Enriched Social Translucence in Medical Crowdfunding

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ABSTRACT
Social translucence theory argues that online collaboration systems should make contributors' activities visible to better achieve a common goal. Currently in medical crowdfunding sites, various non-monetary contributions integral to the success of a campaign, such as campaign promotions and offline support, are less visible than monetary contributions. Our work investigates ways to enrich social translucence in medical crowdfunding by aggregating and visualizing non-monetary contributions that reside outside of the current crowdfunding space. Three different styles of interactive visualizations were built and evaluated with medical crowdfunding beneficiaries and contributors. Our results reveal the perceived benefits and challenges of making the previously invisible non-monetary contributions visible using various design features in the visualizations. We discuss our findings based on the social translucence framework–*visibility, awareness, and accountability*–and suggest design guidelines for crowdfunding platform designers.

Author Keywords
medical crowdfunding, social translucence, computer-supported collaborative work

INTRODUCTION
Human Computer Interaction (HCI) researchers have called for more social transparency in online collaboration systems to help contributors better coordinate their behaviors to achieve a common goal [48, 12]. For example, making a collaborator's contribution visible in a social coding environment can help other collaborators better understand the work progress and provide appropriate contributions accordingly. However, an exceeding amount of transparency can result in decreased creativity, difficulty in finding important information, and/or a breach of privacy for contributors [48, 2, 12]. Therefore, Erickson & Kellog introduced the social translucence framework to balance the benefits and dangers of social transparency [12]. They argue that making fellow contributors' behaviors *visible* in abstract representations can facilitate *awareness* of other contributors without breaching privacy, and thus make contributors *accountable* for their actions. In this work, we investigate the role of social translucence in an emerging online philanthropic collaboration system, medical crowdfunding.

Medical crowdfunding platforms are online platforms that allow users to solicit funds for a patient's medical expenses from a large number of distributed audience. This platforms provide a unique opportunity to explore the social translucence framework. In contrast to other online platforms where the users' activities mainly occur within the platform, as shown in Figure 1, crowdfunding users spend a significant amount of time outside of the platform (e.g., social media, other online communities, and offline) to promote their fundraising, build rapport with potential donors, and provide offline contributions (e.g., babysitting) to the patient [29, 51, 23, 24]. We define these external activities – campaign promotions and offline contributions – as non-monetary contributions. The non-monetary contributions have been shown to play an important role in the success of crowdfunding [29, 51, 40]. However, on the main crowdfunding platform, various non-monetary contributions are less visible than monetary contributions to fellow contributors and to potential contributors. This visibility imbalance among different types of contributions presents several social challenges that include not being able to know 1) the impact of non-monetary contributions [29, 23], 2) various non-monetary contribution opportunities [27, 24], and 3) the patient's contextual information that could increase the perceived credibility of campaigns [28].

To address the visibility imbalance problem, our work investigated ways to enrich social translucence in medical crowdfunding by aggregating and visualizing non-monetary contributions that reside outside of the ecosystem of the current crowdfunding space. First, based on the challenges due to the invisible non-monetary contributions, we developed three different types of interactive functional prototypes that highlight three aspects of non-monetary contributions – impact, opportunities, and contextual information – on medical crowdfunding campaigns. We then recruited medical crowdfunding beneficiaries and contributors who were willing to try our functional prototypes in their medical crowdfunding campaigns. While presenting our prototypes using their own campaign data, via interviews, we elicited how participants might use the visualizations to interact with their contributors or in making contributions. Through the lens of social translucence theory, we analyzed the perceived benefits and challenges of making contributions distributed across different online and offline

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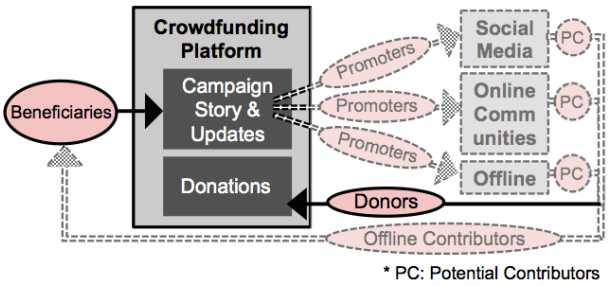

Figure 1. The diagram shows the current contribution structure of crowdfunding stakeholders – Beneficiaries, contributors (including campaign promoters, donors, and offline contributors), and potential contributors (PC). The black solid arrows indicate contribution behaviors that are highly visible on a crowdfunding platform. The grey dashed arrows show contribution behaviors that are not visible on a crowdfunding platform.

sites visible on the main crowdfunding site. Our findings suggest that unlike other collaboration systems where the main goal of social translucence is to facilitate contributions, our participants wanted social translucence to signal the worthiness of the philanthropic cause. Although participants acknowledged the value of visualizations in helping them identify effective ways of increasing contributions, they expressed concern that these visualizations lacked ways to signal the worthiness of a campaign. Drawing on this desire to both promote contributions while establishing the legitimacy of the campaign, we suggest an *enriched* social translucence where the system reveals non-monetary contributions that reside outside of the crowdfunding ecosystem to beneficiaries and contributors in a crowdfunding space through visualization. We further propose design considerations that emphasize a community's care, love, and sincerity in public and emphasize practical ways to elicit more contributions in private.

RELATED WORK

Social translucence refers to the practice of making socially relevant information visible to users on a sociotechnical system in order to influence the way people interact with others [11]. For example, disclosing users' contextual information in instant messaging (IM) such as a user's current location or availability helps other users to easily start a conversation [22]. On the other hand, revealing such information often raises privacy concerns [21]. Therefore, HCI researchers have extensively studied appropriate ways to make various types of information visible on sociotechnical systems [12, 7, 14, 31, 45, 48, 49, 50, 52, 55, 57, 56, 58, 59].

In this section, we first describe types of non-monetary contributions that are hidden from medical crowdfunding campaigns and challenges that medical crowdfunding beneficiaries and contributors face due to these invisible contributions. Then, to explore possible ways of making the information visible, we investigate how existing socio-technical systems employ social translucence to make the invisible activities visible.

Challenges due to Invisible Non-Monetary Contributions in Crowdfunding

Crowdfunding is the practice of raising funds for a campaign with a specific purpose by asking for donations from a large number of people, typically though online. Many researchers in crowdfunding have investigated the factors that lead to success in entrepreneurial crowdfunding campaigns [8, 13, 37, 44, 60, 38]. Because entrepreneurial crowdfunding campaigns typically request donations in exchange for products, high quality campaign materials increase the chance of success. Such materials included high quality videos [8], many campaign updates [60, 38], and persuasive fundraising descriptions [37, 38].

In contrast to entrepreneurial crowdfunding, medical crowdfunding requests funds to cover medical expenses of patients. Therefore, rather than high quality materials, factors showing the existence of a community's support around a patient such as pictures of friends who visited the patient's hospital or friends' long Facebook posts showing the patient's influences on the lives of many people make people trust and donate to these campaigns [28, 29, 51]. However, previous research found that those factors signaling community support are often not visible on a medical crowdfunding interface because they are spread across various online and offline media [29, 51].

Our work defines those people who support patients outside of medical crowdfunding campaigns as non-monetary contributors. Non-monetary contributors help patients prepare campaign materials, publicize the campaign to a wide audience, and provide offline support such as babysitting while patients are in hospital [29]. This wide range of non-monetary contributions together forms the infrastructure of medical crowdfunding that saves patients from the burden of asking for money and provides them with psychological support that often exceeds the monetary value of the campaigns [20, 19].

