Aspects of HCI Research for Older People

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Abstract. HCI research has come of age and now is a good time to reflect upon the HCI research processes that have become established, over the years. This paper examines the HCI research process itself with respect to funding opportunities and the methods used for empirical research in particular assessing the efficacy of standard methods for research dissemination. The focus of the paper is HCI research for older people. The nature of this user group is explored and Alexandrian patterns are proposed both as a means of dissemination of research results and for strengthening the framework of HCI knowledge.

1 Introduction

As technology advances the role of HCI research has changed to the point where it no longer refers simply to optimal design for a desktop interface. Computers and computerised products are found everywhere and the changing role of HCI research is evidenced by the themes of two major HCI conferences, HCI 2003, 'Design for Society' and HCI 2004, 'Design for Life', and collaboration with other research disciplines has become commonplace. HCI research has come of age and now is a good time to reflect upon the HCI research processes that have become established as the norm.

This paper addresses four aspects of HCI research with special reference to interaction and older people: (1) the HCI research process; (2) the effect of funding opportunities; (3) the nature of application based experimental research; (4) research results dissemination concerning HCI and older people; (5) the nature of older adults as a user group.

The author's aim is to question certain HCI procedures in order to strengthen them. There is no intention to undervalue the considerable body of extremely valuable HCI research that has been achieved in recent years, but rather to explore ways of supporting research output to make it more cohesive and accessible in this discipline that has become increasingly important to society as a whole.

In this context, the concept of Alexandrian patterns as a means of research dissemination and to help identify relationships between research outputs across experimental platforms is explored, and a set of patterns for speech systems for older people is presented for analysis. The paper also introduces the notion of investigating the *forces*, properties of the user group, the environment or the supporting technology

that drive the design patterns, in order to build a bridge between disparate research outputs based on different experimental platforms.

2 Reflection on Established HCI Research

2.1 The HCI Research Process

The study of the human-computer interface sits somewhere between computer science and psychology and yet is significantly different from either However, unlike other disciplines within computer science, a priori HCI methodologies for arriving at the optimum interface design or understanding the user are limited, and the HCI research community possess no corpus of research material similar to that available to researchers in psychology. Unlike psychology, which is the study of human beings, HCI covers the interaction between human beings and technology where the technology itself is subject to remorseless change. Thus HCI research based upon technologies, which have been replaced by newer ones, runs the risk of becoming obsolete forcing researchers to try to identify the technology independent aspects of their work to pass on to others.

The difficulty of researching optimum human-computer interaction is acknowledged in that studies usually involve the use of User Centred Design, where researchers refer to subject users' performance or satisfaction in order to gauge the success of new approaches. The process can be characterised as: start with a set of user requirements; build a prototype system; and then evaluate it with users against a set of usability criteria. This process necessarily involves researchers making decisions based upon experience and craftsmanship with little reference to conventional theory.

For example when investigating older people's retention of information from long and short synthetic speech messages (Zajicek & Morrissey, 2001), researchers made several such decisions including, which particular messages to use, how long is long and how short is short, which information should be embedded in the messages, which usability criteria should be used, which evaluation techniques should be used, and if a questionnaire is involved which questions to pose. The HCI researcher is also frequently involved in research which starts effectively from scratch drawing mostly on their experience, with a new user group, a new form of interaction, or a new technology and with no previous work to build upon. This process is recognised as standard HCI research practice which means that researchers find difficulty defending their procedures to the psychologist who is able to build his or her research work upon decades of previously established research

It is also well known that papers that include a wealth of statistical information derived from user's interaction are more likely to be published in learned journals where statistics provide evidence of scientific rigour. Should this be the case? How much of the truth of an interface can be embedded in or represented by measurement or statistics?

2.2 Research Funding Approaches

There is recognition by funding bodies such as EPSRC, EU and NSF that society has access to the technology required to build useful life enhancing applications, which will be successful only if they are usable and which should be accessible by the whole population. Thus HCI and universal access have become major drivers in research funding initiatives as evidenced by the EPSRC EQUAL initiative and the EU Framework VI IST Program..

Research projects funded by EPSRC and EU Framework V commonly involve the exploitation of new technology or the bringing together of new and established technologies to build systems where a degree of sociological research into the users' needs is required in order that more appropriate systems can be built. For example research into the HCI aspects of Smart Homes enables older people to remain living independently for longer (Lines & Hone, 2002). Here sensors are able to detect abnormal activity in a home but substantial research is required into the HCI aspects to ensure that the technology is effective and acceptable to those involved. The focus of this research is application development with researched user needs, and once again is recognised as valid HCI research, where the theory on which it is built may be psychological or sociological in nature.

