Conversational Lives: Visualizing Interpersonal Online Social Interactions

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Abstract. The dynamic and distributed nature of interactions on popular social network platforms creates challenges in personally understanding the collective meaning and impact of this disparate activity over time. We propose the development of the Social Reflector application, a dynamic visualization interface for exploring individual social network activity over time. We discuss the design, implementation and evaluation of three visual strategies for representing key facets of social communication interactions - conversation potential, activity rhythms, and interpersonal communications. Findings and results from a preliminary user study with Facebook users are presented and promising future research directions introduced.

Keywords: Social Network Visualization, Reflective Interfaces.

1 Introduction

Much of our daily reflections, communications and commentary appear today integrated as part of our social media network [7,18]. Social network sites such as Twitter, Facebook and YouTube vary in the consumer interests and communication practices supported, but their key technological features are relatively consistent. As defined in Boyd et al., they allow individuals to 1) construct a public or semi-public profile within a bounded system; 2) share information and ideas to a list of other users; 3) communicate among their list of connections [2]. Our everyday interactions on these sites can be considered as forming a significant part of our digital life-stream, complete with fragmentary statements, media sharing and expressive behaviors. Personally understanding the collective meaning and impact of this disparate activity over time can be challenging, given the dynamic, momentary and forward moving impetus of most social network sites [14].

Social behavior can be understood as the operational effect of two distinct information processing systems: the impulsive system and the reflective system [17]. These dual systems operate in parallel, but the reflective system requires considerably more cognitive processing. Within the impulsive system, knowledge structures arise that "bind together frequently co-occurring features", whereas in the reflective system, generated knowledge is "accompanied by a noetic state of awareness, which consists of knowledge that something is or is not the case" [17]. Our online social interactions occur across a multi-dimensional space comprising people, artifacts, actions and time

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[11]. The speed and diversity of these interactions lend themselves well to the operations of our impulsive system, but forming more reasoned opinions and understandings about the broader impact of our online social activities requires the integrated consideration of our reflective operations.

In this paper, we propose the design, implementation and evaluation of the Social Reflector visualization application. This tool provides three dynamic social network visualizations aimed at supporting reflection and the development of insight about online interactions on social network websites. Our online activities comprise both direct communications and the consumption of messages [3]. In our research, we are interested in investigating perceptions regarding how personal statements and communications are consumed and responded to through reply mechanisms such as comments or 'likes'. Our visualizations provide users with a dynamic interface for exploring their online data from a distance, in a form that emphasizes the quality and nature of their interactions over time.

2 Prior Work

Our work expands and learns from prior research in reflective practice systems, social communication representation and social network visualization.

2.1 Reflective Practice Systems

Reflection is described by educational theorist John Dewey as the examination of the basis for a belief [5]. Research within the field of cognitive science suggests that engaging in reflective activities is a fundamental component of the thinking process, vital for decision making and self-learning. Donald Schön studied reflection within the realm of professional practice [16] and defined two types of reflection as occurring during problem solving activities: reflection-in-action and reflection-on-action. Iterating between in-the-moment and after-the-fact reflective thinking supports individuals in becoming more explicit, accountable and revisionary in their everyday lives. Maeno et al. [13] developed a mediation reflective system displaying dialog utterances between mediator and disputants. Results from preliminary studies demonstrated the value of their visualization as a training mechanism for mediation students to reflect on their dialogue in moving from an impasse point to ultimate agreement.

2.2 Social Communication Representation

The Sociable Media Group at MIT Media Lab have developed a number of applications for analyzing and representing social communication patterns [6]. Projects such as Coterie, Authorlines and the Loom Project, visualize detected patterns in online conversations, thus allowing participants to better understand the activities and behaviors of their virtual communities [20]. More specifically at the level of the individual, applications such as CrystalChat [19] visualize IM chat history from a personal perspective and provide opportunities for reflection and storytelling. Email exchanges have similarly been studied from an ego-centric perspective. For example, Themail [21] visualized the interaction history between participants in an individual email archive, while Thread Arcs [10] visualized overall conversational threads. Additional

research has focused on analyzing and representing the hierarchical, correlational and temporal patterns [15] in email repositories, while other email visualizations encourage reflection for improving social decision-making [14].

