EVALUATING A NEW PATTERN DEVELOPMENT PROCESS FOR INTERFACE DESIGN: APPLICATION TO MENTAL HEALTH SERVICES

Research-in-Progress

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Abstract

Increased incidence of mental illness in Australia’s indigenous youth is a major concern. Despite significant investment in programs to improve the situation, the absence of reliable and valid tools to assess the quality of mental health services is hindering progress. This project creates patterns that can be used to build better evaluation tools. This study develops and tests a new pattern language development process for the design of culturally sensitive user interfaces. Drawing on the pattern approach within the human-computer interface literature, we propose a distinctive set of procedures that aim to: (1) improve the validity of patterns; (2) improve the organisation of pattern languages; and (3) integrate stakeholder values into the interface design process. As a proof of concept, we will test our approach in the mental health services setting using data from a sample of indigenous youth in the Northern Territory of Australia.

Keywords: Systems analysis and design/development, human-computer interaction, user interface.
Introduction

Over the past two decades “recovery” has become the dominant ideology among consumers and others who advocate for people with mental illness. Though different definitions of recovery exist, most people who use the term agree that it represents a process that encourages people diagnosed as having mental illness to feel “hope, healing, empowerment, and connection” (Jacobson and Greenley, 2001), giving them a sense of control over their lives toward the goal of maximizing their ability to function in the world (Ranz and Mancini, 2008). This view of recovery draws on self-determination theory, where recovery is less concerned about whether the person achieves some kind of symptom and disability free endpoint, and more about whether they can achieve meaning in life and personal comfort (Campbell and Schraiber, 1989; Ralph, 2000).

In line with the shift from fixing to facilitating, the evaluation of recovery has moved from psychiatric assessments to psycho-social evaluations that rely greatly on the perceptions of the client (see Campbell-Orde et al., 2005 for a detailed review of existing recovery measures). The psycho-social rehabilitation model (Anderson et al., 2013) is an example of an Australian-based measurement framework that was developed to assess client perception of their autonomy (i.e., ability to live and work independently), competence (i.e., ability to learn and apply new skills and tools) and connectedness (i.e., propensity to develop meaningful and healthy social relationships). The model also captures the influence of external drivers (i.e., service quality, program satisfaction and social influence) on recovery perceptions, and accordingly, how these factors impact on higher order recovery outcomes, well-being and empowerment. This model is presented graphically in Figure 1.

Preliminary testing of the psycho-social rehabilitation model with data from a general Australian adult and youth population has shown the instrument to be a reliable and valid tool for the measurement of recovery perceptions (Anderson et al., 2013). However, the model has performed much less admirably with indigenous Australian youth—a population that is over-represented statistically as clients of mental health services, particularly in the Northern Territory where the preliminary testing was conducted. In all instances, direct caseworker intervention was required to facilitate data collection with this group, violating the requirement for independence. The need for independence is important as the framework assesses, amongst other things, the quality of client-caseworker relationships and perceptions of the services delivered by caseworkers. Extensive testing using both paper-based and Internet-based versions of the measures in the psycho-social rehabilitation model highlighted problems with traditional survey-based assessment. A senior indigenous caseworker commented that part of the problem was that indigenous Australian youth often distrusted such surveys, associating the text based instruments with negative experiences with authority and government (Anderson et al., 2013). This points to need to develop a measurement framework that could be completed independently by indigenous youth clients that was sensitive to the cultural, social and intellectual needs of this target group.

![Image of the psycho-social rehabilitation model]

**Figure 1. Psycho-social rehabilitation model**
A subsequent inspection of the recovery measures reviewed by Campbell-Orde et al. (2005) reveals that minority groups are, in general, not very well catered for with existing recovery measures. This highlights a pressing and unaddressed need in the recovery literature. Furthermore, at present there appears to have been no effort to account for clients with poor literacy levels in the measurement of recovery, which raises serious concerns regarding the validity of the existing measures as prior research points to the coexistence of significant social disadvantage and mental health issues (Kitchener and Jorm, 2002). This is particularly true of indigenous Australian youth, where the group is over-represented statistically in terms of youth mental health, and performs well below national literacy averages in standardized literacy testing.