Despite the significant role non-monetary contributors play in sustaining medical crowdfunding campaigns, those contributions are not recognized on the campaign webpage. Little research has explored possible ways to make non-monetary contributions visible on medical crowdfunding campaign interfaces. Although Kim et al.'s work recognized non-monetary contributions on an existing contribution interface (see Figure 1-1) [27], the table view interface Kim et al. used does not highlight which campaign promotions have an impact on raising monetary donations. Further, the table view makes it difficult to identify all the possible types of non-monetary contributions because it only shows the most recent contributions on the front page. Therefore, in the next section, we explore how other researchers use visualizations to highlight hidden contribution patterns.

Supporting Social Translucence using Visualizations

Achieving the right level of visibility in socio-technical systems is a challenge, as simply revealing more data does not imply supporting social translucence. In fact, showing more data can actually lower the visibility for large datasets where meaningful data is buried under a large amount of non-significant data [2]. In these situations, aggregating data over meaningful dimensions and visualizing the results can help reach the desired level of visibility.

Researchers have visualized online communities to obtain a sense of the culture and patterns of the community without reading through years' worth of posts [10, 59, 58]. Visualizations often depicted contributions such as posts on Usenet

[58, 10, 52], code lines on Github [35, 16], and articles on Wikipedia [31, 50, 51]. Although these contributions are already embedded into the infrastructure or visible on the site, the visual representations uncover patterns of data (e.g., trends and outliers) that are hard to detect in textual representations [16, 31, 39, 50, 52, 57, 55, 56].

Contribution-based visualizations often show the distribution of contributions by members and/or over time (i.e., history). AuthorLines displays contributions of a single member by showing a double histogram of one's annual post activity [58] while Newsgroup Crowds visualization depicts the distribution of contribution over members [52]. Other works combine the distribution of contribution by members and over time in a single visualization. History flow visualization, which displays contributions by members on a timeline increased visibility as previously unknown patterns of social activity emerged, such as edit wars and article vandalism [59]. This type of visualization has been revived recently as DocuViz, an app that visualizes revisions of collaborative writing on Google Docs to assist authors, instructors, and researchers [56]. Github uses visualizations to show the history and members of a project using a timeline view. Developers use the activity history to make sense of the project structure and the roles of the contributors. This further allows contributors to make social inferences about fellow contributors' expertise and working style [7, 35, 36]. These details even assisted employers in assessing potential employees during the recruiting and hiring process [35].

All of the previous work on contribution visualization has focused on contributions that are embedded into the infrastructure and visible on the system. However, medical crowdfunding campaigns involve contributions that reside out side of the ecosystem of the current inhabited system: non-monetary contributions. Based on prior work on contribution visualization, we aim to investigate ways to make these external contributions visible on the system and thereby explore the impact of enriched social translucence of the community.

RESEARCH QUESTION

The goal of this study is twofold. First, we investigate possible ways to make non-monetary contributions visible on medical crowdfunding campaigns. Second, we aim to understand possible benefits and challenges of recognizing non-monetary contributions. To understand these issues from the perspectives of both medical crowdfunding beneficiaries and contributors, we investigate the following research question.

RQ: What inferences do medical crowdfunding beneficiaries and contributors make from interactive visualizations highlighting the impact of non-monetary contributions on their medical crowdfunding webpage?

METHODOLOGY

To answer our research question, we developed three different types of functional visualization prototypes that make non-monetary contributions residing outside of campaigns visible on participants' medical crowdfunding campaigns (Figure 2). This section first presents our rationale for choosing the features for visualizations and the design process of visualizations as well as procedures for participant recruitment, our study, and data analysis.

Rationale for Choosing the Features for Visualizations

Before developing interactive prototypes, we chose three features – contextual information, impact, and opportunities – that need to be highlighted on a medical crowdfunding platform to mitigate challenges due to the invisibility of outside non-monetary contributions [28, 29]. Below we explain why we selected each feature and how the feature can be presented in the context of medical crowdfunding.

Contextual Information

Some of the contextual information about the patient (e.g., medical journey, relationships with other people, and personal life) are often shared by the patient, friends, and family on social media when they promote the patient's campaign [29]. Although such contextual information can influence people's decision to contribute, it is not currently visible on the primary crowdfunding platform. Therefore, following the previous work's finding – people can infer a rich background story of medical crowdfunding patients through the non-monetary supporter's messages and pictures [27] – we decided to present the names of each contributor, and pictures and messages shared by the contributors to surface the contextual information.

Impact

Both patients and contributors of medical crowdfunding have difficulties in estimating the impact of their campaign promotions [29, 23]. Because they were not able to see what kinds of campaign promotions result in potential contributions, they had difficulties in coming up with an effective fundraising strategy. To present the impact of non-monetary contributions, we first estimated the value of each campaign promotion considering the amount of monetary donations that each campaign received after each promotion. For offline contributions, we asked each beneficiary participant to assess their value.

Opportunities

Potential contributors have difficulty in identifying possible non-monetary contributions they could provide [29]. To present various opportunities of medical crowdfunding contributions, we categorized contributions based on common features and a hierarchical structure emerged. For example, contributions were categorized into monetary and non-monetary contributions. Non-monetary contributions were further categorized into campaign promotions and offline support.

Visualizations Design Process & Rationale

To highlight three features mentioned above, three visualizations were created. Each visualization was designed to emphasize each feature at a time, but also included all three features. With the goal of visualizing these three features in the most effective manner, we chose visualizations that could best highlight those three axes based on visualization literature that compares graphical presentations [34, 33, 3]. Below, we show how we highlighted each aspect in the table, double histogram, and tree map views.

