Predictive Network Analysis in Game User Research

Brooke Foucault Welles
Northwestern University
2240 Campus Drive
Room 1-459
Evanston, IL 60208
b-foucault@northwestern.edu

CHI'12, May 5–10, 2012, Austin, Texas, USA.
ACM 978-1-4503-1016-1/12/05.

Abstract
Based on the results of a study of social relationships in the immersive virtual world Second Life, I argue for the value of predictive network analysis as a methodological tool for game user researchers, particularly those interested in studying social interaction in online games. My research shows that predictive network analysis can offer unique insight into user behavior and motivation, beyond that which is easily available through direct observation and/or self-report.

Author Keywords
Network analysis; online games; virtual worlds; social relationships.

ACM Classification Keywords
H.5.m. Information interfaces and presentation (e.g., HCI): Miscellaneous.

Introduction
Recently, scholars have begun to argue for the inclusion of predictive social network analysis in the suite of tools HCI researchers use in their work [4]. Unlike its more descriptive counterpart, predictive network analysis allows researchers to make theory-based inferences about networks – not only summarizing the network in its current instantiation,

but also predicting how the network is likely to develop in the future. In this paper, I will argue that predictive network analysis is especially well suited for the study of user interactions in online games, offering insights into the online game user experience that are difficult or impossible to gain using any other method.

Social Interaction in Online Games

Social interaction is central to the online game user experience and several studies have demonstrated that meeting new people and making friends is among the primary motivations for most users of immersive virtual worlds, including online communities and massively multiplayer online games (MMOGs) [1, 8].

Therefore, it is important for game user researchers to understand and identify opportunities to facilitate social interaction within online games. Historically, researchers have studied social relationships in online games and on the Internet more broadly using surveys and in-depth interviews [6, 7]. While such studies provide important foundational insight for game user researchers, they are not perfect. Based on research conducted in the offline world, we know that individuals typically have great difficulty identifying and accurately reporting how and why they form social ties with others [5]. So, relying solely on self-report methods to investigate the nature of social relationships within online games is likely to yield limited and/or biased results.

It is for that reason that I argue for the importance of using predictive network analysis to study social interaction with online games. Specifically, p*/ERGM modeling can offer unique insights into how and why users select certain social partners, and how designers and developers can cultivate productive social ties within their games.

Overview: Predictive Network Analysis

Two recent developments enable the use of predictive social network analysis to study social interaction within online games. First, game developers are storing an increasing amount of information about the actions that users take within games. Many developers have complete records of all the actions taken by players within online games, including records of social interaction that can be used to construct complete and objective network data. These data, combined with advances in computational power, enable researchers to both analyze and make statistical inferences about online social networks in ways that were never before possible.

Social networks are comprised of nodes (in this case, individuals) connected by links (in this case, social relationships). Unlike other types of data collected from individuals, social network data usually show strong interdependencies. These interdependencies make it inappropriate to analyze network data using traditional statistical analysis approaches, such as regression analysis or correlation tests. So, historically, researchers were limited to describing networks – naming the number of nodes, links, and the general structure of the network.

Recently, however, researchers have developed a new class of statistics that allow us to make statistical inferences about social networks. Exponential Random Graph Modeling (ERGM), also known as p* models, can be used to make predictive inferences about network relationships [3]. Combined with records of social

interaction with in online games, ERGM can be used to predict why social relationships emerge, offering insight into how to nurture and sustain those relationships for the benefit of the game user experience.

Like other inferential statistics, predictive network analysis is theory based, and predicated on the following assumptions:

- An observed network is one instantiation of a number of possible theoretical instantiations of a network containing a given number of nodes and links.
- The observed configuration of nodes and links is a result of deliberate action on behalf of the members of the network.
- Theories of social selection map to network configurations that can be measured, observed and estimated using predictive network analysis.

Case Study: Social Relationships in the Virtual World Second Life

In order to demonstrate how predictive network analysis works, I offer an example from my mixed-methods research on social relationships in the immersive virtual world SECOND LIFE (SL). In SL, users interact with one another via highly customizable avatars and can socialize, join groups, own land, participate in activities together, and build objects. More recently, SL has also added a formal gaming component (Linden Realms), although SL has always had informal games and play among its many uses.

For the sake of brevity, complete results from this study are not presented here. Instead, I focus on one factor influencing social relationship formation: popularity. I examine how popularity influences the formation of social ties in SL in two ways. First, in a series of 65 semi-structured interviews with users (called "residents") of SL, I asked them to reflect on whether or not there were popular residents in SL, and if so, whether popularity affected their likelihood of forming a social relationship with another resident. Of the 34 residents who spoke in depth on the topic, 9 indicated that they tended to choose popular friends over unpopular ones, 7 said popularity made no difference in who they sought as friends, and a majority (18 of 34) of residents I spoke with suggested that they would be *less* likely to form a relationship with a popular resident, often citing limited time and divided attention as factors that made popular residents less desirable friends. In short, the interview results suggest that popularity is detrimental (or at least neutral) for the formation of social relationships in SL.

However, the predictive network analysis models tell a different story. In a second test of the effect of popularity on social relationship formation, I sampled a network of 282 users connected by 360 in-game "Friendship" ties (representing contacts more than true friends, similar to "friends" in social networking sites). Using p*/ERGM modeling, I tested the network for the presence of stars, a network configuration where certain nodes have many ties, while others have very few. In the network literature, this star configuration is used to denote popularity because it suggests that individuals are demonstrating a preference for forming social ties with certain popular individuals and avoiding forming social ties with other, less popular individuals.