2.3 Empirical Research

The focus of the research presented in this paper is interface design for older people, where over the last few years much empirical research has been published presenting significant amounts of numerical data relating to measurements of older people's performance, enjoyment, attitude etc to systems under laboratory conditions. In order to obtain answers to particular questions about interaction many parameters are kept constant or not factored in which renders laboratory testing somewhat artificial and divorced from real-world interaction. On completing of their work the researcher frequently aims to generate generic guidelines for others designing systems for older people.

This research work is, of necessity, based around a particular application. Thus we have for example a voice Web browser used as a platform to compare older people's information retention from text, synthetic speech and a mixture of both (Zajicek & Morrissey, 2003). Researchers have also recently investigated the effects of combinations of feedback (auditory, haptic and/or visual) on the performance of older adults completing a drag-and-drop computer task (Emery et al, 2003), which produced much data concerning time taken to complete tasks and the number of errors made, from which researchers were able to craft three guidelines. Other work employed an email system to experiment with older people and optimum levels of functionality (Czaja et al, 1990). There are many other instances of this kind of research where laboratory based applications are used to generate universally applicable guidelines. The research output from this work must be to a certain extent system specific and yet researchers often try to generalise it to generate a useful body of data concerning HCI for older people.

2.4 The Dissemination of Research Results as Guidelines

A further concern of this paper is the effective dissemination of research results. HCI design knowledge such as that derived from empirical research discussed above is traditionally encapsulated in design guidelines in the form of simple statements that provide a much simplified version of the information generated by the original experimental work. In the particular the 'Why' part of the information which may be based on theoretical knowledge, or may derive from observation during experimentation or the experimental results themselves, has been lost. For example the guideline 'Keep speech output messages for older people as short as possible' derived from experimentation which found that older people were confused by long messages and actually remembered less than they did from short messages, and moreover this phenomena was not found with younger people (Zajicek & Morrissey, 2001). This guideline is concerned with memory loss and how it affects older people's information retention, useful information which risks being lost when generalizing experimental knowledge to craft simple guidelines.

Some researchers have sought to include more detail in their guidelines. For example the W3C, Web Access Initiative, Web Authoring Guidelines (Web Authoring Guidelines, 1999) developed for Web designers to help them create more accessible Web pages for non-standard users, are accompanied by the reasons for the guidelines, in order to make the Web designer more aware of the people that he or she is excluding by not following the guidelines. However this creates a further level of complexity and in many ways distances the designer even further from the original concepts from which the guidelines were generated.

Interestingly, in order to reduce the complexity of their formal guidelines the Web Access Initiative have created a set of ten Quick Tips to be used as a quick checklist for accessibility. So the Quick Tips are actually a set of simpler guidelines derived from the more detailed guidelines because they were too complex for new designers to apply. The ambivalent approach demonstrated by the Web Access Initiative exemplifies the dilemma inherent in the use of guidelines as research output. One contains detailed information but is difficult to access and the other is easy to access but contains too little information.

2.5 Ways to Strengthen HCI Research

The nature of HCI research, the manner in which it is funded and the constraints placed upon it by the necessity that experimental research should be made universally applicable, force it into an uncertain position. It is misleading to assume that HCI research should produce copious amounts of statistical data and operate in the same way as other scientific research, and it would be useful if HCI researchers could find new forms of expression for the output of their research that preserves the essence of human computer interaction more effectively. It would also be helpful if the HCI community were able to address the applicability problem associated with experimental research applications.

HCI researchers working with older adults, whichever application platform they use are responding to certain motivators or *forces* that are explicitly recognised in the

design patterns proposed below. For example some *forces* operating in speech systems for older adults are as follows. (1) Older adults commonly suffer from memory impairment (2) Memory impairment affects the ability to build conceptual models at the interface. (3) Errors and error recovery represent the primary usability problem for speech systems. (4) Standard menu driven systems often start with a long set of instructions in a bid to avoid errors happening.

A move towards integrating research from several experimental platforms might be to identify cross platform interactional factors by looking for *forces* that apply across applications and then group the research outputs that respond to particular *forces*. This could lead to the formation of an enduring corpus of HCI research work concerned with older people's interaction.