This research aims to address these gaps by developing an interactive user interface for indigenous Australian youth to facilitate the measurement of recovery perceptions and recovery outcomes (the two central constructs of the psycho-social rehabilitation model – depicted by the shaded box in Figure 1). Drawing on the human-computer interaction research (HCI) tradition, we will use a pattern-approach to bring together users, interface designers and domain experts in an interdisciplinary design team. A significant contribution of this research will be the use of pattern language as lingua franca (common language) to facilitate the exchange of ideas, opinions and values amongst design stakeholders. Importantly, the resulting patterns, pattern language and design will serve as a ‘proof of concept’ for our approach, and provide a valuable and reusable resource for future design projects.

**Conceptual Framework**

Simply stated, a pattern is a proven solution to a recurring design problem. It pays special attention to the context in which it is applicable, to the competing “forces” it needs to balance, and to the positive and negative consequences of its application (Borchers, 2001). Patterns often reference higher-level patterns to describe the context in which they can be applied, and lower-level patterns that can be used after the current one to further refine the solution. This hierarchy structures a comprehensive collection of patterns into a pattern language. The central idea is that users, interface designers, and application domain experts in a project team each express their expertise in the form of a pattern language. This makes their knowledge and assumptions more explicit and easier for the other stakeholders to understand and refer to. Such a common vocabulary can greatly improve communication within a design team, and also serve as a corporate memory of the design process (Zaki and Forbrig, 2012).

The original concept of pattern languages was conceived by architect Christopher Alexander in the 1970’s. He explained how a hierarchical collection of architectural design patterns could be identified to make future buildings and urban environments more usable and pleasing for their inhabitants (Alexander, 1979). He presented 253 such patterns of “user-friendly” design solutions to recurring problems in urban architecture. It is less known that Alexander’s goal in publishing this pattern language was to allow not architects, but the inhabitants (that is, the users) themselves to design their environments. This is strikingly similar to the notion of user-centered and interaction (participatory) design, which both aim to involve end users in the software development cycle. Pattern languages essentially aim to provide users with a vocabulary to express their ideas, and to be able to discuss them with design professionals.

While patterns have become a popular tool for HCI researchers over the past decade, the overall format of a pattern has not changed very much from Alexander (1979). A meaningful, concise name identifies the pattern, a ranking indicates the validity of the pattern, a picture gives a “sensitizing” and easily understood example of the pattern applied, and the context explains which larger patterns it helps to implement. Next, a short problem statement summarizes the competing “forces”, or design tradeoffs, and a more extensive problem description gives empirical background information, and shows existing solutions. The proposed solution is the central pattern component. It generalizes the examples into a clear, but generic set of instructions that can be applied in varying situations. A diagram is often used to describe this solution and its constituents graphically, providing references that point the reader to other patterns that are related to proposed solution, or can be used to implement the pattern language.

A key feature of the pattern approach in HCI, is that patterns can include prescriptions for both design and activity. In this regard, patterns are interspersed with the values of all stakeholders involved in the interaction design process. Fincher and Utting (2002) insist that patterns and pattern languages must
embody values since they advocate particular design ideas to be emulated and all patterns challenge users, interface designers and domain experts to examine the value systems that they employ. In a critical review of the pattern-approach, Dearden and Finlay (2006) assert that the research on patterns within HCI has been dominated by form and potential, with limited examination of the practical worth of pattern based design. They subsequently assert that future research on patterns in HCI should prioritize the following issues:

1. Evaluating the validity and practical value of existing patterns, and documenting the processes by which new reusable patterns are developed;
2. Improving the processes by which pattern languages are identified, recorded and reviewed; with particular attention to the organization of pattern languages so that patterns at different levels (e.g., broader social context, personal user preferences, detail of interfaces, etc.) can be incorporated into designs;
3. Examining the way that values influence patterns and pattern language development.

**Improving the validity of patterns**

One of the weaknesses in HCI research on patterns is the paucity of empirical evidence demonstrating the benefits of the approach in practice. To date, attention has focused on generating patterns rather than showing how patterns can contribute to effective design solutions at a practical level. Furthermore, little attention has been afforded to evaluating the quality of the available patterns and languages. Bayle et al. (1998) suggests that identifying and writing patterns needs to become a genuine community effort within HCI, where the goal is to raise the quality of patterns and create new patterns that serve as reusable assets in future design efforts.