2.3 Social Network Visualizations

Visualizing social networks has a long and rich history, from hand-drawn pictures of social patterns to computationally derived images of massive online networks [8]. In recent years, numerous end-user visualization applications have been developed to investigate the structure and behavior of popular social network platforms including LiveJournal[1], Friendster/MySpace [9] and Facebook[2]. Researchers within Facebook have also developed several applications such as Project Palantir[3] that visualizes Facebook activities happening in real-time and the "The Road to 200 Million" infographic[4] which displays the world-wide growth of the Facebook network.

3 Design and Implementation

There are an estimated 30 billion pieces of content (web links, news stories, blog posts, notes, photo albums, etc.) shared each month on Facebook, making it a complex multi-dimensional platform that can be observed at many scales. Our Social Reflector application focuses on the ebb and flow of information on a user's wall, specifically the status updates (posts), comments and likes left by profile visitors. We propose three visual strategies for representing key facets of these social communication interactions - conversation potential, activity rhythms and interpersonal communications. Within the Social Reflector tool, the WordCloud, Clock and Circles interfaces express these patterns respectively.

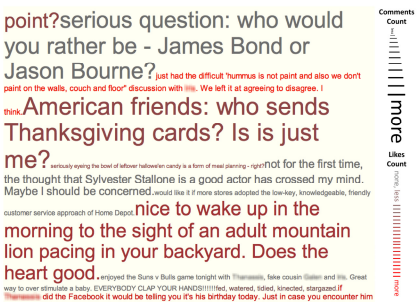

Fig. 1. Screen shot of the WordCloud interface depicting an individual's Facebook wall posts, likes and comments as a weighted 2D list

[1] http://www.touchgraph.com/facebook
[2] http://vansande.org/facebook/visualiser; http://thomas-fletcher.com/friendwheel
[3] http://blog.facebook.com/blog.php?post=41339392130
[4] http://www.nytimes.com/imagepages/2009/03/29/business/29face.graf01.ready.html

A common property of social network sites is the ability to respond to statements or mediated messages by posting comments or indications of support (e.g. digg, like). The conversational potential of a statement or artifact can be understood by the volume, diversity and value of the responses it generates. The WordCloud interface (Fig.1) presents an individuals' Facebook status updates[5] as a weighted 2D list. In this interface, the font size of each status post indicates the number of associated comments (the more comments the larger the font) and the font saturation depicts the number of associated 'likes' (the more likes, the more saturated).

Understanding when (i.e. during the workday, only at weekends), how (i.e. browsing news feeds, searching for friends) and why (i.e. communicate with family, personal diary) people use platforms such as Facebook can offer insights into contemporary interpersonal communication dynamics. The Clock interface (Fig. 2) depicts an individuals' monthly Facebook status posts and received comments in a radial layout [1]. Here, each circle represents a day in the selected month, and posts and comments are represented as icons placed on the circle lines according to their time of posting. The icons are color-coded blue (posts) and orange (comments) to give participants an at-a-glance overview of the ratio between their outward expression and their inward feedback reception. The circles are presented using a tree ring metaphor, where the innermost circle represents the last day of the month, while the outermost circle represents the first day. A "reverse" function (reverse the order of the circles) was also implemented to allow closer inspection of densely populated inner circles.

