

Persuasive sustainable cities: personalized, place-based behavior change informed by contextual urban data

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Abstract. With the increasing rate of urbanization worldwide, cities have been deemed places where the “battle for sustainability” will be either lost or won. Intelligent infrastructure and increased capabilities for data collection through wearables, ubiquitous computing and IoT offer the opportunity to better understand (un)sustainable behavior at a city scale. They can also help study the effects of urban design on individual behavior. My research contributes to a growing body of work in the field of *persuasive cities*, which aims to reshape the way people behave in urban areas. I aim to identify ways of integrating data from different sources such as crowdsourcing, apps, analytics and sensors to understand individual behavior and place-based qualities. Based on these, I will design and implement nudging interventions for more sustainable behavior. These interventions will be based on personalization through mobile applications and in-the-wild experiments. The outcome of this work will be used to draw conclusions about designing interventions at a city scale and the possibilities of integrating persuasive technology and urban interaction design.

1 Background

“Persuasive cities” was coined as a term in 2016 as an approach to designing persuasive technology at an urban scale, in order to “intentionally reshape how people think and act” [1]. Inherently, the term shares a place-based approach with “urban interaction design” [2], concerned with interaction in public spaces to improve everyday urban experience. However, there are still few examples of public space interventions that make explicit use of behavioral or persuasive frameworks or theories, even when designing with the goal of changing a behavior.

The deployment of intelligent infrastructure, wearables and IoT has opened up two exciting possibilities for persuasion in cities. On one hand, access to location-based data can improve understanding of user behavior and therefore increase personalization of interventions for sustainability. For example, integrating data from multiple sources such as public transportation, GPS and weather can help nudge users towards sustainable travel plans [3, 4]. Automatically tracking transportation modes can be used to “challenge” the user to meet sustainable mobility goals [5, 6], to improve smart urban water management [7] or offer context-aware recommendations of points of interests

in cities [8]. Anagnostopoulou et al., for example, incorporate both personal characteristics as well as context-aware recommendations, such as weather and destination, to design personalized persuasion strategies for urban mobility [9].

On the other hand, location-based data can offer insights into place-specific characteristics that may encourage or discourage sustainable behavior. Environmental psychology has long postulated the strong interlink between human behavior and environment [10, 11], but this overlap has been less addressed in persuasive technology research. Ambient, persuasive applications have identified the opportunity for designing interventions in the right time and place [12], but less research has been carried out on the context and spatial qualities embedded in a location. One of the few examples using a behavioral framework for public space interventions, Bloeme et al. [13] explored the spatial (in)visibility of public urinals in central Amsterdam. They designed nudging installations as light projections, arrows and graphics, to make them more recognizable by inebriated pedestrians [13]. Footprint stickers, lights and sound-enhanced staircases have also been explored as ways of increasing physical activity in public spaces [14, 15]. Installations placed on building façades can determine pedestrians to change their route [16], but these did not explicitly rely on persuasive or behavioral theories.

The state-of-the-art shows there is an opportunity for urban interaction design to benefit from using theoretical constructs and frameworks from persuasive technology. Conversely, urban interaction design offers new opportunities for designing persuasive interventions in public spaces, through a more place-based and contextual approach.

2 Research questions

My PhD explores the way that persuasive technology can support design processes for sustainable behavior at an urban scale. I focus on the role of personalization and place-based interventions in encouraging sustainable behavior. My research questions are:

RQ1: How can data from different sources such as mobile tracking, wearables, apps, sensors be integrated with each other to understand user sustainability behavior? *I will focus on analyzing data from multiple sources to derive user types and local contexts.*

RQ2: How can these derived user types and local contexts inform the design of persuasive interventions for sustainable behavior change? *I will design interventions to increase sustainable behavior, based on personalization and in-the-wild experiments.*

RQ3: How can personalization and place-based interventions inform urban policy and urban design? *I will reflect on potential ways of integrating urban interaction design and persuasive technology and on ways of incorporating my results in the work of urban interaction designers, persuasive designers and local administrations.*

3 Research plan and methodology

My work draws on both approaches from persuasive technology as well as urban interaction design. A large part of the work is being undertaken in framework of the JPI Urban Europe SimpliCITY project, in partnership with two municipalities, in Austria and Sweden.

In the first stage, a persuasive web and mobile platform is being developed which is integrating data sources provided by the municipalities, such as sensor data, open data and existing mobile applications. A mobile tracking feature is also being implemented on the platform. Initial work has been carried out, with two surveys having been implemented with users. Three workshops have also been organized together with local stakeholders. The main functionalities for the application have been defined and initial persuasive strategies have been selected. Initial user studies will be carried out in the following 6 months. From these and the analysis of data collected through the platform, I will define user types and local contexts. To complement these and capture qualitative information, I will carry out in-situ observations and ethnographic data collection in selected public spaces.

