Questioning the Technological Panacea: Three Reflective Questions for Designers

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Abstract
Many papers in the field of human-computer interaction begin by presenting a problem and then propose a solution for that problem. Despite the varied natures of the problems these papers address, the solutions presented are often implemented through the use of computing technologies. This paper argues that asking whether or not a technological solution is appropriate should be an explicit and exposed part of the design process. It raises three questions that should be addressed during the design process: Are there other, possibly non-technological, solutions that could address the problem equally well, if not better? Are designers creating solutions to problems that users themselves do not need to have? Are these technological solutions treating a problem rather than its cause? This paper uses examples from the literature to show how these questions might be answered, cases in which they were at least partially addressed, and cases that show some of the possible results of not addressing these questions.

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Design, critique, non-technical problems

ACM Classification Keywords
H5.m.: Miscellaneous.

Introduction

Most trades have a specific set of tools particularly amenable to solving the problems encountered in that trade. The doctor uses forceps, scalpel, and syringe; the architect uses draft paper, T-square, and French curve; the carpenter uses hammer, nail, and tape measure. Tradespersons tend to have a high level of familiarity and proficiency with those tools, allowing them to determine which tools are most fit for which situation. In computer science and related fields, the focus is often placed on the development and implementation of tools for other trades or disciplines. Examples include the use of computational models to predict weather patterns, or the use of CAD/CAM tools in the development of mechanical engineering component. However, this situation downplays the fact that computer science is itself a discipline with its own unique set of tools. While the tools available to the computer science researcher may be malleable enough to assume different forms amenable to accomplishing myriad varied tasks, they are not necessarily suited to solving every possible problem. Computational applications have been developed to address social, educational, health related, mental, emotional, and a host of other sorts of problems that do not obviously call for a technological solution.

Although this trend pervades many areas within computer science, this paper focuses on the field of human-computer interaction. The purpose of this paper is not to lament this trend; indeed, a field can often be greatly advanced by pushing its boundaries. However, in the process of pushing disciplinary boundaries, caution must be taken to ensure that the one's methods are still relevant to the problem areas being subsumed. In particular, when technological solutions are proposed for non-technological problems, it may behoove researchers to incorporate the following questions into their design process. Note that it is not necessary that the answer to each of these questions be 'no.' Rather, the purpose at hand is to raise awareness of, and discussion about, these issues in the technology design community, as well as point to some possible results of not addressing these questions during the design process.

- Given a technological solution, are there other, possibly non-technological solutions that could address the same problem equally well, if not better?
- Is the problem being addressed perceived as a problem by the proposed users, or is the situation being unnecessarily problematized by designers?
- By focusing on a specific problem, is the solution treating a symptom and hiding the cause?

This paper draws on recent research in human-computer interaction to show how researchers might go about incorporating these questions into their work. The specific projects chosen are not meant to be all-inclusive, but rather are particularly relevant examples of situations in which designers propose technological solutions for non-technological problems. These examples were selected also because they are, to varying degrees, well known in the community surrounding the CHI Conference and are examples of research at the forefront of the field. This paper is not an argument that these examples, or the field as a whole, are lacking in some way or fundamentally

flawed. The purpose at hand is to unpack the assumptions that underlie these projects, question those assumptions, ask whether the technological solutions they propose are well-suited to the various non-technological problems they attempt to address, suggest considerations of other approaches, and discuss how the design process can be made to incorporate such considerations.

Non-technological Solutions

Technology, in general, is expensive. Designing, developing, implementing, testing, deploying, evaluating, and improving it are time consuming processes. Furthermore, many computing and information technologies generate large amounts of toxic environmental waste [4], which merits pausing to consider whether or not there are significant benefits to the proposed technological solution. For example, in her advocating of engaging user experiences, Rogers [11] supplies an argument for why ubiquitous computing technologies present unique opportunities in the application areas she proposes. Another simple example is using a PDA to support grocery shopping, e.g. [10]. While the PDA may accomplish myriad other activities, if its predominant use is storing and recalling the shopping list, pen and paper would be just as effective.

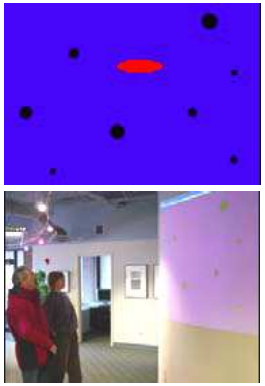

Figure 1. A sample of Miro's display (left) and users examining it (right) [12].