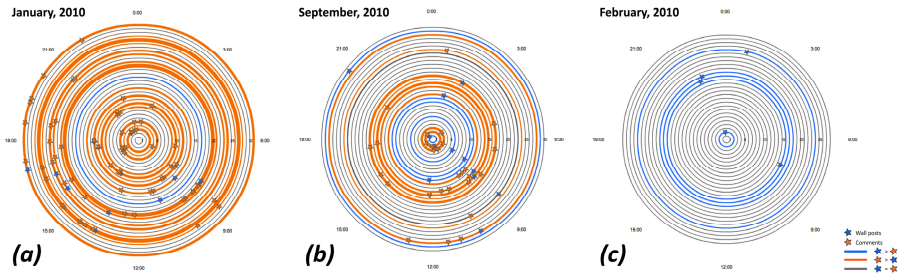

Fig. 2. Screen shots of the Clock interface depicting Facebook data from three users. *(a)* Data depicts significant inward traffic on a user's birth-date; *(b)* Data indicates regular morning posting by a user; *(c)* Data indicates little interactive communication from a user's network.

As our online social networks expand and contract, we develop and discard interpersonal relationships by maintaining or ignoring communication interactions. The Circles interface (Fig. 3) allows users to explore the inward and outward flow of communications within their Facebook network. The rings in the visualization depict status updates (inner), comments (middle) and friends (outer) as selectable, interrelated bars. Users can click on a bar in any of the three rings (e.g. a post bar) and any related bars (e.g. comment and contributor bars on that post) will be highlighted, together with general statistical information (e.g. overall % comment contribution of selected friends).

[5] `http://apps.facebook.com/my-year-in-status`

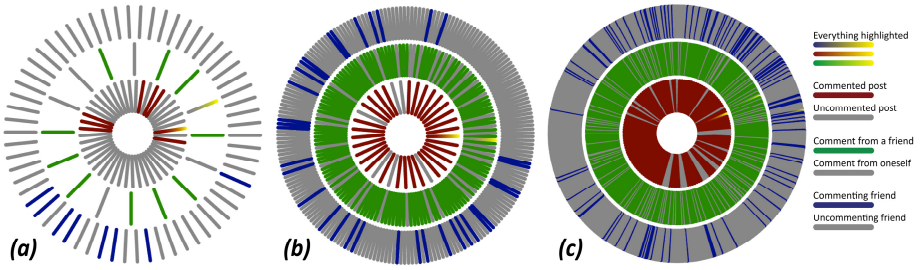

Fig. 3. Screen shots of the Circles interface depicting data from three user categories as detailed in Table 1: *(a)* Low number of friends and low activity volume; *(b)* Low-medium number of friends and medium activity volume; *(c)* High number of friends and high activity volume.

3.1 Implementation

The Social Reflector is a cross-platform desktop application developed with Adobe AIR and the ActionScript SDK for the Facebook Platform, using the Facebook GRAPH API to make calls to get and set Facebook data. Users are prompted to authorize the application to allow access to information in their News Feed. The Social Reflector application does not collect or store any News Feed data and individual's are logged out of their accounts upon application exit.

4 Evaluation

We evaluated the design and reflective utility of our application in a multi-activity user study with a diverse group of Facebook users. In the next section, we describe the study participants, methodology and results and findings.

4.1 Participants

We recruited 20 Facebook users (12 male, 8 female) for our study. The participants ranged in age from 23 to 59, with an average age of 30. The majority of participants were recruited within a large public university in the United States, with representatives from the student, staff and faculty bodies. The participants derived from a wide variety of disciplinary backgrounds, including Design, Music, Computer Science, Engineering and Media Arts. Additional study participants represented engineers working in industry.

At the beginning of our study, participants completed a questionnaire survey examining both their general social communication activities and their specific use of the Facebook platform. Overall, participants ranked phone communication as the primary method by which they communicated with friends and family, followed in order by email, social network services, instant message, Skype, microblog, blog and postal service. In addition to using Facebook, 75% of participants identified as Twitter users, while YouTube and Flickr were used by 55% of the study population respectively. 25% of participants used MySpace, while 25% also stated that they used RenRen, a popular Chinese social networking platform (7 of the study participants were Chinese nationals).

