Generative Walkthroughs: To Support Creative *Re*design

Danielle Lottridge
Mechanical and Industrial Engineering Dept.,
University of Toronto, Ontario, Canada
danielle.lottridge@utoronto.ca

Wendy E. Mackay
In|Situ, INRIA Saclay, Ile-de-France
LRI, Univ. Paris-Sud, Orsay Cedex, France
mackay@lri.fr

ABSTRACT
Generative Walkthoughs support the *re*design phase of an iterative design process, helping designers generate new design alternatives informed by social science principles. Designers first analyze their own scenarios or storyboards with respect to concrete examples drawn from five socio-technical principles: *situated action*, *rhythms & routines*, *co-adaptive systems*, *peripheral awareness* and *distributed cognition*. They then walk through the scenario and brainstorm new design alternatives that reflect the design principle in question. This combination of structured walkthroughs with focused brainstorming helps designers, particularly those with little social science background, to generate concrete, actionable ideas that reflect key findings from the social science literature. We taught Generative Walkthroughs in ten courses with over 220 students and found that technically-trained students not only learned these socio-technical principles, but were able to apply them in innovative ways in a variety of design settings.

Author Keywords
Creative redesign, Generative Walkthrough, Multi-disciplinary design methods, Socio-technical principles

ACM Classification Keywords
H5.2. User Interfaces: Theory and methods.

General Terms
Design, Theory

INTRODUCTION

Although iterative design has long been advocated as an essential part of Human-Computer Interaction [19], little emphasis is placed on the actual process of *re*design. Researchers usually focus on the initial design, viewed as a 'wicked problem' [26] that involves transforming a collection of ideas about users and technology into a concrete proposal. Wolf et al. [33] refer to this as the 'black art of design' and advocate using creative design methods based on non-linear thinking, judgment and reflection. Once an initial design has been produced, the HCI literature offers a wide variety of evaluation techniques, ranging from general heuristics to usability studies, to identify problems. Designers are then urged to reflect upon their designs [27] and essentially repeat the same design process [23,28] in order to improve the design. Initial design is rarely distinguished from *re*design and few, if any, design methods specifically target the redesign process itself.

This paper explores the question of *creative redesign*: how to build upon existing design artifacts and systematically generate design alternatives. Instead of viewing iterative design as identifying problems and reapplying earlier techniques, we see it as an opportunity for creative exploration of the design space from a new perspective.

We are particularly interested in helping designers incorporate insights from the social sciences. In our experience, many designers, particularly those without social science training, have difficulty bridging the gap between the social science literature and the details of the design at hand. Abstract social science concepts are difficult to translate into specific design alternatives. This is not the fault of social scientists, who find it difficult to extract specific 'implications for design' from their findings [5]. It is rarely easy to translate a particular insight about how human beings interact with technology into a simple design recommendation.

For this reason, our redesign strategy starts with scenarios [3] or story-boards, design artifacts that reflect what the designer has learned about target users, likely contexts of use and available technology. These stories encapsulate design thinking and are richer and more concise than a corresponding list of design properties [30]. They encourage designers to think in terms of the user experience and provide concrete examples of how a real person might interact with the proposed technology in a real setting. From this foundation, we provide designers with a systematic method for examining their stories in light of established socio-technical principles. Our goal is to help them brainstorm new ideas that reflect how people interact with technology in the real world, i.e. *creative redesign*.

This paper introduces a new design method: *Generative Walkthroughs*, a method that moves between analysis and generation of new ideas to support redesign. Generative

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Walkthroughs help participants to re-frame design problems in light of relevant socio-technical phenomena and theories that reveal insights as to how human beings interact with technology in the world. We begin with an analysis of related work and offer an example of how to use Generative Walkthroughs. We next report on the results of our experiences teaching this technique and conclude with a discussion and directions for future research.

RELATED WORK

Researchers and practitioners have developed a wide variety of iterative design methods to help designers. Many user analysis techniques, such as interviews and field observation [22] are borrowed directly from the social sciences. Others, such as *Critical Incident Technique* [7], have been adapted specifically for an HCI context [15]. Others offer alternative approaches, such as cultural probes [6], for gathering design inspiration from users, or technology probes [11] which explicitly combine design methods from different disciplines. The results of these methods offer rich narratives about users, and act as resources for design.