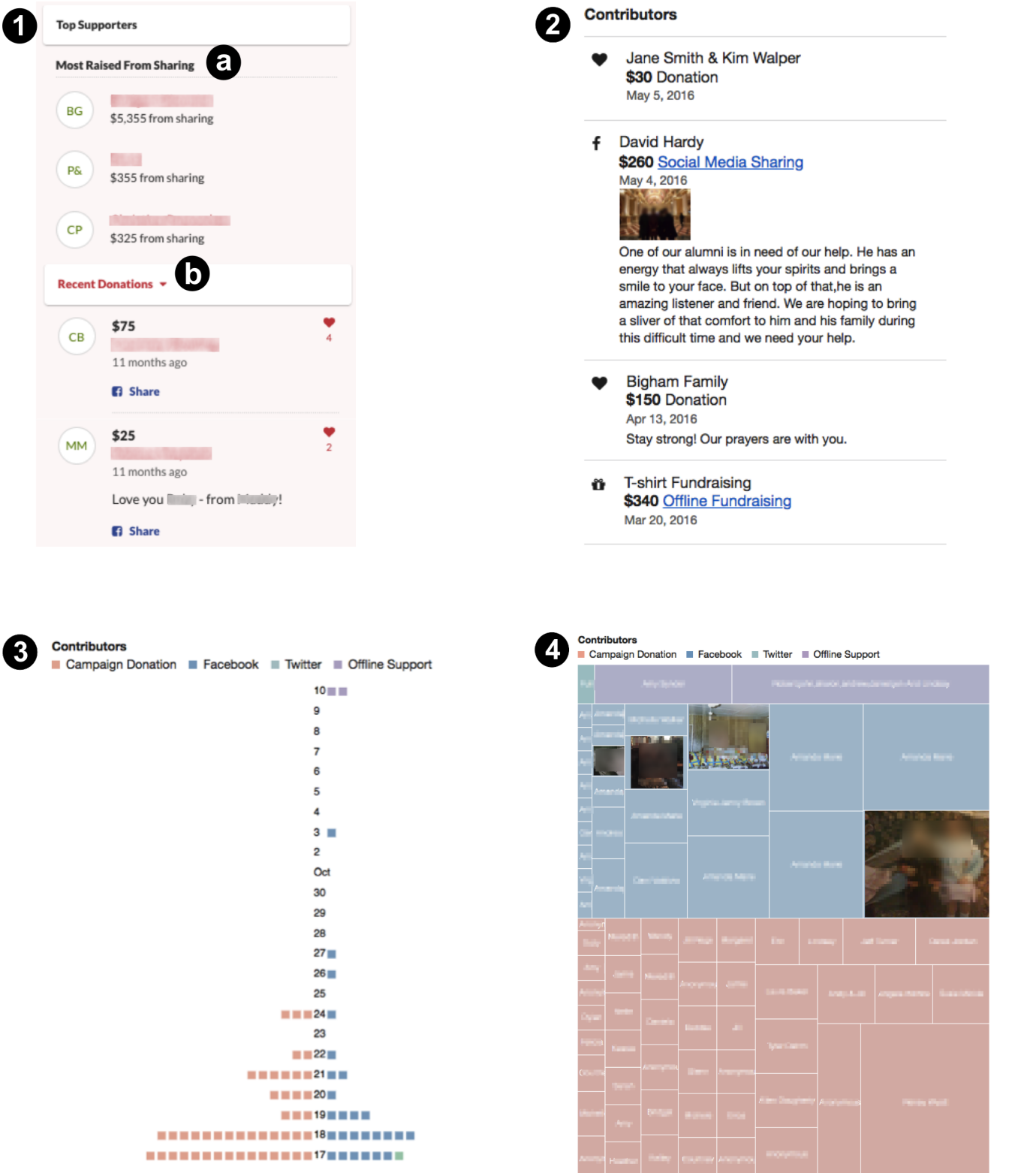

Figure 2. (1) GoFundMe contribution interface: (a) GoFundMe displays the names of the top five campaign sharers and the amount that they have raised from sharing. (b) Every monetary contributor's name, contribution date, amount, message are displayed in reverse chronological order. (Contributor names are blurred for privacy reasons.) (2) Table View: In each row of the table, each contributor's name, message, contribution amount, type, date are presented. (Pseudonyms were used to protect contributors' privacy.) (3) Double Histogram View: Rectangles on the left side of the timeline represent monetary contributions to a campaign. Rectangles on the right side of the timeline represent non-monetary contributions. By placing the same day's contributions on the same row, we can identify the correlation between the two types of contributions. (4) Treemap View: The size of each rectangle represents the amount of contributions. Each color represents different types of contributions. (Contributor names and images were blurred to protect contributors' privacy.)

Table View

The table view was chosen to highlight the contextual information about a patient in the most straightforward way (Figure 2-2).

Contextual Information: To investigate succinct ways of visualizing contextual information, we have tried several text visualizations including *Word Clouds* and *Word Tree*. However, with those visualizations, rich background story about a patient was not readily captured. Instead, our pilot study feedback revealed that reading the actual messages and seeing pictures shared by each contributor upfront was more effective in understanding the patient's stories because people are used to reading stories in the form of social media news feed. Therefore, we presented all the contextual information in the table view. Since the table view is similar to the current form of the monetary contribution interface on medical crowdfunding campaigns (Figure 2-1-b), we anticipated that people would easily make sense of detail contents from it.

Impact & Opportunities: In the table view, we presented the contribution impact in text form using the estimated amount value (e.g., $100). This is different from the existing interface, such as GoFundMe, where the impact of non-monetary contributions is recognized in a separate interface (Figure 2-1-a) by displaying the top five campaign promoters who have raised the highest amount of monetary donations as a result of their sharing activities. In our table view, we displayed all of the campaign promoters and offline contributors because we did not want to prioritize some but wanted to acknowledge all of the contributors.

To expose viewers to various contribution opportunities, we showed the contribution types (e.g., social media sharing) as icons in the table view. Instead of separating non-monetary and monetary contribution interface, our table view combines them, ordered by date.

Double Histogram View

The double histogram view was selected to highlight the impact of non-monetary contributions on campaign monetary donations (Figure 2-3).

Impact: To effectively highlight the impact, we considered two criteria. First, we looked for visual designs that can highlight the relationship between monetary and non-monetary contributions. Second, we searched for designs that can take into account the temporal relationship between campaign monetary donations and non-monetary contributions (e.g., campaign donations typically come a day or two days after the campaign promotions). To find effective ways to highlight the correlation pattern, from prior research [34, 33, 3], we discovered *Double Axis*, *Scatter Plot*, and *Bubble Chart*. Also, to highlight the time difference, the *Timeline* and *Histogram* visualization were investigated. However, none of these visualizations was able to highlight both the correlation and timeline pattern together.

Therefore, we searched for other visualization literature and found *Double Histogram*, developed by Viegas and Smith, that shows two variables along the same timeline and thereby highlights the relationship between the two variables [57]. Our temporal series of double histograms (Figure 2-3) meets both correlation and temporal criteria by showing co-occurring non-monetary and monetary contributions in timeline. Each rectangle represents one contribution event regardless the type of contribution. By placing monetary contribution rectangles on the left side of the timeline and non-monetary contribution rectangles on the right, viewers can easily note the correlation between the two types of donations.

Contextual Information & Opportunities: The contextual information of each contribution is shown when people mouse over each rectangle of contributions in the double histogram view (Figure 2-3). Various contribution opportunities are highlighted with different colors (e.g., campaign donations are presented with pink color).

Treemap View

Treemap view was chosen to emphasize various contribution opportunities in medical crowdfunding (Figure 2-4). As mentioned above, when we categorized various contribution opportunities, a hierarchical structure emerged.

Opportunities: To best present the hierarchical structure, we found *Circle Packing*, *Tree Diagram*, and *Treemap* from prior research [3]. Among these visualizations, our criteria was to select the visual representation that can effectively display a large number of items in a limited space of a crowdfunding interface. The treemap view was chosen because the other two visualizations took up unnecessary space on the interface. With the treemap view, to effectively show a fingerprint of the contribution space [5], we visualized the distribution of contribution by members and by the type of contribution. By coloring and grouping contributions by contribution types and labeling each cell with the contribution's name, the viewer can easily observe the landscape of the contributions for a given campaign in a single visualization.

Impact & Contextual Information: In the treemap view, the impact of contributions is presented with the size of the rectangle. The contextual information of each contribution, such as contributor names and pictures shared by contributors, are presented within each rectangle. The detail messages are shown when people mouse over each rectangle.

Participants

To recruit medical crowdfunding beneficiary and contributor participants, we made a broad recruitment call via a University mailing list and on various online communities such as Craigslist and Reddit. We also posted flyers in public places. We targeted sub-reddits related to charity, fundraiser, and medical crowdfunding sites (e.g., GoFundMe subreddit) because medical crowdfunding beneficiaries and contributors often promote their campaign on those sub-reddits. We could not recruit participants from online crowdfunding sites such as GoFundMe and YouCaring because the sites no longer allowed recruiting.

Our inclusion criteria limited participants to those who have participated in online medical crowdfunding campaigns via online crowdfunding sites such as GoFundMe. We restricted our criteria to crowdfunding sites because our study investigates possible ways to present contributions that would replace an existing contribution interface. Therefore, people who have

privately raised monetary donations via personal Paypal accounts or conducted offline fundraising were excluded from our study. We only recruited 1) people who have created or benefited from medical crowdfunding campaign webpages and 2) people who have contributed through medical crowdfunding campaign webpages. To verify that people who signed up for our study met the inclusion criteria, we asked them to submit a URL for a medical crowdfunding campaign in which they had participated. We reviewed each person's campaign URL and recruited 15 participants who met our inclusion criteria that include six beneficiaries and nine contributors of medical crowdfunding campaigns. Of our 15 participants, 12 were female. The average age of the participants was 32.

