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MULTIDIMENSIONAL HCI

Reflections on the diversity of HCI applications and interests

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The future will confront us with a completely new generation of technology, services, products and consequently challenges. We will need new interfaces to master these fundamental challenges including the aging society, environmental change, cyber-conflicts and the impact of invisible technologies.

HCI draws on a broad range of disciplines and perspectives, which results in diverse research paradigms and interests. This diversity is represented in the three papers that won best paper awards at HCI 2012. We thank BCS for allowing us to reprint these papers and expose our research to a broader audience.

While we cannot deny the advances in our field, there are some blind spots that require careful consideration. Firstly, do we really profit from the diverse approaches we encompass? Theories, models and methods are not communicated well across disciplinary borders but instead the disciplines compete. Secondly, all disciplines should consider the relationship between technology, usability and acceptability – just because we can build it doesn't necessarily mean that it will be a good or desirable step forward. However, perhaps the most substantial blind spot is the lack of an overarching theoretical framework for the design of future generations of technology, and an educational programme to support this framework.

We are at a crossroads in our attempt to be truly multidisciplinary and we continue to see the community breaking into different factions. The positioning of the Interaction group within a computing society is being brought into question, as are our modes of communication in this time of austerity. This may well be the last issue of *Interfaces* in its current form, so I would like to take the opportunity to thank you for your readership and contributions. I urge you to get involved with the group so we can continue to progress. Please get in touch with me or with the Executive if you have any thoughts on the way forward.

I wish you continued success in all your HCI endeavours.

Lynne Coventry

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VIEW FROM THE CHAIR

FACING FORWARD

Dave England, the Chair of Interaction, muses on the challenges and changes facing Interaction as one successful conference ends and we begin to look towards the next.

Another September, another successful HCI conference. HCI2012 in Birmingham was our 26th annual conference. Over five days, 200-plus people took part in the various workshops, main conference sessions and social events, organised by Russell Beale, Chris Bowers, Chris Baber and Ben Cowan. Congratulations to them.

Notable challenges

It would be invidious to pick any particular session; the conference committee made awards for the best contributions. However, I was particularly impressed by our keynote speakers; Patrick Baudisch from the Hasso Plattner Institute and Gary Marsden from University of Cape Town. They presented contrasting styles of interaction: Patrick explored high-end, Natural Interaction based on the principle of uniting Euclidian and Newtonian spaces; whereas Gary presented the challenges of working in third world conditions where power supply, education and sustainability are limiting factors. Both keynotes highlight the wide range of challenges HCI still faces.

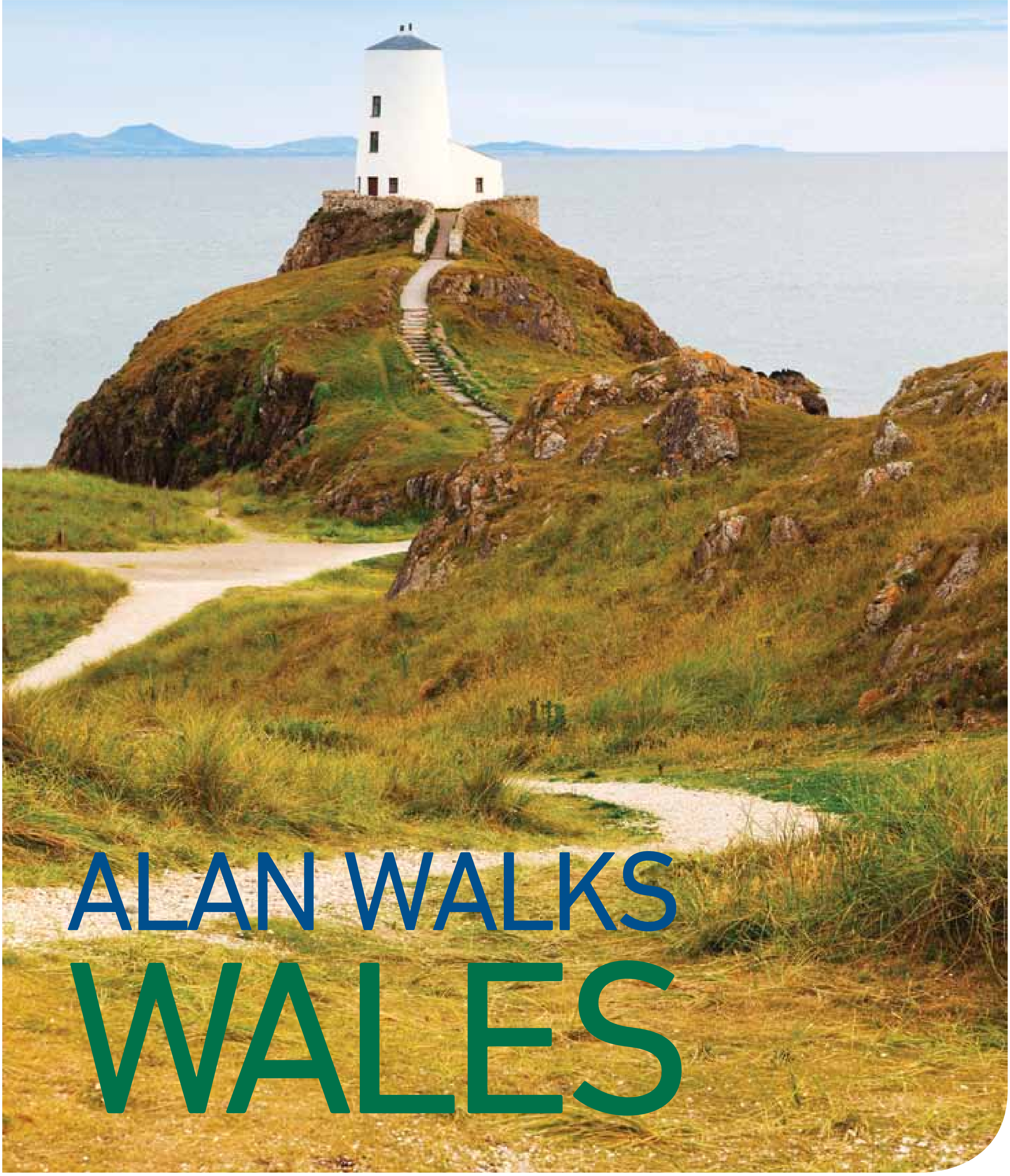
HCI2013 will take place at Brunel University next September and we wish Steve Love and his colleagues equal success with the 27th conference.

We also held the Interactions AGM at the conference and faced some more prosaic challenges. Thankfully we still have new volunteers coming forward to help run the group. Corina Sas is stepping down as treasurer and we thank her for her past services. Ben Cowan will be the new treasurer. Debbie Maxwell is stepping in as Usability News editor. Usability News is now within the main BCS website at **usabilitynews.bcs.org**. Please help Debbie by sending her news items for the site. You can find her contact details on the back cover.

Shamal Faily joins us as the moderator for the British HCI News mailing list. If you are not already on the list send “JOIN BCS-HCI your_firstname your_lastname” to **jiscmail@jiscmail.ac.uk**. The final prosaic challenge is that this will probably be the last hardcopy production of *Interfaces*. BCS is cutting budgets to all special interest groups and branches. At the conference we discussed a strategy for making better use of electronic communications and social media. Most of our new materials will be rolled into the main **bcs.org** website with updates channeled via other platforms. If you have skills to offer in this area please get in touch.

