas, feelings, and experiences (63%), and the latter is more of a means of self-expression (59%).

These findings are rather preliminary given the relatively small sample size. Therefore, we further analyze real danmaku data as archival analysis and explore danmaku users' linguistic practices related to social interactions.

ARCHIVAL ANALYSIS: METHOD AND DATA

We conduct archival analysis on 10 selected videos from bilibili.com that are representative of the popular types of videos shared on danmaku websites (details see Table 1). The first three clips are movie review videos from a weekly

Video	Type	Length	Danmaku	Poster	View	Days	Description
Running Man	Movie Review	3’26’’	1,041	749	315K	46	A Chinese 2015 reality comedy movie featuring team competition among celebrities at a landmark.
Kingsman	Movie Review	3’27’’	906	520	217K	18	A 2014 spy movie about the recruitment and mission of a new young agent in a secret service.
Big Hero 6	Movie Review	3’15’’	1,732	1,112	297K	81	A 2014 Disney animation about how Hiro, his robot Baymax and teammates save the world
Weight Loss	Talk	14’06’’	7,574	5,027	411K	14	A live stream video of a Chinese girl sharing her tips on how to lose weight.
Chinese Test Level 8	Talk	11’56’’	9,903	4,693	521K	10	A live streaming video of a British guy taking the Chinese Language Proficiency Test (a fake test).
White House Dinner	Talk	22’00’’	7,827	3,518	425K	356	A video of President Obama's talk at the 2015 White House Correspondents' Dinner.
Fan Economy	Talk	2’06’’	6,062	3,699	1486K	14	An original video by Papi, a popular Chinese Internet celebrity, talking about fan economy.
I am Papi	Song	2’35’’	33,097	13,920	2569K	43	A third-party music remix of existing videos made by Papi.
Exam Fighting	Song	3’19’’	4,036	1,831	288K	347	An original song by a popular Chinese Internet singer on the theme of school exams.
Courage to Love	Song	4’36’’	13,226	4,677	307K	351	A Japanese song with a remix of scenes from various Japanese animas on the theme of love.

Table 1. Information about the 10 selected videos: title, type, length of video, number of danmaku posts collected, number of unique posters, number of viewing (according to bilibili.com), the duration of data collected, and a brief description.

Communication Function (Expression)		Language Type (Formulation/Mode)		Interaction Addressee (Target)	
Presence	Greeting, self-introduction	Statement (original post)	Self-written message without explicit addressee	Poster	Specific poster(s)
Feeling	Emotion, mood			Uploader	Author / actor of a video
Thought	Personal opinion	Interaction (targeted post)	Self-written message with clear addressee(s)	All	Every viewer of a video
Emphasis	Echo of an existing idea			Others	Others not in the video
Observation	Facts on video and life	Repetition (re-post)	Message that repeats or rephrases others’ words or lines in a video	ACG	ACG characters
Need	Question, demand			Self	Poster him/herself
Warning	Alert of existence			Object	Non-living entity

Table 2. Summary of codes for communication function (bold ones are from [23]), language type, and interaction addressee.

series called “What Movie shall we Watch” produced by one of the most popular uploaders in the Chinese video sharing community. The other seven clips were all once the top 100 most popular videos of the month on bilibili.com.

Data Collection

We obtained the danmaku data of the 10 videos from bilibili.com in the form of XML files, which include each post’s physical and video timestamps, scrolling scheme (i.e., scrolling, fixed at the top of the screen, fixed at the bottom of the screen, reversed scrolling, precise positioning, or advance), font size, font color, category (ordinary, subtitle, special), and poster ID.

Data Processing

In total, we collected 85,404 danmaku comments and extracted a set of attributes based on the SIP theory [39,41], i.e., time, style and content. Timing is reflected by the time stamps. For style, we wrote a python script to compute the length of each post in characters and the number of other posts with a cosine similarity greater than 0.8. This measure somewhat reflects the extent of posters’ language alignment behaviors. In addition, our script automatically detected the use of symbols, including emoji or onomatopoeia such as “hhhh” and “233333”, emoticon, number, letter, pointer, and punctuation (other than comma and period) in the writing. We only marked the most salient syntactic feature of each post according to the order in the previous sentence.

For content, we have two coders independently label the message expressed in each post (a.k.a. communication function, extended from [23] based on open coding on sample data), the mode of expression (a.k.a. language type, indicating the existence of monologue, dialogue, and multilogue [33]), and interaction addressee (if any). Table 2 lists the detailed codes and their explanations. The two coders had a Cohen’s Kappa of 0.90, 0.92, and 0.93 for the three categories labels respectively, on a random sample of 200 danmaku posts. They then coded all the data and resolved disagreement via discussions. They also constructively tagged the topics of the posts together using a bottom-up open coding scheme.