Designers are encouraged to generate a wide variety of ideas, using techniques such as brainstorming [20] and then select specific design directions within which to develop the design, using low or high-fidelity prototyping techniques [18,23,24]. Some techniques are open-ended, with the goal of expanding and exploring the design space. Others, such as design scenarios [3] and video prototypes [16] explicitly embed the design within a specific context of use.

The evaluation phase offers perhaps the largest number of techniques, including open-ended field studies, theoretical analyses, usability studies and controlled laboratory experiments. Here too, HCI researchers have adapted or created new techniques. Yourdon's structured walkthroughs [34] were originally designed to identify bugs in code. Groups of peers would analyze a particular program, line by line, with the goal of identifying as many bugs as possible. HCI researchers adapted this technique as Cognitive [25] and Design Walkthroughs [13]. Both types of walkthrough involve a systematic, step-by-step look at an artifact, with the goal of identifying as many problems as possible.

GENERATIVE WALKTHROUGHS

Most of above techniques belong to a particular phase in the design lifecycle. Here, we are specifically interested in the *redesign* phase, when the designer has already collected information about the user and has begun developing specific design artifacts. The designer can, of course, simply apply the same techniques over again, from the same perspective, and hope for the best. But we argue that offering the designer a new, targeted perspective from which to systematically analyze and react to the design is likely to produce more ideas and help the designer explore new design directions.

In our experience, technically trained designers have particular trouble dealing with the human perspective in their designs. We wanted to help them benefit from the wealth of findings from the social science literature, without asking them to become social scientists. We selected five socio-technical principles [32]: *situated action, rhythms and routines, co-adaptive systems, peripheral awareness* and *distributed cognition*. Each has been influential in the HCI literature and has helped inspire new ways of thinking about designing interactive systems. In addition to presenting them as abstract principles, we also provide specific examples of these principles in use, with associated questions to help designers generate new examples in the context of their own work.

We next developed a design method, called *Generative Walkthroughs*, to help designers think systematically about how these principles can enhance their designs. We selected scenarios (or storyboards) as the design artifact to be analyzed because they offer rich, concrete examples of how users might interact with the new system in a real-world setting. We then combined two techniques: a *walkthrough*, for a systematic, step-by-step analysis of the existing design, and *targeted brainstorming*, to help generate new ideas, inspired by the socio-technical principles. Fig. 1 shows how designers can 'walk through' a storyboard, examining each step of the story with respect to a particular principle. Designers first examine whether the principle is already in evidence and then brainstorm new ways to enhance the design by applying the principle. Repeatedly stepping through the storyboard preserves the narrative, reinforces familiarity with the complexities and nuances of the scenario and makes it easier to identify ideas that integrate multiple principles.

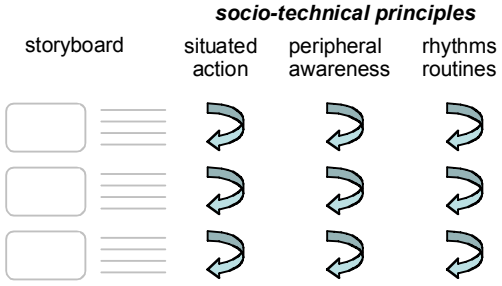

Figure 1: Systematic analysis of a storyboard, generating ideas at each step inspired by a socio-technical principle.

In summary, Generative Walkthoughs offer a method intended for the *re*design phase of a project that: identifies the *form of the design artifact* (a scenario or storyboard), a technique for *analyzing the design* (a walkthrough), and a technique for generating new ideas (*targeted brainstorming*, grounded in a set of *socio-technical principles)*. This combination of structured walkthroughs (formerly a purely evaluative method) and brainstorming (rarely systematic) is easy to apply, providing specific guidelines without acting as a cookbook. The next section

illustrates the Generative Walkthrough method with a specific example from a recent course.

GENERATIVE WALKTHROUGHS: AN EXAMPLE

Ann's group is charged with designing *E-waiter*, a hand-held device to help waiters take orders and communicate with the kitchen. They have already generated a first video prototype that explores a particular scenario and their first informal evaluation has identified a few interface problems. They are now ready to reconsider various elements of the design using a generative walkthrough.

Ann makes copies of the storyboard that shows each step of the scenario, illustrated in the video prototype. She also hands out a summary that briefly describes each socio-technical principle, with associated examples and trigger questions. The first principle she chooses to consider is ***peripheral awareness*****:** *Even when people focus their attention on one activity, they also maintain peripheral awareness of external events and changes in the surrounding environment.*

Ann reads through the following scenario and asks her group members to consider whether peripheral awareness is already evident, and whether it is relevant to the *E-Waiter* or not.