Outreach

We also discussed extending the membership and reaching out to other communities. The UPA UK has been a long-term partner and we should look to running more events with them, in particular in the area of professional UX competency. HCI is probably being taught in more UK institutions, to more students than ever before. However, many people who teach HCI might not be aware of the group. So we suggest reaching out to the Higher Education Academy to spread the word on HCI Education. If you have ideas for other connections, again, get in touch. In the meantime I hope you are planning your papers for HCI2013 and I look forward to seeing you at Brunel, if not before.



ALAN WALKS WALES

Alan Dix, Talis and University of Birmingham, plans an exploration of IT at the periphery for tourists and communities as he circumnavigates the country of his birth.

Many *Interfaces* readers will already know that I am walking round Wales next year. This will be a one-thousand-mile journey, which takes in most of the major towns and cities of Wales as well as many miles of remote and rural coastline.

Earlier this year the Welsh Government announced the opening of the Wales Coastal Path, a new long-distance footpath around the whole coast of Wales. There were several existing long-distance paths covering parts of the coastline, as well as numerous stretches of public footpaths at or near the coast. However, these have now been linked, mapped and waymarked, creating, for the first time, a continuous single route. In addition, the existing Offa's Dyke long-distance path cuts very closely along the Welsh–English border, so that it is possible to make a complete circuit of Wales on the two paths combined.

As soon as I heard the announcement, I knew it was something I had to do, and gradually, as I have discussed it with more and more people, the idea has become solid.

This will not be the first complete

periplus along these paths; this summer there have been at least two sponsored walkers taking on the route. However, I will be doing the walk with a technology focus, which will, I believe, be unique.

As I go I will be focusing on the IT needs of walkers and local communities, aiming to create both practical interventions and also future research opportunities.

Data and disconnection

Some of this IT focus will build on my own research. For example, back in 1995, I wrote one of the earliest journal papers on the human interface issues of mobile technology, focused particularly on issues of intermittent connectivity and delays. Seventeen years on, these issues are still very pertinent whether on a Scottish island, around the coast of Wales, or in rural areas of developing countries. I have also long had an interest in data integration and aggregation (mashups!), more recently coloured by Semantic Web connections.

Both of these are critical in work I'm involved with to develop a mobile heritage app on Tiree; and both are equally relevant in remote West Wales. It is interesting to recall that back in 1992 Russell Beale and I submitted a grant proposal around the use of synchronisation technology to deal with limited connectivity. The reviewers unanimously said that it would be irrelevant in a few years given increases in connectivity and bandwidth … 20 years on we are still waiting!

Maps on the way

Another aspect will be the use of local maps, connecting with another long-term interest in the nature of maps, mapping and human understanding of space. Communities often have their own maps in locally or individually produced tourist guides. Sometimes these are traced initially from 'standard' maps, but they may also use non-standard and non-uniform projections. For example, town plans are often hillside rather than birds-eye views and a recent map of Cardigan has been knitted into a giant cardigan. However, Google maps and similar online services, while revolutionising day-to-day mapping, use 'standard' maps, losing the sense of local identity and ownership. I hope to challenge this Cartesian hegemony, seeking to empower locality through cartography.

Open to community

Most important, though, will be listening for the needs and problems of the local communities through which I pass. Many will be rural and remote, maybe with similar issues to Tiree. However, the coast path will also cut through the edges of industrial and urban areas: Milford Haven, Port Talbot, Swansea, Newport and Cardiff itself. Historically the docklands have been the deprived poorer areas of towns, and while substantial parts have been 'gentrified', still I expect to encounter economic marginality in the urban as well as rural areas.

Living lab

As I walk I'm also offering myself as a 'living lab' to other research groups. This maybe to trial ubicomp technology, mobile applications, body sensors, or to aid in ethnographic data gathering.

The three months of the project allow time for me to use some prototype technology or technique for a short period, and then for it to be modified and tried again later in the walk. There will be one rule, 'no blood': at the first hint of sensor sores they go in the bin!

A personal journey

I am Welsh, born and brought up in Cardiff, so there is clearly a personal dimension and I will be blogging and writing more reflectively and philosophically as I go. Furthermore it will be a physical challenge as I haven't walked any distance for 30 years. However, this is not divorced from the academic and technological side of the journey and I will be drawing on my own past writings, as well as those of others such as Rebecca Solnit's *Wanderlust* and Phoebe Sengers' *What I learned on Change Islands*.

… and you

This is a personal journey, but also a community journey, and not least the HCI community; I won't be able to do it without the help of others, but likewise I hope to be able to help fellow researchers as well as the communities through which I pass.

Put on your boots and join me for part of the walk. Be a remote partner offering advice, solutions, coding for issues that arise along the way. Use me to trial and experiment with your applications and technology or as a source of field data. Help me with logistics … I am not the world's most organised person. Also, I am seeking funding to cover some of the costs, so if you know any suitable sources (I'm happy to wear sponsorship logos on my T-shirts!), or if my walk could contribute to existing projects that would supplement travel and subsistence for some of the journey, do let me know.

However, while contributions to expenses will be welcome, the offer to be a 'living lab' does not in any way depend on this.

Finally

Follow my progress as I plan the journey on twitter at **@AlanWalksWales** or at the walk web site: **www.alandix.com/alanwalkswales**.

PARTICIPATE IN RESEARCH

Dr Shailey Minocha at The Open University is looking for HCI researchers who have helped older adults to participate in online communities to share their stories and anecdotes for a project investigating the role of online communities in the quality of life and well-being of elderly people.

Can you help a research team understand perceptions of value, barriers and risks and their motivation for joining online communities?

Researchers at The Open University have received funding for a one-year project to investigate the role of online communities and social networking sites in supporting elderly people in our society to overcome social isolation, develop social connectedness and to build supportive relationships and companionship.

For example, online communities may help elderly people to keep in touch with the younger members of their families, to share information with their friends, develop new friendships, engage in games and active entertainment and gain ICT skills, to exchange experiences and receive or offer support regarding health conditions, and even generate offline initiatives, groups, and friendships.

Enhancing communication

The proportion of elderly people has become a predominant aspect of our society. Instead of moving to a hospital or nursing home, elderly people often prefer to live in their own homes. Therefore, methods and strategies are required to help them to increase their communication with the outside world, building their self-esteem rather than fostering the sense of frustration and loneliness. This involves providing elderly people not simply with care, but with ways in which they can actively engage with others: for example, sharing their experiences and being in a dialogue with others. Only by integration and participation will they feel socially connected and creative.

Specific aims

The *specific aims* of the project are to investigate:

- the motivations that elderly people have for participating in online communities;
- the advantages that they experience while interacting in online communities;
- the obstacles that they encounter in engaging with online communities, whether these are related to the skills required, or the equipment, or having privacy or security concerns;
- whether there are particular dangers and risks for elderly people in online communities;
- and usability and accessibility guidelines for the design of online communities for elderly people.

The empirical investigations will involve:

- eliciting requirements from people such as carers or family members who have had experiences with their parents, friends, etc;
- conducting workshops and individual interviews with elderly people aged 65 and above; the participants will include elderly people who have already engaged with online communities and those who have not;
- conducting user-observation sessions to evaluate the user experience;
- and conducting workshops or group interviews with representatives of local organisations (where our university is based) such as Carers Bucks and Carers MK, Milton Keynes Council, and Age UK Milton Keynes.

The *research outcomes* of the project will be to develop a set of online resources for organisations to link to. The target audience of these online resources will be elderly people, their families and carers, website designers, policy makers in organisations such as Age UK, trainers and IT equipment suppliers in local communities, and voluntary organisations.

