iasdr 2021 WITH DESIGN

PolyU Design
School of Design
The Hong Kong Polytechnic University
5–9 December 2021

Designing HCI Strategies to Communicate and Suggest Action for Climate Change Mitigation

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Climate change is arguably the most urgent issue of our time, demanding the participation of all types of stakeholders, from individuals to governments. However, climate change communication has been focused on negative framings based on the mere presentation of data, in many cases demotivating or simply not helping in action. This Ph.D. proposes using a Research through Design (RtD) approach to create and evaluate communication design and HCI strategies to meaningfully encode and present outside the obvious, actionable climate-related messages to diverse audiences of non-experts. The studies will focus on the development of HCI projects focused on less explored climate change topics, addressing the gaps found and implementing the implications for design proposed in the first stage of the research. The purpose is to design, test, and evaluate different interactive communication strategies through iterative studies to contribute to new design solutions and guidelines for future work.

Keywords: Human-computer interaction; Design; Interaction; Visualisation; Climate change

1 Introduction: HCI to engage with Climate Change

Climate change is an urgent, global and complex issue directly correlated to human activity (IPCC, 2018; Wuebbles et al., 2017) which demands immediate global action. It is a systemic problem that needs the participation of most of the population to be resolved – from individual action to major government policies – so being able to effectively reach a varied audience is essential. The debate around which form of action to push for has been prolific in the design and HCI communities, from individual behavior change (Barreto et al., 2011; Huizenga et al., 2015; Moere et al., 2011; Nisi et al., 2013), to community and collective action (DiSalvo, 2011; Le Dantec, 2016), to shifts in political or economic systems (Dourish, 2010; Fritsch et al., 2019; Knowles et al., 2014). It is undeniable that major social changes are needed, so individual action and systemic change can be seen as “two sides

of the same coin" (Climate Outreach, 2021). Because of its complexity, this is a very polarizing issue that represents a huge communication challenge. On the one hand, people need to be informed of the urgent situation and the science behind it, ideally accompanied with suggestions of actionable steps to be taken. On the other hand, this dire scenario can lead people to not see "a light at the end of the tunnel" and conclude there is no point in actually taking action (Revkin, 2014).

Because of its pressing nature, the discourse around climate change has been mainly one of urgency and alerts, resulting in increased stress and worry about the issue (European Commission, 2019; Leiserowitz et al., 2019). Effective communication and interaction to inform the public, trigger changes in mindsets and behaviours, helping with tools for community or political action, are crucial parts in the path towards mitigation of the Anthropocene (UNEP, 2018). The way these exchanges are crafted is essential for its success (Corner et al., 2018).

Research is already promoting a shift towards more positive, action focused communication which builds a visual vocabulary that goes beyond melting ice and polar bears (Bertolotti and Catellani, 2014; Climate Outreach, 2020; Corner et al., 2018; IPCC, 2018; Mayer and Smith, 2019; Tonkinwise, 2011). However, these assets and recommendations need to be used in media channels that will actually reach the public and in ways that will connect with them. This premise is one of the factors that fuels this research project. By using HCI and testing different communication design strategies through the creation of prototypes, this study will gather data on the effects of the used approaches and draw conclusions to develop guidelines for future work. As the theme of IASDR 2021 highlights, design research needs to transcend the limits of its discipline to respond to pressing social issues. This PhD study intends to do so through an applied lens.

1.1 HCI Research on Climate Change in the Past Decade

As part of understanding the problem space in which the prototypes will live in, and build on past research, a mapping of past projects was conducted using the Grounded Theory Literature Review method (Wolfswinkel et al., 2013). This survey provides an overview of HCI and Design climate change projects from the past decade (Jan. 2010 - Dec. 2020) and analyzes particular communication choices. By doing so, the intention is to understand how HCI and Design research is treating the topic, aligned with the latest recommendations regarding climate change communication, and propose design implications and suggestions for future work that will inform the next stage of this study. A first stage of this survey focused on HCI has already been published (Ferreira et al., 2021) with the analysis of a corpus of 40 projects. The study concluded that there is a prevalence of a neutral messaging – neutral framing based on showcasing examples –; that most projects don't show actionable steps of suggest solutions; that topics follow trends overtime; and that most projects are created for institutions. Four implications for design were derived: 1) Explore less developed themes: think of impact and your audience; 2) Frame the message in a positive and action focused way, adapted to your audience; 3) Explicitly show further steps to help the user(s) in their journey; 4) Explore interaction possibilities in places of passage (daily routine).