The average user on Facebook has 130 friends, with 50% of active users logging onto Facebook on any given day[6]. The participants in our study represented a relatively active group of Facebook users, with 70% indicating they logged on at least once a day. 3 participants indicated they logged on several times a week, 1 checked Facebook several times a month, while 1 other indicated rarely using the service. Our study group also presented a higher than average size friend network, with participants on average having 319 Facebook friends. However, 30% of participants did have fewer than 130 friends, with the smallest network representing 57 connections, in contrast to the largest at 955 friends. In terms of regular activity, 35% of participants stated that they added content to their Facebook wall (e.g. status update) at least several times a week, with 40% indicating they did so several times per month. Participants estimated that their posts on average attracted 3 comments, with 12 being the average maximum number of comments ever received.

4.2 Methodology

Participants in our study completed a survey, a two-part comparative activity and a short interview, with an overall study duration length of 40 minutes. The first module of the study, as described in 4.1, comprised a short questionnaire survey, examining participant demographics, their general social communication activities and their specific use of the Facebook platform. The second component comprised a comparative activity session, where participants were asked to indicate their beliefs and understandings about their usage patterns and interactions on Facebook. Participants completed the following four tasks twice, first while viewing their data on Facebook and second while viewing their data using the Social Reflector interface:

1. Communication Network: we asked participants to complete an ego-centric sociogram diagram depicting the friends/alters of their social network in a series of four concentric circles, placing closer friends nearer the center (Fig. 4a). Sociograms have proved helpful not only in reliably recording network data, but also function as a strong cognitive aid helping participants reflect and think about their social ties and associated activities [4].
2. Events: we asked participants to name some of the most important events in their life in the past year (e.g. travel, birthdays, achievements). Participants were also requested to indicate if they posted about those events on Facebook, and if so, whether or not they received comments of communications in response.
3. Activity: we asked participants to indicate where and when they regularly use the Facebook platform (e.g. home/work/in transit and time of the day).
4. Activity Distribution: we asked participants to characterize their Facebook activity along a distribution from purely maintaining an online profile (i.e. only adding to your own wall) to high levels of interaction and communication with friends (i.e. extensive commenting and activity on others' walls). Participants were asked to indicate their answer by marking their location on an activity distribution bar (Fig. 4b).

[6] http://www.facebook.com/press/info.php?statistics

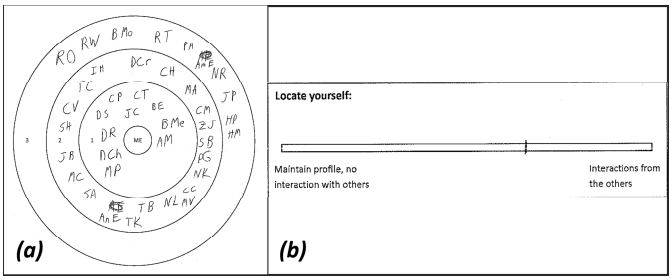

Fig. 4. Completed elements of comparative activity forms from two users: *(a)* Completed sociogram depicting the closeness of members in a user's social network; *(b)* Marked activity distribution bar depicting a user's self-identified level of interaction with members of their social network.

The final study component comprised an approximately 15-minute audio-recorded semi-structured interview, where participants were asked a series of questions about their use of the tool, their perceived value of the approach and suggestions for design refinements.

5 Results and Discussion

Analysis of the reported and observed study data indicate the potential of different facets of our approach for certain types of social network users and communicators. While participants were able to successfully use and navigate our tool, some users indicated confusion with particular elements of the design and functionality of the interfaces, indicating the need for additional refinement and improvement.

5.1 General Findings

We categorized the study participants along two primary dimensions (number of friends and volume of activity) in order to analyze the usefulness of our approach across diverse types of users. Combining k means and average clustering, the participants were grouped into 4 friend size collections: low, low-medium, medium-high and high taking into consideration both the number of friends of the average Facebook user and that of our study participants. Secondly, we examined screengrabs of each participant's Facebook activity captured using the Circles visualization, categorizing user activity based on the sparseness or density of the circular representation. Table 1 below indicates the distribution of the network size and communication activity of the study participants.