> Zack, the waiter, goes to table 3, where a young couple has been waiting for about 10 minutes. He sets the *E-waiter* to table 3 and asks if he can take their order. The wife asks for a salad and Zack taps on the 'salad' button. The husband asks for chicken, but Zack says he'll have to check if there's any left. The husband says it's ok, he'll have a steak, and Zack clicks the 'steak button. The wife changes her mind and decides to have a steak as well. Zack cancels the salad and clicks on 'steak' again. Table six is getting restless, several new groups just arrived at the door and the kitchen is getting noisy…

Ann now walks through each step of the storyboard, not to find problems, but to generate specific new design ideas related to peripheral awareness. They begin with Zack's approach to the table: where is his focus and what information is available to him in the background? Bob mentions that Zack is aware that the other table is getting restless and wants to order. Ann mentions that Zack's workload is likely to go up, because he can see the crowd growing at the door, from the corner of his eye. Charlie says it must be getting busy, given the noise in the kitchen.

They next brainstorm specific ideas about how to enhance the *E-Waiter* to incorporate peripheral awareness. They consider how Zack can keep track of other people (other clients, other waiters, the receptionist, the cook) and the states of various relevant events. They brainstorm various ideas for how to indicate changing information, including color, vibration and graphical cues. Fig. 2 shows how the group added color to the display to show how many of each type of dish remain, allowing Zack shift his attention as required.

Figure 2: Design idea generated by considering how peripheral awareness features might enhance the E-Waiter.

Here, Zack sees that three chicken dishes remain, so he can order it for the client. He notes that the steak and lamb are green (indicating fresh) which encourages him to recommend them.

Socio-Technical Principles

One of the key ideas behind Generative Walkthroughs is the notion of targeted brainstorming to generate new ideas inspired by what we call *socio-technical principles*. These are derived from the social science literature, related to the concept of socio-technical systems [32] in which technology and social systems are treated together.

Table 1 defines five phenomena: *situated action, routines and rhythms, co-adaptive systems, peripheral awareness* and *distributed cognition*. Note that this is by no means an exhaustive list of potentially useful socio-technical principles. The generative walkthrough method can be used with other principles. We chose these because they:

- employ evocative examples that are easy to understand,
- cause an 'aha' reaction when understood, and
- relate directly to the design of interactive systems.

Motivation	Goals
Situated Action 'beyond plans'	Go beyond planned activities; let users decide how to act in unforeseen circumstances [29]
Rhythms & routines 'identify use patterns'	Take advantage of routine activities and spatial patterns to help users integrate the system into their daily lives [31]
Peripheral awareness 'include the periphery'	Design for both the focus and the periphery, allowing users to vary their degree of engagement [9]
Co-adaptation 're-interpret system'	Expect users to re-interpret and customize software, help them capture and share those customizations [14]
Distributed cognition 'outside the head'	Consider how other people or objects in the world can reduce the cognitive load for memory or communication tasks [10]

Table 1. Selected socio-technical Phenomena

Each phenomenon is derived from extensive observation in the field, with a variety of rich examples that have been replicated in multiple settings. Each challenges hidden assumptions about how people interact with technology and sheds light on why particular interactive systems fail. Unfortunately, these principles are often ignored by designers because few guidelines exist on how to apply them in particular design contexts.

We need a way to teach socio-technical principles in a concrete, accessible form that enables technically trained developers to incorporate these socio-technical principles into their designs. Our approach is to provide specific examples for technologists who are not familiar with this literature and guide them, step by step through a process of deconstruction (to analyze their own data through these lenses) and reconstruction (to reinterpret and focus their design ideas to generate a design that takes these phenomena into account).

We are aware that distilling these complex socio-technical principles into simple examples omits much of the richness that makes them interesting in the first place. Yet we believe that this is a trade-off worth making: if we can demystify the social science literature for designers and give them an easy-to-use method for considering key ideas, we believe it will help them to design better, more human-centered systems. This may also provide sufficient scaffolding for some designers to investigate these phenomena further. The next section describes how we teach the socio-technical principles and apply them during a generative walkthrough.

Teaching Generative Walkthroughs

The first step is to explain each socio-technical principle. We cite findings from the original research and describe specific examples that illustrate the principle in a real-world setting.

Next, we help students to generate their own examples of the principle, using post-it notes as an easily understood, readily available technology. Post-its are a familiar, and incredibly flexible 'technology' and enabled us to create a coherent set of related, compelling examples. At this point in the teaching process, we ask students to generate their own examples, either with post-it notes or with some other familiar technology.