Resources may include: checklists for addressing ongoing privacy and security concerns of interacting in online communities; etiquette and social norms in social networking sites; how different equipment configurations and devices such as iPads and tablets may be able to address the needs of elderly people; the role and responsibilities of the moderator in online communities; case studies as exemplars; guidelines for the design of sites that are aimed at elderly people and guidelines for web design, in general, that address their requirements; and guidance for sites such as **gransnet.com** or **grandparentsnow.com** about the kinds of discussions and resources that they should be focusing on for the benefit of their audience.

How you can help us

We hope that colleagues with experience of interacting with and helping their parents or grandparents, relatives, neighbours, acquaintances or friends to join online communities such as Facebook, Twitter and online discussion forums may be willing to share their stories and anecdotes with us: the benefits the elderly perceive, the obstacles they face, or if they perceive any risks, and finally their motivation for joining online communities.

Due care will be taken to ensure anonymity of the participants and their contributions. We are carrying out the project within the human research ethical framework prescribed by our university: **www.open.ac.uk/research/ethics/human.shtml**.

We welcome your participation. Please contact Dr Shailey Minocha, s.minocha@open.ac.uk, if you would be able to help us or for further details about the project. Many thanks.

Project team: **Kathryn Dunn, Shirley Evans, Liz Hartnett and Shailey Minocha.**

A New Test of Throughput Invariance in Fitts' Law: Role of the Intercept and of Jensen's Inequality

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Fitts' law states that movement time varies linearly with the index of difficulty or, equivalently, that throughput (*TP*) is conserved across variations of the speed/accuracy strategy. Replicating a recent study by MacKenzie and Isokoski (2008), we tested the throughput invariance hypothesis with some fresh data and found the *TP* to be systematically affected by the strategy. This result, we suggest, pleads against the currently popular definition of the *TP* inherited from Fitts (1954), namely *TP = ID/MT*, which we recall is incompatible with the Shannon equation of Fitts' law. We also show that the statistical elaboration of the *TP* suffers from a problematic amount of uncontrolled variability due to the multiple inadvertent impact of Jensen's inequality.

Keywords: Throughput, Fitts' law, y-intercept, Jensen's inequality, statistics, aggregation order

1. INTRODUCTION

Humans have innumerable opportunities in everyday life to move their hand to some target location, for example to reach a light switch on a wall or to grasp some nearby object. In the specific context of human-computer interaction (HCI), the ubiquitous graphical user interface requires the people to express almost all their decisions by reaching and clicking target objects like icons, menu items or hypertext links. In all these cases users face a speed/accuracy dilemma—as everyone knows, the faster the reaching movement, the more likely the miss. This speed/accuracy trade-off is what Fitts' law is all about.

In the present paper, concerned with both the mathematical consistency and the empirical validity of Fitts' law modeling, we focus on a seldom-considered version of the law that takes the form of an invariance: if the equation is correct, a certain quantity, called the throughput, should be conserved across variations of the speed/accuracy balance. We will discuss, in light of some data, two difficulties that have hindered progress in the understanding of this conservation so far. One has to do with the controversial role of the equation's intercept and the other with the inadvertent influence of the order in which one computes the throughput and aggregates the data statistically.

2. FITTS' LAW

Fitts' law (Fitts, 1954; Fitts & Peterson, 1964) is a well known empirical regularity which predicts movement time (*MT*) as a function of target width (*W*) and target distance (*D*). HCI researchers generally use the Shannon equation (MacKenzie, 1992; Soukoreff & MacKenzie, 2004):

$$MT = a + b \cdot \log_2(D/W + 1) \quad (1)$$

where *a* and *b* stand for adjustable constants and where the log term represents the task's index of difficulty (*ID*).

In fact there are many candidate mathematical models for Fitts' law (see Plamondon & Alimi, 1997, who list a dozen respectable equations), and not all models take the logarithmic form. In a famous contribution to the literature, Meyer et al. (1990) have proposed to model *MT* as a power function of the ratio *D/W*, arguing that such a model encompasses the logarithmic model as a limiting case. This argument, however, has been recently challenged by Rioul and Guiard (2012), who showed that mathematically Meyer et al.'s model is a quasi-logarithmic, not a genuine power model. Not only is Equation 1 of the logarithmic category, not only is it known to tightly fit most data sets, it is also of special importance in practice, being

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actually part of an International ISO standard (ISO9241-9, 2002).

In this paper we re-examine the calculation of throughput (*TP*) from Equation 1 and draw attention to a previously unnoticed methodological difficulty that may hinder the empirical evaluation of the model.

3. LAW OF VARIATION VS. INVARIANCE

The Shannon model of Fitts' law is usually written as in Equation 1, which states a *law of variation* of the form $y = a + bx$. That is, y varies lawfully (linearly) with x. But the model may just as well be formulated as an *invariance*, as either

$$\frac{y-a}{x} = b \tag{2}$$

or

$$y - bx = a, \tag{3}$$

emphasizing that two quantities, a and b, are invariant across the variations of x.

It is noteworthy that, despite their mathematical equivalence, the law-of-variation formulation of Equation 1 and the invariance formulations of Equations 2-3 place the model in markedly different positions with regard to the risk of empirical falsification (Platt, 1964; Popper, 1959). The Shannon equation (Equation 1) is in fact quite unlikely to be disproved by empirical data: at worst, one will obtain a disappointing fit, wondering whether one should continue to trust the model with an r^2 below .9, .8, or lower. But take the claim that $(y\text{-}a)/x$ must be independent of x, which has the form of a null hypothesis (H_0): if the data plead for the rejection of H_0, then one faces an empirical falsification of Equation 3—and, by implication, of Equation 1. Consistent with classic Popperian epistemology (Platt, 1964; Popper, 1959), this more challenging way of empirically testing the theory is commonplace in stronger domains of science like physics (Meehl, 1967).

4. THE THROUGHPUT

The throughput (*TP*) of Fitts' law tasks is a standard of measurement widely used in the HCI community as a tool to quantify user performance with different input devices and different interaction techniques.

In classical Fitts' law experimentation participants are instructed to perform their movements as fast as possible given the *ID*, with a certain (ideally constant) level of accuracy. Although many factors such as mood, fatigue and alertness, may influence the *TP*, the Shannon model of Fitts' law says that the *TP* should be conserved within participant across variations of task difficulty (nominal *ID*) and movement accuracy (effective *ID*). Because the *TP* is a global index of performance which takes both speed and accuracy into account, its practical utility in the context of HCI research is very high.

MacKenzie and Isokoski (2008) recently tested the robustness of the *TP* under three different instructional conditions: standard, speed emphasis, and accuracy emphasis. While, unsurprisingly, speed and accuracy of performance were both strongly affected by the change of instructions, the key outcome was the authors' failure to detect a significant effect of the instructional manipulation on the *TP*. MacKenzie and Isokoski argued that this result is evidence for the Shannon model of Fitts' law.

Our purpose below is two-fold. First we reanalyze the data of a recently published study (Guiard et al., 2011) to test the null hypothesis of *TP* invariance across speed/accuracy variations. It occurred to us that because MacKenzie and Isokoski (2008) varied instructions within a limited range, their test of the Shannon model of Fitts' law was somewhat lenient. Obviously, the issue being the demonstration that a certain experimental manipulation exerts no effect on a certain dependent measure, the larger the extent of the manipulation, the more persuasive the demonstration. Thus, while our analysis below reproduces MacKenzie and Isokoski's lenient test on some fresh data, we will also report the results of a much tougher test in which the speed/accuracy strategy of our participants was made to vary over its whole spectrum, from a maximum-speed to a maximum-accuracy effort.

