Personal Informatics in Everyday Life

Daniel A. Epstein
Computer Science & Engineering
DUB Group
University of Washington
Seattle, WA 98195
depstein@cs.washington.edu

Ubicomp/ISWC'15 Adjunct , September 07-11, 2015, Osaka, Japan
© 2015 ACM. ISBN 978-1-4503-3575-1/15/09…$15.00
DOI: http://dx.doi.org/10.1145/2800835.2801643

Abstract
Personal informatics is becoming increasingly prevalent. The lived informatics perspective considers the everyday behaviors people experience while tracking, such as switching tools, forgetting to track, or giving up on tracking. My work furthers theory, design, and implementation of lived informatics in technology. I contribute a theoretical framework to characterize how people use self-tracking tools in practice, independent of their original motivation to track. I design and build technology for analyzing personal data, improving sharing experiences around physical activity data, and promoting food mindfulness.

Author Keywords
Personal informatics; lived informatics; self-tracking; physical activity; finances; location; food journaling.

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

Introduction
Improvements in personal sensing technology have enabled a large increase in personal informatics devices and applications [14]. These tools are extremely popular, and are integral features of new wearable devices such as the Apple Watch (Figure 1). Much

Figure 1. The recently-released Apple Watch includes a suite of capabilities for monitoring exercise and sedentary activity.

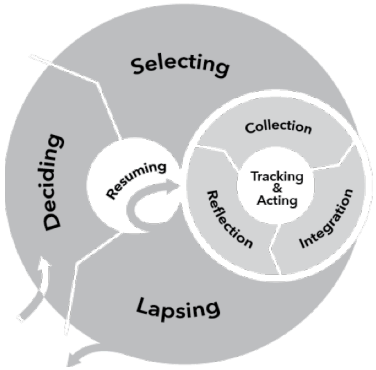


Figure 2. My lived informatics model notes people's process of deciding to track and selecting tools to use, people tracking and acting as part of the ongoing process of collection, integration, and reflection, and people inevitably lapsing and resuming to track.

research to date focuses on using personal informatics to improve self-reflection [14] or change behaviors [2,12]. However, self-tracking tools are now a part of people's everyday lives, a concept which Rooksby et al. describe as "lived informatics" [18]. Some people decide to track out of pure curiosity or a fascination with numbers and do not necessarily want to improve or change their behaviors. People choose to switch tools [13], devices break [10], and people give up on tracking [3]. We in the Ubicomp community need to further our understanding of lived informatics. Our design of personal informatics tools should account for this increasingly common perspective on technology.

The first and most widely-used model describing how people use personal informatics tools is Li et al.'s five-stage model of personal informatics systems [13]. The model describes how people transition between preparation, collection, integration, reflection, and action, emphasizing knowledge toward behavior change as the end goal. I recently proposed a new model of personal informatics that embraces the perspective of lived informatics [7]. My model characterizes how people decide to track, select a tool, track and act, and inevitably lapse and resume tracking again.

Through this model and related projects, my research contributes an understanding of how lived informatics can manifest in technology design. In this submission to the Ubicomp Doctoral School, I briefly describe my lived informatics model and three projects related to lived informatics. I conclude by describing the research I plan to complete prior to finishing my degree, and what I hope to learn as part of the Doctoral School.

Lived Informatics Model

My lived informatics model (Figure 2) characterizes how people use self-tracking tools in practice by describing people's use of tools as well as how they select, start, stop, and resume using them. In this section I briefly describe these activities.

Deciding to Track and Selecting Tools

I divide the process of preparing to track into two phases: (1) deciding to track and (2) selecting a tool to use. People decide to track for varied reasons, including to share their activity with others [6,15], curiosity [13,18], or to receive rewards [15]. When selecting a tool, people may engage in substantial research, such as reading online reviews or asking friends. Other people may not consider tool selection, such as someone who receives a pedometer as a gift.

Tracking and Acting

Consistent with prior work [1,20], we combine the acts of collecting, integrating, reflecting, and acting on personal data into the process of tracking and acting. In practice, these acts occur simultaneously as people use personal informatics tools, analyze the collected data, learn about themselves, and potentially change their habits.

