

The Channel Matters: Self-disclosure, Reciprocity and Social Support in Online Cancer Support Groups

Diyi Yang, Zheng Yao, Joseph Seering, Robert Kraut
School of Computer Science, Carnegie Mellon University
{diyi,yzao2,jseering,robert.kraut}@cs.cmu.edu

ABSTRACT

People with health concerns go to online health support groups to obtain help and advice. To do so, they frequently disclose personal details, many times in public. Although research in non-health settings suggests that people self-disclose less in public than in private, this pattern may not apply to health support groups where people want to get relevant help. Our work examines how the use of private and public channels influences members' self-disclosure in an online cancer support group, and how channels moderate the influence of self-disclosure on reciprocity and receiving support. By automatically measuring people's self-disclosure at scale, we found that members of cancer support groups revealed more negative self-disclosure in the public channels compared to the private channels. Although one's self-disclosure leads others to self-disclose and to provide support, these effects were generally stronger in the private channel. These channel effects probably occur because the public channels are the primary venue for support exchange, while the private channels are mainly used for follow-up conversations. We discuss theoretical and practical implications of our work.

CCS CONCEPTS

• **Human-centered computing** → **HCI theory, concepts and models**; **Computer supported cooperative work**; **Empirical studies in collaborative and social computing**.

KEYWORDS

Self-disclosure; Channel Difference; Social Support; Online Health Support Groups; Online Communities

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1 INTRODUCTION

Self-disclosure refers to the process “by which one person verbally reveals information about himself or herself to another” [28]. The self-disclosure of feelings, thoughts, and experiences can provide

insightful information about the communicator [32], support impression management practices, [73] and facilitate the development of social relationships [71], both in offline and online contexts. Although self-disclosure helps fulfill people's fundamental needs for social connectedness and strategic rewards, it also carries risks of vulnerability and information loss because disclosers “give up some degree of privacy and personal control” and have no guarantee how others will use the information they reveal [1].

Despite the risks, self-disclosure is key to the realization of benefits afforded by many types of support groups. Self-disclosure has been found to be much higher in online health support groups than in general purpose discussion forums [9]. Many people with serious diseases need to self-disclose personal details about their emotions and health conditions [10] so that others can better understand their situation. For example, when one member of an online health support group was seeking support following her surgery, her appeal was filled with self-disclosure: “... *I had my surgery after 18 weeks of chemoradiation...I'm having a hard time. I just burst out in tears at anything. They started giving me an antidepressant. Did anybody else have a problem like this?*”. Though self-disclosure can be positive or negative, much prior work has examined disclosure of negative experiences on social media platforms, with topics ranging from eating disorders [55], sexual abuse [4], suicide behaviors [7, 24], depression [6] or other major life events [31, 52, 69]. Self-disclosure in these types of support groups is different from providing background information in technical support groups such as Stack Overflow. In technical support groups, only posters need to provide information about the problem in their code so that helpers can provide more targeted advice. They can achieve their goals without revealing many personal details about themselves or their thoughts and feelings.

Beyond its impact on the discloser, self-disclosure can elicit reciprocal self-disclosure from other group members as a form of emotional or informational support. These responses may facilitate validating social comparison and may start conversations that are the basis for forming social ties with others experiencing similar circumstances [21, 37]. Other members can also benefit from this process. Lurkers, for example, can eavesdrop on the conversations to glean health information as well as to learn about the group and what to expect from it if they decide to actively participate. However, revealing personal information, such as very sensitive medical details, is a loss of privacy that can make the disclosers more vulnerable to identity theft, targeted advertising, and unwelcome personal overtures.

One strategy adopted by many social media users to maximize the benefits they receive from self-disclosure and minimize personal risks is to choose different channels for different amounts or types of self-disclosure [42, 49, 53]. One difference between a public channel and a private channel is the audiences who have access to a message and, correspondingly, people's ability to select who is in the audience

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[8]. Prior work has suggested that disclosers keep their audiences in mind when presenting themselves [63]. Public audiences are more heterogeneous and contain a large fraction of people unknown to the self-discloser. Facebook users, for example, can choose to broadcast a message to a large audience on their news feed or communicate selectively to specific friends via private messages. People self-disclose differently in the private and public channels on social media platforms. Bazarova et al. 2015 found that Facebook users revealed more intense and negative emotions in private messages than in their public status updates. Vitak et al. 2014 found that the publicness of the channels people use for self-disclosure on Facebook influences goals and impression management strategies. Andalibi and Forte, in a study on announcing pregnancy loss on Facebook, found a wide variety of motivations for self-disclosing publicly on Facebook rather than privately or one-on-one, from keeping control of the narrative and avoiding having to have many separate conversations to using the public forum to memorialize the lost child and help healing [3]. Studies also show that users of social networking sites self-disclose less when they have larger audiences [73]. People might regard revealing personal information in public channels as inappropriate or as a violation of social norms [12, 51].

As in Facebook and other generic social media platforms, online health communities provide tools that allow members to communicate publicly in discussion boards or privately through messages and chats. However, both public and private modes of communication in health support groups are more “private” than those in Facebook because users are pseudonymous. Self-disclosure in the (pseudonymous) public discussion boards can be compared with the use of “throwaway” accounts on Reddit [5, 46], where users self-disclose private information that they’d prefer not to have tied to their public identity. Andalibi et al. [5] found that users were more likely to use these throwaway accounts when disclosure was particularly stigmatizing (e.g., men disclosing having been sexually abused). Other work has looked at a mix of anonymous and identified disclosures and responses in semi-public spaces (e.g., ask.fm forums [29] and Facebook Groups [15]), finding that the anonymity allowed users to ask questions that they might not otherwise ask, particularly about sensitive experiences they might not want linking to their identity.