Holding constant several other factors influencing social relationship formation (including age, gender, time

spent online, and total number of social ties), ERGM modeling revealed that residents are more than 9 times more likely to form a relationship with a popular resident than with a less popular one. This effect was the strongest in the model, predicting relationship formation with better strength than age, gender, time spent online, or number of friends in common. Thus, the predictive network analysis results suggest that, although users may be unaware that they are doing so, users of SL are far more likely to socialize with popular residents than with unpopular residents.

Implications

The implications of these findings are numerous. First, this case study demonstrates how predictive network analysis can be used to identify patterns in social relationship networks within online games that may be difficult to identify using other methods. By this, I do not mean to imply that users will deliberately mislead researchers who conduct interviews and/or administer surveys to game users, rather I argue that users may not be fully aware of all of the factors influencing their in-game social decisions. By combining methods, we get a more complete picture of the dynamics online games, and potentially derive new insights into how best to facilitate satisfying in-game experiences.

To that end, I believe that predictive network analysis is a valuable methodological tool for game user researchers interested in a variety of topics. Clearly, the method has utility for studies of social interaction. I believe it could also offer insight on any number of other networked behaviors including, effective grouping and guild composition, building trust for trade and in-game coalitions, examining the flow of money, items, or information through networks of game users, and isolating greifers and trolls who disrupt online game experiences for other users. Using predictive network analysis, game user researchers can investigate these and related topics in new and productive ways.

References

[1] Boellstorff, T., *Coming of Age in Second Life.* Princeton University Press, Princeton, NJ, 2008.

[2] Cairns, R.B. and Cairns, B.D., *Lifelines and Risks: Pathways of Youth in Our Time.* Cambridge University Press, Cambridge, UK, 1994.

[3] Contractor, N., Wasserman, S., and Faust, K., Testing multi-theoretical multilevel hypotheses about organizational networks: An analytic framework and empirical example. *Academy of Management Review*, 31 (2006), 681-703.

[4] Keegan, B., Gergle, D., and Contractor, N. Do Editors or Articles Drive Collaboration? Multilevel Statistical Network Analysis of Wikipedia Coauthorship, *Proc. CSCW 2012,* ACM Press (2012).

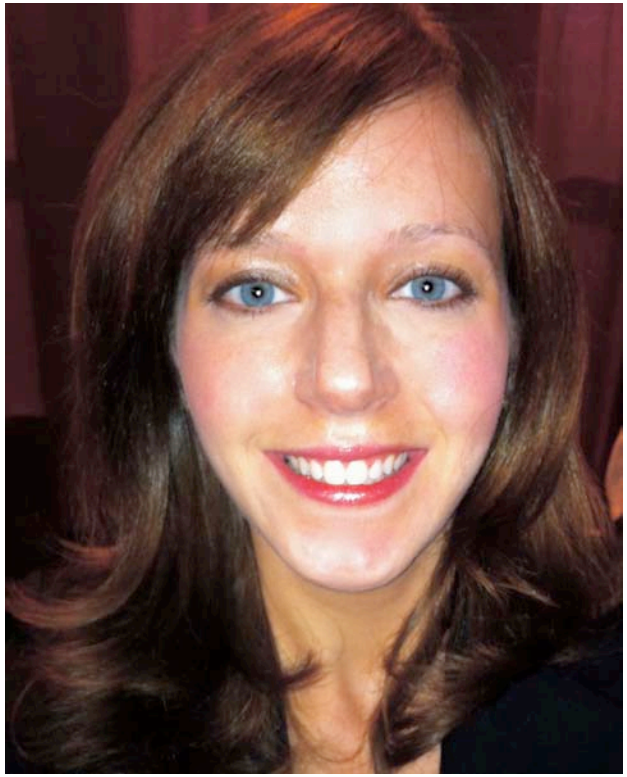
[5] Kumbasar, E., Romney, A.K., and Batchelder, W.H., Systematic biases in social perception. *American Journal of Sociology*, 100, 4 (1994), 477-505.

[6] Livingstone, S. and Bober, M., *UK children go online: Surveying the experiences of young people and their parents.* LSE Research Online (2004). http://eprints.lse.ac.uk/archive/00000395.

[7] Wolak, J., Mitchell, K.J., and Finkelhor, D., Escaping or connecting? Characteristics of youth who form close online relationships. *Journal of Adolescence*, 26, 1, (2003), 105-119.

[8] Yee, N., The demographics, motivations and derived experiences of users of massively-multiplayer online graphical environments. *PRESENCE: Teleoperators and Virtual Environments*, 15, (2006), 309-329.

Author Bio:



Brooke Foucault Welles is a Ph.D. candidate in the School of Communication at Northwestern University and she will be joining the faculty in the department of Communication Studies at Northeastern University in the fall. She studies how social media shape and constrain personal relationships, using quantitative and qualitative methods to examine online social interaction at the macro- and micro-analytic levels. Currently, she is investigating the structure of social relationships in the immersive virtual world *Second Life*. She has also examined how age influences social behavior in online games, how teenagers use new media to support and strengthen close friendships, and how interacting with avatars affects social behavior. Brooke's research is funded by the National Science Foundation, the Army Research Institute, Intel Corporation, and Northwestern University's Graduate School. She has presented her work at the CHI, ICA, NCA, AAPOR and Sunbelt conferences, and two manuscripts on her research in immersive virtual worlds are currently under review. Prior to starting her Ph.D. at Northwestern, Brooke worked as a design researcher at Intel, and she earned her B.S. and M.S. degrees from Cornell University.