DANMAKU USERS’ SOCIAL INTERACTION PRACTICES

In this section, we present our analysis results of danmaku users’ social interaction practices. Overall, we identified

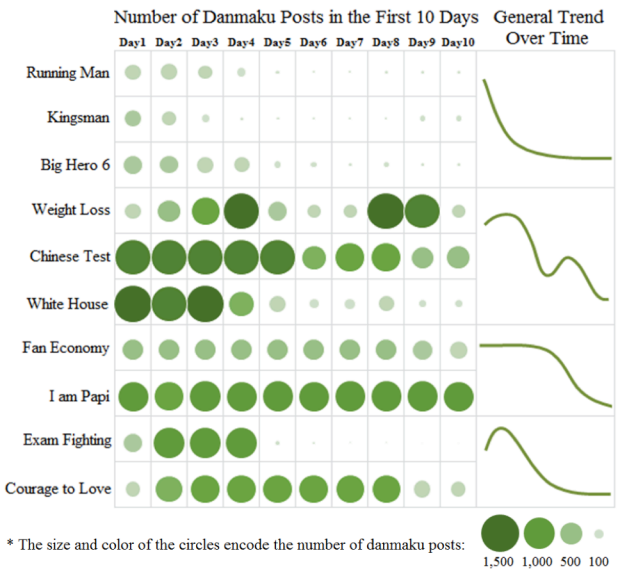

Figure 6. Overview of the frequency distribution of danmaku posts of the 10 videos.

38,164 unique danmaku commenters, 1,582 of whom posted on more than one video. The comment-to-poster ratio is 2.24. About 65% of the danmaku users submitted one message, 27% wrote two to four comments, 8% posted five-plus times or more. We examined the chronological inconsistency between the physical and video timestamps of posts by the same user on the same video, and found that at least 11% of people replayed the video and wrote comments in different rounds of viewing.

Temporal Characteristics of Danmaku Posts

The majority of the danmaku comments occur within the first week of video release (Figure 6). Popular videos such as "I am Papi" and "Fan Economy" that are related to a well-known Chinese Internet celebrity at the time, i.e., with a rather "ripe" viewer network [11], has a slower decline. Some videos such as "Weight Loss" may get a surge in commentary number sporadically if ranked high on the site or mentioned in other media, i.e., of a "non-ripe" viewer network fluctuating with exogenous events [11].

While the compositions of danmaku comments of different communication functions vary greatly from video to video (Figure 7a), the temporal patterns share certain similarities. For example, 20% of the messages about one's presence, such as "[*I am the*] *first 100* [*poster*]" and "*Hello everyone*, occur in the first 5% of the video length (82% by the first third of the videos). Since there is not much to talk about during this period, danmaku users take the opportunity to call for more participation and entertain one another.

The number of thought-, feeling-, and observation-related danmaku posts rise periodically depending on the organization of the video content, which is different from the pattern found in live tweeting [45]. In particular, bursts of positive or negative feedback (e.g., sarcasm, a form of flaming [39], Figure 3c) created by aggregating collective comments over time (Figure 7a) may evoke similar feelings in danmaku viewers given clear contextual cues – the video content. This may lead to perceivably intimate, even hyperpersonal relationship among the users [40], possibly faster than in email or traditional discussion forum.

Linguistic Characteristics of Danmaku Posts

We also summarize the linguistic features of the comments.

Scrolling 11-Character-Long White Text with High Similarity

We calculated the descriptive statistics of the format, the length, and cosine similarity of the danmaku commentary. Results showed that the comments were generally 11±7 characters long, 63% ~ 93% were scrolling text, 99% were in the default medium 25-point font size, and 47% ~ 84% were white. Across the 10 videos, 35% ~ 82% of the posts were similar (cosine>0.8) to at least one other comment.

Frequent Omission of Personal Pronouns

We studied whether there was an increased use of personal pronouns by danmaku commenters due to the need for a sense of presence and addressivity in an anonymous setting. However, we actually observed the pronoun-dropping phenomenon, e.g., "*Frankly speaking* [*I*] *don't really understand the logic*", "*Shouldn't* [*you*] *say 'wait a second'* (´・_・`)*?*", "[*She*] *looks like ZHAO Wei*", etc. For most of the videos, only 5% ~ 9% of the danmaku posts contained first person pronouns and 1% ~ 6% for second person. The videos of "Courage to Love" and "Fan Economy" are exceptions that will be discussed in the later section. Similar to findings of a previous study on Internet chatroom [12], the omission of pronoun occurs in danmaku because of 1) sufficient inference of the instance being referenced from context, given that the comments are attached to specific video time point; and 2) fast pace of this CMC, as the floating comments have very limited screen time.

Heavy Use of Onomatopoeia, Emotional Symbol and Emoji

Average over the 10 videos, 17% of the danmaku comments contain onomatopoeia such as laughter and cry and 18% come with punctuations such as "!!!" and "……" (Figure 7b). Another 5% have some emoji / emoticon. This may be because danmaku service feels more like instant messaging or online chat where sending emoji and emoticons to express momentary, hyperpersonal feeling has become a common practice [30]. We discuss the function of all these emotion expressions in the next subsection.

In the following analysis, we discuss danmaku users' adaption to medium with an emphasis on the following questions: 1) who are the common addresses of danmaku commenters? 2) What do they communicate about to facilitate identification of possible community? And 3) how do they maintain the social connections?