Lapsing and Resuming

Over time, people lapse in their tool use and stop actively tracking. We define four categories of lapsing: *forgetting* to use a tool, *upkeep* required for use, intentionally *skipping* certain entries, and temporarily *suspending* tool use. While people often resume tracking after lapses, sometimes a temporary break causes someone to stop tracking entirely.

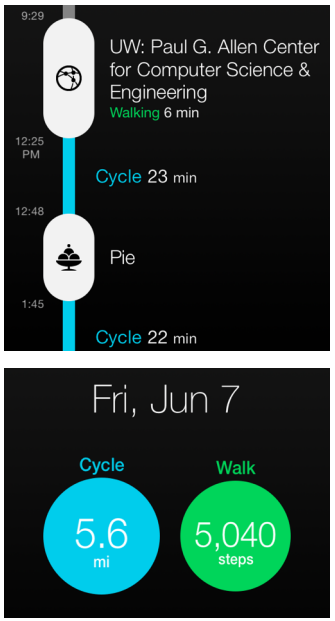


Figure 3. A fine-grained lifelog and corresponding summary collected from the smartphone app *Moves*.

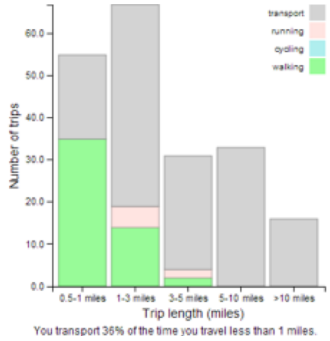


Figure 4. Cuts through personal data can offer actionable findings, such as highlighting opportunities to walk more on short trips.

Lived Informatics in Design and Practice

The lived informatics model describes how people use personal informatics tools to support a variety of motivations. I use this model to inform my research, thus far focusing on improving how people track and act. I now describe three projects I have completed in lived informatics.

Project 1: Understanding High-Dimension Personal Data

Taking advantage of advances in mobile sensing capabilities, smartphone applications such as Moves (Figure 3) can passively record location and physical activity throughout the day. However, Moves and similar tools provide little assistance in analysis and interpretation of the collected data. This places the burden of synthesis and reflection on the self-tracker. This burden makes the process of tracking and acting more difficult, frustrating self-trackers and often leading to lapses in tracking [7,13].

In my DIS 2014 paper, I design a method for identifying meaningful and actionable findings in self-tracked data [5]. This method uses the idea of a *cut* through collected data, or a subset of data with a shared feature. Some examples of cuts include visiting a category of location (e.g., a restaurant), a particular transit pattern (e.g., a run in a park), or aggregations in in time (e.g., by day of week). My method projects cuts through data onto others, highlighting how one factor influences another, such as how the weather influences commute time. I evaluate the impact of different visual presentations of cuts including maps, short summaries, and graphs. Figure 4 presents one example of a cut and its visualization: trips of various transit modes are grouped by the distance traveled, presented as a bar chart with a caption.

To develop a set of meaningful cuts, we surveyed 139 people using commercial self-tracking applications. We identified their goals for self-tracking and factors they believed impacted their activity level. Using these findings, we generated 13 cuts that people might find meaningful. We piloted these cuts in a study of 14 participants reflecting on a month of their Moves data.

Our provided cuts surfaced answers to questions participants long had but never had the tools to answer, such as how long they spend at work per day of the week. They further found cuts actionable, identifying moments where they could change their habits. For example, the cut presented in Figure 4 highlighted participant use of transportation on short trips, which led some participants to mention they would consider walking on these trips in the future.

Project 2: Sharing Collected Physical Activity Data

Many personal informatics applications include features for sharing collected data with others. Sharing provides opportunities for people to receive emotional support, information, motivation, and accountability from their sharing audiences [6,16]. People often share for the benefit of others, such as to motivate their sharing audience. While sharing features readily support some of these goals, using these features frequently conflicts with other goals in people's everyday lives. People often find it necessary to curate their lives before sharing with others, such as hiding embarrassing music tastes [19]. People are also concerned about sharing accomplishments their audience might find trivial or uninteresting, such as someone's first run [4,17].