According to Dearden and Finlay (2006), only three notable studies have demonstrated possible approaches to evaluating patterns in use. Borchers (2002) describes evaluations of the value of patterns to student learning in two undergraduate HCI modules. Dearden et al. (2002) and Finlay et al. (2002) describe a qualitative study of the role of patterns in simulated participatory design activities. Chung et al. (2004) report on a structured empirical study using a pattern language in a simulated design activity including a group of experienced designers. These studies provide some possible ways in which such evaluations could be conducted. However, none of these studies can be treated as conclusive, suggesting a need for further research that explores the efficacy and use of patterns.

More fundamentally, the duplication of patterns highlights the conflict between pattern languages that are: (1) aiming in some sense to be generic and applicable to a range of situations; (2) those that are specific to a particular platform or interaction style; and (3) those that are targeted to a particular domain or application area. The tendency in prior HCI pattern research has been to focus on developing patterns for particular interaction styles in particular domains (Borchers, 2002). This has limited the significant of the pattern approach. However, to create patterns and pattern languages that are generic across platforms, styles and domains, and that are timeless and reusable; requires a better understanding of how the pattern approach can contribute to successful design in HCI. Frameworks for analysing pattern-based design quality are needed. Dearden and Finlay (2006) suggest that work in other areas, from traditional usability assessment and more recent work on understanding the nature of user experience (e.g. Wright and McCarthy, 2004) to observations from other design disciplines (e.g. Dorst, 2003) may be useful.

This project will respond to these needs in three important ways. First, we will add to the sparse literature on patterns in use. By examining the application of existing user interface patterns and developing patterns that can be reused to assist designers developing user interfaces for indigenous Australian youth, our research will move beyond simulation to focus on the real world benefits of the pattern approach to interaction design. Second, our work will take a critical approach to pattern development. We will focus on evaluating the efficacy of existing patterns, and adapting, where possible, rather than creating. Lastly, our research will document the steps taken in the pattern development and design process. By documenting the rationale for design decisions, it is expected that our research will inform future design work, and possibly, alternative ways in which patterns can be constructed and used to develop effective design solutions. It is also noteworthy that our work will form part of a real-world solution. As such, we will have the unique opportunity to collect data and monitor the long-term benefits of the pattern.
approach to design (however, this is beyond the scope of the present study).

Improving the organization of pattern languages

Fincher and Windsor (2000) have raised concerns about how pattern languages in HCI should be organized. This issue has a significant implications for the way in which pattern languages might be applied as practical resources in design. The organization of pattern languages in HCI is particularly problematic because of the wide range of different levels that need to be addressed by pattern languages, from the broader social context in which an interactive system is used, to the low-level details of interaction. Unlike architectural patterns, where “scale” provides a useful organizing principle, in HCI the problem is multi-dimensional. Scale is important, but designers also need to address issues of technology, task, information, and time. Providing pattern languages that reflect these different needs is a challenge that requires further research. To this end, Fincher (2002) argues that pattern language development should move beyond HCI and draw on design theories and principles in other theoretical domains.

The proposed project makes a valuable contribution to the challenge of organizing pattern languages by pioneering the use of an advanced combinatorial methodology—discrete choice analysis (DCA). DCA is an approach that allows users to conceptualize individual choices as a process of decision states. The method requires respondents to compare alternative choice options and make a decision that involves trade-offs between the components of these options. The result of this process is a ‘choice outcome’ that can be deconstructed based on the marginal utility for each of the ‘options’ available within the choice task conditional upon an underlying experimental design. Recent advances in experimental design theory and DCA modeling has resulted in extremely efficient models that minimize the cognitive demands on respondents while obtaining robust estimates of preference that are extremely accurate at predicting future behavior (Louviere et al., 2000). Stated simply, the use of DCA will enable us to better understand the relative importance of a particular pattern, as well as the inter-relationships between the patterns.