In online health communities, both pseudonymous discussion boards and pseudonymous direct one-to-one messaging are actively used. For example, we found that 11.7% of the people who posted on the public discussion boards of the American Cancer Society’s Cancer Survivors Network, the site of our research, also communicated via one-to-one private messaging. Although the tools for managing self-disclosure might be similar in general-purpose social networking sites and more specialized ones organized around social support, it is unclear whether prior findings of how people use different communication channels for self-disclosure in general-purpose sites will generalize to online health support groups.

This paper investigates how members of one large online cancer support community decide where and how much to disclose, and how they strategically use different communication channels to balance benefits and risks brought by their self-disclosure. Our research questions are:

- (1) How do people self-disclose in private and public communication channels of an online cancer support group?

- (2) How does people’s self-disclosure elicit others’ self-disclosure and social support in return?
- (3) How does the communication channel affect the relation between self-disclosure, reciprocity, and social support?

In the following section, we review theories that attempt to explain why people using generic social networking sites disclose less in public versus private channels. We then raise the possibility that these effects might be reversed in online support groups because the benefits and risks of public self-disclosure are not the same compared to generic sites. The remainder of this paper describes the results of analysis using machine learning methods to measure self-disclosure and an empirical study that examines how members of online health support groups self-disclose in private and public channels. We further demonstrate how self-disclosure in these channels predicts the extent to which responders self-disclose and provide support.

2 SELF-DISCLOSURE & CHANNEL EFFECTS

2.1 Reward-Risk Balance

As Altman notes in the Reward-Risk Balance Theory [1], people have to balance their need for self-disclosure and vulnerability [60]. When deciding what personal information to disclose, they erect psychological boundaries [61] to control who can access various types of information about them. The more private the information, the greater the potential risks and therefore need to control boundaries. In dyadic communication, people can decide on a case-by-case basis who receives what information. In contrast, on the discussion board boards of large online communities, people cannot easily coordinate such boundaries with each other. Once people self-disclose in a public space, their information will be freely accessible to other members, passersby, and even unknown future audiences. This theory predicts that to reduce risks people will censor themselves more and self-disclose less in public channels than private ones [66]. This is consistent with findings in Bazarova et al., [13] which found higher rates of negative self-disclosure in Facebook direct messages than in public posts. However, Andalibi and Forte [3] note that public disclosure can be a method for boundary management - having many individual conversations about painful personal topics may be more painful than disclosing it widely in a less-controlled context.

2.2 Self-disclosure Goals

The functional theory of self-disclosure proposed by Derlega and Grzelak [25] states that people’s communication goals and what they hope to accomplish through self-disclosure activate a disclosure-decision-making process that shapes the content of their disclosures. Formally, these goals reflect the social rewards that people want to attain through self-disclosure and can be organized into five categories: (1) Social approval, in which people try to increase general social acceptance and the amount others like them. (2) Relational development, in which people try to increase intimacy and closeness with particular others. (3) Relief of distress, in which people try to relieve their distress by disclosing problems and disclosing pent-up feelings. (4) Identity clarification, in which people disclose information about their identity to define themselves for others and even for themselves. (5) Social control, in which people share information in an effort to obtain benefits for themselves, generally from more powerful others.

According to both Baumeister [11] and Omarzu [54], social approval is the default motive for self-disclosure. Baumeister states that public self-presentation derives from a motive to impress others in general with one's good qualities, and these good qualities are defined by the self-presenter's personal ideas along with their beliefs about others' expectations of what constitutes good quality. For example, people try to behave professionally in their work environment to demonstrate their competence and commitment, both because they themselves aspire for a positive professional image and because they expect others will also value these qualities. Another important goal in public self-disclosure on most social media sites is impression management. People try to maintain a positive self-image, particularly where their potential audience includes large numbers of people whom they do not know well [68], but positive self-presentation can also be an important motive with a smaller audience [61]. However, recent research challenges the assertion that social media is primarily a place for positive self-disclosure. Keller, Mendes, and Ringrose's, analysis of the *#BeenRapedNeverReported* movement finds that users are willing to share extremely negative personal experiences publicly with their name attached, though with great care and forethought, if motivated by a sense of solidarity and community. These findings may not be completely at odds - disclosure of negative experiences may help users find the support that lead them to feel more positive about themselves [70].

These theories explain how boundary management and a search for positive self-image may alternately lead to more or less self-disclosure in public spaces, depending on circumstances. Online health support groups offer a different environment in which to explore these distinctions [23]. Online health support groups are designed specifically as environments for people to share their experience and receive social support, help, and advice [77]. To get help or to provide it to others, members often have to reveal information about their health, their emotions or their personal circumstance. They can receive support or relieve distress more effectively if they self-disclose to others about their health problems honestly, even though doing so reduces control over who can access this information. They do so to increase the possibility of receiving desired support compared to what they could receive from sending messages to an individual in a dyadic setting. Previous research has focused primarily on comparisons between pseudonymous and identified disclosures in forums or on spaces like Facebook, while no prior work has compared pseudonymous self-disclosure on forums to pseudonymous self-disclosure through private messages. We begin by hypothesizing that this comparison will lead to similar results as in previous research [3, 39, 70], where relief of distress and social control motives may become more important than self-presentation in online health communities. This shift in motives may lead users to be comfortable disclosing negative experiences, but that this effect will be compounded by further lack of concern about self-presentation in pseudonymous private messaging. Thus, we expect that:

HYPOTHESIS 1. *People will self-disclose more when eliciting support than when providing it.*

HYPOTHESIS 2. *When replying to others' messages, people will self-disclose more in a private channel (direct messages) compared a public one (pseudonymous forums).*

2.3 Reciprocity

The reciprocity of self-disclosure refers to the process by which self-disclosure by one person elicits self-disclosure from an interaction partner [36]. This process has also been called the 'dyadic effect' or the 'mutual effect' [28]. Jourard 1969 originated the idea that self-disclosure is reciprocal and found that as participants in dialogues disclose their thoughts, feelings, prior behavior, and similar personal information to others, the others disclose comparable information about themselves in return. Reciprocity of self-disclosure is partially the result of people's general tendency to mimic the language, gestures, mannerisms and other behaviors of the people with whom they interact. As with other types of human mimicry, the reciprocity of self-disclosure improves coordination and increases liking among people in the exchange [19]. However, reciprocity of self-disclosure goes beyond generic human mimicry and serves additional functions. First, receiving intimate information can make respondents feel trusted. This creates attraction and leads the respondent to return disclosure as a sign of liking and trust [28]. Second, receiving disclosures can make recipients think they have received something of value, engendering an obligation to return things [76].