Our second purpose is to draw attention to a methodological difficulty that many authors may have incidentally noticed, without paying much attention to it, but that the results of present study forced us to consider seriously. The difficulty arises from the fact that the *order* in which one does the various operations required for the calculation of the *TP* affects the outcome to an appreciable extent. We will show that the problem is due to a mathematical result known as Jensen's inequality.

Twenty years have passed since MacKenzie (1992) first proposed to replace Fitts' original equation $MT = a + b \cdot \log_2(2D/W)$ with Equation 1. MacKenzie has convinced the HCI community that the Shannon formula is theoretically valid and empirically predictive, but there is still no agreement on the exact definition of the *TP*.

While Zhai (2004) identified three candidate definitions in the literature, the basic dispute boils down to a simple mathematical dichotomy. What is not agreed upon is whether in the *TP* calculation one should take into account the intercept *a* of the Shannon equation (Equation 1) and thus calculate the *TP* as

$$TP_{\mathrm{Z}} = \frac{1}{b} = \frac{ID}{MT - a} \tag{4}$$

or one should ignore the intercept and, in keeping with Fitts' (1954) initial suggestion, calculate the *TP* as

$$TP_{\mathrm{M}} = \frac{ID}{MT} \tag{5}$$

Equation 4 is a straightforward derivation of Equation 1. It gives the definition of the *TP* that Card et al. (1978) used in their well-known pioneering study of Fitts' law in the context of HCI. More recently that definition was forcefully advocated by Zhai (2004), hence the subscript Z.

As emphasized by Zhai, Equation 5 is inconsistent with Equation 1, whose intercept *a* it leaves aside. Nevertheless this definition of the *TP* has been inflexibly advocated by MacKenzie (hence the subscript M), based on the argument that in principle this intercept *should* be zero (Soukoreff & MacKenzie, 2004). Recently Guiard and Olafsdottir (2011) argued that no sensible assumption regarding the value of Fitts' law intercept can be made because the *ID* runs on a non-ratio scale of measurement (*i.e.*, an equal-interval scale with no physical zero), meaning that the value of the intercept is arbitrary and uninterpretable. But the fact is, the TP_{M} has never ceased to be popular among HCI researchers and its credibility is now further strengthened by an ISO standard (ISO9241-9, 2002).

In a recent study Wobbrock et al. (2011) warned against comparisons across the two categories of *TP*, which necessarily produce more or less discrepant estimates. But unfortunately there is room within one and the same approach for quite another sort of discrepancy. To make this point below we will stick to MacKenzie's definition of the *TP* (Equation 5). Consider Equations 6 and 7, two concrete statistical implementations of the mathematical formula of Equation 5:

$$\overline{TP}_{\mathrm{M,CtA}} = \frac{1}{N}\sum_{i=1}^{N} TP_i \tag{6}$$

$$\overline{TP}_{\mathrm{M,AtC}} = \frac{\overline{ID}}{\overline{MT}} = \frac{\log_2\left(1 + \frac{\overline{A}}{4.133 \cdot \sigma_A}\right)}{\overline{MT}} \tag{7}$$

The only difference lies in the order in which one performs the averaging and the computing: in Equation 6 one first computes a number of *TP* values and then averages them (the CtA order), while in Equation 7 one first averages the *ID*s and the *MT*s and then computes one value of *TP* (the AtC order). Both equations seem to be mathematically and statistically sound and researchers who have utilized both versions may have considered them equivalent. The *TP* description offered by the International ISO9241-9 standard hesitates between them. In our view there is reason to be concerned by this irresolution.

5. FIRST AGGREGATE THEN COMPUTE OR THE REVERSE ORDER: A JENSEN'S INEQUALITY ISSUE

To reiterate, the calculation of *TP* involves two sorts of operations. One is *averaging*, a statistical operation that compresses a set of numbers into a single summary value, typically a mean. The other is *computing* (e.g., calculating the quotient of a fraction), an arithmetic operation that also often combines several numbers into a single result. Unfortunately, the final *TP* value depends on the order in which the averaging and the computing are done, as shown in Figure 1 with a very simple numerical example.

Computing →

Averaging ↓

	ID	MT	TP_{Z} $ID/(MT-a)$	TP_{M} ID/MT
	1	0.225	8.0	4.444
	2	0.350	8.0	5.714
	3	0.475	8.0	6.316
	4	0.600	8.0	6.667
	5	0.725	8.0	6.897
	6	0.850	8.0	7.059
	7	0.975	8.0	7.179
	8	1.100	8.0	7.273
	9	1.225	8.0	7.347
	10	1.350	8.0	7.407
Mean	5.50	0.788	8.0	**6.630**
	6.984 $TP_{\mathrm{M,\,AtC}}$			$TP_{\mathrm{M,\,CtA}}$

***Figure 1**. Two ways of calculating the* TP_{M} under the assumption that Fitts' law follows the Shannon formula, with *a* = 0.1s and *b* = 0.125s/bit. The third column TP_{Z} = *ID*/(*MT* – *a*) is constant by hypothesis.

Figure 1 displays a hypothetical set of ten *MT* values computed from Equation 1 whose coefficients have been set to arbitrary but plausible values, *a* = 0.1s and *b* = 0.125s/bit (Zhai, 2004). The figure helps to see that there are two ways to obtain a global value of TP_{M} from ten pairs of *ID* and *MT* values. One option is to start by computing TP_{M} in each row and to then average the ten values of TP_M at the bottom of the rightmost column—this is what we call the *Compute-then-Average* (CtA) option. With the hypothetical data set of Figure 1 one obtains TP_M = 6.63bits/s.

The alternative option is to start by averaging the 10 *ID*s and the 10 *MT*s downward and to then compute the TP_M just once from the mean *ID* and the mean *MT*—this is what we call the *Average-then-Compute* (AtC) option. With the data of Figure 1 this option yields TP_M = 6.98bits/s, which is more (+5.3%) than 6.63 bits/s.

The problem one is encountering here is *Jensen's inequality*, which states that for any convex function[1]

$$f(\overline{x}) \leq \overline{f(x)}, \qquad (8)$$

while the opposite holds true if the function is concave.

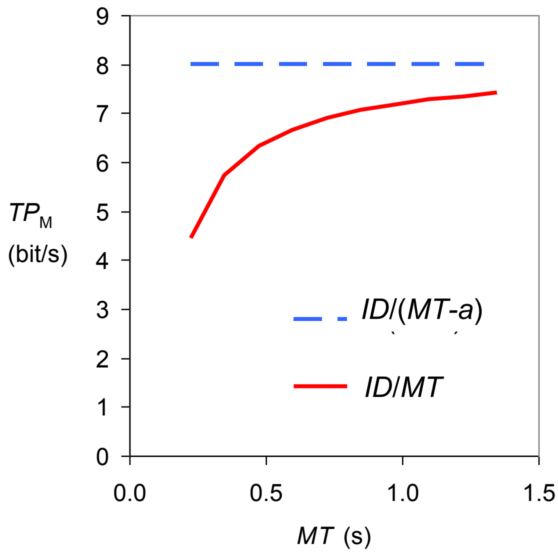

***Figure 2**. The function $TP_M = f(MT)$ under the Shannon model.*

Figure 2, which plots the data of Figure 1, shows that the function TP_M / TP_Z = f (*MT*), or f (*MT*) = 1 – *a*/*MT*, is concave, thus

$$\overline{TP}_{\mathrm{M,AtC}} \geq \overline{TP}_{\mathrm{M,CtA}} \qquad (9)$$

Let us return to real-world formulas like those of Equations 6 and 7. The impact of Jensen's inequality is complex and rather hard to guess for two reasons.