Adaption to Danmaku Medium for Social Interaction

As Herring suggests, text-based communication can be simultaneously incoherent but enjoyable, as users have the ability to adapt to the medium [15]. Compared to traditional text-based interaction methods such as email and instant

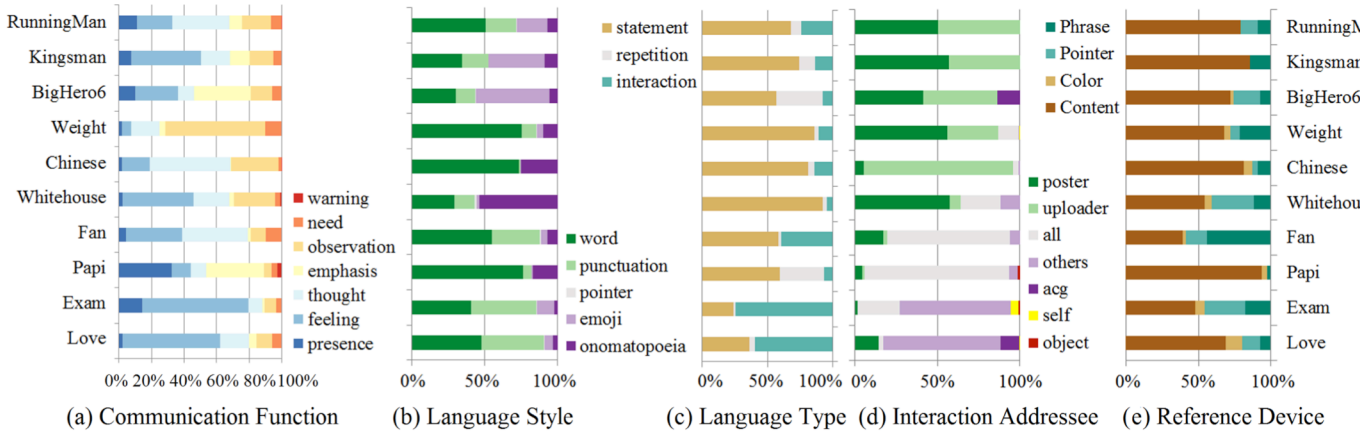

Figure 7. Distribution of danmaku posts of different (a) communication functions, (b) language styles, (c) language types, (d) interaction addressees, and (e) reference devices.

messaging, danmaku may have more disadvantages as a communication medium. First, danmaku messages are generally unidentifiable, both in terms of the author and the time of submission [41]. Second, it is difficult, if possible, for commenters to know who is going to read or even reply to their message and when that is going to happen. Third, danmaku posts have very limited screen time. The scrolling ones are even harder to capture as they are constantly moving. Fourth, danmaku posts may come in large volume, and thus any individual piece may not get sufficient attention from the viewers. Despite the above-mentioned drawbacks, the body of danmaku users in China is growing, covering a much wider population than when the services started. It is interesting to explore how danmaku users leverage the unique features of the medium and SIP strategies (i.e., timing, style, and content) [39] to ensure a pleasant, immersive experience as indicated in our survey.

Topics Organization and Maintenance

One of the challenges of asynchronous computer-mediated communication is topic decay [15]. Users' memories of the "current" topic may have faded away after a long wait. In danmaku, the close connection between the comments and the video session that they are attached provides good contextual information for the users. Take the three movie review videos as an example. About 50% of the comments are directly related to the current movie scene. Most of the other topics are extended from the video content, such as general comment on the movie (7%), character (6%) and actor/actress (6%) in the scene, lines (5%), voice-over (3%), and subtitle (1%). Another 8% are replies to previous danmaku messages. The off-topic danmaku posts are mostly in the presence category (14%).

Although not explicitly written as official guidelines by all danmaku sites, our survey respondents stress that there are some general norms of danmaku etiquette that help maintain the topics, such as no ad, no spoiler, and no discussion on irrelevant works. Sometimes posters question, even confront potential off-subject comments. People can clarify their motivation upfront to avoid such criticism. For instance, "*Those who want to gain weight, please go to another video.*" ("Weight Loss", challenge another poster) "*So, I come for the uploader.* [to the uploader] *You are so cute!*" ("Weight Loss", declaration)

Most of the disputes on topical appropriateness that we observe in the 10 videos occur when people vent their feelings related to the general theme of the video but not necessary to the specific content, such as love confessions to people in real-life in the "*Courage to Love*" anime song video and in the "*Fan Economy*" video. To resolve such issues, many danmaku sites organize their contents into different channels with distinct practices, as a way to define group identity (SIDE model [29]). As a commenter wrote, "*I never thought that I could cheer for Korean idols without getting yelled at in other channels.*" ("Fan Economy")

In general, danmaku posts are short-lived. It means that off-topic messages which are relatively small in quantity are likely to be left unattended anyway. On the contrary, if an initially unintended subject matter gets reinforced by a significant percentage of commenters, negative voice gets suppressed. Consequently, the video, e.g., "*Fan Economy*", becomes an outlier for such messages to be accepted.

Signals of Listenership

According to our analysis on language type, an average of 78% of danmaku comments over the 10 videos does not have a direct addressee (i.e., 62% statement and 16% repetition; Figure 7c). However, a considerable portion of these messages actually plays an important role in maintaining social connections between the posters and the videos (or characters in the videos). They serve as backchannels [Mclau84], a kind of signal of listenership. To be more specific, we identify two major types of backchannel activities. The first is non-verbal, including:

- Onomatopoeia (or description) of laughter, applause, etc.
- Exclamation represented as punctuations, symbols, or some vocal utterance with little referential meaning.
- Facial expressions in the form of emoji and emoticons.
- Head motion such as nods.