A more in depth analysis, including more HCI and Design databases, is being developed to further the understanding of the state of the art. These implications will inform the second phase of this study – the conceptualization, development and implementation of the prototypes to put these theories to test.

1.2 Sustainable HCI and Climate Change Communication

This Ph.D. thesis focuses on interactive communication strategies, living in the intersection of sustainable HCI (SHCI) and climate change communication.

Sustainable HCI (SHCI) (Blevis, 2006; DiSalvo et al., 2010; Mankoff et al., 2007; Silberman et al., 2014; Wakkary et al., 2013; Yang et al., 2014) is a broad topic that generally refers to designing systems that either reduce environmental impact or influence people to behave and live more sustainably. Blevis' definition of design as "an act of choosing among or informing choices of future ways of being" (Blevis, 2007) highlights how sustainable principles applied to design *now* have an impact on *the future*. Fallman (Fallman, 2008) also points to this possibility of "shaping possible futures" linked to interaction design's connection with society at large and its voice in societal issues. These are principles we hope to materialize through the prototypes.

Recently, concerns about sustainable HCI's approaches, and in particular when applied to climate change, resulted in a proposed shift in perspectives and call to actions from the academic community, such as: design futuring and sustainment (Fry, 2019, 2017), participatory and civic design (Clarke et al., 2018; DiSalvo, 2014; DiSalvo and Dantec, 2017; Le Dantec, 2016), transition design (Tonkinwise, 2015; Tonkinwise et al., 2015), and the call to move from a user-centered design to more inclusive, diverse, multispecies perspectives (Akama et al., 2020; Forlano, 2016; Light et al., 2017; Liu et al., 2019; Mancini and Lehtonen, 2018; Smith et al., 2017). These new perspectives will serve as guidelines for possible new avenues of exploration that are "outside the obvious".

Climate change communication (Anderson, 2011; Corner and Groves, 2014; Dulic et al., 2016; Koteyko et al., 2015; Levine and Kline, 2017; Moser, 2010; Nerlich et al., 2010; Russill and Nyssa, 2009; Schäfer, 2015) aims to bring knowledge via experimentation about the phenomena, making them visible and actionable in everyday life. It examines various factors that affect and are affected by how we conduct this communication exchange, and its research has mostly focused on public understanding of climate change, factors that affect this understanding, framing and media coverage, media affects, and risk perceptions (Chadwick, 2017).

1.3 Communication Design Strategies

The hypothesis for this study is that the communication design elements chosen throughout the HCI development – such as framing (Kahan, 2012; Lakoff, 2010; McDonald et al., 2015; Morton et al., 2011; Nabi et al., 2018; Nisbet, 2009; Shaw and Nerlich, 2015; Spence and Pidgeon, 2010; Tversky and Kahneman, 1981), transmedia storytelling (Bala et al., 2020; Dionisio and Nisi, 2021; Jenkins, 2007, 2006; Pratten, 2015), and visual communication (Baldwin and Roberts, 2006; Climate Outreach, 2020; Corner et al., 2015; Jordan et al., 2017) – play a crucial role in how the audience will react and act upon the information transmitted in climate change related interactions. This research project intends to test message creation, visual concepts, graphic design, media choices, and other factors that will enhance the message being imparted. The way the data is crafted into a message and then visually represented has a great influence in how the information is perceived.

2 Objectives of the Research

This study intends to bring together the fields of HCI and communication design to test the interaction possibilities linked to framing, transmedia, and visual communication.

By doing a mapping of interaction projects on climate change to the general public from the past decade (Ferreira et al., 2021), several gaps in the field and implications for design were identified. This research will focus on addressing two of these gaps: i) topics follow trends, with topics like energy, biodiversity and sustainable lifestyles being the most developed, leaving other topics with little or no exploration; ii) most projects use a neutral framing with no explicit suggestions for further action, pointing to a need of further research in interactions with a positive and action focused approach. These gaps will be addressed through two main research questions: a) Can HCI contribute to the communication and engagement of the general public with climate change topics that are outside the obvious; b) Does a positive framing focused on actionable steps contribute to better engagement in HCI projects on climate change.

