A Literature Review About Persuasive Interfaces

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ABSTRACT

Software applications and websites facilitate interactions between a user and some data. Research into human-computer interaction has shown that changes to the presentation of objects in an interface affects how users respond to the information - in other words, design is not value-neutral from the perspective of user behavior. This literature review considers several academic papers, based on both theory and applications. It attempts to ascertain both the strengths and limitations of the existing research. It concludes that both user interfaces and the structure of the information itself affect the decisions a user makes in an interaction and how quickly they implement those decisions.

1. INTRODUCTION

The interface between the human and the computer has been a subject of theoretical investigation and software development since computers have existed but particularly since the mid-twentieth century. Then humans interacted with computers via punch cards. After that, display screens allowed computer programmers and operators to interact by way of strings of characters, a format still in common use today. The invention of the graphical user interface (GUI) was a key component of the popularization of computing late in the twentieth century. Now the expectation for applications, hardware controls, and the like is that they be carefully tested for functionality and usability.

Breakthroughs in both human-computer interaction (HCI) and in behavioral economics have revealed further that small factors in an interface can drastically alter user behavior, a concept called a "nudge". For any two interfaces providing identical underlying functionality, one may be easier or more intuitive to use, or it may subtly provoke a user to take a particular action they may not have otherwise.

This paper will investigate how computer interfaces affect human behavior, as examined in a review of the literature on the topic. It considers both theoretical papers and experiments. It concludes with a plan for further research.

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2. LITERATURE REVIEW

2.1 Theoretical Foundations

HCI as an academic discipline in computer science emphasizes communication. Haynes et al., for example, conducted a series of interviews with HCI design researchers about how design facilitates understanding. They described several established and emerging social theories. Of particular concern in this context is their description of the established, fundamental frames of reference cited by their interviewees. Most important are causality, instrumentality, and prediction, all of which are relevant to considering user responses within a given interface.[2] This paper is more general than the direct topic of concern here, but emphasizes that computers communicate with people, an assumption that underlies the rest of this review.

Within HCI, the most valuable model for this research is the comprehensive theoretical approach of Oinas-Kukkonen about how interfaces on a variety of platforms change human behavior, with an explicit emphasis on the human's side of the interaction. After a brief description of some behavioral models in the social sciences, he defined a series of specific changes an interface may want to produce: changes in attitude, in behavior, or in compliance. He provided some detail for each of them along with a more comprehensive analysis. Finally, he used health as an example of the research prospects of a persuasive computing framework. He argued that his model offered a more specific and empirically-driven approach than past approaches to the same topics. Except for the health example, there was little in the way of applications. It was meant instead to serve as a base for a maturing research domain. Critically, he emphasized that his approach applies across platforms and applications.[5]

2.2 Applications: Desktop

The breadth of the academic literature supports Oinas-Kukkonen's point about generality across platforms. Wang et. al., for example, focused on improving the content users choose to post to Facebook on the desktop. They implemented three nudges for their interface: photos of a subset of their friends, a timer to offer users some short time interval in which to cancel a post, and a "sentiment" analyzer to tell users if the post may be seen as positive, negative, or something else. They briefly described their recruitment process and participant set, and then reviewed the three interventions. Participants felt the sentiment nudge was the weakest and showed some preference for the timer. A sample size of just 21 participants and technical difficulties described in

the paper made some of its specific outcomes questionable, as the authors acknowledged, but its research was otherwise sound.[6] In this sense their findings are in accord with those of the other papers. In terms of Oinas-Kukkonen's framework, this is a change in both behavior and attitude.

The stakes for focusing on user persuasion through design also affect personal security, as in the case of Liu et al. They, too, examined Facebook, conducting an experiment about preventing users from opening dangerous links, such as phishing expeditions (a behavior change). They acquired information about whether a link is dangerous from both Facebook globally and the participants' own individual networks. They sought a series of both automatic and manually-solicited responses from users. Most relevant to this research topic are their discoveries about click-through rates for dangerous links: When experiencing a visual warning nudge, users were less likely to click through and more likely to employ a "dismiss" feature than when no warning was activated.[4] This study shares the flaw of the Wang et al. study: an interface that is now years out of date and a small sample size. Still, other research does not discredit their findings and their methodology was satisfactory. In particular, they provide unique insight in the form of its quantitative investigations of click-through rates.

2.3 Applications: Modern Platforms

As mobile devices and embedded computing expand, focusing excessively on desktop- and web-based interfaces misses critical user interactions. Cockburn and Gutwin, for example, examined the literature in HCI about how users interact with a computing device other than the classic drag-point-click of the desktop computer. Theirs was an explicit evaluation of theory, supported by experiment. They considered some of the deficiencies of past theoretical models for interaction in what they called constrained-input interfaces (CIN), with specific regard to user performance on mobile and embedded devices. They built on the existing CIN approach with their own model, aiming to increase the theory's predictive power. Theirs was a quantitative, carefully reasoned investigation into such interactions as mobile touchscreens. They conducted a series of trials with "grid," "linear," and "binary" interfaces. They concluded that information structure and user experience directly affects the time required to complete a set of tasks through an interface.[1]

Other papers further explore nudges in human-computer interaction, using much the same language. Future research may emphasize larger-scale systems than these, as the growth of ubiquitous computing has reduced the distinction between a hardware-oriented user interface and a software-oriented user interface. Kalnikaite et. al., for example, conducted an experiment in which they considered shopping technology at a high level. They specifically focused on what factors impact a user's decisions and attempt to bring software development in line with behavioral science research. They found that an overwhelming interface presenting too many options or indicators is excessive. Reaction time is improved with an emphasis on fewer factors rather than more.[3]

2.4 Limitations

A significant deficiency in this field is the extent to which this work is conducted outside academic environments. The theoretical work is thorough, but the experiments tend to take place in, for example, private companies performing A/B tests. The academic experiments reviewed here do not have large user samples and come to only general conclusions.

A trickier and potentially unavoidable problem the experiments share is that the interfaces change rapidly thanks to internal, commerce-driven design choices. As a result, there is little to be gained from sustained academic focus on any one interface. The best approach, then, is to consider a range of both experiments and theoretical models to derive insights that apply across interfaces that exist now and may exist in the future.

3. CONCLUSION AND FUTURE WORK

The use of design as an instrument of behavioral change has solid support in the academic literature in computer science as well as in the lives of the billions of computer users in the world. Therefore, the impact of design choices on user behavior must be considered as part of the process of software and system development. Users are rarely forced to complete an interaction in a certain way, but their interactions are always affected by design factors.

A comprehensive research project on this topic is forthcoming. It will include a research paper, which itself will include a substantial portion of this paper, as well as a software component that may be used to test how users interact with the same data across different interfaces. This is an area in which studying some of the research findings to emerge in commercial contexts, as opposed to exclusively academic ones, will be valuable, so it will include a broader range of sources than this review.

4. ABOUT THE AUTHOR

Craig J. Earley is a December 2016 graduate of the Earlham College Computer Science Department.

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