Finally, we identify a set of *trigger questions* that help the student identify the principle in the current design context (Fig. 3). Trigger question probe relevant properties of the situation, user and system. Trigger questions invite the student to view the scenario through the lens of a particular socio-technical phenomenon and then analyze how the users they observed interact in similar ways. Answers to trigger questions can help focus brainstorming and helps the student ground their ideas, based on a deeper understanding of how people interact with technology in the real world. For example:

Rhythms and routines

Crabtree and Rodden [4] studied how family members and activities shaped the use of mail in the home. The predictable actions of family members enable the maintenance of patterns, for example: whoever comes home first brings the mail inside, or, leaving an envelop addressed to a child at his/her 'place' at the dining table. In an ethnographic study, Palen & Aaløkke [21] identified various rhythms and routines regarding how the elderly manage their medication in the home. Participants created logical practices based on daily rhythms to help them keep track of their medications, e.g., putting pill boxes near the breadbasket in order to remember to take their medicine with breakfast. They relied on spatial and temporal organizing strategies, such as placing pills in a left-to-right configuration**.**

Rhythms and Routines

Classic Example

"Mary places her pills next to the coffee maker and coffee, to remind her to take her pill every morning."

Post It Example

"Bob received a call for his 13-year old son, Roger, from his friend Chris. He wrote this message on a post-it note and left it at Roger's place at the dinner table."

Trigger Questions

What biological rhythms influence people? (temporal rhythms)

What spatial layouts help people find things? (spatial rhythms)

What routines occur on a regular basis, at home? at school? or at work?

Figure 3. Classic Example, Post-it Example and Triggers questions for Rhythm and Routines.

APPLYING GENERATIVE WALKTHROUGHS

Assessing concrete improvements in creativity or design due to a new design method is a challenge [8]. This section presents the results of applying our method in multiple classroom and workshop settings over a period of three years. After each course, we reflected on student behaviours and outcomes to improve and refine our method. We first present how Generative Walkthroughs evolved over time. Second, we describe the changes that we witnessed in our students' process and products.

We used Generative Walkthroughs in 10 different courses over a period of three years, each with different audiences. The method evolved over time based on students' understanding, feedback and design output (Table 1). In these courses, we asked students to design in a rapid manner. We describe a subset of the teaching instances, and the outcomes, and implications for the Generative Walkthrough method. Due to space restrictions, we highlight the results concerning only one principle, rhythms and routines, to represent how the principles were understood and applied.

	type	hrs	n	level	results
1	3-day workshop	3	17	HS	Projects, videos questionnaire
2	1-day workshop	2	6	PhD	Own system ideas, questionnaire
3	Lecture/workshop	4	56	MA	Project ideas
4	Graduate Lecture	1	10	PhD	Discussion
5	BA Lecture	2	14	BA	Project ideas
6	Lecture/workshop	4	44	MA	Project ideas, exam
7	3-day workshop	3	20	HS	Project ideas, videos questionnaire
8	BA Lecture	2	22	BA	Project ideas
9	Lecture/workshop	4	20	MA	Project ideas, exam
10	Lecture/workshop	2	20	MA	Project ideas, exam

Table 2. Applying Generative Walkthroughs

Generative Walkthroughs: Proof of Concept

Our first two applications were intensive workshops for 1) high school and 2) graduate students. We noted general understanding and correct application of the method.

Application 1: High School Students The first application was a week-long summer school course for gifted high school students, with 90-minute to three-hour workshop-style sessions conducted over three days. We divided the 17 students into four design groups and asked them to design an augmented paper agenda. The course followed a full cycle of user-centred design. We began by teaching students how to interview and observe users. Members of each group then interviewed one or two agenda users from within their group. These results served as user data for their design of an augmented agenda. We taught students how to create a scenario and asked them to storyboard an augmented agenda. This design acted as an informal control, without the influence of the socio-technical phenomena. We then presented the five socio-technical principles (classic and post-it examples, trigger questions) and held a group discussion to answer their questions.

On the second day, we quickly reviewed the post-it note examples and trigger questions as part of a group discussion, and offered alternative solutions. Students then regrouped and used their user data to work through each of the principles to generate augmented agenda solutions. Groups used low-fidelity prototyping tools (paper, etc.) to make a simple prototype of their final design. The last day, students were given time to finalize their designs and build prototypes (Fig. 4). Each group then presented a five-minute scenario, acting out what it would be like to use their prototype in a real situation. At the close of the workshop, we asked students to generate an example of each socio-technical phenomenon and to reflect upon what they learned and what might be improved in the class.