First, the TP_M formula involves not one, but five calculation steps. Since computing the TP_M involves a function of the form

$$\frac{\log\left(1+\frac{x}{\sqrt{y}}\right)}{t} \qquad (10)$$

the computation of the TP_M requires five computation steps, represented from left to right in Figure 3.

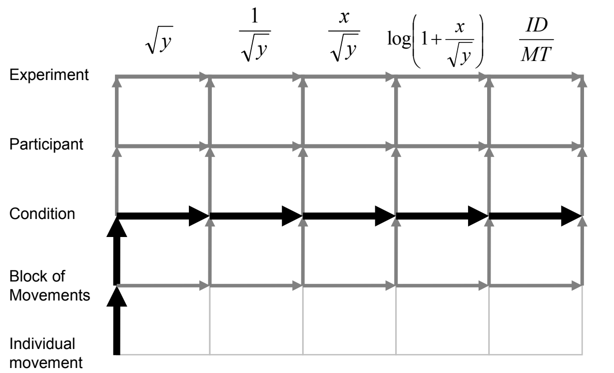

***Figure 3**. The statistical-aggregation and calculation steps involved in the computation of a TP_M. One example path is highlighted, which delivers the TP_M value of one particular participant for one particular condition.*

Second, as illustrated in Figure 3, a data set normally involves more than two levels of statistical aggregation. In fact the calculation of a TP_M may require up to four aggregation steps in a typical Fitts' law experiment (allowing for averaging over participants). Starting from the individual measure of *MT*—the atoms, so to speak—four successive aggregation steps, represented in the figure from bottom to top, can take place in a typical Fitts' law experiment:

a. the *movement-block* averages, each of which summarizes a number of individual measures;
b. the *condition* averages, each of which summarizes performance over a number of trial blocks;
c. the *participant* averages, each of which summarizes performance over a number of conditions; and
d. the *experiment* averages, each of which summarizes performance over a number of participants.

The important fact is that, contrary to the feeling that may arise from the simple comparison of Equations 6 and 7, there are many more than two ways of arranging the various computation and aggregation steps involved in the estimation of TP_M. The number of paths we are looking for is the number of possible ways of inserting 3 objects in 6 possible places

[1] A function is said to be convex (concave) if its graph lies above (resp. below) any tangent line.

$$\binom{6}{3} = \frac{6 \times 5 \times 4}{3 \times 2 \times 1} = 20 \quad (11)$$

Thus, with five computation steps and four aggregation levels, there exist 20 possible paths, which all deliver different TP_M values.[2] Thus the Jensen inequality has many opportunities to operate, leading to a troublesome amount of uncontrolled variability in data processing.

The concrete example of the next section will show that this bias may be quite damaging. Depending on the CtA vs. AtC order, we found that our lenient test either succeeded or failed to replicate MacKenzie and Isokoski's (2008) result.

6. A RERUN OF MACKENZIE AND ISOKOSKI'S TEST

This section reports the results of a fresh test of the *TP*-invariance hypothesis based on a re-analysis of recently published data of ours (Guiard et al., 2011). Our experimental test differs from MacKenzie and Isokoski's (2008)—and by the same token from most standard Fitts' law tests—in three noteworthy respects.

First, we used discrete rather than reciprocal movements to obtain more reliable estimates of *MT*. As noticed by Fitts and Peterson (1964), the discrete protocol allows more rigorous control over the variables of interest than is possible with the reciprocal protocol. In the reciprocal protocol movement time is the time it takes to carry out a movement *and* to evaluate the error inherited from the previous movement *and* to prepare the next movement. The discrete protocol, in contrast, measures the duration of a pure movement-execution process.

Second, the target was displayed as a one-pixel line, rather than as a band of width *W*. This feature does not mean that the experiment used a zero-width target, but rather that *W* was left unspecified, the one-pixel target serving to just indicate to participants what the amplitude of their movements should be on average. Accordingly, in our calculations the *ID* was computed from the ratio of mean movement amplitude (in fact always virtually equal to target distance *D*) to the standard deviation of the amplitude (rather than target width *W*). While the usual methodology uses *D* and *W* with a post-hoc adjustment for error because *W* provides a notoriously poor control over the actual spread of movement endpoints (e.g., Soukoreff & MacKenzie, 2004), our strategy is to forget once and for all about any tolerance specification and to simply consider actual spreads of movement endpoints.

Third, and perhaps most importantly, our manipulation covered the complete range of speed/accuracy strategies, allowing a tougher and hence more informative empirical test of the Shannon model of Fitts' law.

6.1. Method [3]

Sixteen participants were presented with five sets of instructions, which formed an ordinal independent variable:

- max speed
- speed emphasis
- speed/accuracy balance
- accuracy emphasis
- max accuracy.

In the max-speed condition the only accuracy requirement was to terminate the movements on average in the vicinity of the target. At the opposite end of the instructions continuum, in the max-accuracy condition participants were to bring the cursor exactly to the target (zero pixel error), the only time constraint being to not waste any time. The three central levels of instructions, one unbiased (speed/accuracy balance) and two biased (speed emphasis and accuracy emphasis) were similar to those of MacKenzie and Isokoski.

The experiment used a computer screen and a Wacom™ tablet set to the absolute mode with a one-to-one mapping. The screen displayed two fixed vertical lines, 150 mm apart, indicating movement start and movement target, and a movable crosshair whose horizontal motion was controlled by the Wacom™ stylus. An L-shaped ruler was attached to the tablet to guide the stylus movement along the horizontal dimension, the shorter (vertical) leg of the L being aligned with the screen's start line, thus eliminating start point variability.

Each of the 16 participants ran five 15-movement blocks in each of the five instructional condition (25 blocks overall). In sum this experiment involved 15 movements x 25 blocks x 16 participants = 6,000 movements.

6.2. Data Analysis

We ran two within-participant one-way ANOVAs on TP_M. In one of them, aimed to replicate the lenient

[2] This calculation takes account of the fact that the very first operation can only consist of an aggregation, because the standard deviation of movement amplitude is undefined below the level of the block of movements.

[3] For a detailed description of the method, see Guiard et al. (2011).

test of MacKenzie and Isokoski, the instructions factor was restricted to its three central levels, namely speed emphasis, speed/accuracy balance, and accuracy emphasis. The other ANOVA considered all five levels, providing a much tougher test of the *TP* invariance hypothesis.

Individual-movement measures were *MT* (s) and amplitude (mm). For each or the 25 blocks we computed the three ingredients needed to calculate any *TP*, namely, median *MT* and the mean and standard deviation of amplitude.[4] We then computed the condition-level estimates of TP_M using both the CtA and the AtC order, ending up with two candidate dependent variables for the ANOVA test, $TP_{M,\ CtA}$ and $TP_{M,\ AtC}$. The figures below show averages computed over all 16 participants.

6.3. Results and Discussion

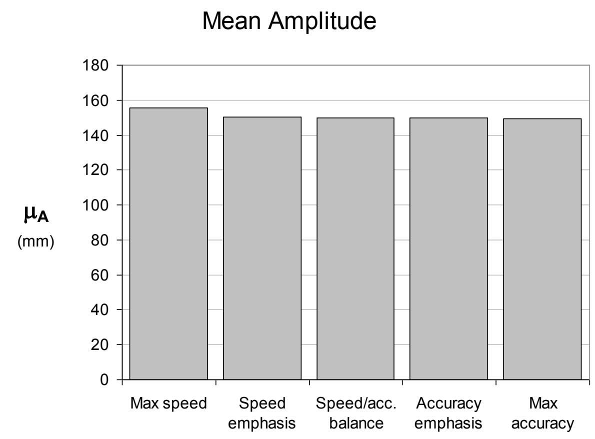

Figure 4. *Mean amplitude vs. instructional condition.*

As shown in Figure 4, mean movement amplitude (μ_A) was very nearly a constant 150mm, as required. The participants were able to produce essentially unbiased aiming movements, the only exception being a 5.5mm overshoot error in the max-speed condition; although a statistically significant effect (t_{15}=4.50, *p*<.001) this is a remarkably small bias of +3.7%, which we shall not discuss here.