The majority of participants amended or updated their initial responses for each task in the comparative activity, ranging from little or no change to substantial response reconsideration following their use of our visualization tool. The Circle visualization proved most effective in helping participants identify and add forgotten network members or to redefine relationships between members by deleting, moving or connecting them on their depicted sociogram. One participant noted during the

Table 1. Taxonomy of Facebook usage diversity of our study participants

	Low # of Friends	Low-Medium # of Friends	Medium-High # of Friends	High # of Friends
Low Activity Volume	6 (30%)	3 (15%)		
Medium Activity Volume		1 (5%)	2 (10%)	1 (5%)
High Activity Volume		1 (5%)	4 (20%)	2 (10%)

interview that they "*spent a lot of time looking at the names of people who wrote things*" and at the "*breakdown of percentages to see how much people are commenting – that was interesting*". Several participants indicated surprise at the amount (or lack) of communication from some members in their network, with one participant commenting that "*the surprise was that there are some people who commented ... like this person contributed 5 percent of my comments, but it's not somebody I consider very close.*" One participant in particular outlined a theory about the possible disconnect between their perception of a communication relationship, versus that depicted in the visualization. "*I knew this person was commenting but this is the interesting part: I think the relationship has to be connected with my own activities changing over time. So this person commented in the early part of the year and not the later part of the year. So now I don't remember him - it's not because he is not important but he's not part of my life now. I think somehow there needs to be a connection between these changes in relationship and activities and time...it's surprising. It's not consistent in my understanding of how the relationship has changed over time.*"

Overall, the majority of participants indicated a preference for the WordCloud visualization, with several commenting on its usefulness in identifying posts that attracted interesting conversation (i.e. comments) versus those that their network just seemed to like. For example, one participant noted that "*I really like the text cloud a lot because it shows a useful function to me which is just first of all, I don't have any other way at all to look at all the posts I published, and then I can also see what people really like, or what was less interesting."* Of the three interfaces, the WordCloud visualization appealed and made sense to the greatest number of participants, primarily because of its legibility regardless of the level of communication activity or network size. Over half of the participants placed themselves in a different location on the activity distribution diagram after exploring their data using the Social Reflector visualization. While many of these changes were relatively minor (less then 2 unit change), several were notable in that the participant placed themselves over 4 units away from where they originally indicated. Several users noted their change of opinion as being based on an incorrect assumption such as "*I think that I have even less status updates then I thought*" or "*I didn't realize that I had a post with 5 comments this year. I guess I'm just not aware.*"

6 Conclusions and Future Work

In this paper we presented the design, development and preliminary evaluation of the Social Reflector application, a reflective interface that visualizes the conversation

potential, activity rhythms and interpersonal communications of an individual's social network. Results from a preliminary user study indicate the utility and potential of our approach in instigating reflection and promoting awareness of the underlying patterns of our online communications. Of particular value is the ability to reveal an overall interpretation of aggregated activity by presenting disparate data in one interface (ie WordCloud) and an opportunity to precisely explore interactions with specific network members as a percentage of overall activity (ie Circles). The study also highlighted several limitations in our design, particularly in representing the network structure and activities of highly connected, highly active individuals. We intend to address this issue in future iterations of our work through the use of search and zoom features that will enable varying levels of scaled exploration from whole network to specific members. Creating tighter integration between the three interfaces and the underlying data (e.g. revealing all post or comment content) would also allow users to more thoroughly explore particular areas or patterns of interest.