Reciprocity of self-disclosure is especially important in health support groups. When people seek support by revealing their personal experiences and emotions, responders' follow-up self-disclosure can benefit support-seekers in several ways. First, such reciprocal self-disclosure can inform support-seekers that they are being understood and that others care about them. Second, responders' self-disclosure provides social comparison information and is thus an element of support. For example, when support seekers start a conversation describing being scared, depressed and overwhelmed, support providers may self-disclose by mentioning similar feelings and experiences [75], reassuring the seekers that their reactions were normal. Moreover, by self-disclosing, the people who respond often provide information about their own disease to give context for the advice they provide. In addition, their self-disclosure can provide credibility for their comments. The following responses illustrate these points: *"I was diagnosed this past Jan ..., with Stage 4 CC, with a tumor in my liver, and believe me, I was horrified!"* *"It is surreal and it does make your head spin. ... When they originally diagnosed me with liver mets I assumed I was a dead man ... You and your husband should never give up hope, and he has not been handed a death sentence. It won't be easy but it is possible."* Finally, reciprocal self-disclosure exchanged among members might also inform lurkers that this community is safe and interactive.

As previously discussed, whether the communication channel is public or private can shape both the content people are willing to disclose and how the recipients of the disclosure are likely to respond [9, 13]. Although the personal stories that support-seekers receive may be equally valuable regardless of the channel through which it is received, the cost to the provider of revealing this personal information may be less when they deliver it over a private channel. Providers should have less concern about losing face when they are telling their stories to a particular other. Because people can reduce their personal risks when responding to another's self-disclosure in private, they should reciprocate self-disclose more in private. Responders may also reciprocate self-disclosure more in a private channel because in this channel they can imagine the specific

individuals with whom they are communicating to more easily and can tailor their responses to a particular support-seeker, thus increasing their intimacy [76]. In contrast, when communicating in a public channel, responders are more likely to consider their audience to be a general, unspecified public as well as the specific support-seeker to whom they are responding. As a result, they may find it more difficult to express liking and trust in front of such a large audience.

Moreover, if people respond to a support seeker in a private channel rather than a public one, the support seeker is more likely to notice it and attribute it to its author, because the response is not mixed with other responses that the seeker might receive. As a result, those responders may feel more pressure to reciprocate self-disclosure in the private channel because the seeker is paying more attention to them and where other members are not helping.

Taken together, responders may reciprocate self-disclosure more in private conversations, because they have more control over their self-disclosure and because the concentrated attention they receive from their conversational partner may increase their obligation to respond to them with self-disclosure. Thus, we expect that:

HYPOTHESIS 3. Self-disclosure will be reciprocated more in the private channel, compared to the public channel.

2.4 Social Support

People join online health communities for “information sharing and exchange of medical information and life experiences” [35]. Self-disclosure is key to getting the benefits offered by online health support groups. Seekers can help other community members understand their situations better and provide them with more appropriate information, advice, and emotional support when the seekers self-disclose information about their disease, their experiences with their doctors and family, their emotions and other personal details like gender, age, and insurance coverage. Studies show that people who disclose their identities on their SNSs are more likely to receive social support [47]. Prior research health support groups also found that self-disclosure about events together with thoughts and feelings elicits emotional support from other members of their group and that recounting negative experiences elicits informational support [75]. Therefore, we expect that when support seekers disclose more, they will receive more social support from potential responders.

Although support providers could respond to seekers in either public or private channels, using the public channel can give extra benefits, both to the provider and to other members of the community. First, if providers’ respond to a particular seeker in a public channel, their response might potentially help a larger audience of lurkers, members in similar situations or even non-members who come across their responses via Internet search. That is, public responses augment providers’ effort by allowing their support to help more people. Second, in addition to helping others, support providers may be concerned with the way that others perceive them. This motivates them to manage their behaviors strategically in order to present positive images to others [30, 68]. By responding in a public channel, their altruistic actions become known to more people, enhancing their status [44]. By responding publicly, they can earn reputation with a larger audience as “helpful”, “knowledgeable”, and “supportive”. Therefore, we expect that:

HYPOTHESIS 4. People are more likely to provide support in response to self-disclosure in the public channel compared to the private one.

3 DATA AND MEASURES

We collaborated with the American Cancer Society and got permission to analyze all public posts, comments and private messages on its Cancer Survivor Network (CSN) from Dec 2002 to Oct 2016. As the largest online support community for cancer survivors and their caregivers, CSN provides both public discussion boards and a private communication channel (a function called “CSN Email” where CSN members can communicate directly with each other) for people to seek and offer support. The sample for the current research comprises 5,649 users who used both public discussion boards and private chats, resulting in 826,389 public messages from 28,911 threads in the public channel and 105,213 private messages. We removed posts from discussion boards that were peripheral to the site’s mission (e.g., Humor and Technical Problems) and posts from administrators’ accounts.

Self-disclosure refers to linguistic expressions by which people reveal personal information about themselves to others. The norm in generic social networking sites is to look good by presenting a positive and happy image of oneself [20, 72]. In contrast, in cancer support groups negative self-disclosure about one’s conditions and emotions do not make people look bad. In this context, we are more interested in whether people are self-disclosing negative content in their messages. Formally, we define negative self-disclosure as sharing negative thoughts or emotions, such as worry, sadness or anger, as in this example: “*I am freaked out after reading my mammogram report*”. In the context of cancer support groups, we use self-disclosure and negative self-disclosure interchangeably.