Rather than movement amplitude, what our instructional manipulation did influence were, unsurprisingly, the speed and accuracy of performance, two very strong effects just as they were in the MacKenzie and Isokoski (2008) study. Figure 5 shows the gradual increase of median movement time (μ_T) from the max-speed condition (about 200ms) to the max-accuracy condition (more than a second), a considerable five-fold increase. Obviously a monotonic lengthening of movement time at a constant level of amplitude means a monotonic drop of average movement speed, shown in Figure 6.

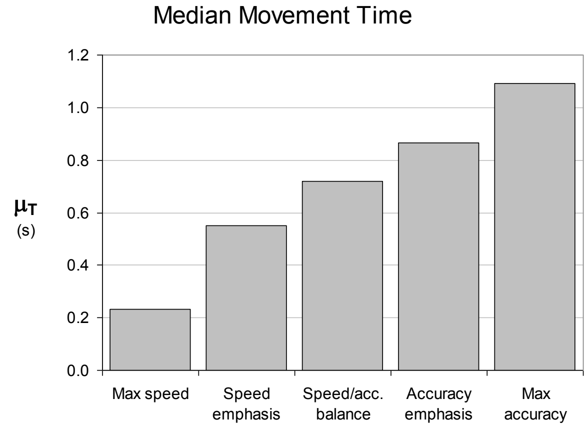

Figure 5. *Median movement time as a function of instructional condition.*

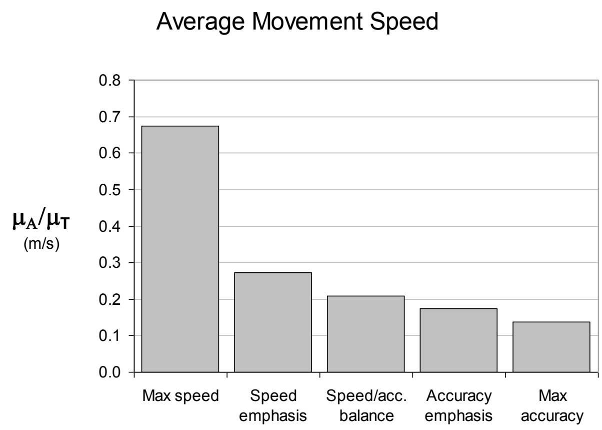

Figure 6. *Average movement speed as a function of instructional condition.*

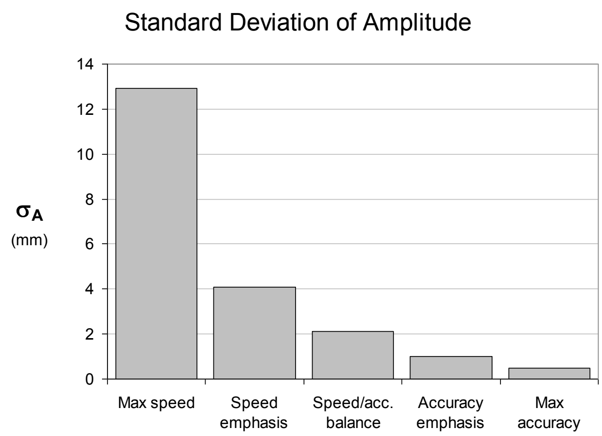

Figure 7. *Endpoint spread as a function of instructional condition*

The other side of the evidence that our instructions were instrumental in modulating the participants' strategy is visible in Figure 7, which shows how

[4] The distributions of movement time showing some positive skewness, we used the median, rather than the mean, for that dependent measure.

the spread of movement endpoint, measured as the standard deviation of amplitude σ_A, declined gradually from the max-speed condition (with a standard deviation of amplitude σ_A of 13mm, or 8% of the mean) to the max-accuracy condition (0.5mm, or 0.3% of mean amplitude).

The crucial result of this experiment is shown in Figure 8, which plots $TP_{M,\ CtA}$ and $TP_{M,\ AtC}$, the two variants of the ISO estimate of *TP*, against the instructional factor.

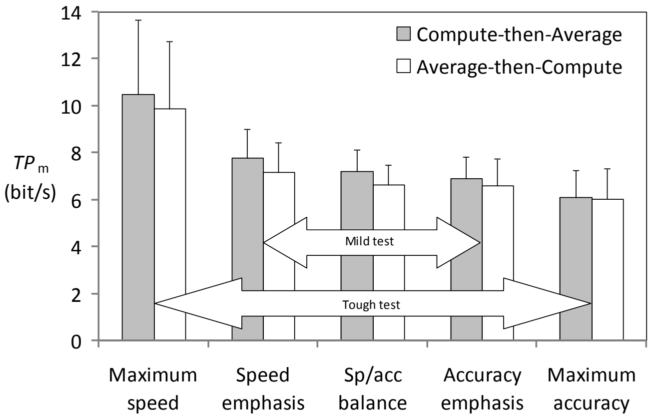

***Figure 8**. TP_M vs. instructional condition. Error bars show 95% confidence intervals based on between-participant standard deviations.*

Recall that according to MacKenzie and colleagues the TP_M should *not* vary across variations of the speed/accuracy strategy. Tested over our complete set of instructions from maximum speed to maximum accuracy, the TP_M invariance hypothesis markedly failed. Whether computed with the CtA or the AtC order, the TP_M declined monotonically, from about 10bits/s down to about 6bits/s, as the instructions were shifted from the max-speed to the max-accuracy condition. This is a substantial effect, a 42% reduction of the *TP*, and it is highly significant statistically (Table 1).

***Table 1**. Results of the tough and lenient ANOVAs conducted on the CtA and the AtC estimate of TP_M.*

	Tough 5 level			**Lenient 3 level**		
	F	*df*	*p*	*F*	*df*	*p*
CtA	23.54	4	<.001	5.03	2	.013
AtC	19.69	4	<.001	1.86	2	.173

Turning to the lenient 3-level test, the outcome turned out to be equivocal. With the AtC order our lenient test replicated MacKenzie and Isokoski's non-rejection of H_0 (p>.05). With the CtA order, however, it did not (p<.02). This irresolution is a troublesome complication induced, we suggest, by Jensen's inequality.

In our view it is not necessarily the Shannon model of Equation 1 that should be questioned in light of the present results, but rather Equation 5, which requires the assumption that the intercept of Fitts' law is zero—actually an untenable assumption given the non-ratio level of measurement on the continuum of μ_A/σ_A or *D/W* (Guiard & Olafsdottir, 2011).

Would the test have been successful if the TP_Z had been used instead? We found with a simulation on our data set that the effect of instructions on *TP* would have been small and marginally significant, had the TP_Z been used instead of the TP_M. This result is doubtful, however, because a test of the invariance of $TP_Z = 1/b$ across variations of the speed/accuracy strategy requires the other coefficient, the intercept *a*, to be used in the calculation. This requires that the Shannon equation be calculated beforehand, and so the test begs the question. Another sort of experimental test is needed to evaluate the invariance of the TP_Z.