- Hand gesture and body movement shown as kaomoji.

They are mainly depiction of audience's emotional reactions, and thus occur more frequently in talk show or live streaming type of videos. As shown in Figure 7b, the videos of "*White House 2015 Correspondents' Dinner*" and "*Chinese Test Level 8*" received a relatively higher percentage of onomatopoeia comments. The White House video in particular had very few interactive danmaku messages, because the Chinese viewers may not be that familiar with the topics presented by President Obama. However, the posters experienced emotional contagion [5], and were eager to show that they have paid attention and are part of the crowd in the scene. For example, " *23333 Although* [*I*] *don't know what's the punch line, I laugh as the audience are laughing. It must be funny* ('infected' by the dinner guests in the video when President Obama talked about the 'bucket list')." "*Cheers!* ~ (ﾟ▽ ﾟ)つ口 (when president Obama proposed a toast at the end of his speech)"

The second type of backchannel activity is repetition, i.e., mirroring the language in the video or paraphrasing it with some minor revision. The former feels like singing along in a live concert. A good example is the "I am Papi" music video with about 34% of the danmaku comments in this category (Figure 7 right). Figure 1 shows another example. There is a burst of "(●–●)" and "*I am Baymax, your personal healthcare companion*" in danmaku when the movie title "Big Hero 6" showed up as well as when Baymax was first introduced. Paraphrasing with revision in contrast, adds more personal flavor to the message. For example, in all three movie review videos, we found someone modifying and re-posting the opening line "*what movie shall we watch*" as "*what movie shall we tease*", which somewhat explains their nature.

In general, when well synchronized with the video timeline, the backchannel messages look like simultaneous feedback to the video in the eyes of danmaku viewers. This is a pragmatic approach to demonstrate active listenership, strengthening the posters' affective connection to the videos on one hand, and creating a more engaging "group-viewing" experience on the other hand.

Cross-Turn Reference

We further explored how danmaku posters resolved the challenge of addressivity in the remaining 22% of the anonymous, interactive comments. We recorded several devices for referencing a previous message under disturbed adjacency, by manipulating content and style (Figure 7e):

- By location
  Phrase, e.g., "*the one in the front*" and "*the one upstairs*"
  Pointer, e.g., "←", "↓", "↖", "←_←" (*looking to the left*)
- By color, e.g., "*Thank you, the red words*"
- By content, e.g., "*the one who said Beijing*", "*love it +1*"

Interestingly, danmaku posters often treat a scrolling comment as the avatar of its unnamed writer, and thus may use words as if they were talking to a social actor, such as "*wait for me*", "*don't go / run away*", and "*hold on*". Results of the reference analysis above give us good hints to identify intended addressees of interactive comments.

(Who) Common Addressees of Danmaku Comments

Although danmaku commenters cannot conveniently direct messages to specific users as in conventional social media services, they still try to initiate social interactions with other people. Sometimes people really want the message to reach its intended recipient. One of the most common strategies is to post the same message multiple times to ensure its visibility, either all at once as static danmaku occupying the center of the screen, or separately at different location of the video. For example, in the video "Courage to Love" with 59% of targeted comments, 39% of the posters repeated their messages at least once (maximum = 163). Consequently, some danmaku users would actively look for messages that are possibly for them, so that they could respond instantly, such as "*I am just checking if anyone confesses love to me.* [*I*] *don't want to miss it* ヽ(ノ ▽ ヽ)ノ"

We also notice that some people just want to speak out the words that they have intended to say to another person, whether that person could hear it or not, "*Love you forever, you may not see my words anyway.*" There are occasions when users deliberately leverage danmaku to say things they would not say otherwise, knowing that the addressee would never read the message, "*<name>, wait for me. I will tell you that I love you when I graduate!! Wait for me* =w="

Regardless of the posters' original intent, we classify their direct recipients into seven categories, including poster, uploader, all viewers, other people, ACG character, self, and object. Table 2 provides detailed descriptions of each category, and Figure 7d shows the distribution of addressees in each of the 10 videos. We give some example danmaku comments in each category below.

To other Poster(s)

The major categories of conversations occurring between danmaku commenters include:

- Disapproval, e.g., "*[I as] People from New York feel happy about being able to stay at home for several weeks…*" and "*Those from New York, don't mention it. [I as] People from Boston are smiling at you*" ("White House 2015 Correspondents' Dinner" about snow storms)
- Praise and appreciation, e.g., "*Thank you for warning me of the upcoming danmaku wall*" ("I am Papi")
- Question and answer, e.g., "*The one who likes <name of an actor>, any movie of his to recommend?*" and "*Actually, he is more of a theater performer*" (discussing about a celebrity that appears in "Running Man")
- Demand or request, e.g., "*Go off the subtitle!*"

To the Uploader or Key Actor in the Video

The videos analyzed in this paper were all pre-recorded. In other words, the uploaders (or actors / characters) in the videos are not giving a live speech. However, danmaku

users still treat them as if they were talking face-to-face. In some cases, the uploader throws out a question and stimulates heated responses in danmaku. For example, the uploader asks the audience if he gets a full mark in the Chinese Proficiency Test. Comments e.g., "*You did great*" and "*No, one problem is incorrect!*" soon cover the screen.