Consider Miro [12], a visualization designed to depict the affective climate in an office environment (Figure 1). One of Miro's successes was that it precipitated conversations between inhabitants of the office trying to decipher its meaning. However, other methods may have been similarly effective at triggering such conversations: an emotional bulletin board, group therapy or counseling, a collaborative art wall, or many other such lo-tech interventions may have produced similar exchanges. Why was Miro any more effective than any of these methods?

In another project, Williams et al. explore how wireless technologies can allow children to create an augmented soundscape in their physical environment [14]. This sort of exploration of the applicability of technologies like augmented spaces to children is certainly important. However, one theme that came up during their discussion was that of "hazard tagging," where in children or adults could place certain audio signals near dangerous places, such as "busy roads, icy surfaces in winter, or … alleyways or subways" where "they feel vulnerable." This suggestion, although it came directly from the children who were subjects of the study, seems somewhat unnecessary; children and people in general know places in an urban area that might be "unsafe," either by peripheral cues about the area, by direct instruction from others, or by word-of-mouth. Furthermore, this also seems like imposing a technological solution on a problem that is currently dealt with relatively well without any technological intervention. While there are certainly horrible cases of children being abducted or worse, it is not clear that an augmented soundscape would help prevent such occurrences any more than peripheral, social, or cultural cues about places to avoid. The effort that would be put into developing and deploying these technologies might have a more significant impact if channeled instead into a different approach.

A similar pattern emerges in Taylor and Swan's study of the artful design of organizing systems in the home [13]. After presenting the results of an ethnographic study of the ways in which people use various

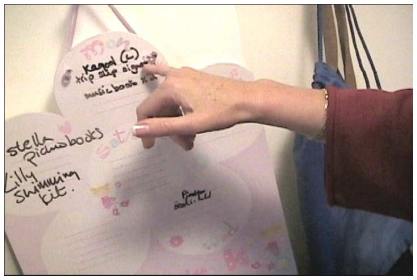

Figure 2. A lo-tech domestic organizing system; each petal on the flower represents family members' activities on different days of the week [13].

multimedia and multimodal systems to organize their domestic lives, the authors suggest some design implications for developing ubiquitous computing systems for organizing the home. These suggestions in and of themselves are perfectly reasonable, but one must question whether ubiquitous computing systems would be a necessary or even desirable addition to the environments studied. Do the mothers studied or their families feel that they need a computational system to help organize or control their lives? It would seem, based on Taylor and Swan's study, that their subjects have developed many ingenious lo-tech organizing systems, such as Figure 2. Furthermore, do the subjects themselves see this as a problem that needs a technological solution, or do they see it as a problem at all? This patterns brings us to the next reflective question for technology designers.

Problematization

As technology designers, we tend to see nearly any situation as one in which technological devices can help. However, in our eagerness to develop the next great gadget, are we potentially trying to solve problems where none exist? Furthermore, by attempting to create these technologies, are we problematizing situations that users themselves do not see as problematic?

Of course, it is not always the situation that users know the range of possibilities that technology can bring to a situation, and users might not know that a technology exists that could potentially help them. It is not the case that designers need to wait for users to tell them that a new technology is needed. With the coining of the phrase "Clic clac, merci Kodak," amateur photography was created, and users became aware of a "need" they never knew they had [6]. Conversely, though, designers should not assume that technology would be a welcome addition to any situation.

As stated above, Taylor and Swan conclude their study with a series of design implications for ubiquitous computing technologies intended to assist with organizing systems in the home [13]. However, is it unclear that the subjects of this study actually want or need such technologies. The authors argue that with the research into "smart home" technology, attention should be paid to the existing practices in the home. There is little contention here, as technologies that ignore existing practice are almost certainly bound for limited success at best. However, the question at hand is whether, in designing these "smart home" technologies, designers are problematizing situations that are either unproblematic or are not seen as problematic by users. Did the mothers and families who were subjects of the study see the organization of their domestic lives as a problem that needed to be solved?

Another example of problematization can be seen in many airports in developed countries. Armed with laptop, cell phone, and blackberry, the information "road warrior" never has to worry about having a wasted moment of downtime but can utilize every free or otherwise unoccupied minute. However, one might ask if unused downtime is truly a problem? Is it truly crucial that you one be productive during the four minutes while waiting on the platform for your next train? Using a cross-cultural study of techno-spiritual practices as a design inspiration, Bell [2] recently questioned this value of constant connectivity and productivity, asking if we might be better served by

taking the occasional minutes of downtime to pause and reflect on our day. In creating always on, always connected, always productive technologies, are we problematizing the situation of idle downtime? Beyond just creating a problem where none previously existed, are we transforming potentially beneficial downtime into the problem of wasted time?