7. CONCLUSION AND PERSPECTIVES

Routine TP_M measurement is an established norm of HCI, further strengthened since 2002 by an official ISO standard. There is no question that standardization, which facilitates comparisons, is useful (Soukoreff & MacKenzie, 2004). Twenty years of consensus about the Shannon model of Fitts' law have certainly been an asset for input research in HCI. However, failure to acknowledge Zhai's (2004) demonstration that the standard method of measuring the *TP* (Equation 5) is inconsistent with the Shannon model (Equation 1) has been a handicap. Our data, which show that the TP_M not simply fails a tough invariance test but hardly passes a rather lenient test, support Zhai's (2004) suggestion that researchers should return to the mathematically correct definition of the *TP* shown in Equation 4.

Another, no less important lesson to be learned from this study is that serious methodological work is needed to try to master the hidden variability that arises inadvertently in Fitts' law data due to Jensen's inequality. To our knowledge the impact of this methodological difficulty on data processing has not been yet correctly understood and we believe this general problem is worth a systematic investigation. There is reason to believe that this is a general methodological problem whose scope presumably extends far beyond the study of Fitts' law. Whether the solution rests on some mathematical or statistical principles or perhaps on some arbitrary conventions is an open question which we are currently investigating.

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YourWellness: Designing an Application to Support Positive Emotional Wellbeing in Older Adults

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Emotional wellbeing is an important indicator of overall health in adults over 65. For some older people, age-related declines to physical, cognitive or social wellbeing can negatively impact on their emotional wellbeing, as can the notion of growing older, the loss of a spouse, a loss of sense of purpose or general worries about coping, becoming ill and/or death. Yet, within the field of technology design for older adults to support independence, emotional wellbeing is often overlooked. In this paper we describe the design process of an application that supports older adults in monitoring their emotional wellbeing, as well as other parameters of wellbeing they consider important to their overall health. This application also provides informative and useful feedback to support the older person in managing their wellbeing, as well as clinically-based interventions if it is determined that some action or behaviour change is required on the part of the older person. We outline findings from a series of focus groups with older adults that have contributed to the design of the YourWellness application.

Emotional Wellbeing, Older Adults, Application Design, Feedback

1. INTRODUCTION

Population projections estimate a significant increase in the number of older adults in the near future (Hayutin, 2007). By 2050 an estimated 22% of the world's population, nearly 2 billion people, will be aged 60 or over (United Nations, 2007) and spending on pensions, health and longterm care is expected to triple by this time. Whilst ageing is wrought with challenges, it also offers many opportunities. Thus, improving the period of healthy ageing, by enabling older adults to manage their own health in the place of their choice, is an essential and pressing need. Technology can play a significant role in this (Jones, Windegarden & Rogers, 2009; Sainz-Salces et al. 2006). Emotional wellbeing is an important indicator of overall health in adults over 65 (Engel, Siewerdt & Jackson, 2011; NIMH, accessed 2012). Yet, within the field of technology design for older adults to support independence, emotional wellbeing is often overlooked, with research tending to focus on the three 'geriatric giants' of health and ageing - physical, cognitive and social health. A significant barrier to deliver technology solutions to support emotional wellbeing involves a lack of research into how to 'close the loop' in such applications i.e. what to do with a person's emotional wellbeing data once it has been collected and analysed, as well as unnecessarily complex interfaces and interaction techniques that make it difficult for older adults to benefit from such technology.

For some older people, age-related declines to physical, cognitive or social wellbeing can negatively impact on their emotional wellbeing, as can the notion of growing older, the loss of a spouse, a loss of sense of purpose or general worries about coping, becoming ill and/or death. However, the reverse is also true - poor emotional wellbeing can equally adversely affect one's overall health and wellbeing. Fair to poor emotional wellbeing has been shown to be significantly associated with poor appetite in older adults (Engel, Siewerdt & Jackson, 2011). Furthermore, many chronic health problems faced by older adults have a high rate of co-occurring depression. Up to 25% of people with cancer suffer depression, as do up to 27% of people who have had a stroke and 1 in 3 people who have suffered a heart attack (NIMH, accessed 2012). It is estimated that up to 5% of US citizens over the age of 65 living in the community have major depression compared with 13.5% of those who require home health care and 11.5% in nursing homes (Hybels & Blazer, 2003). However, a significantly larger number suffer depression that remains largely undiagnosed and thus untreated (Sable, Dunn & Zisook, 2000). Thus systems that can help older adults to monitor and self-manage their emotional wellbeing by providing feedback and interventions can be used to promote positive emotional wellbeing and perhaps, more significantly, might increase overall wellbeing.

The purpose of our research is to design and implement a tightly-knit, closed-loop feedback mechanism to deliver wellbeing interventions to the older population, that include support for emotional

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wellbeing. By closed-loop we mean not only monitoring emotional wellbeing and mood over time, but detecting declines in positive wellbeing, assessing why wellbeing has declined and ultimately providing interventions to promote increased positive emotional wellbeing. To this end, we are designing an application - YourWellness - that supports older people in self-reporting on their wellbeing through interactive questionnaires. More critically for the older person, the application also provides them with informative feedback on their wellbeing over time and supports interventions to promote positive emotional wellbeing. YourWellness has currently been designed for use on an iPad but will also be made available as a web-based application. The focus of this paper is on the design process of the YourWellness application.

2. RELATED WORK

There has been a recent increase in the design of technology-based wellness applications that support people in actively monitoring their wellbeing, largely due to the wide availability of smart phones embedded with powerful sensors. Such applications promote wellbeing by providing the individual with some level of feedback based on the data collected. One of the issues with such applications tends to be a narrow focus, in terms of only monitoring one or two parameters of health. Furthermore, while there has been a recent increase in smartphone applications to monitor mood (MoodPanda: www.moodpanda.com; MoodJam: www.moodjam.com), we are not aware of an appropriate tool that provides clinically-based feedback to support older people in managing their emotional wellbeing.

UbiFit is an application that uses on-body sensing and activity inference to encourage and promote physical activity (Consolvo & Landay, 2009). However, it only looks at this single parameter of wellbeing. BeWell is a smartphone application to monitor, model and promote wellbeing across three parameters - quantity of sleep, physical activity and social interactions (Lane et al., 2011). All sensing is done through the smartphone, for example levels of social interaction are determined by microphone measurement of ambient conversations and duration of sleep is inferred by examining phone usage patters. Both BeWell and UbiFit are targeted at the general population rather than older adults. MindBloom is an application that supports people in improving their quality of life by focusing them on what aspects of their life are important to them and motivating them to improve these areas (www.mindbloom.com). The Nokia Wellness Diary is a tool for Nokia mobile phones that supports users in setting health and wellness goals and aims to help the user in reaching these goals (http://europe.nokia.com/wellnessdiary). Each of these applications provides feedback on various aspects of wellness, but don't explicitly support emotional wellbeing.

Some research efforts have begun to appear in the space of supporting mental wellbeing. Monarca is a persuasive monitoring and feedback system for mental illness and is an excellent example of a closed feedback loop to patients (Marcu, Bardram & Gabrielli, 2011). Furthermore, it has been designed based on a Patient-Clinician-Designer framework to overcome the unique challenges in designing for mental health patients. As such, Monarca acts as an exemplary reference point for any wellbeing application being delivered to patients. Doherty et al. describe a set of guidelines for the design and evaluation of mental health technologies (Doherty, Coyle & Matthews, 2010). These include guidelines relating to the design process, design factors related to the development of such technologies and guidelines for conducting evaluations of mental health technologies and constraints that exist (Doherty, Coyle & Matthews, 2010). While our work benefits from previous research such as that by Doherty et al. and the Monarca system, it differs in focus and intended cohort. Thus, the following section discusses design issues relevant to our specific research.