Sometimes the uploader simply makes a remark, but the commenters are still keen to provide feedback. For instance the uploader notes in the "*Running Man*" video that, *"...after all, my voice sounds the best!*" Many people express agreement in danmaku, "*Yes, yes~233*", "*Uploader, your voice is really sexy, hhhh*", "*But I thought the other voice-over is better* Σ(っ °Д °;)っ". To sum up, danmaku users are willing and often ready to interact with characters in the video as if having an in-person conversation.

To all Viewers

Messages to all viewers can be a greeting, a wish, a demand, or a question. For example, "*See you all at the beginning of the video"* ("I am Papi"), "*Everyone, good luck* (ノ≧∇≦)ノ"("Exam Fighting"), "*He is mine. No objection!*" ("Fan Economy"), and "*Am I the only one who finds it funny?*" ("White House")

Usually, posters do hope to get some reply to their questions raised for all viewers, especially the factual one like name of an actor or a song. However, it is likely that the same questions have been asked and responded multiple times before. People just do not seem to bother with digging out the answer from the pool of danmaku. Instead, they just ask it again, even though those who know the answer get frustrated from time to time, "*Please kill yourself if asking that question* [*about the song*] *again*" ("*Courage to Love*").

To other People (Virtual or Real)

Danmaku posters' "conversational partners" are not restricted to those in or related to the videos. In the example videos, we observed users express affection to their loved ones in real life, to idols, and even to ACG characters that live in the anime world (in "*Courage to Love*" and "*Fan Economy*"). It results in a significant increase in the use of the first and second person pronouns (see examples at the beginning of this section). To our surprise, almost 60% of the love confession messages leave the full name of the recipients (10% using initials and 26% using nick names). Three comments even provide detailed addresses.

Some of these one-directional conversations happen in a fantasized scenario. For example, " *<idol's name>, where shall we have our wedding?*", "*Mom, let me explain!*" (imaging being caught by mom watching the "I am Papi" video over and over again), and "*Police, take this person away*" (complaining about some dirty question in the language test).

It feels like danmaku has given users a safe space to unleash their feelings and imagination. We notice that idols are more socially distant than loved ones in real life. Therefore, most of the love confessions for idols are broadcasted to the entire danmaku audience (see the To all Viewers subsection for example) rather than directly sent to the idols themselves (Figure 7d).

To Self and to Non-living Object

Comments addressed to oneself are generally positive, like encourage and praise. Most of these comments appear in the "Exam Fighting" video, for instance "[*I*] *can make it to my dream school*" and "*Study harder – to myself!*"

Occasionally, commenters personalize a non-human entity and frame it as the recipient of the message. The actual subject of the underlying message is still the poster him/herself. Related to the same video above, an example message directing to a non-living entity is "*Tsinghua* [*University*]*, wait for me."*

Overall, only the messages addressed to other commenters have the potential to evolve into multi-turn communication in the traditional sense. The others take the form of a conversation but are more for emotional venting. Our discussions in the next two subsections focus on the social interactions among posters.

(What) Things to Share that Help Find Similar Posters

Since inter-commenter communication can take up more than 70% of the posts with a clear addressee in some video, it is worth investigating what gets people to interact.

- Geographic location, including culture, language, etc., is the first most potent topic that attracts people together. It occurs in all 10 videos. For example, posters named their own school in "*Exam Fighting*". In the "*Weight Loss*" video, posters from different provinces in China debate about the uploader's accent.
- Hobby, especially if it is related to certain subculture, is also effective, as shown in the "*Fan Economy*" case.
- Demographics information e.g., age and gender is helpful particularly when the video subject matter is intended for certain population. For example, many posters of "*Exam Fighting*" explicitly declare which class they are in because the song is meant for final year students. In "*Weight Loss*", many male viewers voluntarily expose their gender and start conversations among themselves.
- Personal problems such as constipation in "*Weight Loss*" and poor hand writing in "*Chinese Test Level 8*" are discussed, as they are easier to resonate with.
- Physical features such as detailed weight and height exposed by 1,367 commenters under the "*Weight Loss*" video allow people to find others that look like them.
- Thoughts and feelings that can also bring people closer.

As self-disclosure research in CMC indicates, anonymous danmaku users are willing to give away some private, even intimate information when there are fewer face concerns [19]. Users tend to overattribute to group similarity inferred from these self-identity clues (SIDE model [29]) and could result in a form of assertive mixing (a.k.a. homophily), a

tendency that "a contact between similar people occurs at a higher rate than among dissimilar people" [25].

(How) Strategies to Retain Connection to other Posters

Since there are no common handlers available in danmaku as in other social media, posters have creatively developed several methods to maintain self and group identities.

By Appearance

The two most frequent ways to declare one's identity through the style of a danmaku post are fixed location and font color – user control opportunities enabled by CMC [39]. Since danmaku services only allow static posts anchored on the top or at the bottom, these places are usually reserved for posters of specific roles, such as the uploader him/herself, those in charge of contributing subtitles of the video, and those help annotate the video content for all viewers. Other posters can refer to them by location or by the content in the follow-up communications.