We obtained human-annotated data from [75, 78]. Following their procedures and based on the linguistic features described in [75], we trained machine learning models to approximate human judgments of the amount of negative self-disclosure contained in each message. These machine learning models were highly correlated with the human judgments (Pearson Correlation of 0.77 in a hold-out sample). We then applied the models to estimate the negative self-disclosure contained in the 826,389 public and 105,213 private messages.

4 CHANNEL DIFFERENCES

The two rightmost bars in Figure 1 show the average negative self-disclosure per message in thread starting messages and the comments that reply to them. In this cancer support community, thread-starting messages had higher levels of negative self-disclosure than did their replies. This finding is consistent with prior research on health support group showing that people disclose inner turmoil or negative events in their lives when seeking advice and help [75]. This confirms H1, that people negatively self-disclose more to elicit support than to provide it. The first and third bars in Figure 1 compare self-disclosure in the private and public channels when people were responding to others’ messages. The comparison shows that people expressed more negative self-disclosure (i.e., talked about more negative aspects of their lives) in the public channel than in the private one. The effect size is small though, with 6.5% more negative self-disclosure in the public discussion boards than in private

chats. (Also see Table 2.) Taken together, these results dis-confirm H2, demonstrating that when replying to others, people self-disclose more in the public channel than the private one.

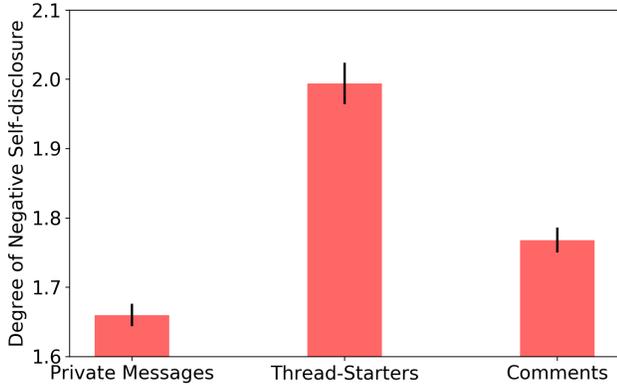


Figure 1: Comparison of negative self-disclosure in private messages, forum thread starting messages and comments (replies). Error bars stand for bootstrapped standard errors.

Note that when comparing people’s responses to others’ messages, we treated private messages as replies, similar to comments. This reasoning is supported by a follow-up corpus analysis that compared the first interaction any pair of users had in both the private and public channels on CSN. Here, the first interaction refers to one person directly replying to another’s public forum thread or private message. We found that people started their first interaction in the public channel 93% of the time, and started them in the private channel only 7% of the time. The first author went through a random sample of 50 first interactions in the private chats and coded how they started their conversation. Half of the first interactions in the private channel were responses to one of their posts or questions about similar situations in the public discussion board.

One concern about the results just reported is that machine learning models of self-disclosure were trained only on public messages, which might have resulted in differential accuracy or biases in the automated measurement of self-disclosure in forum posts and private messages. This restriction on training was an attempt to honor the privacy of private messages, whose authors believed would be seen only by the named addressee. Therefore, to preserve privacy, human annotators did not label private messages. To minimize this concern, we conducted supplementary analyses using indicators of self-disclosure that were not differentially available in public versus private messages. In particular, we examined linguistic features associated with privacy derived from the Linguistic Inquiry and Word Count program (LIWC) [57]. LIWC is composed of 5,690 words and word stems, constructed based on the analysis of a wide variety of public and private samples of text both offline and online, with each word belonging to one or more word categories. LIWC categories have previously been shown to be reliable markers for a number of psychology meaningful constructs such as emotional states, social identity, and cognitive styles [58, 59], including self-disclosure [74].

	Private	Public	t-test	p
Affective Attributes				
negative emotion	0.694	0.771	-16.285	0.00
positive emotion	2.532	3.267	-66.894	0.00
sadness	0.189	0.191	-0.905	0.37
anger	0.129	0.117	6.344	0.00
anxiety	0.080	0.081	-0.572	0.57
swear	0.043	0.033	7.739	0.00
Social/Personal Concerns				
friend	0.083	0.043	21.042	0.00
family	0.328	0.301	8.772	0.00
humans	0.245	0.218	11.590	0.00
social	8.504	7.618	47.762	0.00
work	0.578	0.499	18.303	0.00
money	0.270	0.191	26.584	0.00
leisure	0.452	0.398	14.362	0.00
home	0.246	0.183	22.672	0.00
Personal Pronouns				
1st pers singular	1.830	1.439	47.978	0.00
1st pers plural	0.521	0.637	-25.993	0.00
2nd person	3.524	3.442	6.298	0.00
3rd pers singular	0.969	0.642	52.630	0.00
3rd pers plural	0.381	0.401	-6.150	0.00
impersonal pronouns	3.580	3.745	-16.166	0.00

Table 1: Content measures and their average proportional occurrence in the private and public channels, followed by results of Welch’s t-test for difference between the two groups with unequal variances.

Analyses examining the use of terms from LIWC in the public and private settings are consistent with the results previously presented examining negative self-disclosure derived from the machine-learning measures. To examine the content difference in the private messages and discussion board, we compared messages in two channels on several LIWC dictionaries whose content should directly reflect differences in self-disclosure.

Table 1 presents the differences in the use of the semantic categories *Affective Attributes*, *Social/Personal Concerns* and *Personal Pronouns* in the private messages and comments in the public discussion board. We also performed statistical hypothesis testing between two message sets using t-test. Comparisons showed that (1) people talked more about *negative emotions* and *positive emotions* in the public channel; (2) People tended to talk more about personal relationships e.g, *friend*, *family*, *humans*, *social*, *work*, etc., and (3) were more self-focused in the private channel, with greater use of *1st person singular*, *2nd person*, *3rd person singular* pronouns. In contrast, people were more other-focused in the public channel, using more inclusive communicative words such as higher use of *1st person plural*, *3rd person plural* pronouns. In contrast to these findings, which were generally consistent with results using machine-learned measures showing less negative self-disclosure in the private channel, people are expressed more *anger* and more *swear* words in the private channel. These differences in language use provide explanations for H1 and present a micro-level picture of content differences in both public and private channels.