Study Procedure

Our study consisted of two sessions: a data collection session and a semi-structured interview session. During a data collection session, we collected participants' monetary and non-monetary data prior to the interview in order to show participants' own data in the visualizations. We then conducted semi-structured interviews while participants interact with visualizations. The interviews with beneficiary and contributor participants took about 90 minutes and 60 minutes, respectively. After the interview, we offered $30 and $20 gift cards to beneficiary and contributor participants, respectively. Beneficiaries were compensated more than contributors because they shared their sensitive medical and financial situations.

Data Collection

Prior to each study, all participants were asked to provide a link to their campaign or a campaign that they have contributed to. From the campaign webpage, we pulled monetary contribution data including contributors' names, contribution amount, and contributors' messages. We also collected social media sharing activities associated with the campaign by searching for the campaign URL on various online sites such as Google, social media (e.g., Facebook, Twitter, and Instagram), and online communities (e.g., reddit, personal blogs). We also asked participants to provide offline contributions that they had received or provided. Those offline contributions included monetary donations that they had received offline, offline fundraising events, or being delivered food in the hospital.

Semi-structured Interviews with Visualization Probes

Inspired by technology probes that deploy core features of a future system to examine how users interpret them [25], we conducted visualization probes using three web interfaces that visualize both monetary and non-monetary contributions in different ways. The data visualized on the interfaces were customized to each participant to increase their ecological validity. We first had participants interact with each visualization and asked them to talk aloud about any patterns and inferences they could find from each visualization. We then began the interview by asking their perception of each visualization and the possible uses of each visualization when interacting with the campaign beneficiary or other contributors. More specifically, for beneficiary participants, we asked about the possible impact of visualizations in managing their campaign and contributors. For contributor participants, we asked about influences that the visualization could have on their contribution activities. We further inquired about how the visualizations might affect their perception of the medical crowdfunding beneficiary and other contributors. Participants were asked why they preferred one visualization over another.

Data Analysis

The social translucence theory emphasizes the importance of addressing possible benefits and drawbacks that can emerge as a result of increasing social transparency. Inspired by the theory, we applied an open coding approach to analyze what benefits and drawbacks medical crowdfunding beneficiaries and contributors perceive in the use of visualizations during the medical crowdfunding process. Two researchers coded each line of the interview scripts based on the proposed use of the visualizations. We then based our second coding on the social translucence framework to more deeply understand the benefits of the visualizations in the context of visibility, awareness, and accountability.

RESULTS

In this section, we report how the features highlighting contextual information, impacts, and opportunities in three different types of visualizations can solve different aspects of the visibility problem by enriching social translucence in medical crowdfunding. Our findings organize in three constructs of social translucence: visibility, awareness, and accountability. In addition, we further report how the visualizations can result in unexpected challenges.

Table View

Visibility: Context Feature

In the table view, we presented every message and picture shared by both monetary and non-monetary contributors. The table view was perceived as personal because participants could see contributors' names, messages, and pictures upfront. This finding is consistent with Kim et al.'s work, which shows that those context features help people find more personal connections to the beneficiary [27].

Awareness: Sincere Support

Our contributor participants liked seeing detail contents in the table view publicly on a campaign because they can identify more mutual friends who shared a campaign on social media and gave offline support. Especially in campaign shares, contributors often described their reasons for supporting a campaign. The thoughtful messages made our contributor participants feel more connected to the patient and know more about the patient. Making details of outside contributions visible helped beneficiary participants become aware of how much time and energy their supporters spend to support them on various sites.

"It's nice to have it all [campaign shares] here and it just falls into one story. I'm seeing more people's story of Mark [the patient], I guess, description of him. It takes so much of the time to write it [each message in campaigns shares]. It's nice hearing from other people." - C2

Accountability: Regular Updates & Honest Use of Funds

Since beneficiary participants can now visually see that many people cheer for their quick recovery from medical conditions,

they felt responsible to give back to those contributors by giving updates about their medical progress and how they used the contributors' donations. They felt responsible for using the collected funds more honestly and for expressing gratitude to the community.

"I wasn't supper worried about defending where the money was going. But, we had a lot of stranger givers which was surprising. I know people made sacrifices for our family. So I do want them to see that the money is going to our child's needs." - B3

Challenges: Privacy Issues

However, both beneficiary and contributor participants were concerned about privacy issues that can arise from making detail non-monetary contributions publicly visible on a medical crowdfunding campaign. For example, campaign promotions that are shared on various social media sites were targeted for the audience inside of social media sites. Therefore, participants worried that those detail messages and pictures might contain sensitive medical information, which the promoters do not want to share in public.

"I'm a little bit weary of companies using my data. I usually share something public on Facebook. But I don't know if I would like it to be viewable and aggregated in this way." - C3

Double Histogram View

Visibility: The Impact of Outside Contributions

The double histogram view showed correlation patterns between monetary and non-monetary contributions. Visualizing the correlation pattern between outside non-monetary contributions and campaign monetary contributions helped participants better understand the impact of outside contributors.

Awareness: Reflection

Participants were also excited to discover unexpected patterns or incidents from the double histogram view. For example, one supporter was surprised that an update containing a funny picture taken from the hospital got more shares and donations than other serious medical updates. Furthermore, when some beneficiary participants observed a distinct pattern where they received many donations without any non-monetary contributions noted on the double histogram view, they drew from their memories and talked about why this pattern might have occurred.

"I know these three [donations] came in because a friend sent an e-mail like on June 23rd. I can relate to why that is happening right now. A friend of mine in New York asked how we were doing and what we needed and she sent an e-mail after talking to me. I didn't even ask her to do it. So this is really cool." -B2

Accountability: Sharing & Encouraging Sharing

All of our participants acknowledged the practical value of the impact feature showing correlations between monetary and non-monetary contributions in the double histogram view. For example, participants could relate the number of donations to campaign promotion activities and eventually inferred the identity of the person who elicited the highest number of donations. Seeing the pattern of non-monetary contributions leading to donations motivated participants to share a campaign more on social media and ask an influential person to share more. In medical crowdfunding, contributors often personally know other contributors. Therefore, contributor participants who have many social media audience described feeling responsible for sharing a campaign on their social media as others would know that they can also make similar impact. Further, contributor participants who know the influential person felt accountable for reaching out and encouraging him/her to share a campaign more.

"If someone draws that many donations, maybe ask this friend to make another post because they do have a lot more impact in social media." -C6

Challenges: Feeling Strategically Targeted

Participants perceived that publicly showing the correlation between non-monetary and monetary contributions might be overwhelming for contributors. Participants worried that if contributors saw the campaign promotion that prompted them to donate, contributors might think that they were strategically targeted for soliciting donation. Beneficiary participants would not want to publicly present their strategic motives on their campaign because this would contradict the emotional motivations of donation, such as compassion and altruism.