The use of color is more flexible in comparison. Individual posters with special functions can stick to a non-white color when commenting repeatedly throughout the video. As in the "*Courage to Love*" video, the uploader announced at the very beginning of the clip that, "*Although you should know all these animes* [*in the video*], *the uploader* [*me*] *will explain again in pink words at the bottom* [*of the screen*] …" (by uploader), and "*Pink word, you are awesome!*"(by another poster later)

Groups can also use color as identifier. For example, in the "I am Papi" video, danmaku users start to translate the lyrics into different languages and dialects, such as English, Japanese, Korean, Russian, Arabic, Cantonese, and even Ancient Chinese. The translation is actually a team work. Each language takes a different color, so that later danmaku lyrics of the same language can adopt the corresponding color to maintain the recognition as an integrated whole.

Via Language Play

We also observe that commenters of certain social groups tend to follow a language pattern that is distinguishable from the others. This is an exercise of using linguistic alignment as a social glue to strengthen hemophilic bonds through self-presentation in CMC [7, 39]. For instance, in the "Fan Economy" video, many danmaku users who are actual fans trumpet for their own idols. Some of them actually form authentic, informal fan circle online by applying a particular formation of words among the members, whenever they join the "conversation". Example patterns include "*<name>'s magic is great*", "*<name> don't leave me alone*", and "*<name><kaomoji>*". Sometimes, an organizer would post some key words as a reference for other members. For instance, in the video "Kingsman", one group's leader says, "*<name A>'s fan, show me your hands*", and people would reply, "*hands up*". Another group's leader posts a message saying "*<name B>'s fan, give me a hug*", followed dozens of "*hug, hug*" comments.

Overall, the above-mentioned strategies echo the style-based cross-turn references discussed in the prior section.

DISCUSSION

As suggested by the results of our preliminary survey and archival analysis, viewing and posting danmaku comments are a form of interactive information seeking behaviors. This implies that danmaku services have the potential to serve as a (video-based) crowd computing platform, which can be a good scenario for future research on how to leverage users' social-technical behaviors on digital media.

Danmaku as a Crowd Computing Platform

In this subsection, we discuss the feasibility of using danmaku for crowd computing based on findings of the archival analysis. First of all, danmaku can attract a huge crowd in a short period of time. For example, the video "I am Papi" received about 1,000 comments and millions of viewings in the first week (Figure 6). It was because someone initiated a campaign to make it the most popular video on bilibili.com. The words spread out and hundreds of thousands of danmaku users participated. They encourage each other to view the video a few more times through danmaku messages even late in the evening.

Second, a requester can directly post questions in danmaku when seeking information related to the theme of the video. The questions are likely to receive multiple responses, which can be leveraged for quality control. Requesters can also employ the community attraction methods discussed in the paper to get danmaku users to reveal their demographics and location information. This could enable requesters to better pinpoint a specific user group as the target.

The 10 videos used in the archival analysis provide some examples of social computing tasks that can be accomplished using danmaku:

- Video annotation. Danmaku posters try to identify the guests in the White House Correspondents' Dinner.
- Opinion poll. By counting and comparing the existence of different idols' name in the "Fan Economy" danmaku pool, one can get an estimate of these idols' popularity.
- Marketing research. Commenters of the "Weight Loss" video mentioned different weight control apps and discussed about the pros and cons of each from consumers' point of view.
- Problem solving. This is similar to having the audience work out the Chinese Language Test with the uploader.

Potential Improvement of Danmaku Services

In order to better support social-technical interactions on digital media, potentially for future crowd computing applications, existing designs of danmaku services need further improvement. According to our preliminary survey, 69% of the respondents prefer the current danmaku display format, i.e., overlaying on top of the video, and about 58% of the participants want to keep the services anonymous. However, we can still improve danmaku's support of informational and relational interactions and analysis.

Timing. Instead of having posters manually specify the video timestamps of their messages, danmaku platform could provide simple graphical tools to help anchor comments and plan their screen time. Besides, allowing posters to mark the messages they respond to could benefit information seeking later.

Style. Platforms could provide some style templates for common players e.g., uploader in danmaku interactions. Also, the use of Internet slangs and information language makes danmaku commentary different to process. Providing text prediction and auto completion may reduce typos and minor spelling differences of the same concept.

Content. Applying topic mining techniques and adding corresponding filters would make it easier to search danmaku of interests. Suggesting simple topical hashtags to posters may be another alternative.

CONCLUSION AND FUTURE WORK

In this paper, we study how users of danmaku, an emerging socio-digital media paradigm, perceive and perform social interactions via the service. By conducting a preliminary survey with 71 Chinese danmaku users, we found that users consider danmaku more as a channel to obtain information and vent emotions. Through the archival analysis of real-world data of 10 representative videos, we learned that danmaku messages are generally short commentary closely related to the source video. They are rich in emotions and together create an immersive, engaging illusion of group viewing. Results further suggested that danmaku users may exploit this channel to "talk" to people who will never read their message, and not all the interactive comments are addressed to real recipients. Those who do want to socialize with other danmaku commenters of the same video may reveal some private, personal information in order to attract people share certain commonalities. They have also adapted to the evanescent, anonymous, and asynchronous medium and developed effective mechanisms for topic maintenance, listenership signaling, and cross-turn reference.