In my CSCW 2015 paper, I developed a framework of design dimensions for sharing personal informatics

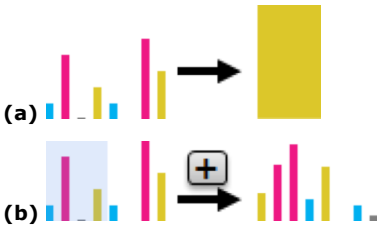


Figure 5. Two transformations to step data. (a) steps can be aggregated into a daily total, limiting support opportunities in favor of privacy. (b) an interactive tool for transforming step data within a day, such as reapportioning evening steps to a region in the morning. This potentially mitigates privacy concerns at the expense of honesty.

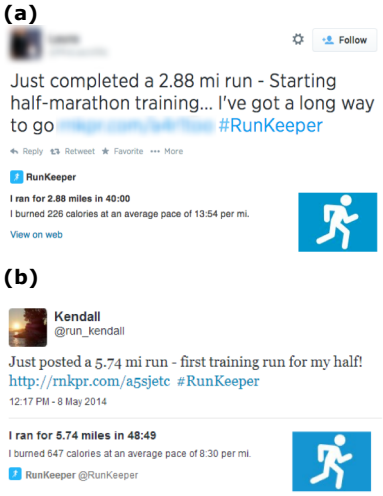


Figure 6. Drawing inspiration from posting behaviors in tweets such as (a), we generated similar tweets such as (b) to identify content people want to see in running posts to Twitter.

data. Through an extensive survey of prior work, I identify dimensions of sharing that were underexplored and often incongruent with people's goals. Two such dimensions are (1) the data transformations systems apply prior to sharing, and (2) the information about the tracked data that is shared in a post [6]. In two papers I explore the design of these two dimensions of sharing in the physical activity domain.

TRANSFORMATIONS FOR FINE-GRAINED STEP DATA

Devices collect physical activity data continuously. In addition to presenting a daily total of steps, the FitBit pedometer visualizes a person's step activity as a series of 15-minute intervals. In our Ubicomp 2013 paper, we used Value Sensitive Design [9] to consider whether and how to share this fine-grained physical activity data. We identified privacy, honesty, and trust as key values to sharing fine-grained data. I developed a set of transformations, including implementing novel methods for transforming step totals within a day (Figure 5). These transformations surface tensions between these values. I conducted 12 interviews with current step trackers around four scenarios describing how people might share and receive this data.

Participants saw the benefits of fine-grained sharing, pointing out new opportunities for social support and increased accountability. However, participants expressed concern over the effort required to curate a feed that keeps the data personal. Future work should consider how and when – if ever – to apply these transformations automatically prior to sharing.

INFORMATION PRESENTED IN RUNNING TWEETS

Our CSCW 2015 paper included two analyses to understand how the content of RunKeeper posts to Twitter influence follower responses and impressions. We first collected nearly 5,000 tweets, analyzing what variations in tweets (e.g., messages written by the poster, images, positive or negative sentiment) led to more replies, favorites, and retweets. We then used common posting behaviors we observed to generate tweets of a similar form (Figure 6) and used a survey to elicit reactions to these tweets from nearly 100 people.

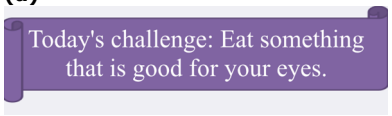
Running tweets with text written by the sharer were more likely to receive replies and favorites than those with only system-generated text. This suggests that running applications should encourage people to add their own comments to tweets composed through the app. People also found tweets with sharer-generated text more interesting and less annoying, particularly when they included the specific reason for the run (e.g., training for a half marathon, Figure 6b) or a request of the audience (e.g., looking for a running partner or asking for route suggestions).

Project 3: Daily Social Challenges to Promote Mindfulness of Food Choices

Keeping track of foods consumed is difficult. People have trouble identifying what and how much food they consume, using food databases, and tracking foods they did not personally prepare [3]. These problems often lead people to forget or skip entries. For a calorie-based food journal, these missing entries lead to an incomplete and unhelpful log. Someone staying under their calorie budget could be a success, or they could have elected not to enter their Venti Mocha with Whip.