Figure 4. Workshop 1: Prototyping, filming design scenarios

Application 2: Graduate students We taught two half-day workshops, each with three graduate students. Participants were students in an HCI or Human Factors program with backgrounds in computer science, human factors or management. Each participant was currently working on a project that included a socio-technical system and was at a different stage of the design process (Table 2). We were interested in whether generative walkthroughs would help them think of modifications to their ongoing design work.

The workshops began with the classic examples and trigger questions presented to the group; requests for clarification and discussion were encouraged. After presenting the post-it examples, the group generated answers to the questions and design solutions. Participants then worked through the trigger questions individually to generate design solutions for their current project. We asked them to present their favorite solutions and answer a questionnaire.

	Background	System	UCD stage
1	Industrial engineering	Temperature bandage & display	early
2	CS, HCI	Interactive voice response (IVR) system	side project
3	CS and Business	Audio-conference software	advanced
4	Business & Management	Medical meeting communication checklist	mid
5	HCI	Video-conference software for patients	early
6	CS, HCI	Automated video conference filming	advanced

Table 3: Application 2: participants and projects

Initial Results: Successful Understanding

All the high school students understood most of the principles, as demonstrated by the examples from their daily lives, e.g., leaving a note on the bathroom mirror so that one's sister will see it in the morning. A common design theme involved reminders placed near where a user would be likely to look, e.g., incorporating a list of 'missed calls' somewhere that could be checked daily e.g., the calendar, nightly computer runs, and Facebook.

Overall we were pleased that each of high school students was able to not only understand, but also apply most of the principles. The scenarios that students used to illustrate their ideas were all complex and not-ideal, which indicates that they have reflected on designs that deal with these types of situations. We found that students focused on the principles and not on the trigger questions so we simplified the language of the trigger questions.

As with the high school students, the graduate students understood the principles and suggested their own stories such as leaving your bag by the door to not forget it in the morning. The exercises caused participants to realize that their systems imposed routines on users. One participant suggested that once the user habituated to her system, "it

would become natural, a routine". Another participants' system currently imposed a schedule on the user but noted that because a nurse was involved, it would be difficult to schedule based on the user's rhythms.

Generative Walkthroughs: Evolution

This section describes how the applications led to two main modifications of the Generative Walkthrough method: working with a scenario rather than a critical incident and targeting the redesign phase.

Application 5: Rooting Designs in Scenarios Our fifth experience involved 14 computer science and graphic arts undergraduate students from an introductory HCI course, for a two-hour lecture. We taught classic and post-it note examples and trigger questions and students used Generative Walkthroughs to generate project ideas.

Students shared their favorite design ideas concerning each of the principles with the class; as with previous applications, their ideas reflected an accurate understanding of the principles. Students shared the scenario that they developed for the walkthrough. Their designs were closely based on the scenario, for e.g., if the driver of an in-car-system was physically incapacitated after an accident, the use of a particular "hot" word would enable an audio interface. Features that were introduced during the lecture were later incorporated into the students' final design for their course project.

We were again pleased at the understanding displayed by this group of undergraduate students, and pleased that they were all able to generate ideas. We were struck with how the ideas were fundamentally rooted in a scenario context. This integration opened up a space for improvement: rather than using one short critical incident, a few could be strung together to form a scenario. Thus, we opted to center the exercises around a mutli-step scenario. Given that a technology would be featured in the scenes of this scenario, future applications would target *redesigning* the technology rather than creating it.

Application 6: Focus on Redesign Our sixth course was a three-hour session, as part of a trimester course on Design and Evaluation of User Interfaces, with 44 Masters-level students in computer science and bioinformatics. We created *E-waiter* system screens (a handheld device for waiters to store orders) to provide a starting point, which would then need to be redesigned by the students. We wanted to root the walkthrough exercise in a strong, coherent scenario, and manage the complexity of design by providing an initial one. Students could first critique problems in the design using a general restaurant context, in relation to the socio-technical principles. Then, students could redesign the *E-waiter* by generating informed ideas.

Students were taught both the classic and the post-it note examples of the five socio-technical principles in a lecture format. Students then split into groups and analyzed their designs in the light of the five principles. They then brainstormed ideas for improving their designs and then were asked to *redesign* the interface, taking at least three principles into account.