In the second stage, the information acquired will be used to design experiments. These will take place (a) through the web and mobile application and (b) in public spaces. The degree of persuasion and acceptability by the users will be measured and compared to inform future iterations. For place-based experiments, similar urban contexts (i.e. a similar street as a baseline) will be used as a comparison.

Finally, in the third stage, conclusions will be drawn with respect to the applicability of the experiments at a larger scale in cities. Focus groups will be conducted with local administration staff from the two partner cities in Austria and Sweden. We will also collect feedback other local stakeholders, researchers, designers and practitioners on opportunities and limitations for cities to implement such strategies for sustainable behavior change.

References

1. Stibe A, Larson K (2016) Persuasive Cities for Sustainable Wellbeing: Quantified Communities. In: Younas M, Awan I, Kryvinska N, et al (eds) *Mobile Web and Intelligent Information Systems*. Springer International Publishing, Cham, pp 271–282
2. Brynskov M (ed) (2014) *Urban Interaction Design. Towards City Making*. Amsterdam
3. Carreras I, Gabrielli S, Miorandi D, et al (2012) SUPERHUB: a user-centric perspective on sustainable urban mobility. In: *Proceedings of the 6th ACM workshop on Next generation mobile computing for dynamic personalised travel planning - Sense Transport '12*. ACM Press, Low Wood Bay, Lake District, UK, p 9
4. Forbes PJ, Wells S, Masthoff J, Nguyen H (2012) SUPERHUB: Integrating behaviour change theories into a sustainable urban-mobility platform
5. Froehlich J, Dillahunt T, Klasnja P, et al (2009) UbiGreen: investigating a mobile tool for tracking and supporting green transportation habits. In: *Proceedings of the 27th international conference on Human factors in computing systems - CHI 09*. ACM Press, Boston, MA, USA, p 1043
6. Jylhä A, Nurmi P, Sirén M, et al (2013) MatkaHupi: a persuasive mobile application for sustainable mobility. In: *Proceedings of the 2013 ACM conference on Pervasive and ubiquitous computing adjunct publication - UbiComp '13 Adjunct*. ACM Press, Zurich, Switzerland, pp 227–230
7. Dini Kounoudes A, Kapitsaki GM, Milis M (2019) Towards Considering User Privacy Preferences in Smart Water Management. In: *Adjunct Publication of the 27th Conference on User Modeling, Adaptation and Personalization - UMAP'19 Adjunct*. ACM Press, Larnaca, Cyprus, pp 209–212

8. Biancalana C, Gasparetti F, Micarelli A, Sansonetti G (2013) An approach to social recommendation for context-aware mobile services. *ACM Trans Intell Syst Technol* 4:1–31. <https://doi.org/10.1145/2414425.2414435>
9. Anagnostopoulou E, Bothos E, Magoutas B, et al (2018) Persuasive Interventions for Sustainable Travel Choices Leveraging Users' Personality and Mobility Type. In: Ham J, Karapanos E, Morita PP, Burns CM (eds) *Persuasive Technology*. Springer International Publishing, Cham, pp 229–241
10. Altman I, Low SM (1992) *Place attachment*. Plenum Press, New York
11. Altman I, Zube EH (1989) *Public places and spaces*. Plenum Press, New York
12. Reitberger W, Tscheligi M, de Ruyter B, Markopoulos P (2008) Surrounded by ambient persuasion. In: *Proceeding of the twenty-sixth annual CHI conference extended abstracts on Human factors in computing systems - CHI '08*. ACM Press, Florence, Italy, p 3989
13. Bloeme R, de Vries P, Galetzka M, van Soomeren P (2017) Persuasive Technology Against Public Nuisance – Public Urination in the Urban Nightlife District. In: de Vries PW, Oinas-Kukkonen H, Siemons L, et al (eds) *Persuasive Technology: Development and Implementation of Personalized Technologies to Change Attitudes and Behaviors*. Springer International Publishing, Cham, pp 187–198
14. Meyer J, Beck E, von Holdt K, et al (2018) ActiStairs: Design and Acceptance of a Technology-Based Intervention to Advocate Stair-Climbing in Public Spaces. In: *Proceedings of the 3rd International Workshop on Multimedia for Personal Health and Health Care - HealthMedia'18*. ACM Press, Seoul, Republic of Korea, pp 59–66
15. From movement to Mozart. In: *Design of the world*. <https://www.designoftheworld.com/piano-stairs/>
16. Houben M, Deneff B, Mattelaer M, et al (2017) The Meaningful Integration of Interactive Media in Architecture. In: *Proceedings of the 2016 ACM Conference Companion Publication on Designing Interactive Systems - DIS '17 Companion*. ACM Press, Edinburgh, United Kingdom, pp 187–191