"I just think it's too much information for someone who's making donations. For example it's just too much for them to see 'oh, I donated it because of this post.'" -B2

Challenges: Feeling Impersonal

Interestingly, the analytic components of the double histogram view also made participants perceive it as "impersonal (see Figure 1-3)." As a result of this, they were reluctant to display it publicly on the front page of a campaign. Two reasons were given for this impression. First, participants described that the number of rectangles reminded them of a dashboard or a spreadsheet, which highlights a "numerical" or quantitative nature, a competition of sorts. Second, context features that were not directly visible from the double histogram view made the view impersonal compared to other views. For example, participants often compared the double histogram view to the table view. In the double histogram view, participants had to hover over each rectangle to see the details. Therefore, instead of publicly displaying a histogram view on a campaign, our participants wanted to use the view for private data analytics.

"I think the table definitely tells a story. I'm more easily able to see people's message, and how much they're donating and their names, instead of having to hover over each dot and see what they say. It [double histogram view]'s a little technical. I can see this being helpful for people who are actually trying to improve the campaign and for future direction." -C5

TreeMap View

Visibility: Contribution Opportunities

In the treemap view, we highlighted a wide range of contribution opportunities in medical crowdfunding campaigns. In this visualization, participants mentioned the benefits of seeing all the names of contributors in one integrated space and navigating a wide range of contribution opportunities.

Awareness: Sense of Community

Beneficiary participants felt touched and cared for when seeing all the contributors' names in the treemap view as they could know that families, friends, and even strangers in different domains of their life supported them together. Furthermore, they felt touched to see a lot of small monetary and non-monetary contributions come together to comprise a large portion of total donations.

Contributor participants also liked the treemap view as it visually showed the collaborative effort of a larger community in supporting the beneficiaries. Especially, the overall design of the treemap view gave participants a sense of belonging because they felt a part of the community by seeing their name integrated into the community "quilt" or landscape. This sense of belonging and being recognized is important because non-monetary supporters often feel the desire to be publicly acknowledged for their work as their efforts are currently invisible [29]. The treemap view that visually shows their contribution in a larger community made non-monetary supporters feel a sense of belonging.

"Design looks like building a house. You have to pile many tiny rocks and it takes so long to build one wall. It looks like people work hard. It's like building something towards the goal. It can be house. It can be a hope or anything. But, I think people are donating and everything is together, and it makes them feel a sense of belonging." -B1

Accountability: Joining & Committing to Deliver Non-monetary Contributions

The treemap uses color-coding to emphasize variations in contribution types and distinguish each type. This approach led contributor participants to be aware of various non-monetary contribution opportunities outside of a campaign. Especially, when contributor participants discovered online and offline non-monetary activities that their close friends or friends that they trust or admire have joined motivated them to participate in the activities. By joining the activities, they also wanted to publicly show their names on the tree map view, so their names can motivate others' contributions. Furthermore, with their names publicly displayed, contributor participants anticipated the benefit of being accountable for delivering their commitment as their friends and others would watch them.

"If there was someone helping with information, 'Oh, I also know about this. I also have a support group that I could tell you about.' Or you could also get ideas like, 'Someone made a drawing I can draw. I can also make a drawing and share it this way.'" -C4

Challenges: Fostering Comparison & Competition

Participants were concerned that the size of rectangles in the treemap view might emotionally discourage other potential contributors. We chose to indicate the contribution amount through size because previous research showed that visualizing the amount of contribution helped people better understand overall interaction patterns within an online community [31, 16, 57]. However, in medical crowdfunding, participants were very cautious about explicitly indicating the monetary contribution amount in public because the amount could imply sensitive information such as their socio-economic status. Participants were also concerned about showing contributions in different sizes because they valued each contribution equally.

"Every small or large contribution was a beautiful gesture. I don't want the people who have means [to] necessary outshine the people, that maybe $10 is a lot harder for one person than $200 for this one person who has a pretty good job or [has] more rich parents or something. I don't want class to be so visibly indicated in whether or not you make a difference." -C1

Most of our participants also worried that publicly displaying the proportions of contribution amount, especially for monetary donations, might foster comparison and competition among contributors. Participants expressed concerns that some contributors who intended to contribute a few dollars might not contribute to the campaign at all because they did not want to see their name represented at a small scale. On the other hand, other participants commented that the competition might have a beneficial aspect as it might spur some contributors to contribute more because they want to see their name bigger publicly on the campaign. This finding was consistent with Smith et al.'s work showing that a large donation amount from peers may spur competition to be the top donor [43].

"This almost looks like a score board. If you wanted to try to be competitive about it, you might want to make your name bigger. -C3

DISCUSSION

Our work offers a new way of considering social translucence in the context of designing crowdfunding platforms where users' activities occur across various online and offline sites. Prior work on social translucence mainly focused on making invisible information that is already available on the site more visible (e.g., log history) to facilitate users' communication and collaboration [12, 11]. However, our work goes beyond this assumption that all essential information is available on the site. For example, in many collective activities such as crowdfunding or crisis responses on social media, people work across sites to achieve a common goal [6, 29, 23]. Therefore, it is important to support social translucence across various sites to help people become more aware of each others' activities and thus accountable for one another. To the best of our knowledge, our work is the first attempt to investigate various ways to visualize across sites' activities to support translucence.

In his work on social translucence, Gilbert identified an area in social network structure where the theory of social translucence broke down due to the one-way visibility in social network sites [15]. Similarly, we illustrate the role of social translucence in the domain of medical crowdfunding. Since the concept of crowdfunding did not exist when the social translucence theory was built, examining the role of social translucence in medical crowdfunding can offer novel theoretical guidances for crowdfunding platform designers.

In this section, we first interpret our study results in the context of social translucence theory. We then suggest design implications that can better highlight the philanthropic cause when enriching social translucence in medical crowdfunding

campaigns. We further discuss how our findings can contribute to a broader philanthropic research community as those communities also aim to promote pro-social behaviors and build a sense of community among volunteers working across various online and offline sites [47, 46, 6, 1, 51, 17].

Enriched Social Translucence

In this section, we summarize our findings in the context of the social translucence framework–visibility, awareness, and accountability–and suggest how other crowdfunding research could benefit from the enriched social translucence. We then discuss privacy issues that can be caused by enriched social translucence.

Visibility, Awareness, and Accountability

Our work showed that making details of outside contributions *visible* in the table view helps beneficiary participants become *aware* that more people care, work, and cheer for the beneficiaries themselves. Becoming aware of many people's involvement in their crowdfunding campaign made beneficiary participants feel *accountable* for using the collected funds more honestly and writing updates on their medical progress and the uses of their funds to express gratitude to their large community.

Establishing the credibility of a crowdfunding campaign is a critical factor for success in both philanthropic and entrepreneurial crowdfunding [51, 30]. In philanthropic crowdfunding, the perceived legitimacy of a campaign draws contributions because potential contributors want to ensure that their funds are used to benefit the cause that they donated for [51, 28]. In entrepreneurial crowdfunding campaign, the active communication behaviors–frequent and regular updates–influence trust by showing the diligence of the fundraiser, and have led to an increased rate of success of the campaigns [60, 30]. Therefore, crowdfunding research communities could benefit from enriched social translucence since making previously invisible outside contributions of crowdfunding visible could help establish trust on crowdfunding.

Furthermore, our study showed that making a wide range of non-monetary contributions and their impact *visible* made contributor participants become *aware* of more non-monetary contribution opportunities that they can participate in. Especially, contributor participants were interested in offline contribution opportunities as many did not even know the opportunity exists due to its invisibility. The crowdfunding sites can facilitate offline contributions by allowing the beneficiaries to list all possible opportunities and allowing the contributors to sign up [41, 29]. Such interface will not only recognize offline contributor' activities in front of all other contributors, but also make contributors who signed-up for the contributions feel more *accountable* for delivering their commitment.