2 HCI Research Methods Should Be Different For Older People

Adults as they get older experience a wide range of age related impairments including loss of vision, hearing, memory and mobility, the combined effects of which contribute to loss of confidence and difficulties in orientation and absorption of information.

3.1 Dynamic Diversity Affects Design Methodology

The effects of ageing described above will be manifest at different rates relative to one another for each individual. This pattern of capabilities varies widely between individuals, and as people grow older, the variability increases (Myatt et al, 2000). In addition, any given individual's capabilities vary in the short term due to a variety of causes including illness, blood sugar levels and just plain tiredness. This collection of phenomenon presents a fundamental problem for the researcher who seeks to develop simple applicable and generic results. The *force* of dynamic diversity operating on systems for older adults is one that researchers must recognize.

The user-centred approach outlined by Nielsen (Nielsen, 1993) and adopted as the most useful method for human computer interaction research, tends to rely upon homogeneous groups for user testing in order to focus on research decisions, and is therefore not appropriate for older adults who display dynamic diversity.

Empirical research methods are not effective in meeting the needs of diverse user groups or addressing the dynamic nature of diversity. This was first proposed by Newell and Gregor (Newell & Gregor, 2000) and the case against using standard user centred design when designing for older people, is provided in a commentary on the design of a voice output Web browser for older people in (Gregor et al, 2002).

3.2 Interaction With Older People As Participating Users

Experimental research carried out with older people is not easy, and the cultural and experiential gap between them and new technology can be especially large (Eisma et al, 2003). Younger people through familiarity with the technology can more easily

participate as users in user-focused activities. Older people are commonly unaware of the possibilities of new technologies, and this can severely limit their ability to contribute actively to a discussion about their requirements.

User requirements are usually elicited by way of a focus group which is often difficult when working with older people. There exist instances of successful use of focus groups with older people, Kirakawski (Kirakawski, 1997) for example reports instances where standard focus group procedures were used successfully for requirements elicitation with older people, and that no adjustments for this user group were required. However more recent work has demonstrated that focus groups must be adapted for older people and that their organisation requires considerable interpersonal skills. For example when gathering requirements for an interactive memory aid researchers at Dundee University (Inglis et al, 2002) reported difficulties in managing focus groups comprising more than three older people. They reported that auditory impairment was affecting older people' attention and the ability to follow a discussion, and that where depth and volume of information are important smaller groups or individual interviews were required.

Lines and Hone (Lines & Hone, 2002) also found that older people are inclined to 'wander' from the topic under discussion, providing unrelated anecdotes and chatting amongst themselves. They reported that it was difficult to keep the participants' attention focused on the task and felt that smaller numbers in sessions were preferable, allowing everybody time to contribute and those who appeared nervous to be drawn into the discussion more easily by the moderators. These comments highlight the challenges involved in researching with older people.

Research with older people therefore requires considerable skill and understanding of the user group. Newell and Gregor proposed (Gregor et al, 2000) that standard user centered design techniques, which rely on relatively homogeneous user groups for user testing, should be replaced by User Sensitive Inclusive Design, which seeks out diversity, in order to ensure that research output is truly representative of older people.

3 The Argument For Alexandrian Patterns

Acknowledging the complexity and challenge described above in researching interface design for older adults, and the unifying aspects of *forces* where different application platforms have been used, this section puts forward the argument for Alexandrian patterns for the dissemination of HCI research concerning older people.

3.1 The History of HCI Patterns

Patterns and pattern language originated in the domain of architecture; with the publication more than twenty years ago of Christopher Alexander's book 'The Timeless Way of Building' (Alexander, 1979), which proposed that one could achieve excellence in architecture by learning and using a carefully defined set of design rules, or patterns: and although the essence of a beautifully designed building is hard

to define the application of patterns for room design etc can contribute to the design of the whole.

A pattern describes an element of design possibly together with how and why you would achieve it. For example Alexander has created patterns that describe ways of placing windows in a room and designing a porch that achieves a successful transition between inside and outside a building. These include textual descriptions and diagrams or photos (Alexander, 1977).