Independent Variables	Model 1	Model 2
intercept	-0.352***	-0.318***
sender female	0.085***	0.062***
respondent female	0.141***	0.136***
respondent negative self-disclosure base rate	0.251***	0.232***
private channel	0.328***	0.349***
sender negative self-disclosure	0.110***	-0.001
private channel x sender negative self-disclosure		0.316***
R-Squared	0.11	0.14

Table 2: Regression coefficients of predicting the reciprocity of self-disclosure. $p < 0.001$: *; $p < 0.01$: **; $p < 0.05$: *. The number of observations is 58,778.**

5 SELF DISCLOSURE AND RECIPROCITY

To investigate whether one person’s self-disclosure elicits others to self-disclose in response and how channel affects the reciprocity of self-disclosure, we built several random-effect linear regression models to predict the amount of negative self-disclosure contained in responders’ messages, using as predictors the amount of negative self-disclosure in senders’ messages initial messages, the public nature of the channel and their interaction, as well as the responder’s gender and the historical levels of self-disclosure as control variables.

5.1 Measures

5.1.1 Dependent Variable.

- **Responders’ Self-disclosure:** We measured *negative self-disclosure* using the machine-learning models described previously. We measured it only for the first response in a thread as suggested by prior work [9, 26], because it is the one that is most likely to be influenced by the thread-starting message; additional responses in the thread might be affected by intervening responses by others. For private messages, we measured self-disclosure in the direct reply of each message.

5.1.2 Independent Variables.

- **Private channel:** This variable *channel* indicates in which channel a message was exchanged, i.e., 0 represents the public discussion boards and 1 refers to private messages.
- **Senders’ Negative Self-disclosure:** We measured the amount of negative self-disclosure contained in each message. Note that in the public discussion board, only the person who posted the thread starting message was considered a sender, whereas in the private messages, the author of each message can be viewed as its sender.

5.1.3 Control Variables. Because people may have individual differences in the degree to which they are willing to reveal information about themselves [36], we controlled for both gender [27] and responder’s prior history of self-disclosure.

- **Gender:** Prior work found that women self-disclose more than men [41]. We controlled for the gender of both senders and responders: *sender gender* and *respondent gender*.

- **Self-disclosure:** Since people who self-disclosed frequently in the past are likely to self-disclose more in each new opportunity to respond to another, we controlled for their responders’ history of self-disclosure. To this end, we constructed one variable *responder’s negative self-disclosure base rate*, computed by averaging the estimated negative self-disclosure in all their messages prior to the current one.

Continuous and independent variables were standardized, with a mean of zero and standard deviation of one, while binary variables were left in their original scale so that zero indicated an absence of some characteristic and one meant its presence.

5.2 Which Channel Has Stronger Reciprocity?

Following prior research [9], we measured reciprocity of self-disclosure as the regression coefficient of senders’ self-disclosure on the responder’s self-disclosure; that is, reciprocity is higher when the sender’s degree of self-disclosure more strongly predicted the responder’s self-disclosure. Table 2 shows the results of two regression models predicting how communication channel and other variables predict a responder’s self-disclosure. Model 1 reports the main effect of the channel and the senders’ negative self-disclosure on responders’ negative self-disclosure. In terms of the control variables, both responders’ female gender ($\beta=0.141$) and their negative self-disclosure history predict their current negative self-disclosure ($\beta=0.251$). Responders display more negative self-disclosure in the private channel than the public one ($\beta=0.328$). In addition, they express more negative self-disclosure the more senders to whom they are responding have expressed it ($\beta=0.110$). To test the effects of the channel on the reciprocity of self-disclosure, Model 2 adds the interactions between the channel and the sender’s self-disclosure. It shows that reciprocity is limited to the private channel, with the senders’ negative self-disclosure predicting responders’ negative self-disclosure in the private channel ($\beta=0.317$) but not in the public channel ($\beta=-0.001$). Figure 2(a) illustrates these results graphically. Overall, this analysis confirms H3.

6 SELF-DISCLOSURE & SOCIAL SUPPORT

Two categories of social support [22] have received the most theoretical and empirical attention in the study of online support groups: informational and emotional support. Specifically, informational support provides recipients advice, information or knowledge, while emotional support provides them encouragement, empathy or care.

Independent Variables	Responder's info support		Responder's emo support	
	Model 1	Model 2	Model 3	Model 4
intercept	0.122***	0.137***	0.056***	0.064***
sender female	-0.045***	-0.054***	0.091***	0.085***
responder female	-0.230***	-0.234***	0.186***	0.183***
responder's informational support base rate	0.083***	0.081***		
responder's emotional support base rate			0.231***	0.230***
private channel	-0.018*	-0.011	-0.516***	-0.511***
sender negative self-disclosure	0.051***	0.011*	0.022***	-0.003
channel x sender negative self-disclosure		0.114***		0.071***
R-Squared	0.02	0.02	0.04	0.05

Table 3: Regression coefficients of predicting the provision of social support. $p < 0.001$: *; $p < 0.01$: **; $p < 0.05$: *. The number of observations is 58,778.**

6.1 Social Support Measures

Using procedures similar to those used in the automated measurement of self-disclosure, we built machine learning models to identify the extent to which public and private messages contained emotional and informational support. The machine learning models use the set of linguistic features described previously in the section on the identification of self-disclosure to predict human annotations of the amount of informational and emotional support a thread-starting message was seeking and how much information and emotional support the first response to a message contained.

Four trained nursing students rated a sample of 1000 threads for the degree to which thread-starting message sought informational and emotional support and the amount of informational and emotional support contained in the first response it received. The human judges were reliable, with Cronbach's alphas of 0.91, 0.83, 0.92 and 0.92, for judgments of seeking informational support, seeking emotional support, receiving informational support and receiving emotional support respectively. The machine learning models correlated highly with the average of the human judgments, with Pearson correlations of 0.72, 0.62, 0.79, 0.76 respectively. Given the validity of these models, we then applied them to estimate the support exchanged in the 28,911 threads, 797,478 comments and 105,213 private messages in the corpus.

