TripAware: Separate Related Works Document

Jesse Zhang
Jack Sullivan
Vasudev Venkatesh P. B.
Kyle Tse
Andy Yan
John Leyden
Kalyanaraman Shankari
Randy H. Katz

Electrical Engineering and Computer Sciences
University of California at Berkeley

August 30, 2019

Acknowledgement

TripAware: Separate Related Works Document

JESSE ZHANG, UC Berkeley

JACK SULLIVAN, UC Berkeley

VASUDEV VENKATESH P.B., UC Berkeley

KYLE TSE, UC Berkeley

ANDY YAN, UC Berkeley

JOHN LEYDEN, UC Berkeley

KALYANARAMAN SHANKARI, UC Berkeley

RANDY KATZ, UC Berkeley

This techreport, written for our publication *TripAware: Emotional and Informational Approaches to Encourage Sustainable Transportation via Mobile Applications* in ACM Buildsys 2019, contains an analysis of related work not mentioned in the paper due to the page limit requirements for Buildsys.

1 RELATED WORKS

1.1 A vehicle for research: using street sweepers to explore the landscape of environmental community action: Aoki et al. [2]

Aoki et al. conducted a project which applies HCI concepts to environmental tracking, analysis, and action. They attached air quality sensors to street sweepers, emphasizing the modern need for collaborative, trustworthy social mapping tools in the environmental space. Although they outlined practical issues at the intersection of technology and environmental decision-making, they did not provide quantitative results proving behavior change from these systems.

1.2 Prescriptive persuasion and open-ended social awareness: expanding the design space of mobile health: Baumer et al. [3]

This paper examines two methods of behavior change: prescriptive persuasion and open-ended social awareness. It claims that open-ended social awareness allows more flexibility and freedom for the user to meet the desired behavior change, but it occasionally has negative impacts. In TripAware, the recommendation in the information app is an example of prescriptive persuasion, while the comparison of the polar bear sizes is an example of open-ended social awareness.

Authors' addresses: Jesse Zhang UC Berkeley, jessezhang@berkeley.edu; Jack Sullivan UC Berkeley, jsullivan27@berkeley.edu; Vasudev Venkatesh P.B. UC Berkeley, vas.venk@berkeley.edu; Kyle Tse UC Berkeley, tse.kylekobie@berkeley.edu; Andy Yan UC Berkeley, yan.andy4@berkeley.edu; John Leyden UC Berkeley, jleyden@berkeley.edu; Kalyanaraman Shankari UC Berkeley, shankari@eecs.berkeley.edu; Randy Katz UC Berkeley, randy@cs.berkeley.edu.

1.3   Power ballads: deploying aversive energy feedback in social media: Foster et al. [10]

This is a study on a social media application that displays household energy feedback to encourage less energy usage. Unfortunately, the number of participants to analyze statistics was small (5) and no quantitative statistical testing was performed.

1.4   The design of eco-feedback technology, Proceedings of the SIGCHI Conference on Human Factors in Computing Systems: Froehlich [11]

This analyzes many technologies that provide feedback to users about their behaviors. The authors write, "To maximize information's transformative potential it must be easy to understand, trusted, presented in a way that attracts attention and is remembered, and delivered as close as possible—in time and place—to the relevant choice." This was one of the motivations for how we designed the information app, especially the suggestion system.

1.5   Mind the theoretical gap: interpreting, using, and developing behavioral theory in HCI research: Hekler et al. [12]

Hekler et al. highlights common problems in behavioral research and what can be done to address them. One key point they advocate for is automatic behavior tracking that allows more metrics to be tracked and analyzed to inform a behavioral system that can target individual persons' behaviors. Tripaware partly implements this, with automatic trip tracking that allows us to collect and analyze many metrics. Although relatively simple, our suggestion system is tailored to each person's individual behaviors.

1.6   Validation of a Smartphone App for the Assessment of Sedentary and Active Behaviors: Toledo et al. [20]

Toledo et al. studies the differences between when participants self-report sedentary/active behaviors and when a device automatically tracks and reports those behaviors for them. This study demonstrates that there is some degree of disagreement between what participants self-reported and what they actually did, highlighting the need for the automatic trip tracking in TripAware.

1.7   Comparative framework for activity-travel diary collection systems: Prelipcean et al. [16]

Prelipcean et al. explores the design of and compares various activity-travel diary collection systems. They investigate systems such as Mode Inference, which E-mission also utilizes. This work primarily focuses on performance and data collection of these spatial-temporal trips as opposed to our study which explores which UI's engage users most.

1.8   Travel Behavior Profiling Using a Trip Planner: Sierpinski et al. [19]

Sierpinski et al. propose an approach to study travel behaviors through a specialized multi-modal trip planner called GTPlanner. This trip planner collects data and encourages individuals to use the most efficient and most sustainble routes, which is similar to the TripAware information feature that suggests sustainable routes. GTPlanner also gives users information about how their trips impact the envirnoment, which is similar to how the TripAware information and emotion apps provide the users information about their carbon footprint.