Other philanthropic crowdfunding communities such as education and disaster support can also benefit from this enriched social translucence as they also have various outside contribution opportunities such as donating stationery, food, or volunteering for organizing shelters for those affected by disaster. Enriched social translucence could widen more contribution opportunities in philanthropic crowdfunding by recognizing a wide range of currently invisible contribution behaviors on their platform.

Privacy Issues

Social translucence framework suggests that we should design online collaboration systems that make contributors' behaviors visible to one another. However, the visibility often causes privacy issues, so the concept of "translucence" plays an important role here. This is why our paper also uses the term enriched social "translucence" instead of transparency. We want to highlight the danger of revealing too much sensitive information in medical crowdfunding campaigns when incorporating outside contributions. In this section, we discuss guidelines for including non-monetary contributions in visualizations by considering both dangers of revealing excessive details and benefits of including more informative contents to emphasize the value of the medical crowdfunding cause.

Our study results show that the privacy issue of enriched social translucence comes into play when visualizing the monetary contribution amount. Since many crowdfunding contributors know each other, seeing each others' contribution amount made people compare and judge other contributors. Furthermore, visualizing external non-monetary medical crowdfunding contributions can reveal potentially sensitive patient's private information such as a personal back story about their medical conditions or financial situations. For example, when a supporter shares a crowdfunding campaign that raises money for a baby's surgery, she might write additional details such as the multiple rounds of fertility treatments the baby's parents had go through to have this baby. Although the additional information provides a richer back story and credibility to the original medical crowdfunding story, beneficiaries may not want to share such private information in public space.

On the other hand, some types of non-monetary data can better signal the worthiness of the medical crowdfunding cause over others. For example, Kim et al. found that messages from the beneficiaries' friends who mentioned the beneficiary's giving personalty or good shared memories with the beneficiary signal the credibility of the cause compared to more generic messages such as good luck [28]. Other research in philanthropic crowdfunding such as crowdfunding for loan lending, educational support, and stigmatized individuals suggest that the social cues signaling the interpersonal similarities between the cause and contributors (e.g., background or belief) [9, 61, 27] or the beneficiaries' expression of appreciation to contributors are likely to draw more contributions [1]. Future research could investigate how to highlight those data in a real philanthropic contribution setting and how they influence the contribution and collaboration behaviors.

Design Implications for Philanthropic Crowdfunding

Our results show that presenting various online and offline channels helped participants obtain a more comprehensive view of the contribution infrastructure that supports medical crowdfunding campaigns. Despite the pragmatic benefit, participants expressed concerns about publicly showing the analytical view such as the double histogram view on medical crowdfunding campaigns. This desire to show specific information in public and private spaces maps onto Goffman's front

and back stage analogy, respectively [18]. Goffman explains that in the "front stage" performers wish to selectively present themselves as a part of the performance. However, on the "back stage" they freely express actions that were not allowed on the front stage. In medical crowdfunding, seeking monetary donations was considered something people should do on the back stage. In the front stage, people were expected to emphasize care, collaboration, and community. **The different needs of the front stage and back stage suggest the need for different interface features for public and private components of medical crowdfunding campaigns.** This section describes different types of representations appropriate for public and private purposes.

Public View: Highlighting Philanthropic Causes with Qualitative Elements such as Pictures and Stories

For the public view, our study found **limitations of visualizing quantitative elements of contributions** (e.g., increases or decreases of contributions or sizes of contributions) in conveying the contributors' sincerity, efforts, and love for the beneficiary. The contributors' collective care for the beneficiary forms the beneficiary's identity as a person who is loved by a large community [27]. However, the number and size of rectangles, charts, and graphs were limited in depicting the human characteristics that contribute to the beneficiary's identity. Participants wanted to see more personal elements such as messages, names, and pictures of contributors to feel the contributors' care for the beneficiaries. The visualization research community has also examined effective ways to visualize humanitarian data to elicit empathy and pro-social behaviors such as donation. For instance, visualization practitioners have suggested using anthropomorphized graphics (e.g., isotype [32]) to demonstrate a "human dimension" of the abstract data instead of existing chart visualizations as they have more immediate visual connection to people. However, a recent study by Boy et al. found that anthropographic and standard charts had no significant difference in eliciting empathy and pro-social behaviors [4], which signifies that changing the form of visualizing illustrating quantitative elements is still limited when representing human characteristics.

Instead of visualizing quantitative elements of contributions, our results suggest **visualizing qualitative elements better to convey the community's sincerity, efforts, and care.** Those qualitative features include a broad range of support activities, diverse topics that supporters discuss about the cause (or beneficiaries), reciprocal communications among supporters, and pictures of offline support activities. For example, in a philanthropic community like Red Cross, a potential volunteer might be more willing to help people affected by an earthquake after seeing a broad range of difficulties that people face (e.g., losing homes, lack of food, deficit care for children who lost their parents) rather than the number of people affected by an earthquake. This idea of highlighting concrete situations and stories of victims rather than quantified elements of victims follows the concept of the "identifiable victim effect [42, 26]."

The identifiable victim effect suggests people are more willing to contribute their resources to help identified victims rather than unidentified or statistical victims [42, 26]. We found that a categorical visualization such as a treemap and qualitative data of non-monetary contributions have adequate features to bring out the identifiable victim effect. Therefore, **to highlight stories of people affected by crisis events, we suggest visualizing the broad range of difficulties faced by people in a treemap and add stories to the visualization**. For example, breaking down a difficult situation (represented by the entire treemap) into specific challenges people face (represented by big rectangles in the treemap) might help more people relate to the cause and the affected people. To incorporate more context and story into the visualizations, each category can be further divided into individual stories, represented as small rectangles. When people click a smaller rectangle in a category, they can read actual stories and see photos and videos of the affected people or volunteers who are helping them. This visualization highlighting qualitative features over quantitative features could signal the community's care for the cause and may attract more volunteers to join the community.

Private View: Supporting Analytics for Contributions

In the private view, as our study demonstrated, **visualizations highlighting quantitative features of contributions using analytical components can help beneficiaries better identify effective fundraising strategies** such as finding the updates that had the most impact on the contributions or finding contributors who raised a large amount of money from sharing. To better support fundraising strategies, the medical crowdfunding community could also benefit from other commercial analytic tools used by digital volunteers in philanthropic communities [6] such as TweetTracker [53] or Ushahidi [54]. Such tools not only track various social media data but also allow users to curate the data in a more flexible way by filtering and labeling the data using keywords, hash tags, and locations. Furthermore, they make the visualizations more interactive and use the configurable bars and timeline views to support the data analysis process. These flexible and interactive data analysis tools can also help medical crowdfunding beneficiaries to find insights from their contribution data.

LIMITATIONS

Our study is limited by the small number of participants. Although we made a large recruitment call using various online and offline channels, only six medical crowdfunding beneficiaries responded. The low response rate of beneficiaries might be due to their difficult medical conditions and reluctance of sharing sensitive medical and financial situations as reported in other medical crowdfunding studies [29, 27, 20]. Further, we could only recruit supporter participants via beneficiaries as we needed the permission and help from the beneficiary to collect rich external non-monetary contribution data. Even with a small number of participants, our study presents rich qualitative data regarding the uses of different styles of visualizations in their medical crowdfunding.

REFERENCES

[1] Tim Althoff and Jure Leskovec. 2015. Donor Retention in Online Crowdfunding Communities : A Case Study of DonorsChoose.org. In *Proc. WWW 2015*. 34–44. DOI: http://dx.doi.org/10.1145/2736277.2741120

[2] Mike Ananny and Kate Crawford. 2016. Seeing without knowing: Limitations of the transparency ideal and its application to algorithmic accountability. *new media & society* (2016), 1461444816676645.