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References

1. Bergstrom, T., Karahalios, K.: Conversation Clock: Visualizing audio patterns in co-located groups. In: 40th Annual Hawaii International Conference on System Sciences, HICSS 2007, pp. 78–86. IEEE, Los Alamitos (2007)
2. Boyd, D.M., Ellison, N.B.: Social network sites: Definition, history, and scholarship. Journal of Computer-Mediated Communication 13(1), 210–230 (2008)
3. Burke, M., Marlow, C., Lento, T.: Social network activity and social well-being. In: Proceedings of the 28th International Conference on Human factors in Computing Systems, pp. 1909–1912. ACM, New York (2010)
4. Carrasco, J.A., Hogan, B., Wellman, B., Miller, E.J.: Collecting social network data to study social activity-travel behavior: an egocentric approach. Environment and Planning B: Planning and Design 35(6), 961–980 (2008)
5. Dewey, J.: How we think: A restatement of the relation of reflective thinking to the educative process. DC Heath Boston (1933)
6. Donath, J.: A semantic approach to visualizing online conversations. Communications of the ACM 45(4), 45–49 (2002)
7. Ellison, N.B., Steinfield, C., Lampe, C.: The benefits of Facebook "friends:" Social capital and college students' use of online social network sites. Journal of Computer-Mediated Communication 12(4), 1143–1168 (2007)
8. Freeman, L.C.: Visualizing Social Networks. Journal of Social Structure 1 (2000)
9. Heer, J., Boyd, D.: Vizster: Visualizing online social networks. In: Proc. IEEE Symposium on Information Visualization (InfoVis), pp. 32–39 (2005)
10. Kerr, B.: Thread arcs: An email thread visualization. IEEE Computer Society, Los Alamitos (2003)
11. Lin, Y.-R., Sundaram, H., Kelliher, A.: JAM: Joint Action Matrix Factorization for Summarizing a Temporal Heterogeneous Social Network. In: Proceedings of the 3rd International AAAI Conference on Weblogs and Social Media, ICWSM 2009 (2009)

12. Lin, Y.-R., Sundaram, H., Kelliher, A.: Multi-Relational Characterization of Social Network Communities. In: Furht, B. (ed.) Handbook of Social Network Technologies and Applications. Springer, Heidelberg (2010)
13. Maeno, Y., Nitta, K., Ohsawa, Y.: Reflective visualization of dispute resolution. In: IEEE International Conference on Systems, Man and Cybernetics, SMC 2009, pp. 1698–1703. IEEE, Los Alamitos (2009)
14. Morrison, D., Gooch, B.: ConnectDots: Visualizing social network interaction for improved social decision making. In: Schuler, D. (ed.) HCII 2007 and OCSC 2007. LNCS, vol. 4564, pp. 134–140. Springer, Heidelberg (2007)
15. Perer, A., Smith, M.A.: Contrasting portraits of email practices: visual approaches to reflection and analysis. In: Proceedings of the Working Conference on Advanced Visual Interfaces, pp. 389–395. ACM, New York (2006)
16. Schön, D.A.: The reflective practitioner: How professionals think in action. Basic Books (2006)
17. Subrahmanyam, K., Reich, S.M., Waechter, N., Espinoza, G.: Online and offline social networks: Use of social networking sites by emerging adults. Journal of Applied Developmental Psychology 29(6), 420–433 (2008)
18. Strack, F., Deutsch, R.: Reflective and impulsive determinants of social behavior. Personality and Social Psychology Review 8, 220–247 (2004)
19. Tat, A., Carpendale, S.: CrystalChat: Visualizing personal chat history. IEEE Computer Society, Los Alamitos (2006)
20. Viegas, F.B., Smith, M.: Newsgroup Crowds and AuthorLines: visualizing the activity of individuals in conversational cyberspaces. In: Proceedings of the 37th Annual Hawaii International Conference on System Sciences, p. 10 (2004)
21. Viegas, F.B., Golder, S., Donath, J.: Visualizing email content: portraying relationships from conversational histories. In: Proceedings of the SIGCHI Conference on Human Factors in Computing Systems, pp. 979–988. ACM, New York (2006)