Some people need complete food budgets, such as someone trying to detect a food intolerance. However, for others, it remains unclear whether having a

(a)



(b)

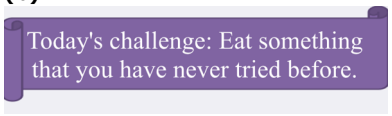


Figure 7. We generated two types of daily crumbs, based on (a) nutrition and (b) the celebratory nature of food. We found non-nutrition crumbs improved food mindfulness more than nutrition crumbs.

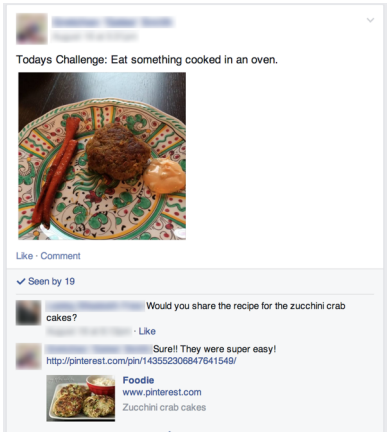


Figure 8. Our participants in the social conditions of our Food4Thought study got recommendations and advice from each other, exchanging recipes and discussing food choices.

complete record of all foods consumed is necessary to receive some of the key benefits of journaling. We hypothesize that recording even one food eaten each day can achieve the food mindfulness benefits associated with journaling [8]. To test this hypothesis, we developed the concept of a crumb, a daily challenge requiring only a single picture of a food to complete, in a recent project. We designed two types of crumbs, one set based on nutrition (Figure 7a) and one set based on the celebratory nature of food (Figure 7b) [11]. We further looked to see whether a social experience on crumbs could achieve offer further accountability and increase engagement.

We evaluated crumbs to see whether using them over a 3-week period would result in food mindfulness benefits. We further evaluated whether people would find using crumbs an engaging self-tracking experience, and whether people would learn about the nutritional makeup of food or their eating habits. We integrated crumbs into the photo-based food journal Food4Thought, and deployed it with 61 participants. These participants were split into a 2x2 study design: which set of crumbs they received and whether they were in a social or non-social condition.

Daily food challenges proved to be an effective tool for promoting mindfulness. Non-nutrition crumbs increased mindfulness more than nutrition crumbs. We suspect this occurred because the non-nutrition crumbs led participants to consider more options for what foods might meet a challenge. The inclusion of social features helped sustain engagement. Participants learned from each other, such as exchanging a recipe in Figure 8.

Proposed Remaining Research

I plan to continue these lines of research to further our understanding of how to design for lived informatics. My current technique for producing visual cuts requires that someone curates a list of cuts people might find interesting. I will contribute a method that enables interactive exploration of personal data using techniques from exploratory visualization. These techniques first offer recommendations of potentially interesting visualizations, allowing further querying and analysis based on the recommendations. I plan to also contribute a set of techniques for collaborative personal data exploration, allowing self-trackers to learn from one another through their data exploration.

While my work to date has focused on how people track and act on their data, I want to consider lapsing in my lived informatics model. I further plan to design and build a tool for people looking to return to tracking after a long-term lapse, to see if an improved experience can be created. Finally, I want to evaluate the theoretical benefits of social support by understanding whether social support leads to more self-tracking or improved performance, such as someone running faster or more regularly after receiving social support.

Involvement in the Ubicomp Doctoral School

I started my PhD in Fall 2012. I plan to complete my PhD in **Spring 2017**, at which point I hope to pursue a position as a faculty member at a top research university. While my graduation is not imminent, I have completed substantial work toward framing my dissertation. The Ubicomp 2015 doctoral school comes at a great time to receive feedback as I design the last few contributions that will form my PhD. I believe Ubicomp is a great forum to discuss this work,

integrating advances in ubiquitous sensing to everyday self-tracking life. The community will push me to think further about the design implications of my work as self-tracking technology becomes even more prevalent.

Acknowledgements

My work is sponsored by the Intel Science and Technology Center for Pervasive Computing and the National Science Foundation under awards OAI-1028195 and SCH-1344613. I would like to thank all of my collaborators on these projects, particularly my advisors, James Fogarty and Sean Munson.