Patterns for human-computer interface design were first discussed in the late nineties, and there exist a range of different pattern forms. Some pattern builders choose a purely narrative approach such as those found in the Design of Sites (Van Duyne, 2002) whereas others are more structured. Martin van Welie for example sets out patterns under the headings Problem and Solution (Van Welie, 2002). A comprehensive list of pattern forms can be found at Sally Fincher's Pattern Form Gallery (Fincher, 2003)

To address the problem of multiple pattern forms a workshop attended by several of the pattern developers referenced above under the title of 'Perspectives on HCI Patterns: Concepts and tools' was held at CHI 2003, where the participants formulated the Pattern Language Markup Language (PLML)(Fincher, 2003b) which provides an easy-to-use generic pattern form encapsulating features of several of those already existent pattern forms described above..

A pattern set provides a powerful and acceptable means of presenting knowledge concerning the design requirements of older people, where examples of good design and reasons for using it are presented in an accessible form. Alexander's work also encourages a design community to find their own patterns and use them selectively for individual problems. Their purpose is to educate, and to stimulate discussion between designers and ideally users as well. The CHI 2004 workshop 'Human-Computer-Human Interaction Patterns: on the human role in HCI Patterns' specifically addresses the issue of user involvement in interface design patterns (Workshop, 2004). Extending the concept of patterns to encompass user participation is particularly challenging when working with older people, as the difficulties experienced with user participation with older people for requirements gathering and user testing are likely to become more acute when older people are called upon to discuss and formulate abstract entities such as patterns.

However, simply because communication on technical and abstract subjects between researchers and interface designers has proved challenging in the past, does not mean that it need always be. Lines and Hone (Lines & Hone, 2002) have made a start with recommendations on interview procedure, and Newell and Gregor (Newell & Gregor, 2000) have outlined a new design methodology, User Sensitive Inclusive Design with more emphasis on the characteristics of the user. A future challenge is to find a fluent channel of communication that will enable older adults to provide effective input to HCI research.

3.2 A Set of Patterns For Speech Systems For Older Adults

Patterns for speech systems possess different properties to those of the more visually orientated graphical user interface patterns of Tidwell and van Welie (Tidwell, 2002)

(Van Welie, 2002), and indeed the architectural patterns of Alexander (Alexander, 1977) where diagrams or screen representations can be used to convey information. Speech dialogues use two forms of input, speech and keypad, and output in the form of a speech message. The usability of the dialogue hinges on its structure and the quality of the output messages. Patterns relevant to speech systems therefore must include those concerned with the construction of output messages, and also those related to dialogue structure.

This section describes a set of patterns for speech systems for older adults that are specially designed to support memory loss and increase user confidence. One pattern *Error Recovery Loop*, which is concerned with dialogue structure, is presented in its complete PLML form as follows:

Pattern ID: 7-ERL-SPST-OP-MPZ
Pattern Name: Error Recovery Loop
Problem: Errors and error recovery represent the primary usability problem for speech systems. Standard menu driven systems often start with a long set of instructions in a bid to avoid errors happening. Older users are not able to remember these messages, which also slow down the dialogue, rendering them useless. The pattern described here directs designers to embed instructions in an error recovery loop: in effect to wait for the error to happen and then try to recover it.
Context: This approach is most useful in dialogues which are used mostly by experienced users who are unlikely to require any instruction and will if they use the dialogue successfully never have to listen to an error recovery message. Use when errors in data input are likely to occur. This form of error recovery does not prepare the user in advance for possible errors, as they have to create the error before it is invoked. The trade-off is against providing long instructions before the user embarks on a task.
Forces: (1) Errors and error recovery represent the primary usability problem for speech systems. AND (2) Standard menu driven systems often start with a long set of instructions in a bid to avoid errors happening. AND (3) Older users are not able to remember these messages. AND (4) Long instructions slow down the dialogue, rendering it useless for older people. AND (5) Different people have different tendencies to make errors. AND (6) Providing different levels of error recovery ensures support for each user at their own level AND (7) Error Recovery Loop does not delay those who make few errors. BUT (8) Error Recovery Loop allows users to make errors before it instructs them which might irritate some users.
Solution: Count how many times a data input occurs and on each count invoke an increasingly detailed error recovery message. In the examples below Example (1) simply gives instructions for efficient input, but the more detailed Example (2) provides information about which might help the user work better with the system.
Synopsis: Error Recovery Loop provides increasing levels of information as more errors occur.
Evidence: The Error Recovery Loop pattern was successfully applied in the Voice Access Booking System (Zajicek et al, 2003).
Example: (1) "Your name has not been recognized. Please speak slowly and clearly into the telephone.