The approach of providing a stem scenario worked well with the students. They were able to provide compelling examples of the principles applied to the *E-waiter* design, within the context of the final exam of the course.

Generative Walkthroughs: Refinement

Based on past teaching experiences combined with the latest classroom experience, we were motivated to tighten integration of the *E-waiter* system to the generative walkthrough method. We noted that the complexity and persuasiveness of the scenario were critical in generating useful design ideas. We refined the stem scenario for the *E-waiter* system that was provided to students, along with the screens to be redesigned. The stem scenario included second actors including waiters, patrons, the manager and the chef. Two patrons both ordered the daily special, but the chef only had one left. Students were encouraged to finish the scenario and include more events.

As with the first teaching instance, we participated in 6 hours of a week-long summer school course for gifted high school students, with 90-minute to three-hour workshop-style sessions conducted over three days. We divided the 20 students into ten design groups and asked them to design an *E-waiter*. We used smaller groups in order to encourage each student to actively participate.

The course followed a similar cycle of user-centred design. On the first day, we taught the classic examples of the socio-technical principles. We wanted to give students a chance to become familiar with these concepts. In the second session, we separated students into two groups of 10. One group completed unstructured brainstorming for 40 minutes (as a control group). The other group stepped through the post-it note examples and trigger questions for each of the principles, and conducted focused brainstorming after each one. Then, all students were given time to incorporate their ideas into a storyboard to be presented to the entire class. On the third day, student finished their prototypes and were filmed acting out their scenario.

In general, concepts seemed well-understood. We 'quizzed' them on this during their presentations and we noted that most of them had something to say. However, this was confounded, since the later groups got better at answering after hearing the earlier groups come up with ideas. Initially, the group who used generative walkthroughs answered with more understanding, but after several presentations, everyone else also learned how to answer.

Students' design ideas and their scenarios were tightly integrated, and illustrated each of the principles (Fig. 5). One group created a scenario that included a waiter taking an unplanned smoke break (situated action). This inspired inclusion of instant messaging (IM) to connect all the restaurant staff. Here, the hostess sends a message to

another waiter to keep an eye on the extra tables for the next few minutes. Another group noted that restaurants tend to have usual sections to assign waiters to certain tables (rhythms and routines). They prototyped a default visualization of "typical sections" for easy selection. Other students thought of using peripheral awareness to solve the problem of keeping track of the daily specials. They devised a brightly coloured screen to let the waiter know when a special was about to run out. This particular screen is bright yellow with a large symbol intended to be visible from the waiter's peripheral vision. The same group also thought about all the unexpected requests and preferences that clients often have. They included an open input box for flexible commentary (co-adaptation). Lastly, students from another group recognized that systems can get out of date in a fast paced restaurant atmosphere. They quickly brainstormed a button to double-check with another staff (distributed cognition). These creative and relatively novel ideas were created quickly by young students with little prior experience.

Figures 5:
a. Impromptu IM request
b. Our restaurant sections
c. Warning: only one special left
d. Flexible comments
e. Double-check with someone who knows.

The observation of linked scenarios and design solutions motivated a change to the current walkthrough procedure. As opposed to applying all principles to each scene of the scenario, we recommend stepping through an entire scenario once per principle (Fig. 1). For example, if there are five relevant principles, students would step through the scenario five times. This increases familiarity with the nuances of users, technology and situations, so that the brainstorming at each step can generate and highlight ideas that support multiple principles.

Discussion

Using Generative Walkthroughs in this diverse range of settings helped us to both to refine and improve the method and also to better understand how this approach helps students. The next section describes some our key insights.

Enriched Scenarios

We found that learning the principles stimulated students to recall past related situations, and to incorporate similar situations into their scenarios. When applying the principles to building on the *E-waiter* stem scenario, most groups added a number of other realistic, unexpected events that can occur within a restaurant. For example, students built on the *E-waiter* stem scenario with: customers changing their minds, waiters taking breaks, waiters changing shifts, the kitchen running out of a certain dish, requests for the chef to modify dishes, etc.

Not only did participants look at their own experiences in light of the principles, those with user testing experiences were also able to reflect on their work in this way. In the second workshop, two designers with two or more years of experience with their systems were eager to share stories on how users used their system in unexpected ways. One system has a small text box intended to support audio chat (with a low character limit). Users instead used it to send code back and forth while talking, and wanted a larger text space. Another's videoconference system had cameras that automatically followed one's hands with the goal of filming where the action was. His users noticed and would move their hands explicitly to control the camera. It was clear that designers with real-world experience with users of their systems had a deeper understanding of these principles.