Another example of problematization occurs in the ticket2talk system [8]. Designed to be deployed at academic conferences, ticket2talk includes RFID tags on the badges of attendees and an RFID reader placed behind a coffee table during breaks. When an attendee approaches the coffee table, the system displays information they volunteered about themselves, such as affiliation, recent publications, favorite book, or hobbies, on a projection screen behind the coffee table. The goal is to provide attendees a "ticket to talk" to one another, hopefully breaking down some of the social barriers that might otherwise prevent fruitful exchanges and possible collaborations. One wonders, though, if there are truly extenuating circumstances that prevent good and important research from happening because the right people are not connecting, or is such occasional awkwardness just a normal part of interaction? Does ticket2talk's problematization of social awkwardness turn an aspect of everyday social exchange into a problem that must be solved, inadvertently exacerbating the problem it sought to mitigate and possibly distracting from the possible root causes of the problem? This brings us to the third question for designers of technology.

Treating the Symptoms

Attempting to address any sort of complex problem is much like the situation of a doctor attempting to diagnose a patient. The doctor must determine which aspects of the patient's condition are symptoms and which are causes. Treating the symptoms and not addressing the root causes may not be the best way to help the patient improve. Similarly, it may be beneficial for technology designers to ask whether the situation they are attempting to address is actually the result of a different, root cause.

In the example of ticket2talk [8], one might want to consider that some people are naturally introverted, and these introverted people often still manage to have quite successful careers. In fact, being introverted has its own set of benefits, and extroversion is certainly not always a beneficial trait. Furthermore, some social situations are, by their nature, quite awkward. Rather than try to give these people technology to help them become more extroverted, rather than try to alleviate the awkwardness of these situations, perhaps it might be more beneficial to address *why* such situations feel awkward. Is this awkwardness a function of certain individuals' neuroses, or is there something intrinsic to the situation itself that makes it awkward? Despite the presence of a "ticket to talk," McCarthy et al. note that there is still a good deal of awkwardness between attendees, that there is not a dramatic increase in social exchanges, and that a new set of arguably more awkward situations and behaviors have emerged in ticket2talk's users. This may due partially to the way in which the system attempts to address a problem without addressing its root cause. In this case, perhaps the awkwardness is due more to the history, power structures, and career hierarchies at work in academic disciplines. Rather than simply attempt to decrease social awkwardness, a technological intervention that

challenges the root causes of this awkwardness might do more to actually alleviate the awkwardness.

A similar questioning approach might be taken towards the study of organizing systems in the home cited above [13]. It is noteworthy that the first keyword they give for their paper is "mother's work." Part of their goal is to develop technologies to help their mothers with their work of organizing the home, as evidenced by the design implications they include. However, one might ask, why is it the mother's work? Why is it not parental work, or father's work? Why is it the job of the mother to organize the home? Rather than trying to develop technology to help mothers in their organizing tasks, why not develop technology that questions why the mother is seen as the home's organizer? Instead of supporting this division of domestic labor, why not build devices that challenge it and encourage shifting and rethinking of roles and responsibilities in the home?

Another recent trend in HCI has been the use of ubiquitous computing technologies in health- and fitness-oriented applications, e.g. [1, 3]. Many of these focus on general behavior modification, such as encouraging exercise and decrease prolonged periods of inactivity. Fish'n'Steps [7] encourages physical activity through the use of affective feedback based on pedometer readings. ViTo [9] attempts to reduce the amount of television that users watch by subtly influencing their choices and interjecting alternate possible activities. Intille [5] makes the point that ubiquitous computing technologies offer a unique opportunity to provide information and alternate options to users at the crucial moment of decision, regardless of where or when that decision may be made. While it may be possible to influence or even change users' behaviors via an external, technological intervention, it might be more effective to induce an internal, mental, attitudinal, or emotional change. Furthermore, by suggesting a specific set of alternate activities, ViTo may inadvertently create artificial constraints on the perceived options. Although the world is full of possibilities, ViTo may only list watching TV, listening to the radio, watching a movie, or playing NEAT (non-exercise activity thermogenesis) games as possible activities for the user. Rather than discouraging a user from watching television, perhaps it might be more effective to encourage users to reflect on their TV watching, the role of television in their home or for their family, why they choose to watch TV, and why they might want to do something different. Rather than attempting to alter users' television viewing patterns, perhaps it would be more effective to attempt to alter their attitudes toward television that guide their viewing patterns. Admittedly, evaluating, quantifying, and measuring the occurrence of such internal reflection is significantly more difficult than measuring external changes in behavior, but such difficulties do not mean that internal changes are any less important than external ones. Indeed, when the user's device breaks, wears out, or is lost, will the behavioral changes be more likely to continue if the device was able to induce an external behavioral change or an internal attitudinal change?

