A Petri Dish for Networked Culture

Hari Sundaram

Dept. of Computer Science
University of Illinois at Urbana-Champaign
Urbana, Illinois, 61801.
hs1@illinois.edu

Lowering the Barrier for Experiments

Technological interventions such as smartphones are rapidly shaping how we interact with friends as well as our physical world behavior. For example, smartphone apps have made it easy to check prices on amazon when we are at a physical retail store, exchange messages on social networks, and look up Google maps for directions. From recent ethnographic work by Ito et al. (2008), we know that new media encourages youth to be "always on" and they are almost always associating with people that they know in offline lives. In particular these new media forms allow for a sense of autonomy, development of new norms, and self-directed exploration. Finally, youth are often more motivated to learn from each other than from adults. Thus, youth use new technological interventions to form dense social network structures critical to shaping their behavior. Furthermore, there is robust empirical data to suggest that knowledge of social norms (Goldstein et al. 2008) and types of network structure (Centola 2010) influence behavior adoption.

Despite knowledge that technological innovation enables stronger ties amongst youth, that social norms influence behavior, and that smartphones provide a wealth of *in situ* observational data, testing hypotheses about physical world behavior through technological interventions remains challenging. Researchers lack a simple "petri-dish"—an experimental testbed—to systematically test the impact of specific technological interventions on physical-world behaviors. Developing specific smartphone apps or online websites (ibid.) to test different hypotheses consumes valuable resources especially for researchers who are less interested in developing the technology than in using it to answer their questions.

Many researchers have turned to analysis of networks such as Twitter or Facebook to understand behavior diffusion (Bond et al. 2012) in online networks. While online networks typically have simple, well documented API's to access data, allow for very large observational studies, a researcher has limited control—in particular, researchers cannot alter in real-time, and in response to a situational context, the social media steam of an individual. Online networks are very useful in analyzing archival data, but difficult to use for technological interventions in the physical world. Enabling the following *real-time* interventions via a third-party Facebook application is non-trivial: while a person is at a grocery store, send messages about what other friends have bought here; reframe behavioral information of peers and send notifications about healthy places to eat nearby when we know that the person is walking and it is around lunch time.

We know from our own experience (Nikkila et al. 2012, 2013) that designing engaging custom social network applications to shape physical world behavior is costly. Not only do these apps require tremendous amount of work to develop, but also there is very little chance of code reuse because the code design is typically too closely tied to answering the specific research question. Importantly, longitudinal studies are hard to perform. This is in part because these apps are developed to address a research question, not to address the needs of the end user—an individual who has downloaded the application for the purposes of the experiment has little incentive to use it beyond the experiment itself.

Our goal is to create a generic, open source, mobile application architecture that can be easily altered to suit a broad range of experimental needs. Note that the architecture itself isn't an application, but a template that enables rapid development of smartphone apps. Here are some questions that the architecture should enable us to answer: (a) Can we observe human activity and shape decision making in the wild, *in situ*, in real-world contexts and in real-time? Can we do so in physical world, mobile contexts? (b) How to see the effects of: altering information network structure?; noisy communication networks?; advertising?; role of incentive mechanisms? (c) How can we incorporate real-world constraints on behavior (time, money, access to resources), as well as preferences on action contexts? (e.g. exercise in the evening; eat vegetarian).

We've made modest attempts to build a smartphone-based "petri-dish." We've used our mobile application architecture to develop an social network for application called "healthy living" that encourages members of the UIUC community to eat at restaurants that have many healthy options, and walk to the restaurant to eat. Within the application, individuals can post pictures of food that they've eaten, as well as comment and share posts by friends. The application sends them short "nudges" daily as well as at different points of the week; these nudges frame behavioral information (food eaten, walking activity) obtained from the social network at different social (self, friends, network) and spatio-temporal granularities. A user can also control search results by setting constraints. Thus someone can specify that the application search for nearby restaurants that have an average cost of $5, have vegetarian options, and that they cannot spend more than 45 min away from where they are. The application also provides a user with private charts comparing their walking and restaurant visits with data from their friends.

In general, there are four elements to our architecture. First, the smartphone social networking itself whose interface will be familiar to anyone who uses mobile apps from Twitter or Facebook; we use PhoneGap (`http://phonegap.com`) a cross-platform mobile development environment to generate smartphone applications for different operating systems. Second, the application connects to a backend server that gathers behavioral data and that has functional hooks for data analysis. Third, the application always provides an information service to support long-term engagement. Our test application, users can search for restaurants that serve healthy food. These services are essential—without them there is little need for a user to continue to use the application. Finally, the experimenter can use a web configuration tool to set the different experimental parameters including network topology, types of resource constraints, personalizing the "nudges", setting up the database to collect the experiment data. Our application architecture doesn't yet support push notifications or incentive mechanisms and we plan on incorporating them in Fall 2015. We plan to make the application architecture open source in Fall 2015.

Today, technological innovations such as smartphones have made it easy for youth to form close relationships with their peers, develop norms, as well as engage in self-directed exploration. However, researchers have to spend significant resources for developing custom smartphone applications to conduct *in-situ* experiments; complicating matters, the application software design is likely tightly coupled to the specific experiment making it unlikely that the software is re-used. We are developing an open-source, extensible, easily configurable mobile application software architecture that allows researchers to rapidly prototype custom smartphone applications for their experiments. An open-source architecture will not only reduce the barriers to conducting research on how specific technological interventions influence physical world behavior, but also allow for experimental replication.

References

Bond, Robert M et al. (2012). "A 61-million-person experiment in social influence and political mobilization". In: *Nature* 489.7415, pp. 295–298.

Centola, Damon (2010). "The Spread of Behavior in an Online Social Network Experiment". In: *Science* 329.5996, pp. 1194–1197.

Goldstein, Noah J. et al. (2008). "A Room with a Viewpoint: Using Social Norms to Motivate Environmental Conservation in Hotels." In: *Journal of Consumer Research* 35.3, pp. 472 –482. ISSN: 00935301.

Ito, Mizuko et al. (2008). "Living and Learning with New Media: Summary of Findings from the Digital Youth Project." In: *John D. and Catherine T. MacArthur Foundation*.

Nikkila, Shawn et al. (2012). "Wind Runners: Designing a Game to Encourage Medical Adherence for Children with Asthma". In: *CHI '12 Extended Abstracts on Human Factors in Computing Systems*. CHI EA '12. Austin, Texas, USA: ACM, pp. 2411–2416. ISBN: 978-1-4503-1016-1.

Nikkila, Shawn et al. (2013). "Taskville: Visualizing Tasks and Raising Awareness in the Workplace". In: *CHI '13 Extended Abstracts on Human Factors in Computing Systems*. CHI EA '13. Paris, France: ACM, pp. 151–156. ISBN: 978-1-4503-1952-2.