In this project we will employ a novel combination of DCA-related methods. Rather than relying on the traditional first-choice only DCA methods to investigate preferences, we will utilize an exploded ranked order model that treats each subsequent choice in a particular choice task as if it were the first choice out of a set of alternatives from which the options already selected have been eliminated (Flynn et al, 2007). This extension will enable us to capture more information on pattern preferences, which in turn will enable us to make more accurate prescriptions for the organization of pattern languages. Further, the utilization of latent class modeling will enable us to examine the extent to which group-level differences account for preference variation. That is, we will be able to further decompose the aggregate level findings (from the DCA) to identify a range of different pattern languages that reflect the preferences of sub-groups within the user population. This innovative combination of advanced combinatorial methods will add substantial rigor to the process of pattern language development, and could potentially revolutionize the way in which design process decisions are made.

Integrating values into the pattern approach

Dearden and Finlay (2006) assert that values need to be given more attention in HCI, and that the wider social and cultural implications of user populations need to be better recognized through the design process. This is particularly relevant to the present study, where the resulting patterns and pattern language need to reflect the cultural and personal values of indigenous Australian youth. This will require that we understand and codify the values embodied in the pattern development and design processes.

A valuable advantage of the discrete choice approach described above is that, once codified, values can be introduced as additional explanatory variables in the DCA and latent class models to help us understand how values influence pattern preferences, and the development and organization of pattern languages.

Approach and Method

This research program consists of a three-stage mixed methodology (Cresswell and Plano Clark, 2011) to realize the objectives of this research.
**Stage 1: Pattern Development Phase**

**Task 1: Ethnographic study.** This qualitative fieldwork in this project will be conducted according to the critical ethnographic tradition. Critical ethnography adopts an analytical perspective to ethnography by focusing on the implicit values expressed within ethnographic studies, and on the unacknowledged biases that may result from such implicit values (Thomas, 2003). Traditional ethnography tends to emphasize the researchers role in controlling interactions in the field and in reporting their findings in a disengaged way. Critical ethnography, on the other hand, examines the assumptions behind actions, and postulates that a researcher can ask questions. It attempts to free researchers from ideologies that detract from informed reportage.

The purpose of the ethnographic fieldwork is to observe and uncover implicit cultural rules that influence how indigenous Australian youth interact with technology. The fieldwork will be guided by Berry’s (1997) eco-cultural framework, and will make use of first-hand observation and semi-structured interviews. While these are amongst the more common methods for collecting data in an ethnographic study, the eco-cultural framework will ensure that we uncover latent cultural and ecological issues as they influence behaviour in a given society or polity (Lonner and Adamopoulos, 1997). The fieldwork will take place over a 9 day period, and will involve 9-12 clients across three different mental health services offices in the Northern Territory of Australia (state with the largest proportion of Indigenous persons). Clients will be observed in two contexts: (i) their normal care environment; and (ii) a simulated environment where they will interact with three different web-based interfaces designed to decrease depressive symptoms/anxiety symptoms (i.e., eCouch, Bluepages and MoodGYM). These activities will be punctuated by semi-structured interviews conducted according to the laddering technique (Reynolds and Gutman, 1988). This particular interviewing technique draws on means-end theory to identify and rank issues in terms of importance.

The transcribed observation and interview data will then be analysed to identify important themes using the well established genealogical method (Rivers, 1900). This method is employed to discover and record connections, relationships and values which are the represented using diagrams and symbols. The goal of this analysis is to identify and understand the relationship between important issues. This work will form the starting point for the identification of problem statements and the development of patterns.

**Task 2: Development of patterns.** The pattern development will be undertaken using the pattern template developed by Alexander (1979), and the “common ground patterns for HCI interface design” proposed by Tidwell (1998). These will be used as a starting point and will focus on translating the problem statements identified in Task 1 into a pattern collection. Each pattern will include a short, descriptive title followed by examples of the application of the pattern, a description of the context in which the pattern would be applied, an overview of the various forces impacting on the pattern use, and the proposed solution. In line with the work of Tidwell (1998), our patterns will also include a free text field in which random comments regarding the pattern and its application can be recorded.