Our work has some limitations. The sample size of the danmaku survey is small. There are other genres of videos not covered in the archival analysis, and the total data size is limited due to the need of manual annotation. We can carry out more analysis on the danmaku comments, such as sentiment analysis. In the future, we plan to study danmaku commentary on a wider range of video genres and include real live streaming videos. We will recruit specific danmaku users and follow their practices over a longer period of time to get a more in-depth view. In addition, we will explore ways to facilitate crowd sourcing and crowd creativity in danmaku.

ACKNOWLEDGMENTS

We thank all the respondents who participated in our preliminary online survey.

REFERENCES

1. Jorge Abreu, Pedro Almeida, and Vasco Branco. *2BeOn—interactive television supporting interpersonal communication*. Springer Vienna, 2002.
2. Alexa. Internet Traffic Statistics of bilibili.com. Last update on July 18, 2016 from http://www.alexa.com/siteinfo/bilibili.com
3. The Asahi Shimbun. 2012. Online viewers top 1.4 million for pre-election debate. Retrieved September 9, 2014 from http://ajw.asahi.com/article/behind_news/social_affaffai/AJ201211300060
4. Nancy K. Baym. 1995. The performance of humor in computer-mediated communication. *Journal of Computer-Mediated Communication*. 1, 2.
5. Johan Bollen, Bruno Gonçalves, Guangchen Ruan, and Huina Mao. 2011. Happiness is assortative in online social networks." *Artificial life* 17, 3: 237-251.
6. Judee K. Burgoon and Thomas P. Saine. 1978. *The unspoken dialogue: An introduction to nonverbal communication*. Houghton Mifflin Harcourt.
7. Tanya L. Chartrand and John A. Bargh. 1999. The chameleon effect: the perception–behavior link and social interaction. *Journal of personality and social psychology*. 76, 6: 893.
8. Gloria Chatzopoulou, Cheng Sheng, and Michalis Faloutsos. 2010. A first step towards understanding popularity in YouTube. *IEEE Conference on Computer Communications Workshops INFOCOM 2010*.
9. Herbert H.Clark and Susan E. Brennan. 1991. Grounding in communication. *Perspectives on socially shared cognition* 13, 1991: 127-149.
10. Toon Coppens, Lieven Trappeniers, and Marc Godon. 2004. AmigoTV: towards a social TV experience. In *Proc. EuroITV*, 4.
11. Riley Crane and Didier Sornette. 2008. Robust dynamic classes revealed by measuring the response function of a social system. In *Proceedings of the National Academy of Sciences*, 105 (41): 15649-15653.
12. Slobodan Cvjetkovic. 2010. Computer-Mediated Communication: A Study of Language Variation on Internet Chat. *rapport nr.: SPL kandidatuppsats i engelska SPL 2010-005*.
13. Stuart Dredge. 2015. YouTube promises more measures to tame its comment trolls. Retrieved July, 27, 2015 from http://www.theguardian.com/technology/2015/jun/02/youtube-competition-freedom-of-speech-comment-trolls