References

1. Choe, E.K., Lee, N.B., Lee, B., Pratt, W., and Kientz, J.A. Understanding Quantified-Selfers' Practices in Collecting and Exploring Personal Data. *CHI 2014*, 1143–1152.
2. Consolvo, S., Everitt, K., Smith, I., and Landay, J.A. Design Requirements for Technologies that Encourage Physical Activity. *CHI 2006*, 457–466.
3. Cordeiro, F., Epstein, D.A., Thomaz, E., Bales, E., Jagannathan, A.K., Abowd, G.D., and Fogarty, J. Barriers and Negative Nudges : Exploring Challenges in Food Journaling. *CHI 2015*, 1159–1162.
4. Epstein, D.A., Borning, A., and Fogarty, J. Fine-Grained Sharing of Sensed Physical Activity : A Value Sensitive Approach. *UbiComp 2013*, 489–498.
5. Epstein, D.A., Cordeiro, F., Bales, E., Fogarty, J., and Munson, S.A. Taming Data Complexity in Lifelogs: Exploring Visual Cuts of Personal Informatics Data. *DIS 2014*, 667–676.
6. Epstein, D.A., Jacobson, B.H., Bales, E., McDonald, D.W., and Munson, S.A. From "nobody cares" to "way to go"! A Design Framework for Social Sharing in Personal Informatics. *CSCW 2015*, 1622–1636.
7. Epstein, D.A., Ping, A., Fogarty, J., and Munson, S.A. A Lived Informatics Model of Personal Informatics. *UbiComp 2015*.
8. Framson, C., Kristal, A.R., Schenk, J.M., Littman, A.J., Zeliadt, S., and Benitez, D. Development and validation of the Mindful Eating Questionnaire. *American Diet Association 109*, (2009), 1439–1444.
9. Friedman, B., Kahn, P.H., Borning, A., and Kahn Jr., P.H. Value sensitive design and information systems. *Human-Computer Interaction and Management Information Systems: Foundations*, (2006), 1–27.
10. Fritz, T., Huang, E.M., Murphy, G.C., and Zimmermann, T. Persuasive Technology in the Real World : A Study of Long-Term Use of Activity Sensing Devices for Fitness. *CHI 2014*, 487–496.
11. Grimes, A. and Harper, R. Celebratory Technology : New Directions for Food Research in HCI. *CHI 2008*, 467–476.
12. Klasnja, P., Consolvo, S., McDonald, D.W., Landay, J.A., and Pratt, W. Using Mobile & Personal Sensing Technologies to Support Health Behavior Change in Everyday Life: Lessons Learned. *AMIA 2009*, 338–342.
13. Li, I., Dey, A., and Forlizzi, J. A Stage-Based Model of Personal Informatics Systems. *CHI 2010*, 557–566.
14. Li, I., Dey, A.K.A., and Forlizzi, J. Understanding My Data, Myself: Supporting Self-Reflection with Ubicomp Technologies. *UbiComp 2011*, 405–414.
15. Lindqvist, J., Cranshaw, J., Wiese, J., Hong, J., and Zimmerman, J. I'm the Mayor of My House: Examining Why People Use foursquare-a Social-Driven Location Sharing Application. *CHI 2011*, 2409–2418.
16. Munson, S.A. and Consolvo, S. Exploring Goal-Setting, Rewards, Self-Monitoring, and Sharing to Motivate Physical Activity. *PervasiveHealth 2012*, 25–32.
17. Newman, M., Lauterbach, D., Munson, S.A., Resnick, P., and Morris, M.E. "It's not that I don't have problems, I'm just not putting them on Facebook": Challenges and Opportunities in Using Online Social Networks for Health. *CSCW 2011*, 341–350.
18. Rooksby, J., Rost, M., Morrison, A., and Chalmers, M. Personal Tracking as Lived Informatics. *CHI 2014*, 1163–1172.
19. Silfverberg, S., Liikkanen, L.A., and Lampinen, A. "I'll press Play, but I won't listen": Profile Work in a Music-focused Social Network Service. *CSCW 2011*, 207–216.
20. Whooley, M., Gray, K., Ploderer, B., and Gray, K. On the Integration of Self-tracking Data amongst Quantified Self Members. *HCI 2014*, 151–160.