Conclusion

This paper seeks to bring to the research community's attention the current trend of using computing technology to solve problems that are not inherently computational. While it is certainly necessary to push the boundaries of any field of study in order for that

Figure 3. Leaning too strongly in the direction of either theory or practice can reduce a project's impact.

field to grow and develop, researchers should do so with a reflective and self-critical eye to the effects that results from the expansion of their discipline. Specifically, this paper has advocated asking three questions as part of the technology design process: why is the given technological solution better than any other solution, technological or non? in creating the technology, are we problematizing a situation that is not inherently problematic? in addressing a potential problem, does the technology effectively mask the underlying causes of the problem?

This paper has cited several instances of technology that was intended to address non-tech problems, and the literature contains many more. This does not mean that that any of these projects, or that the body of work they represent, are fundamentally flawed in any way. All of the systems mentioned in this paper enjoyed some degree of success in addressing the problems they confronted. However, the above examples also containing certain shortcomings. ticket2talk [8] was able to engender some social exchange, but it also created new situations that were almost as awkward as those it attempted to alleviate. Although the investigations on mothers' work [13] points to some interesting and important aspects of current organizing systems in the home; however, they do not question whether these mothers actually needed a technological organizing system, and the proposed technologies would support the division of domestic labor rather than possibly questioning it. While Miro [12] inspired social and emotional reflection, users' reflections rarely dealt with the actual data being visualized. Though ViTo [9] demonstrates the capability to change users' behavior by suggesting alternatives, it may inadvertently and artificially constrain users' behavior, and it likely would not encourage users to question the attitudes and beliefs that lead to their television viewing and activity patterns in the first place.

Furthermore, the systems described here were not the only possible solutions to the problems they sought to address. For many of the examples given above, low-tech or no-tech solutions could have also been pursued. Such non-technological solutions are almost certainly the subject of publications in other areas of research. However, it is unlikely that papers about such research would be published at a conference like CHI. Even the name of the conference, *Computer*-Human Interaction, carries a focus on technology, and its proceedings are somewhat self-selecting in that regard towards papers that describe novel technological developments. Furthermore, due to a bias against negative results, it is uncommon to see a user study or ethnographic investigation concluding that a technological intervention is either inappropriate, unnecessary, or not as effective as a non-technological one. This is not to say that low-tech solutions are preferable to high-tech ones. Neither is it to say that technological tools are only fit for solving technological problems. Innovative adaptations of technology to address social, educational, emotional, cognitive, cultural, health related, and other non-technological problems are among the great successes of modern computing. This paper is not arguing that such innovative explorations should cease to be undertaken. As depicted in figure 3, there is a balance to be struck between theory, questioning the underlying assumptions and beliefs that guide an implementation, and practice, developing innovative implementations that explore a technology's practical boundaries. Too much focus on questioning

assumptions without a focus on implementation can decrease the value of research, as it might not lead to an actual implemented project. On the other hand, too much focus on implementation without questioning the assumptions and beliefs guiding that implementation can also decrease the implementation's impact, as it may solve a non-problem. The most effective approach leans neither too heavily in the direction of theory without practice nor practice without theory. Many implementation-focused papers in HCI tend to fall too far to the right side of this graph, and the design questions described in this paper are intended to push this research back towards the left and the apex of the curve.

Given any technological approach to a situation, alternate, non-technological solutions should be considered if we are to justify the expenditure of resources, including human, monetary, and temporal, to create such technologies. Furthermore, it has been argued that by exposing design decisions that are made and the reasons for pursuing a specific implementation can help the research community come to a better understanding of the design process behind such technologies. Pushing the limits of one's tools is an important way to advance the field, but one must also be willing to reflect upon practice, as well as recognize and admit when the available tools may not be the most well-suited to the problem at hand.

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