14. Ericsson ConsumerLab. 2012. TV and video: An analysis of evolving consumer habits. Retrieved July 29, 2015 from http://www.ericsson.com/res/docs/2012/consumerlab/tv_video_consumerlab_report.pdf
15. Fabio Giglietto and Donatella Selva. 2014. Second screen and participation: A content analysis on a full season dataset of tweets. *Journal of Communication* 64, 2: 260-277.
16. William Hamilton, Oliver Garretson, and Andruid Kerne. 2014. Streaming on Twitch: Fostering Participatory Communities of Play within Live Mixed Media, *Proceedings of the SIGCHI conference on Human factors in computing systems (CHI'14)*, 1315-1324. http://dx.doi.org/10.1145/2556288.2557048
17. Gunnar Harboe, Crysta J. Metcalf, Frank Bentley, Joe Tullio, Noel Massey, and Guy Romano. 2008. Ambient social tv: drawing people into a shared experience. In *Proceedings of the SIGCHI Conference on Human Factors in Computing Systems (CHI '08)*. 1-10. DOI=10.1145/1357054.
18. Susan Herring. Interactional coherence in CMC. 1999, *Journal of Computer-Mediated Communication.* 4, 4.
19. Adam N. Joinson. 2001. Self-disclosure in computer-mediated communication: The role of self-awareness and visual anonymity. *European journal of social psychology*. 31, 2: 177-192.
20. Lisa Katayama. 2008. Meet Hiroyuki Nishimura, the Bad Boy of the Japanese Internet. Wired. Retrieved July 30, 2015 from http://archive.wired.com/techbiz/people/magazine/16-06/mf_hiroyuki
21. Patricia G. Lange. 2007. Publicly private and privately public: Social networking on YouTube. *Journal of Computer-Mediated Communication* 13, 1: 361-380.
22. Yi-Chieh Lee, Wen-Chieh Lin, Fu-Yin Cherng, Hao-Chuan Wang, Ching-Ying Sung, and Jung-Tai King. 2015. Using Time-Anchored Peer Comments to Enhance Social Interaction in Online Educational Videos. In *Proceedings of the 33rd Annual ACM Conference on Human Factors in Computing Systems (CHI'15)*, 689-698.
23. Matthew McKay, Martha Davis, and Patrick Fanning. 1995. *Messages: The Communications Skills Book*. New Harbinger Publishers.
24. Margaret L. McLaughlin. 1984. *Conversation*. Sage, Beverly Hills, CA.
25. Miller McPherson, Lynn Smith-Lovin, and James M. Cook. 2001. Birds of a feather: Homophily in social networks. *Annual Review of Sociology* , 27, 1:415–444.
26. Niwango, Inc. I went to Nico Nico Chokaigi 2 Report. 2013. *Monthly Magazine gokigen Inaugural Issue June 2013*. Gokigen, Inc.
27. Kensuku Nonami. 2014. Sumo, shogi broadcasts stir excitement on hip Nico Dou video website. Retrieved September 9, 2014 from http://ajw.asahi.com/article/cool_japan/style/AJ201406140012
28. Derek Powazek. 2001. *Design for Community: The Art of Connecting Real People in Virtual Places*. New Riders Publishing, Thousand Oaks, CA, USA.
29. Stephen D. Reicher, Russell Spears, and Tom Postmes. 1995. A social identity model of deindividuation phenomena. *European review of social psychology*. 6(1): 161-198.
30. Sean E. Rintel and Jeffery Pittam. 1997. Strangers in a strange land interaction management on internet relay chat. *Human Communication Research*. 23, 4: 507-534.
31. Steven Schirra, Huan Sun, and Frank Bentley. 2014. Together alone: Motivations for live-tweeting a television series. In *Proceedings of the 32nd annual ACM conference on Human factors in computing systems (CHI'14)*, 2441-2450.
32. David A. Shamma, Ryan Shaw, Peter L. Shafton, and Yiming Liu. 2007. Watch what I watch: using community activity to understand content. In *Proceedings of the international workshop on Workshop on multimedia information retrieval*, pp. 275-284. ACM.
33. Gary Shank. 1993. Abductive multiloguing: The semiotic dynamics of navigating the Net. *The Arachnet Electronic Journal on Virtual Culture*. 1,1: 1-13.
34. Keith Stuart. 2014. PewDiePie switches off YouTube comments: 'It's mainly spam'. Retrieved July 27, 2015 from http://www.theguardian.com/technology/2014/sep/03/pewdiepie-switches-off-youtube-comments-its-mainly-spam
35. John C. Tang, Gina Venolia, and Kori M. Inkpen. 2016. Meerkat and Periscope: I Stream, You Stream, Apps Stream for Live Streams. 2016. In *Proceedings of the SIGCHI Conference on Human Factors in Computing Systems (CHI'16)*. Vol. 16.
36. Bodo Thielmann and Michael Dowling. 1999. Convergence and innovation strategy for service provision in emerging Web-TV markets. *International Journal on Media Management* 1, 1: 4-9.

37. Twitter. Integrate Twitter into your TV programming. Retrieved July 27, 2015 from https://media.twitter.com/best-practice/integrate-twitter-into-your-tv-programming
38. Joseph B. Walther. 1992. A longitudinal experiment on relational tone in computer-mediated and face to face interaction. In *Proceedings of the Twenty-Fifth Hawaii International Conference on System Sciences*. 4: 220-231. IEEE.
39. Joseph B. Walther. 1992. Interpersonal effects in computer-mediated interaction a relational perspective. *Communication research*.19(1):52-90.
40. Joseph B. Walther. 1996. Computer-mediated communication impersonal, interpersonal, and hyperpersonal interaction. *Communication research*, *23*(1), 3-43.
41. Joseph B. Walther and Malcolm R. Parks. 2002. Cues filtered out, cues filtered in. *Handbook of interpersonal communication*. 529-563.
42. Justin D. Weisz, Sara Kiesler, Hui Zhang, Yuqing Ren, Robert E. Kraut, and Joseph A. Konstan. 2007. Watching together: integrating text chat with video. In *Proceedings of the SIGCHI conference on Human factors in computing systems*, 877-886.
43. Justin D.Weisz, Thomas Erickson, and Wendy A. Kellogg. 2006. Synchronous broadcast messaging: the use of ICT. In *Proceedings of the SIGCHI conference on Human factors in computing systems (CHI'06)*, 1293-1302.
44. Stefan Wilk, Dimitri Wulffert, and Wolfgang Effelsberg. 2015. On Influencing Mobile Live Video Broadcasting Users. *2015 IEEE International Symposium on Multimedia (ISM)*. IEEE.
45. Yvette D. Wohn, and Eun-Kyung Na. 2011. Tweeting about TV: Sharing television viewing experiences via social media message streams. *First Monday* 16, 3.
46. Sharon Wolf & Bibb Latane. 1981. If Laboratory Research doesn't Square with you, then Qube it The Potential of Interactive TV for Social Psychological Research. *Personality and Social Psychology Bulletin*, *7*, 2: 344-352.
47. Asta Zelenkauskaite and Susan C. Herring. 2008. Television-mediated conversation: Coherence in Italian iTV SMS chat. In *Proceedings of the 41st Annual Hawaii International Conference on System Sciences*, 145-145.