(2) "The system is trying to match your name against the names it holds in the database. Please try to speak your name in the same way that you did when you registered for the Voice activated Booking System.
Rationale: Because older people cannot remember lengthy preliminary spoken instructions about data input. It is best to let them try to input data and if it goes wrong invoke an error recovery message.
Confidence:` 50%
Literature: Zajicek M., Wales, R., Lee, A., 2003, Towards VoiceXML Dialogue Design for Older Adults, In Palanque P., Johnson P., O'Neill E (eds) Design for Society. Proceedings of HCI 2003
Related Patterns: This pattern is a member of the Pattern Group (3) - 'Reducing Input Errors patterns' consisting of three patterns that offer different solutions to reduce the errors associated with speech data input.
(3) Default Input Message Pattern (3-DIM-SPO-OP-MPZ)
(7) Error Recovery Loop Pattern (7-CM-SPST-OP-MPZ)
(8) Partitioned Input Message Pattern (8-PIM-SPST-OP-MPZ)
Pattern (4) Context Sensitive Help Message Pattern (4-CSHM-SPO-OP-MPZ) can be used as part of pattern (7) Error Recovery Loop Pattern (7-CM-SPST-OP-MPZ)
Author: Mary Zajicek
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We see that each pattern includes a description of the problem that it seeks to solve, the context in which it would be used and the way in which it can be achieved with examples. The *forces* heading is of particular interest here as described above and refers to existing circumstances that force the need for the pattern. The confidence level is set at 50% because the pattern has as yet been used in only one system. This will increase as the pattern is used successfully in further systems. Other patterns in this pattern set are the speech output message type patterns:

Confirmatory Message (1-CM-SPO-OP-MPZ) - suggests (with examples) providing confirmatory messages at certain points in the dialogue to boost users confidence;

Menu Choice Message (2-MCM-SPO-OP-MPZ) - suggests that menu choices should be limited and provides examples for setting them up;

Default Input Message (3-DIM-SPO-OP-MPZ) - suggests (with examples) ways of setting up default input when errors in speech input have occurred;

Context Sensitive Help Message (4-CSHM-SPO-OP-MPZ) - suggests (with examples) providing help messages at particular points in the dialogue to help those who are lost;

Talk Through Message Pattern (5-TTM-SPO-OP-MPZ) - suggests (with examples) output messages that talk the user through their interaction telling the user where they are in their interaction and what they can do next;

Explanation Message Pattern (6-EM-SPO-OP-MPZ) - suggests (with examples) that explanation messages can be useful at points in the dialogue that might not be easy to understand;

There are also two dialogue structure patterns in the set *Error Recovery Loop* described above and;

Partitioned Input Pattern (8-PIM-SPST-OP-MPZ) - suggests (with examples), as an alternative to speech input, how to arrive at an element of ordered input data by successively halving the search area.

The complete pattern set in PLML form, can be found at (Workshop, 2004)

The patterns are also placed in *Pattern Groups* according to their functions as shown below.

Pattern Group (1) - *Extra Confidence Messages*. Four related patterns that suggest messages that can be added to the dialogue to increase confidence in older adults and help them build conceptual models of the dialogue.

(1) Confirmatory Message Pattern (1-CM-SPO-OP-MPZ)
(4)Context Sensitive Help Message Pattern (4-CSHM-SPO-OP-MPZ)
(5) Talk Through Message Pattern (5-TTM-SPO-OP-MPZ)
(6) Explanation Message Pattern (6-EM-SPO-OP-MPZ)

Pattern Group (2)- *Reducing Input Choice Messages.* Two alternative patterns that encourage designers to offer either two (8) or reduced (2) selections for speech input.

(2) Menu Choice Message Pattern (2-MCM-SPO-OP-MPZ)
(8) Partitioned Input Pattern (8-PIM-SPST-OP-MPZ)

Pattern Group (3) - *Reducing Input Errors patterns.* Three patterns that offer different solutions to reduce the errors associated with speech data input.

(3) Default Input Message Pattern (3-DIM-SPO-OP-MPZ)
(7) Error Recovery Loop Pattern (7-CM-SPST-OP-MPZ)
(8) Partitioned Input Pattern (8-PIM-SPST-OP-MPZ)

Some patterns are clearly closely related, for example patterns *Talk Through Message Pattern* and *Explanation Message Pattern* and *Explanation Message Pattern* can also be used as an alternative to or as part of *Talk Through Message Pattern*. Grouping patterns enables researchers to identify the relationships and similarities between individual patterns and enables them to see where their own research fits into the body of HCI research already completed.