[3] Michael Bostock and Jeffrey Heer. 2009. Protovis: A graphical toolkit for visualization. *IEEE transactions on visualization and computer graphics* 15, 6 (2009), 1121–1128.

[4] Jeremy Boy, Anshul Vikram Pandey, John Emerson, Margaret Satterthwaite, Oded Nov, and Enrico Bertini. 2017. Showing People Behind Data: Does Anthropomorphizing Visualizations Elicit More Empathy for Human Rights Data?. In *Proceedings of the 2017 CHI Conference on Human Factors in Computing Systems*. ACM, 5462–5474.

[5] danah boyd, Hyun-yeul Lee, Daniel Ramage, and Judith Donath. 2002. Developing Legible Visualizations for Online Social Spaces. Figure 1 (2002).

[6] Camille Cobb, Ted McCarthy, Annuska Perkins, Ankitha Bharadwaj, Jared Comis, Brian Do, and Kate Starbird. 2014. Designing for the deluge: understanding & supporting the distributed, collaborative work of crisis volunteers. In *Proceedings of the 17th ACM conference on Computer supported cooperative work & social computing*. ACM, 888–899.

[7] Laura Dabbish, Colleen Stuart, Jason Tsay, and Jim Herbsleb. 2012. Social Coding in GitHub: Transparency and Collaboration in an Open Software Repository. In *Proc. CSCW 2012*. 1277–1286. DOI: http://dx.doi.org/10.1145/2145204.2145396

[8] Sanorita Dey, Brittany Duff, and Karrie Karahalios. 2017. The Art and Science of Persuasion : Not All Crowdfunding Campaign Videos Are The Same Predictors of Crowdfunding Success. In *Proc. CSCW 2017*. DOI:http://dx.doi.org/10.1145/2998181.2998229

[9] Sanorita Dey, Karrie Karahalios, and Wai-Tat Fu. 2018. Effects of Socially Stigmatized Crowdfunding Campaigns in Shaping Opinions. In *Proceedings of the 2018 CHI Conference on Human Factors in Computing Systems*. ACM, 242.

[10] Judith Donath, Karrie Karahalios, and Fernanda Viegas. 1999. Visualizing conversation. *Journal of computer-mediated communication* 4, 4 (1999), JCMC442.

[11] Thomas Erickson, Christine Halverson, Wendy A Kellogg, Mark Laff, and Tracee Wolf. 2002. Social translucence: designing social infrastructures that make collective activity visible. *Commun. ACM* 45, 4 (2002), 40–44.

[12] Thomas Erickson, Wendy A Kellogg, and I B M T J Watson. 2000. Social Translucence : An Approach to Designing Systems that Support Social Processes. *ACM Transactions on Computer-Human Interaction* 7, 1 (2000), 59–83.

[13] Elizabeth M Gerber and Julie Hui. 2013. Crowdfunding : Motivations and Deterrents for Participation. *ACM Transactions on Computer-Human Interaction* 20, 6 (2013), 32. DOI:http://dx.doi.org/10.1145/2530540

[14] Eric Gilbert. 2012a. Designing social translucence over social networks. *Proc. CHI 2012* (2012), 2731–2740. DOI:http://dx.doi.org/10.1145/2207676.2208670

[15] Eric Gilbert. 2012b. Phrases that signal workplace hierarchy. *Proceedings of the ACM 2012 conference on Computer Supported Cooperative Work - CSCW '12* (2012), 1037. DOI: http://dx.doi.org/10.1145/2145204.2145359

[16] Eric Gilbert and Karrie Karahalios. 2007. CodeSaw: A Social Visualization of Distributed Software Development. (2007), 303–316. DOI: http://dx.doi.org/10.1007/978-3-540-74800-7_25

[17] Jeremy Goecks, Amy Voida, Stephen Voida, and Elizabeth D Mynatt. 2008. Charitable technologies: Opportunities for collaborative computing in nonprofit fundraising. In *Proceedings of the 2008 ACM conference on Computer supported cooperative work*. ACM, 689–698.

[18] Erving Goffman. 1959. *The Presentation of Self in Everyday Life*. Anchor: New York.

[19] Amy Gonzales. 2017. Flexibility and Intangibles : The Crowdfunding Needs of Stigmatized Individuals. *Proc. CHI 2017* (2017), 2371–2375. DOI: http://dx.doi.org/10.1145/3025453.3025647

[20] Amy L Gonzales, Elizabeth Y Kwon, Teresa Lynch, and Nicole Fritz. 2016. "Better everyone should know our business than we lose our house": Costs and benefits of medical crowdfunding for support, privacy, and identity. *New Media & Society* (2016). DOI: http://dx.doi.org/10.1177/1461444816667723

[21] Jeff Hancock, Jeremy Birnholtz, Natalya Bazarova, Jamie Guillory, Josh Perlin, and Barrett Amos. 2009. Butler Lies: Awareness, Deception, and Design. In *Proc. CHI 2009*.

[22] Gary Hsieh, Karen P Tang, Wai Yong Low, and Jason I Hong. 2007. Field Deployment of IMBuddy : A Study of Privacy Control and Feedback Mechanisms for Contextual IM. *Proc. Ubicomp 2007* (2007), 91–108. DOI:http://dx.doi.org/10.1007/978-3-540-74853-3_6

[23] Julie S. Hui, Elizabeth M. Gerber, and Darren Gergle. 2014a. Understanding and Leveraging Social Networks for Crowdfunding: Opportunities and Challenges. In *Proc. DIS 2014*. ACM Press, 2083–2088. DOI: http://dx.doi.org/10.1145/2559206.2581289

[24] Julie S. Hui, Michael D. Greenberg, and Elizabeth M. Gerber. 2014b. Understanding the role of community in crowdfunding work. In *Proc. CSCW 2014*. 62–74. DOI: http://dx.doi.org/10.1145/2531602.2531715

[25] Hilary Hutchinson, Wendy Mackay, Bo Westerlund, Benjamin B Bederson, Allison Druin, Catherine Plaisant, Michel Beaudouin-Lafon, Stéphane Conversy, Helen Evans, Heiko Hansen, and others. 2003. Technology probes: inspiring design for and with families. In *Proceedings of the SIGCHI conference on Human factors in computing systems*. ACM, 17–24.

[26] Karen Jenni and George Loewenstein. 1997. Explaining the identifiable victim effect. *Journal of Risk and Uncertainty* 14, 3 (1997), 235–257.

[27] Jennifer G Kim, Hwajung Hong, and Karrie Karahalios. 2018. Understanding Identity Presentation in Medical Crowdfunding. *In Proc. CHI 2018* (2018).

[28] Jennifer G Kim, Ha Kyung Kong, Karrie Karahalios, Wai-tat Fu, and Hwajung Hong. 2016. The Power of Collective Endorsements : Credibility Factors in Medical Crowdfunding Campaigns. In *Proc. CHI 2016*. DOI:http://dx.doi.org/10.1145/2858036.2858289

[29] Jennifer G. Kim, Kristen Vaccaro, Karrie Karahalios, and Hwajung Hong. 2017b. "Not by Money Alone" : Social Support Opportunities in Medical Crowdfunding Campaigns. In *Proc. CSCW 2017*. DOI: http://dx.doi.org/10.1145/2998181.2998245

[30] Yongsung Kim, Aaron D Shaw, Haoqi Zhang, and Elizabeth Gerber. 2017a. Understanding Trust amid Delays in Crowdfunding.. In *CSCW*. 1982–1996.