6.2 Which Channel Offers More Support?

We used random-effect, linear regression, with thread nested within support-seeker, to test the extent to which support-seekers' negative self-disclosure predicted responders' providing them informational and emotional support and whether these effects varied with the privacy of the communication channel. The control variables were support-seekers' gender and the average amount of informational and emotional support contained in responders' prior messages (*support-provision base rate*). Multicollinearity was not a problem for all the analyses in Table 3, with variance inflation factors smaller than 2.

6.2.1 Informational Support. : Model 1 in Table 3 describes the main effects of channel and senders' self-disclosure on responders' provision of informational support. It shows that women provided less informational support than men ($\beta = -0.230$). As expected, responders' who provided more informational support in the past

provided more informational support in response to the current message ($\beta = 0.083$). The negative coefficient of the private channel on responders' provision of information support ($\beta = -0.018$) shows that they provided less informational support in the private channel. Senders' negative self-disclosure led to more informational support ($\beta = 0.051$). Model 2 adds the interaction between channel and senders' self-disclosure. Senders' negative self-disclosure positively predicted receiving informational support in both channels, but the effect was an order of magnitude larger in the private channel ($\beta = 0.114$) than the private one ($\beta = 0.011$). The interactions are illustrated in Figure 2(b).

6.2.2 Emotional Support. Model 3 in Table 3 describes the main effects of channel and senders' self-disclosure on responders' emotional support provision. In terms of control variables, women provided more emotional support than men ($\beta = 0.186$) and when they have given more emotional support in the past ($\beta = 0.231$). Responders provided less emotional support in the private compared to the public channel ($\beta = -0.516$). Senders received more emotional support when they started the conversation with messages that contain more negative self-disclosure ($\beta = 0.022$). Model 4 adds the interaction between channel and senders' self-disclosure on responders' provision of emotional support. After controlling for the gender of both senders and receivers and responder's emotional support provision base rate, senders' negative self-disclosure in the public discussion board did not predict the amount of emotional support they received ($\beta = -0.003$). In contrast, people received more emotional support in the private channel when their messages contained more their negative self-disclosure (an increase of $\beta = 0.071$). The interaction effects are graphed in Figure 2(c), which dis-confirm H4.

6.3 Robustness Check

To rule out other possibilities that might explain the influences of self-disclosure on reciprocity and receiving social support, we performed two regression analyses under a random setting for both public and private content as a robustness check. For example, to test the potential correlation between threads and replies, we constructed a corpus similar in size to Table 2 where thread-comment pairs are randomly matched. That is, instead of using the original first comment as a response for a thread, we randomly selected a reply

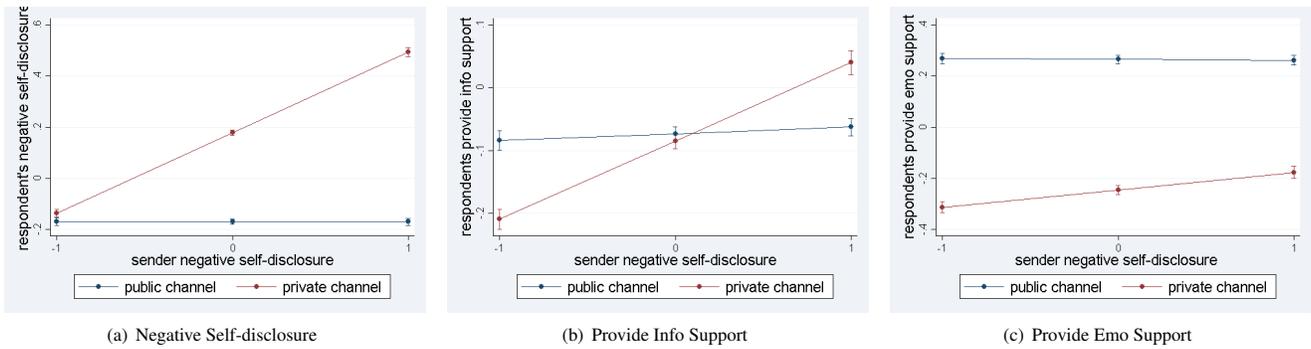


Figure 2: Interaction between Channel and Level of Self-disclosure on Reciprocity and Support Provision.

from the entire corpus. We conducted the same random-effect linear regression analyses shown in Table 2 on the simulated data and found no significant reciprocity effects between senders’ messages and responses. Similarly, there were no significant influences of self-disclosure on receiving social support in the simulated data set. We also conducted robustness check for private messages (instead of using the next message that directly replied to a message m , we randomly selected one message that came later), and did not obtain strong relations between senders’ self-disclosure and respondents’ self-disclosure or support provision.

6.4 How Self-disclosure Elicits Social Support

The results reported to this point indicate that (1) negative self-disclosure was associated with receiving more informational and emotional support; (2) although in general people seem to provide less social support in the private channel, senders’ more negative self-disclosure in the private chat was associated with receiving more social support. Prior research suggests that self-disclosure might lead observers to infer that seekers are seeking social support, which further leads respondents to provide it [75]. To further investigate how self-disclosure leads respondents to provide social support, we conducted a mediation analysis using structural equation modeling testing whether senders’ self-disclosure predicts judgments that they are seeking support which, in turn, predicts their receiving support. As shown in Figure 3, this model fits the data well according to both the Comparative Fit Index (CFI=0.96) and the Standardized Root Mean Square Residual (SRMR=0.03) [33, 67].