The pattern set above does not cover all patterns for speech systems for older people. It can be developed further with additions and refinements. The patterns are intended for research discussion and for use by prospective system developers who have little knowledge of the requirements of older people, and could conceivably be replaced or discarded, or grouped together as a set of alternative solutions to a particular problem.

3.3 Why Use Patterns For Dissemination of Research Results with Older Adults?

Patterns represent a particularly effective means of encapsulating research knowledge concerning older people. They set out designs, with examples that are known to be effective, based upon research investigation.

They actually encapsulate the experience of being an older adult. Using patterns the researcher starting a new project with a new application for older adults can, at the very least, get to know the *forces* at work from existent patterns and may well go so far as to build their research upon existing patterns. The researcher would be no longer left to make their own, application based, interpretation of guidelines and the patterns would also reduce the compulsion for older people themselves to be involved in design as some their experience will be already encapsulated in the patterns. This is not to say that older people do not have a very valuable contribution to make as users participating in the research process, but there will no longer be the compulsion for their involvement in every step.

Patterns encourage researchers to consider the *forces* driving their research and an important outcome would be the discovery of new forces to add to the community's collection. Indeed patterns can be examined and inform cross platform research.

Given time patterns might form that important body of well-grounded research, which is sometimes lacking in HCI research, on which HCI researchers can build.

3.4 Good HCI For Older People is Usually Good For Everyone

Patterns have been used successfully by Christopher Alexander in architecture and by the software engineering community. However in these domains the patterns put forward were useful for everybody not just a small section of society. At first glance it looks as though the patterns put forward in this paper are useful only for research concerned with older people, and would not help those investigating interface design for younger computer users, and moreover that the suggested design patterns might make speech interfaces complicated and slow for younger people who require less support.

It is important to research interface design patterns for systems for use by older people because their design needs are more complex as a result of their dynamic diversity and because it is more difficult to include older people in a user centred design process. However everybody to a greater or lesser extent experiences problems remembering aspects of their computer interaction for example and can therefore benefit from memory supporting patterns.

Although there is insufficient space to include the full pattern set for speech systems for older adults in detail, it can be demonstrated that all but one of the patterns represents good design for all users, from any age group. Patterns *Menu Choice Message*, *Explanation Message* and *Confirmatory Message* represent standard HCI good practice. *Partitioned Input*, *Default Input Message* and *Error Recovery Loop* serve to sensitise researchers to the difficulties users experience with poor speech recognition, and offer solutions. However, younger users also experience speech recognition problems and could therefore also benefit from these patterns.

Default Input Message, *Context Sensitive Help* and *Error Recovery Loop* are invoked only when difficulties arise, thus ensuring that young people who do not experience recognition problems would be unaware that they exist. It could be argued that the pattern *Talk Through Message* could make interaction tiresome for younger people if the system were continually telling the user where they are in the dialogue and what they can do next. The solution here is to provide for the talk through option to be either on or off, or invoked as the user starts to display a non-optimum interaction. These patterns therefore provide a strong argument for universal design, where designing for older people can help the younger user who might otherwise be expected to be flexible and adapt to poor speech interaction design.

Additionally Dulude (Dulude, 2002) showed that performance with interactive voice response systems was worse for older people than younger users simply because older people were responding more negatively to design problems that made their interaction difficult, whereas younger people were more flexible and able to work around the problem. The inference here is that features that are specially designed to make interaction easier for older people will be useful for everybody. We should perhaps therefore be researching interfaces for older people as an integral part of the user group in order to promote the design of systems that are easier for everybody to use.

Just as we have shown that young people can also benefit from the designs encapsulated in the above patterns, and in most cases not even know that extra support for age related disabilities was built into the speech dialogue, so older people with variable abilities are also served. Thus the dynamic diversity found in older people is accommodated by these patterns. The *Error Recovery Loop* pattern in particular accommodates dynamic diversity because error messages are linked to the number of mistakes that a user makes, which will be related to their ability.

4 Conclusions

This paper has identified areas in which HCI research differs significantly from other research disciplines and has uncovered certain paradoxes concerning dissemination of research results. While focussing on speech systems for older adults it also suggests Alexandrian patterns as a means by which useful research dissemination can occur and the continuity of HCI research can be assured.

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