As an extension to the original pattern template, and based on the recommendations of Dearden and Finlay (2006), our patterns will also include specific information regarding cultural values. This information will be codified according to Trompenaar et al.’s (1998) seven cultural dimensions, which have been found previously to be particularly effective at uncovering cross-cultural subtleties (Kriz, 2009). The first five of these relate to the ways in which human beings deal with each other: (i) universalism vs. particularism (i.e., what is more important, rules or relationships?); (ii) individualism vs. collectivism (i.e., do we function in a group or as individuals?); (iii) neutral vs. emotional (i.e., do we display our emotions?); (iv) specific vs. diffuse (i.e., is responsibility specifically assigned or diffusely accepted?); (v) achievement vs. ascription (i.e., do we have to prove ourselves to receive status or is it given to us?). In addition, there is a different way in which societies look at time, and their attitude towards the environment: (vi) sequential vs. synchronic (i.e., do we do things one at a time or several things at once?); (vii) internal vs. external control (i.e., do we control our environment or are we controlled by it?). Other factors that will be considered during this task include factors related to social connectedness (e.g., centricity, contagion, epidemiology), socio-economics (e.g., poverty) and individual level factors (e.g., literacy level).

The resulting pattern collection will be presented to practitioners at a workshop in the Northern Territory to examine the face validity of the resulting patterns, and ensure the accuracy and relevance of the content.
by seeking the critical input of a range of persons with experience in the support of indigenous Australian youth with mental health problems.

**Stage 2: Pattern Language Development Phase**

**Task 3: Creation of pattern language.** Arguably the most critical aspect of the pattern approach is the creation of pattern languages. A significant and novel contribution of the present study is the use of DCA methods to inform the creation of pattern languages. The creation of the pattern language will be done in four distinct steps. The first step will be to translate the patterns into design elements that can be incorporated into a mock interface. For example, where the problem of poor literacy may result in a pattern solution to use audio instructions, the decision still needs to be made regarding the nature of the audio instructions (e.g., whether to use a male or female voice, a mature or youthful voice). Every pattern solution will have options that will need to be translated into design elements. The presence or absence of a particular design element in a mock interface will be controlled via an underlying experimental design derived from first principles using the optimal design theory (Street and Burgess, 2007). The educational design team at major Australian university will provide support for the development of the design elements and the mock interfaces. This team has in-house graphic design and web programming capabilities, and has access to cutting edge audio-visual production equipment.

The second step is to identify an efficient resolution five design (i.e., a design for main effects and all two-way interactions) such that each respondent is presented with a manageable number of choice tasks. Each task will require respondents to select the mock interface they like most and least from a set of three mock designs. The resulting number of choice tasks is determined by combinatorial design theory, and will take into consideration the number of patterns (design elements), the number of options for each pattern solution, and the number of respondents available to complete the task. While we are unable to provide specific details regarding the nature of the design until the preliminary work has been completed, we anticipate that around 120 clients will complete the DCA experiment.

The third step will be to analyse the resulting data using a conditional logit model (McFadden, 1973). The conditional logit model is a regression-type model that was developed as part of McFadden’s Nobel Prize winning research. It extends the multinomial logit model to estimate parameters based upon an underlying experimental design. As we are using a exploded ranked order model, we will also need to weight each choice according to the Luce and Suppes (1965) weighting theorem. The resulting analysis will provide a sound basis for a pattern language, where the importance of each pattern is established along with the strength of the relationships between patterns. In this research, we will also seek to pioneer a nomenclature for presenting pattern languages based on a combination of concept mapping and density mapping. The resulting map will represent patterns as circles, where the size of the circles will reflect the importance of the pattern, and the proximity of one circle to another will reflect the strength of the inter-pattern relationships.

The final step is to examine how factors such as cultural values influence the preference for and relationship between patterns. To do this we will need to introduce additional information and estimate a latent class (finite mixture) model over the original conditional logit model. In doing so, we attempt to capture some of the unexplained variance in the pattern preferences at the aggregate level by segmenting the respondents into groups based on respondent characteristics and their associated preference models. The result of this analysis is the identification of different pattern languages for sub-groups of users with different cultural values. Ultimately, this will provide the basis for designing a range of interfaces that are catered to the preferences and needs of different user segments within the indigenous Australian youth population.

The resulting pattern language(s) will be presented to a second practitioner workshop to be held in the Northern Territory, and will involve the same representatives mentioned in Task 2.