As Figure 3 indicates, (1) seekers posting in the private channel was associated with the perception that they were looking for emotional support ($\beta=0.14$), rather than were informational support ($\beta=-0.59$). (2) Senders receive informational support when they were perceived as seeking it ($\beta=0.08$) and receive emotional support when they were perceived as seeking that ($\beta=0.05$). (3) People’s negative self-disclosure was associated with the perception that seekers were seeking emotional support ($\beta=0.88$). After controlling for the perception that seekers are looking for emotional support, the direct effect of senders’ negative self-disclosure on receiving emotional support became insignificant ($\beta=-0.01$, $p=0.667$). (4) People’s negative self-disclosure correlated with receiving informational support ($\beta=0.051$ as in Table 3), and this effect was partially mediated by

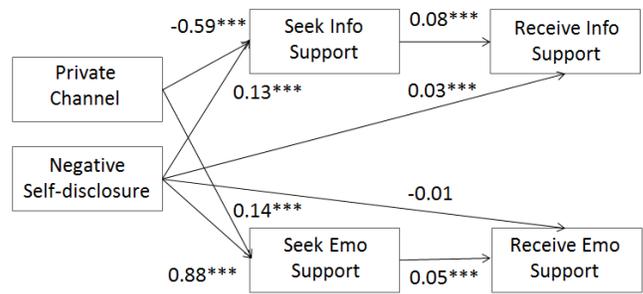


Figure 3: Structural equation model showing the mediation analysis of self-disclosure, senders’ seeking social support behavior and respondents’ provision of social support. Values represent standardized regression coefficients. Here, $p<0.001$: *; $p<0.01$: **; $p<0.05$: *; $p<0.10$: .**

the perception that seekers were seeking for informational support ($0.13*0.08/0.051 = 21\%$).

To sum up, the perception that senders are seeking social support partially mediates the relationship between their self-disclosure and respondents’ providing them with support. Specifically, negative self-disclosure is strongly associated with the perception that senders’ are seeking emotional support, which then is associated with them receiving emotional support from those who respond. In addition, negative self-disclosure is weakly associated with the perception that senders’ were seeking informational support, which then is associated with them receiving informational support.

7 DISCUSSION AND CONCLUSION

This research examined how members self-disclosed in private and public channels in an online cancer support community, and how channel differences moderated the reciprocity of self-disclosure and the social support they received. To summarize the major results:

- **H1 and H2:** People expressed more negative self-disclosure when starting threads to seek support than when replying to them. When replying to others, people expressed more negative self-disclosure in public channel, revealing more about negative aspects of their lives.

- **H3:** Reciprocity occurred for negative self-disclosure. The reciprocity effect was stronger in the private channel than in the public one.
- **H4:** Senders' negative self-disclosure was associated with their receiving both informational and emotional support. Again, these effects were stronger in the private channel. The effects of self-disclosure on receiving support were mediated by the effects of self-disclosure on judgments that people were seeking support, with complete mediation in the case of emotional support and partial mediation in the case of informational support. Specifically, senders' negative self-disclosure was associated with the perception that they were seeking both emotional and informational support which, in turn, was associated with them receiving the corresponding type of support.

In the cancer support groups studied here, participants were more likely to reveal personal information, especially their negative thoughts and feelings, when they communicated in public to a large audience of strangers than when communicating in private to a smaller, known audience. This finding is consistent with some observations in [3], notably that public disclosure can limit subsequent need to privately self-disclose, but is inconsistent with the larger body of work that generally shows more negative self-disclosure in private channels [13]. The results are inconsistent with explanations arguing that people tend not to reveal private information in public social media sites because their positive self-presentation is their dominant motivation for participating in these sites [13]. These results are also inconsistent with the theory about the role of intimacy in self-disclosure [64]. The prior predictions derive from theory on self-presentation. Goffman [30] and other scholars who studied self-presentation have argued that in virtually everything people do, they are aware of its effects on audiences and therefore stage behavior to create and save 'face'. People do not want to reveal too much about themselves in front of a large and diverse group of observers to reduce the risk of looking bad or having their information misappropriated. However, self-presentation is only one motive for online self-disclosure. In health support groups the dominant motives are to elicit and provide social support. Participants can both seek and provide support more effectively by disclosing information to others about their health problems. The different affordances between CSN and other social media sites may also explain these inconsistent findings.

Sharing experiences with a larger audience increases the probability that at least one person in the community will provide the desired support, either informational or emotional. In contrast, sharing negative experiences with a single person via private messages puts substantial pressure on the communication partner and might be overwhelming. These ideas are consistent with the major result revealed in Figure 1. which shows that people are especially likely to reveal their negative thoughts and feelings in public when they are starting conversations to seek support.

Moreover, self-disclosure is an effective strategy for providing support to others. Describing one's own health-related experiences and emotional reactions provides people seeking support with social comparison information that helps them to contextualize and validate their own experiences and reactions. For example, they may

cope better with the terror they feel with a cancer diagnosis if they hear that others have been through similar experiences. Follow-up interviews we conducted with some CSN users are consistent with this reasoning. Participants indicated that they were "*totally fine*" with sharing some of their treatment details publicly, "*as long as it can help other users on the forum*". In addition to the exchange of support, public self-disclosure may arise from identity-clarification goals – for example, publicly asserting one's identity as a cancer patient or a caregiver and expressing solidarity with others in the same state. Public self-disclosure may also arise from self-expression goals – to reduce one's own distress by writing about problems and sharing these with a larger audience. In summary, public self-disclosure magnifies the potential for receiving social support and the other benefits available in online support groups [40, 76].