1.9 Sustainably unpersuaded: how persuasion narrows our vision of sustainability: [4], Mapping the landscape of sustainable HCI: [6]

Sustainably Unpersuaded and *Landscape of Sustainable HCI* map out larger trends within HCI, identifying common approaches and flaws in research methodology. *Sustainability Unpersuaded* questions the premise of this study, arguing that "[proposing] technical solutions to social problems" is in fact, "not producing solutions." However this study indicates that we may not want to rule out technical solutions so quickly. With smartphones now using a significant portion of our total attention, there exists greater potential for mobile applications to sculpt our daily habits by becoming more 'social' and integrated within human existence. In other words, it becomes increasingly difficult to distinguish between technological and social solutions.

2 TANGENTIAL WORKS THAT WE ALSO EXAMINED

2.1 Green tracker: a tool for estimating the energy consumption of software: Amsel et al. [1]

Amsel et al. describes a tool, Green tracker, that estimates the energy consumption of software. This is an interesting concept to explore, however TripAware specifically focuses on people's transportation carbon emissions.

2.2 Understanding conflict between landlords and tenants: implications for energy sensing and feedback: Dillahunt et al. [5]

This work studies energy feedback and usage in an adversarial scenario between landlords and tenants, but our situation is vastly different and not in such an adversarial environment.

2.3 HCI and environmental sustainability: the politics of design and the design of politics: Paul Dourish [7]

Dourish examines the politics and economics of HCI design for environmental sustainability. Our study's scope is much more narrow than Dourish's paper, we don't take into account any of the driving forces that Dourish writes about.

2.4 Persuasive computers: perspectives and research directions: B.J. Fogg [8]

This work examines different perspectives of how computers can change behavior. It was written much before smartphones as we know it exist today, so many factors we address aren't considered here, however it does mention that one way computers can affect behavior is by "providing information that allows informed decisions." This is exactly what the *Information* group of TripAware was intended to study.

2.5 Persuasive Technology: Using Computers to Change What We Think and Do: Fogg et al. [9]

Fogg et al. analyzes how computers and technology have influenced human behavior. But because this chapter was written in the early 2000's, it does not include discussion about how specifically mobile smartphones can influence human behavior.

2.6 Some consideration on the (in)effectiveness of residential energy feedback systems: Pierce et al. [14]

Pierce et al. focuses on designing interactive systems to promote sustainable consumption of energy through the design of two qualitative home studies. TripAware, on the other hand, uses quantitative methods to assess human trip behavioral change.

2.7 Home, habits, and energy: examining domestic interactions and energy consumption: Pierce et al. [15]

Pierce et al. conduct a qualitative study to promote sustainable energy-consuming products and systems in the home and additionally analyze personal survey questions, while TripAware measures behavioral change through quantitative statistical testings.

2.8 Fit4life: the design of a persuasive technology promoting healthy behavior and ideal weight: Purpura et al. [17]

Fit4life proposes the use of behavioral strategies to reduce weight and also collects human weight data. Although TripAware also is a behavioral study that collects human data, TripAware aims to sustainably influence human travel patterns.

2.9 A bright green perspective on sustainable choices: Woodruff et al. [21]

Woodruff et al. present a qualitative study of 35 United States households that analyzes the motivations, practices, and experiences of the occupants that aim to make their homes and behaviors more environmentally responsible. In our study, TripAware focuses on quantitatively measuring the behavior change of trip data.

2.10 This Changes Sustainable HCI: Knowles et al. [13]

Knowles et al. presents a lot of key takeaways regarding sustainable HCI research as a whole. However, these points are more or less orthogonal to the specific domain in which our work lies.

2.11 Evaluation Beyond Usability: Validating Sustainable HCI Research: Remy et al. [18]

This paper raises questions about the validation and evaluation of sustainibility research in HCI. One point Remy et al. makes is regarding having good evaluation metrics to measure the effects of mechanisms employed in sustainability research, which is something Tripaware stresses as well.

REFERENCES

[1] Nadine Amsel and Bill Tomlinson. 2010. Green tracker: A tool for estimating the energy consumption of software. *Conference on Human Factors in Computing Systems - Proceedings*, 3337–3342. https://doi.org/10.1145/1753846.1753981

[2] Paul M. Aoki, R. J. Honicky, Alan M. Mainwaring, Chris Myers, Eric Paulos, Sushmita Subramanian, and Allison Woodruff. 2009. A Vehicle for Research: Using Street Sweepers to Explore the Landscape of Environmental Community Action. *CoRR* abs/0905.0200 (2009). arXiv:0905.0200 http://arxiv.org/abs/0905.0200

[3] Eric P.S. Baumer, Sherri Jean Katz, Jill E. Freeman, Phil Adams, Amy L. Gonzales, John Pollak, Daniela Retelny, Jeff Niederdeppe, Christine M. Olson, and Geri K. Gay. 2012. Prescriptive persuasion and open-ended social awareness: Expanding the design space of mobile health. In *CSCW'12 - Proceedings of the ACM 2012 Conference on Computer Supported Cooperative Work*. 475–484. https://doi.org/10.1145/2145204.2145279

[4] Hronn Brynjarsdottir, Maria Håkansson, James Pierce, Eric Baumer, Carl Disalvo, and Phoebe Sengers. 2012. Sustainably unpersuaded. *Proceedings of the 2012 ACM annual conference on Human Factors in Computing Systems - CHI 12* (2012). https://doi.org/10.1145/2207676.2208539

[5] Tawanna Dillahunt, Jennifer Mankoff, and Eric Paulos. 2010. Understanding conflict between landlords and tenants: implications for energy sensing and feedback. In *Proceedings of the 12th ACM international conference on Ubiquitous computing*. ACM, 149–158.