This research aims to i) understand the problem space of climate change related interaction through research and analysis; ii) test different interaction solutions designed to educate and nudge people towards sustainable habits and/or climate action; iii) make methodological contributions: generate design recommendations and methods (e.g. scales). Achieving these goals will provide several contributions: i) improve the knowledge on existing practical approaches to addressing climate change topics; ii) test low-cost HCI interventions in real-world scenarios increasing awareness related to climate change; iii) test the influence of communication design in HCI projects.

3 RtD: An Applied Methodology

The present research intends to have a central applied component with an outlook towards a future "optimised state". Therefore, it is based on the research through design (RtD) approach as compiled and proposed by Zimmerman, Evenson and Forlizzi (Zimmerman et al., 2010, 2007; Zimmerman and Forlizzi, 2008), based on the model proposed by Frayling (Frayling, Christopher, 1994). This approach "employs methods and processes from design practice as a legitimate method of inquiry" that follows the process of "iteratively designing artifacts as a creative way of investigating what a potential future might be" (Zimmerman et al., 2010). RtD allows for research on "wicked problems" – complex social and cultural problems that involve conflicting views and multiple stakeholders – through a holistic and iterative approach based on the designer's natural work process.

During the research design process, it will also be taken to consideration Zimmerman et al.'s (2007) proposed set of criteria for evaluating an interaction design research contribution: a) *process* – rigor of the methods and documentation; b) *invention* – propose a novel application of different subject matters as to advance the state of the art; c) *relevance* – frame the research within real-world contexts and justify the proposed preferred state; and d) *extensibility* – the capacity to build on the outcomes of the research.

The research design will also follow the stages of the design process as described by Zimmerman et al. (2007): (1) *Grounding*; (2) *Ideation* and *Iteration*; (3) *Reflection*. These are presented in more detail in the following sections.

3.1 Grounding stage

The first stage – *Grounding* – comprises of an investigation and understanding of the problem space. With this purpose in mind, we conducted state of the art surveys. These led to a better understanding of the research being done and possible gaps to be explored. From there, topics and implications for design were generated to inform future climate change related HCI and Design

projects, namely: a) Choose topics based on impact and audience; b) Explore interactive engagement in daily routine places; c) Help the users take action by proposing actionable steps; d) Positively frame the message with a narrative adapted to your audience; e) Explore alternative and more inclusive perspectives (Ferreira et al., 2021).

3.2 Ideation and Iteration stages

The second stages are *Ideation* – generating multiple solutions to the problem –, and *Iteration* – iterative refinement of the concept. In these stages we plan, design and implement the artifacts (prototypes).

The implications for design formulated in the grounding stage are informing the creation of the prototypes (*Ideation*). These prototypes will be tested and evaluated in real-world contexts, each project learning from and building on the previous one (*Iteration*). The first two prototypes are already in development and intend to test, respectively: 1) food consumption and narratives associated with possible futures and location-based information ; 2) nature-based solutions and narratives associated with more-than-human/multi-species perspectives. All projects will test a positive, action-focused framing.

3.3 Reflection stage

The last stage serves to analyse the results and produce theory for design through conclusions, design recommendations and guidelines for future design research. These methodological contributions will be derived through the evaluation and analysis of the prototypes – design recommendations and methods for evaluation (e.g. scales). This final stage will lead to the production of new knowledge, addressing the possible lack of theory development from the observation of the artifacts (Fallman, 2008; Friedman, 2003). More specifically, the objective of this stage is to provide the HCI and Design research community with information and guidelines on how to create interactive communication projects to audiences outside academia and the effectiveness of the tested strategies. Furthermore, the conclusions of this study will have a multidisciplinary outreach as they will also be of interest to other communicators working with this topic.

4 Expected Outcomes

The conclusions of this study will help to better understand the general public's perceptions and reactions to particular climate change topics and approaches, and offer suggestions on how to best construct and present their message for a more effective interaction. The research will have three main outcomes: 1) up to four HCI/communication prototypes aimed at a general public of adults, created iteratively; 2) a scale to help evaluate the projects and their impact that will serve as a tool for future research work in this field; 3) implications for design derived from the projects' analysis. The process and conclusions of these stages will be presented through publications in appropriate HCI and Design conferences and journals.

5 Acknowledgments

I would like to thank my supervisors Nuno J. Nunes and Valentina Nisi for their continuous support and for showing me that design research with real-world application is a reality.

This research is being funded by Fundação para a Ciência e a Tecnologia (FCT) through a PhD research grant – SFRH/BD/144434/2019.

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