The analyses of reciprocity support H3, that senders' self-disclosure has a stronger effect on eliciting responders' self-disclosure in the private channel compared to the public one. The weaker reciprocity effect in public channel might indicate that the *dyadic effect* or *reciprocal* effect first identified by Jourard [37] is limited to dyadic conversations and cannot be directly applied to conversations with more than two participants. The analysis of self-disclosure and receiving support dis-confirms H3, which held that the influence of self-disclosure on the receipt of support would be stronger in the public channel. Our finding that the stronger effect in the private channel of senders' self-disclosure leading to recipients' providing support is consistent with social impact theory [45] and suggests that influencing a single person is easier than influencing a large audience. It also suggests that the norms of this cancer support community have evolved so that private channels were the expected place to offer personalized, follow-up support to a particular person's problems. Moreover, we found that (1) in the private channel, more negative self-disclosure was associated with respondents providing more informational support and more emotional support. (2) Although in general people tend to provide less social support in the private channel, senders' self-disclosure was associated with receiving more social support in the private channel. Our follow-up mediation analysis suggests that senders' self-disclosure was associated with the perception that seekers were looking for social support, which further led to respondents' support provision, consistent with prior work [75]. The use of the private channel was associated with the perception that they were seeking emotional support, but that they were not seeking informational support.

We examined self-disclosure in an online cancer group where both pseudonymous discussion boards and private messages are used actively. When participating in online health communities, prior studies found people also use throwaway accounts to engage in deeper descriptions of their conditions [2, 23, 56], and receive longer responses when posting with these throwaway accounts. However, we have no evidence that participants in CSN used "throwaway" accounts and, thus, cannot examine their effects.

7.1 Ethical Considerations

Given the sensitive nature of this data in this study, we have adopted steps to protect participants' privacy: We did not ask annotators to view or annotate private messages but, instead, directly applied our machine-learning models trained on public discussion board messages to estimate members' self-disclosure in private messages as a

compromise between the protection of users and model performance. All analyses were conducted at post-level with de-identified usernames. We also paraphrased all the example quotes in this paper to make finding them via a search engine on CSN more difficult [16].

7.2 Limitations and Future Work

This research has several limitations. First, due to privacy concerns, the corpus used to train machine-learning models to identify self-disclosure was constructed only from public discussion boards. However, we believe this sample did not bias results from the research. The messages exchanged in the public and private channels were from the same set of users and were of similar length. In addition, results based on LIWC dictionaries, which were not trained on the public discussion boards, are consistent with results using measures of self-disclosure trained on the public communication. Despite these assurances, however, we urge future research to use a more representative corpus to train machine learning models and validate our findings in ethically appropriate ways. Despite the reasonable performance of our machine learning models for measuring negative self-disclosure, we acknowledged that it could be further improved via richer feature representation and more annotation data.

Note that we removed messages from four sub-forums that were peripheral to the site's mission such as Humor and Technical Problems. We acknowledge that humor is a form of emotional support in virtual support groups [62, 65]. Our small corpus study showed that very few of the threads in the Humor sub-forum (75 threads in total over 13 years) were related to seeking or offering support, and most were about holidays, jokes, quotes or fun stories. We suggest that future work could examine the effects of humor by measuring humor in a message level and correlating it with the message level emotional support and other psychological outcomes.

Thirdly, we used thread-starting messages and the first responses to them to estimate the level of reciprocity in the public channel; neglecting additional responses in these threads might weaken the influence of reciprocity. We found consistent results when we conducted robustness checks by using a single, randomly selected reply to a message rather than the first reply. We acknowledge that the first response could be a clarification request for additional information, and urge future research to use different operationalizations to study this reciprocity influence more validly. Although our findings suggest that people self-disclose differently in different channels and this channel difference moderates the influence of self-disclosure on reciprocity and receiving social support, the cause of such differences remains unclear. A natural follow-up could be qualitative interviews asking participants about their rationales for using the different channels. Fourthly, this research is correlational. We used lagged dependent variable analysis and controlled the temporal ordering of the messages (i.e., senders' self-disclosure preceded respondents' replies) for models in Table 2 and Table 3. Despite these benefits, without true random-assignment experiments, we cannot show that our results reflect causation between senders' self-disclosure and respondents' self-disclosure and their support provision.

7.3 Implications

This research has several key theoretical and practical implications. Our findings add an additional perspective on research on public

self-disclosure, which has had mixed findings. These inconsistencies suggest the need for richer theoretical models of how people use self-disclosure to accomplish a variety of goals in social interaction beyond positive self-presentation. Our research confirms earlier research that self-disclosure elicits others' self-disclosure as well as social support [9]. But it goes beyond prior work by showing that channels influence the effects of self-disclosure on reciprocity and receiving social support. These findings suggest that community norms may influence where certain types of interaction goals should be accomplished.

Overall, our results show how members' self-disclosure helps them receive benefits from their fellow community members in online health support groups. These findings could inform the development of additional features at a platform level, to support community managers and moderators, and to encourage individual users. First, platforms could introduce interface features/algorithms to encourage community members to self-disclose more in appropriate channels [14, 43, 50] and design more structured guidelines and tutorials as examples to show community members how to seek support effectively and efficiently [18, 38]. In particular, online communities could introduce features that suggest in-group vocabulary or rhetorical strategies in members' introductions to help members be more likely to get responses from other community members [17]. Second, features could be developed to support community organizers and moderators in building more interactive online environments [48]. For example, tools could detect users who are about to share emotionally vulnerable content and inform experienced members to pay attention to their requests. Finally, online communities could consider introducing badges such as "*information expert*" to motivate members on an individual level to provide support and reward their contributions [43].

Though designing interfaces or algorithms to help disclosers get the types of responses that they need could significantly improve users' experiences, we note two concepts that designers should keep in mind. First, it is important that users are made aware of both the potential risks and benefits of self-disclosure prior to posting, and transparency in future tool design could facilitate this. Second, as this work highlights, it is crucial that users retain control over decisions surrounding how much to disclose, where to disclose it and to whom. Systems that provide recommendations about where to disclose are safer in this way for users than systems that adjust defaults or make choices for them.

Broadly, findings on the effect of self-disclosure on support provision can help members identify the right channel to self-disclose in order to be most likely to receive desired benefits; features that can provide hints on which channel to use and which audiences to talk to might be one path to maximize the benefits that the disclosers can receive. Our findings on the reciprocity of self-disclosure may be applicable to a wide range of groups such as support groups (e.g., parenting, dieting, etc) and groups that seek non-support resources (e.g., career advice or friendships).

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