Participants appeared to think about the scenario as integrated with the design. We asked "How did your system incorporate each principle?" Students' answers often described situations, instead of features or artifacts. Thus, students are equally focused on situation and technology, instead of only technology. This stands in contrast to the situation where generative walkthroughs are not taught, and students focus primarily on technology.

Design Diversity

A corollary result to enriched scenarios is enriched triggers for design ideas, i.e. that students' designs were inspired by the numerous details present in their complex scenarios.

E-waiter ideas were typically additions of existing features such as instant messaging, vibration and beeps for incoming messages and alarms. These relatively common features were well-matched and motivated by situations in the scenarios. Other ideas, such as a updated list of dish quantities, were matched to information access needs for different characters in the story. Overall, students designed considerable support for flexibility when they reflected on the possibilities for different types of circumstances.

We saw multiple principles working at the same time. For example, *E-waiter* "communication" (through IM) was cited equally to be inspired by distributed cognition and co-adaptive categories. This reinforced that by going through each scenario multiple times, once for each principle, solutions that resonate with multiple concepts will emerge.

Building on Existing Strengths

We found that the participants' disciplinary background colored their interpretation and use of the exercises. For example, in the second workshop with graduate students, the manager (who has limited design training) focused on using the same checklist for different reasons and seemed unable to generate design suggestions, beyond vague references to an electronic version. She attributed her lack of specific design solutions to the low-tech nature of her paper checklist and assumed that high-tech solutions would somehow solve the problem, without detailed considerations how.

We also saw certain types of misunderstandings associated with certain backgrounds. For example, an industrial engineer misinterpreted co-adaptation to mean redesigning (upgrading to include) new functionality rather than leaving the system open to re-interpretation by users. This may point to a rigid (traditionally engineering) model of designing functionality. Others interpreted this as requiring the system to adapt to unexpected circumstances (for example, automatically detecting ambient noise and adjusting audio filters). Other designers suggested giving users tools to actively deal with the problem at hand.

Our groups of more advanced students were clearly more capable of understanding, and were more interested in, the complexities inherent in these concepts. Overall, the high school students tended to focus on the simple post-it note examples, whereas the graduate participants focused on the classic examples drawn directly from the literature.

Our experiences show that Generative Walkthroughs has benefits for people at all levels, and that the benefit is an increase relative to the previous training of the participant. While this method may be used by designers of all disciplinary backgrounds, those with a technology background represent lead users because of their lack of social science training. Those with a technology background are comfortable with technical ideas, and this method uses this existing ability to trigger ideas from the socio-technical principles.

SUMMARY AND CONCLUSIONS

Generative Walkthroughs are applied in the redesign phase to facilitate creative insights from social science principles. Principles are quickly presented to designers through a classic example, a post-it note example and trigger questions. Then, designers step through a scenario, using each principle as a lens to find aspects of the design that could be changed or improved.

The Generative Walkthrough procedure evolved over the course of ten instructional settings with over 220 students. We observed that students successfully understood the principles. Most students were able to generate ideas, of which most were tightly related to the scenarios that included unexpected and non-ideal circumstances.

It is clear that thinking about socio technical principles in the redesign phase is better than not thinking about them. We found that introducing principles and applying them in a systematic and generative manner can help students successfully create compelling designs.

We have identified two separate, but related problems for HCI design. The first is the communication gap between social scientists and technologists: social scientists are ill equipped to provide 'implications for design' from rich ethnographic data [5] and most design engineers are not trained to read and apply the social sciences literature. The result is that many of the insights in the social sciences literature are never incorporated into implemented designs.

The second problem relates to the problem of redesign, i.e. the disconnect between evaluative activities and generating improved solutions. Although HCI textbooks and courses urge designers to engage in iterative design, they offer little guidance for pursuing the design ideas that are most appropriate based on found problems.

Generative Walkthroughs are intended to be used with a real systems and scenarios that arise from real user data. It is in the details of the user data (complex real world problems[26]) where socio-technical patterns can be recognized and used as inspiration for design. The trigger questions associated with each principle are intended to stimulate reflection and initiate a dialogue with the unique socio-technical situation that the designer is confronted with. These steps are provided for guidance; we do not aim to provide a recipe.