[6] Carl Disalvo, Phoebe Sengers, and Hrönn Brynjarsdöttir. 2010. Mapping the landscape of sustainable HCI. *Proceedings of the 28th international conference on Human factors in computing systems - CHI 10* (2010). https://doi.org/10.1145/1753326.1753625

[7] Paul Dourish. 2010. HCI and environmental sustainability: the politics of design and the design of politics. In *Proceedings of the 8th ACM conference on designing interactive systems*. ACM, 1–10.

[8] Brian J Fogg. 1998. Persuasive computers: perspectives and research directions. In *Proceedings of the SIGCHI conference on Human factors in computing systems*. ACM Press/Addison-Wesley Publishing Co., 225–232.

[9] Brian J Fogg. 2002. Persuasive technology: using computers to change what we think and do. *Ubiquity* 2002, December (2002), 5.

[10] Derek Foster, Conor Linehan, Shaun Lawson, and Ben Kirman. 2011. Power Ballads: Deploying aversive energy feedback in social media. *Conference on Human Factors in Computing Systems - Proceedings*, 2221–2226. https://doi.org/10.1145/1979742.1979944

[11] Jon Froehlich, Leah Findlater, and James Landay. 2010. The design of eco-feedback technology. *Conference on Human Factors in Computing Systems - Proceedings* 3, 1999–2008. https://doi.org/10.1145/1753326.1753629

[12] Eric B. Hekler, Predrag Klasnja, Jon E. Froehlich, and Matthew Buman. 2013. Mind the theoretical gap: Interpreting, using, and developing behavioral theory in HCI research. In *Conference on Human Factors in Computing Systems - Proceedings*. 3307–3316. https://doi.org/10.1145/2470654.2466452

[13] Bran Knowles, Oliver Bates, and Maria Håkansson. 2018. This changes sustainable hci. In *Proceedings of the 2018 CHI Conference on Human Factors in Computing Systems*. ACM, 471.

[14] James Pierce, Chloe Fan, Derek Lomas, Gabriela Marcu, and Eric Paulos. 2010. Some consideration on the (in) effectiveness of residential energy feedback systems. In *Proceedings of the 8th ACM Conference on Designing Interactive Systems*. ACM, 244–247.

[15] James Pierce, Diane J Schiano, and Eric Paulos. 2010. Home, habits, and energy: examining domestic interactions and energy consumption. In *Proceedings of the SIGCHI Conference on Human Factors in Computing Systems*. ACM, 1985–1994.

[16] Adrian Prelipcean, GyÅŚzÅŚ GidÃşfalvi, and Yusak Susilo. 2015. Comparative framework for activity-travel diary collection systems. 251–258. https://doi.org/10.1109/MTITS.2015.7223264

[17] Stephen Purpura, Victoria Schwanda, Kaiton Williams, William Stubler, and Phoebe Sengers. 2011. Fit4life: the design of a persuasive technology promoting healthy behavior and ideal weight. In *Proceedings of the SIGCHI conference on human factors in computing systems*. ACM, 423–432.

[18] Christian Remy, Oliver Bates, Alan Dix, Vanessa Thomas, Mike Hazas, Adrian Friday, and Elaine M Huang. 2018. Evaluation beyond usability: Validating sustainable HCI research. In *Proceedings of the 2018 CHI Conference on Human Factors in Computing Systems*. ACM, 216.

[19] Grzegorz SierpiÅĎski, Marcin Staniek, and Ireneusz CeliÅĎski. 2016. Travel Behavior Profiling Using a Trip Planner. *Transportation Research Procedia* 14 (2016), 1743 – 1752. https://doi.org/10.1016/j.trpro.2016.05.140 Transport Research Arena TRA2016.

[20] Meynard John Toledo, Eric Hekler, Kevin Hollingshead, Dana Epstein, and Matthew Buman. 2017. Validation of a Smartphone App for the Assessment of Sedentary and Active Behaviors. *JMIR Mhealth Uhealth* 5, 8 (09 Aug 2017), e119. https://doi.org/10.2196/mhealth.6974

[21] Allison Woodruff, Jay Hasbrouck, and Sally Augustin. 2008. A bright green perspective on sustainable choices. In *Proceedings of the SIGCHI Conference on Human Factors in Computing Systems*. ACM, 313–322.