[31] Aniket Kittur, Bongwon Suh, Ed H Chi, and Palo Alto. 2008. Can You Ever Trust a Wiki ? Impacting Perceived Trustworthiness in Wikipedia. In *Proc. CSCW 2008*. ACM Press, 7–10. DOI: http://dx.doi.org/10.1145/1460563.1460639

[32] Ellen Lupton. 1986. Reading Isotype. *Design Issues* 3, 2 (1986), 47–58. http://www.jstor.org/stable/1511484

[33] Jock Mackinlay. 1986. Automating the design of graphical presentations of relational information. *Acm Transactions On Graphics (Tog)* 5, 2 (1986), 110–141.

[34] Jock Mackinlay, Pat Hanrahan, and Chris Stolte. 2007. Show me: Automatic presentation for visual analysis. *IEEE transactions on visualization and computer graphics* 13, 6 (2007), 1137–1144.

[35] Jennifer Marlow and Laura Dabbish. 2013. Activity Traces and Signals in Software Developer Recruitment and Hiring. In *Proc. CSCW 2013*. 145–155. DOI: http://dx.doi.org/10.1145/2441776.2441794

[36] Jennifer Marlow, Laura Dabbish, and Jim Herbsleb. 2013. Impression Formation in Online Peer Production : Activity Traces and Personal Profiles in GitHub. In *Proc. CSCW 2013*. 117–128. DOI: http://dx.doi.org/10.1145/2441776.2441792

[37] Tanushree Mitra and E Gilbert. 2014. The Language that Gets People to Give: Phrases that Predict Success on Kickstarter. *CSCW conf.* (2014), 49–61. DOI: http://dx.doi.org/10.1145/2531602.2531656

[38] Ethan Mollick. 2014. The dynamics of crowdfunding: An exploratory study. *Journal of Business Venturing* 29 (2014), 1–16. DOI: http://dx.doi.org/10.1016/j.jbusvent.2013.06.005

[39] Peter Pirolli, Evelin Wollny, and Bongwon Suh. 2009. So You Know You're Getting the Best Possible Information: A Tool that Increases Wikipedia Credibility. In *Proc. CHI 2009*. ACM Press, 1505–1508. DOI:http://dx.doi.org/10.1145/1518701.1518929

[40] Vineeth Rakesh, Jaegul Choo, and Chandan Reddy. 2015. Project Recommendation Using Heterogeneous Traits in Crowdfunding. In *Proc. ICSWM 2015*.

[41] Meredith M Skeels, Kenton T Unruh, Christopher Powell, and Wanda Pratt. 2010. Catalyzing social support for breast cancer patients. In *Proceedings of the SIGCHI Conference on Human Factors in Computing Systems*. ACM, 173–182.

[42] Deborah A Small, George Loewenstein, and Paul Slovic. 2007. Sympathy and callousness: The impact of deliberative thought on donations to identifiable and statistical victims. *Organizational Behavior and Human Decision Processes* 102, 2 (2007), 143–153.

[43] Sarah Smith, Frank Windmeijer, and Edmund Wright. 2014. Peer effects in charitable giving: Evidence from the (running) field. *Economic Journal* 125 (2014), 1053–1071. DOI:http://dx.doi.org/10.1111/ecoj.12114

[44] Jacob Solomon, Wenjuan Ma, and Rick Wash. 2015. Don't Wait! How Timing Affects Coordination of Crowdfunding Donations. *Proc. CSCW 2015* (2015), 547–556. DOI: http://dx.doi.org/10.1145/2675133.2675296

[45] Susan Leigh Star and Anselm Strauss. 1999. Layers of Silence, Areanas of Voice: The Ecology of Visible and Invisible Work. *Computer Supported Cooperative Work* 8, 1995 (1999), 8–30. DOI: http://dx.doi.org/10.1023/A:1008651105359

[46] Kate Starbird. 2013. Delivering patients to sacré coeur: collective intelligence in digital volunteer communities. In *Proceedings of the SIGCHI Conference on Human Factors in Computing Systems*. ACM, 801–810.

[47] Kate Starbird and Leysia Palen. 2011. Voluntweeters: Self-organizing by digital volunteers in times of crisis. In *Proceedings of the SIGCHI conference on human factors in computing systems*. ACM, 1071–1080.

[48] H Colleen Stuart, Laura Dabbish, Sara Kiesler, Peter Kinnaird, and Ruogu Kang. 2012. Social Transparency in Networked Information Exchange : A Framework and Research Question. *Proc. CSCW 2012* (2012), 451–460. DOI:http://dx.doi.org/10.1145/2145204.2145275

[49] Lucy Suchman. 1995. Making Work Visible. *Commun. ACM* 38, 9 (1995), 56–64.

[50] Bongwon Suh, Ed H Chi, Aniket Kittur, and Bryan a Pendleton. 2008. Lifting the veil: improving

accountability and social transparency in Wikipedia with wikidashboard. *Proc. CHI 2008* 4, 1 (2008), 1037–1040. DOI:http://dx.doi.org/10.1145/1357054.1357214

[51] Katie G Tanaka and Amy Voida. 2016. Legitimacy Work : Invisible Work in Philanthropic Crowdfunding. In *Proc. CHI 2016*. DOI: http://dx.doi.org/10.1145/2858036.2858110

[52] Tammara Combs Turner, Marc A Smith, Danyel Fisher, and Howard T Welser. 2005. Picturing Usenet: Mapping computer-mediated collective action. *Journal of Computer-Mediated Communication* 10, 4 (2005), JCMC1048.

[53] TweetTracker. 2012. *http://tweettracker.fulton.asu.edu/*.

[54] Ushahidi. 2018. *http://ushahidi.com*.

[55] F.B. Viegas, D. Boyd, D.H. Nguyen, J. Potter, and J. Donath. 2004. Digital artifacts for remembering and storytelling: posthistory and social network fragments. *In Proc. HICSS 2004* (2004). DOI: http://dx.doi.org/10.1109/HICSS.2004.1265287

[56] Fernanda Viégas and Martin Wattenberg. 2013. Google+ ripples: A native visualization of information flow. *Proc. WWW 2013* (2013), 1389–1398. DOI: http://dx.doi.org/10.1145/2488388.2488504

[57] Fernanda B Viégas and Marc Smith. 2004. Newsgroup Crowds and AuthorLines: Visualizing the Activity of Individuals in Conversational Cyberspaces. In *Proc. HICSS 04*. 1–10.

[58] Fernanda B Viégas and Marc Smith. 2004. Newsgroup crowds and authorlines: Visualizing the activity of individuals in conversational cyberspaces. In *System Sciences, 2004. Proceedings of the 37th Annual Hawaii International Conference on*. IEEE, 10–pp.

[59] Fernanda B Viégas, Martin Wattenberg, and Kushal Dave. 2004. Studying cooperation and conflict between authors with history flow visualizations. In *Proceedings of the SIGCHI conference on Human factors in computing systems*. ACM, 575–582.

[60] Anbang Xu, Xiao Yang, Huaming Rao, Wai-tat Fu, Shih-wen Huang, and Brian P Bailey. 2014. Show Me the Money! An Analysis of Project Updates during Crowdfunding Campaigns. In *Proc. CHI 2014*. 591–600. DOI:http://dx.doi.org/10.1145/2556288.2557045

[61] Diyi Yang and Robert E Kraut. 2017. Persuading teammates to give: Systematic versus heuristic cues for soliciting loans. *Proceedings of the ACM on Human-Computer Interaction* 1 (2017), 114.