While the method was created for a UCD process[19], it may be used in other contexts. For example, within a Participatory Design project, system designers and end-users could collaborate. Scenario-Based Design [3] is similar to Generative Walkthroughs in using narrative to capture context and denouement. The methods contrast because Generative Walkthroughs engage participants to repeatedly step through the narrative to identify problems and brainstorm socially-informed design options.

Generative Walkthroughs are not explicitly related to design rational documentation [17], which is a detailed post

hoc analytic method that justifies design choices. However notes taken during walkthroughs could be used towards that end.

Generative Walkthroughs address some similar aims as Technomethodology, which is an inquiry in the use of ethnomethodology in critiquing and designing technology[2]. Technomethodology encourages the open accounts of system activities. Dourish and Button discuss tension between the valuable details of the particular and the necessary step towards abstraction for system design. Generative Walkthroughs extends this work by providing structured steps that guide the focus from scenario details, to socio-technical patterns, to specific design solutions.

In fact, Generative Walkthroughs facilitate links between properties of the problem (analytic, or deconstruction) and of the solution (idea generation). Generative walkthroughs push socio-technical analyses beyond their deconstructive origin and make them generative. The method uses the insights gained during the analytic phase (stepping through scenarios with trigger questions) to reconstruct new solutions (brainstorming). By reconstruction, we mean to create novel design ideas using combinations, variations and inspiration relating to the material and situational properties elucidated in the trigger questions. Put simply, the activity of deconstruction and reconstruction moves from the specific to an abstraction and then back to the specific.

We start with specific scene of a scenario, where the user is solving a particular problem in a particular way. Then, we look at the scenario with the lens of a distilled socio-technical phenomenon to recognize a pattern, i.e. to make an abstraction. Finally, we vary the details of the pattern to create a specific design focus, i.e. to generate specific design ideas. For example, for the principle Rhythms and Routines, in which Palen & Aaløkke [21] investigated how the elderly manage their medications, one can extract a specific example, i.e. placing pills next to the coffee maker so they would be remembered at breakfast time. The specific example is relevant to the design of a medicine reminder system. The principle of rhythms and routines helps to identify the rhythm (one is hungry upon waking) and the routine (one eats breakfast every morning) and see them as dependable patterns that can be used as part of a design. Once understood, one can identify this phenomenon in other contexts, and explore other rhythms and routines that might afford similar opportunities, such as sleeping.

CONCLUSIONS

This paper focuses on the *redesign* phase of an iterative design process and presents a novel design method called *Generative Walkthoughs*. Our goal is to help designers incorporate key insights from the social science literature, even if they are not trained as social scientists. Rather than asking them to incorporate vague principles from the start of the design process, we ask them to reconsider an existing design portrayed in a scenario or storyboard, analyzing it step by step in light of a set of distilled socio-technical principles. Our goal is to increase creativity as they iterate the design, reflecting sound socio-technical principles. By focusing on *redesign*, we help designers explore ideas along new dimensions that might have been too difficult to incorporate from the start.

Our applications of the generative walkthrough method have demonstrated that we can successfully teach non-social scientists (i.e., technical system designers) to situate their designs in the context of five socio-technical phenomena (*situated action, rhythms and routines, peripheral awareness, co-adaptation,* and *distributed cognition*). In some cases, the method also helped students focus on design ideas that incorporated multiple phenomena. In the future, we plan to add additional socio-technical principles to the method.

We conclude with five key insights gained from this work.

- *Redesign:* This is a relatively overlooked problem in HCI. We need to provide more guidance on how to create improved design ideas in an iterative process.
- *Post-its:* Using post-it notes for our applied examples added consistency and cohesiveness to our method, which supported learning. Post-its present a rich source of examples due to their ubiquitous and flexible nature.
- *Combining scenarios, walkthroughs & brainstorming:* provides a powerful combination of evaluation and generative techniques, rooted in a realistic scenario. They allow for emergent benefits: that problems are identified based on socio-technical issues, and ideas are then generated for improvement.
- *Selection of socio-technical principles.* There many possible principles that one could use during generative walkthroughs; for instance, we also considered boundary objects[1]. We encourage authors of socio-technical principles to consider putting their insights into the format of a classic example, post-it note example and trigger questions, in order to increase and ease dissemination and application.
- *Framework of deconstruction and reconstruction.* Generative walkthroughs support a continuous back and forth between abstraction and concreteness.

Generative walkthroughs are a novel design method created to help technologists generate redesign solutions using socio technical principles. This method can be used at the point of redesign to generate design ideas informed by key insights from the social sciences.

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