**Stage 3: Proof of Concept**

**Task 4: Prototype design.** The translation of the pattern language(s) into a working prototype(s) will be a relatively straight forward process. The DCA analysis conducted in the previous task, and the resulting pattern language, will provide information on user preference for different design elements, as well as an
optimal combination of these elements. This optimal combination will represent a recipe for the prototype design, where the ingredients for this recipe are the relevant design elements prescribed as options within the identified patterns. Two different prototypes will be designed. The first will be a web-based interface for use with a laptop, the second will a more compact version for use with a handheld PDA device. The production of the prototype user interface will be supervised by software development team at the aforementioned university.

**Task 5: Usability testing.** The study will involve both field and laboratory testing of the interfaces. This testing will observe people using the prototype interface(s), and to discover errors and areas for improvement. The testing will involve three waves of measurement, and will be conducted at various locations in the Northern Territory of Australia. Each wave will examine how well the interface responds in the areas of performance, accuracy, recall, and emotional response. The results of the first wave will be treated as a baseline/control measurement, with all subsequent waves compared to the baseline to indicate improvement. Specific issues to be examined during the testing phase include:

- **Performance:** How much time, and how many steps are required for people to complete the task?
- **Accuracy:** How many mistakes did people make and were the mistakes fatal or recoverable with the right information?
- **Recall:** How much does the person remember after the testing, or after periods of non-use?
- **Emotional response:** How does the person feel about the tasks completed? Are they confident? Would the user be willing to participate in future testing?

Based on the recommendations of Virzi (1992) each test will involve 10 users (i.e., 60 persons in total). This recommendation is based on the observation that the probability of identifying an actual problem increases with the number of participating users up to about 10 persons, with the benefit of additional participants deemed marginal beyond this number. The results of the usability testing, and the final design solution(s), will be presented to our expert panel as part of a final practitioner workshop to be held in the Northern Territory. The workshop will involve the same participants mentioned above.

**Conclusion**

Understanding recovery is a priority of mental health providers at a national and international level. The profile of mental health disorders have increased significantly over recent years. Health statistics highlight the importance of improving recovery outcomes as nearly half of Australia’s population (45.5%) is predicted to experience a disorder in their lifetime (MHCA, 2007). Further research reports that one in five Australians will suffer a mental health disorder in any given 12 month period (ABS, 2008), with an estimated 1 million Australians diagnosed with mood and affective disorders, and 2.3 million people with anxiety disorders. Recent economic analysis by the Mental Health Council of Australia suggests that mental health disorders now account for around 14% of Australia’s national health budget. These statistics are common to virtually every developed country.

The picture that emerges when we focus in on youth mental health, and indigenous Australian youth in particular, is even more grim. Indigenous Australian youth are over-represented in mental health statistics with considerably higher rates of adversity (ABS, 2010). Notably, a national inquiry into human rights and mental health identified a direct relationship between undiagnosed mental distress in the indigenous population and resulting anti-social and self-destructive behavior (HREOC, 1993). This is known to have a direct impact on the level of criminal activity within the indigenous Australian youth population. Despite only accounting for 2.5% of the Australian youth aged 10-17 years (ABS, 2007), indigenous Australian youth represent around 32% of youth in juvenile detention. A Royal Commission into the broader issue of indigenous incarceration observed that offenders “...often experience depressive symptoms and unresolved anger which sometimes leads them to attempt or commit suicide whilst in custody” (HREOC, 1993, p. 698). Further, mental health problems with incarcerated indigenous youth are viewed as a significant contributor to social problems, drug and alcohol abuse and repeat offence (AIHW, 2010); contributing to a dangerous downward spiral that is difficult to break.

Developing a tool that can help improve mental health recovery perceptions and outcomes of indigenous
Australian youth is a high priority. Our use of the pattern approach to develop an interface for measuring recovery makes a number of significant contributions. The findings of this study will help Australian mental health service providers to be smarter in their information use, by providing an interface that will capture valuable information on the impact of their program interventions on recovery perceptions and outcomes for indigenous Australian youth. Importantly, the resulting pattern collection will also provide opportunities for government and other industries to be smarter and more innovative in the way they communicate with this target group. Obvious examples include the possibility of employing the patterns developed in this research to create new approaches to online learning for indigenous Australian youth; tools for capturing and documenting indigenous cultural history; or even inform more valid data collection approaches for other minority groups where literacy is a perceived issue.

References