3. DESIGNING YOURWELLNESS

In designing the YourWellness application, we held three focus groups. Each focus group lasted approximately 90 minutes. Focus group 1 had 5 participants consisting of 2 men and 3 women aged between 61 and 82; focus group 2 had 2 men and 4 women aged between 64 and 86; focus group 3 had 5 participants, 2 men and 3 women, aged between 61 and 78. Participants were recruited from local ageing groups and within each focus group, participants knew each other. The aim of the focus groups were to explore values and attitudes to self reporting on health and wellbeing as well as to discuss design issues surrounding inputting such information as well as receiving feedback. This followed from previous work that involved interviews with older adults to explore attitudes to self-management of one's health (Doyle et al., 2011).

All focus group data collected was qualitative. Transcription of responses yielded data for content analysis. Two coders identified important themes based on the frequency and intensity of participant responses. Three major themes emerged which are outlined in the following subsections. Two smaller themes around motivation and compliance also emerged. A detailed discussion on these issues is outside the scope of this paper, but they are considered in our work. Section 4 describes our current prototype application that has been designed based on these findings.

3.1 Important measures of wellbeing

Each focus group began by asking participants what they felt were the most important aspects of wellbeing as they age. A common theme across all 3 focus groups was the importance of social interaction. One participant noted: "That's, I'd say as essential to us as breathing and eating and stuff like that, we are social beings." What was interesting were the types of interactions that people found important. We would have considered 'quality' interactions - those with friends or family - to be most important to older people, with potentially more frequent but less quality interactions such as those with a shopkeeper or bank official not carrying much importance. However, many participants commented on the importance of these latter types of interactions, particularly for those without close family or friends. For some older adults, a quick chat with the postman or shopkeeper can be satisfying. Other research has found that quality of social relationships is a strong predictor of wellbeing in older adults (Pinquart & Sorenson, 2000). Thus, assessing an older adult's satisfaction with their social interactions is potentially an important component of a wellbeing application for this cohort.

Sleep was extensively discussed in each focus group. The majority of participants spoke of their poor sleep patterns and how it can negatively affect them the following day. It emerged that quality of sleep was more important than the number of hours slept, and in particular how rested you feel the next day. One participant stated: "I'd rather have four hours where I slept well than 12 hours in bed, but with regular waking up." This is consistent with research by Pilcher, Ginter and Sadowsky (1997) who found that sleep quality was better related to health, affect balance, satisfaction with life and feelings of tension, depression, anger, fatigue and confusion than sleep quantity.

Interestingly, none of the participants mentioned emotional or mental wellbeing as important to their overall wellbeing. However, once the facilitator introduced this topic, participants began to discuss the role it plays in one's health – "I think sadness would drag you right down. And the consequence of that would be, ultimately, bad health. 'Cos if you're depressed or down you neglect yourself and you stop doing the things you liked to do." Maintaining a good social life was considered important to ensuring positive emotional wellbeing – "A good social life is a tonic. It is, isn't it?" Thus, emotional wellbeing isn't necessarily something that older people think about as being immediately relevant to their overall wellbeing. While participants spoke about actively trying to improve their physical wellbeing or their social interactions, emotional wellbeing was not something they actively thought about improving. Thus, including this topic in the YourWellness application has the potential to help people become more aware of their emotional wellbeing and to 'look after it' as they do other aspects of their wellbeing.

3.2. Design: Input, Feedback and Interventions

Two important aspects of designing YourWellness are the content (both the questions being asked and the feedback being returned) as well as how this content is visualised, ensuring both are easily interpretable and beneficial. The second half of each focus group concentrated on aspects of design relating to participants' preferences for methods of inputting information on their wellbeing as well as on their preference for and ability to interpret different types of feedback. Methods of input included presenting questions as text with buttons or a slider for input, smiley faces with words relating to feelings associated with them and images of a body where you might touch a certain area to indicate pain or a problem. Overall the textual questions were preferred. Most participants felt the smiley faces trivialised the issue of emotional wellbeing: "I find that a bit kindergarten or something, isn't it?" Another participant commented: "You know, I'd find those a little bit patronizing, the kind of thing you would give to a child."

What became apparent across each of the focus groups was that feedback is critical in a wellness application, for the obvious reason of requiring feedback to help you improve your wellness. Thus we focus more on the design of feedback (than input mechanisms) in this paper as the ability to interpret and benefit from feedback is essential if the goal is to support behaviour change and improved wellness. It was pointed out that people would not be motivated to answer a daily questionnaire if they were not receiving beneficial feedback on it. While regular, updated feedback through the technology is important, participants felt it equally important to have some human feedback. "I kind of like the idea that maybe someone would come and talk to you maybe once every... like have a review." Another participant commented "It's the idea that there's somebody keeping an eye on you that's very valuable for older people."

Similar to discussing methods of inputting wellbeing information, participants were shown a number of visualisations that could be used to provide informative feedback to users of the YourWellness application. Relevant literature and commercial applications that provide wellbeing feedback were reviewed in deciding what visualisations to show participants. Some of these can be seen in Figure 1. The least preferred type of visualisation was the metaphor. We showed participants the garden image from Figure 1 explaining that concept of the metaphor. We also showed the UbiFit garden metaphor (Consolvo & Landay, 2009) and the BeWell aquarium metaphor (Lane et al., 2011). Not one of the participants liked the idea of a metaphor as feedback. For many, this was because they felt it was confusing and would require too much effort to interpret: "A bit vague, isn't it?" One participant commented: "I don't know what the relevance of those pictures (the metaphors) is at all. I mean it doesn't do anything for me." Another replied: "Or me. But well, I'm not very visual anyhow, but that makes no sense to me at all." This is in contrast to reported feedback from other studies that use metaphors for wellness feedback (Consolvo & Landay, 2009; Lane et al., 2011). Participants evaluating the UbiFit Garden felt that the garden metaphor, or some metaphor, was an essential form of feedback (Consolvo & Landay, 2009). There may be a number of reasons for these differences. Firstly, the UbiFit garden is displayed as the wallpaper of a mobile phone and thus abstracting the data into a metaphor that only the user of the application can interpret yields a level of privacy. A metaphor is potentially not as important for an application such as YourWellness that is not 'always-on'. Furthermore, password protecting the application can prevent someone other than the owner of the application viewing private data. UbiFit and BeWell were not evaluated with older adults, thus it may be that metaphors are more acceptable to a younger population. However, we realise that long-term use of a metaphor visualisation may result in it becoming easy to interpret. A more detailed study may therefore be necessary to determine the effectiveness of metaphors as wellbeing feedback mechanisms to older adults.

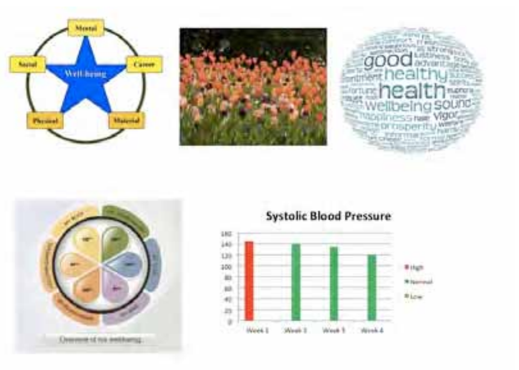

Figure 1: *Some of the feedback visualisations shown to focus group participants*

Participants particularly liked the two visualisations that show various categories of wellbeing. They felt that ideally, something like this could be used to give a quick overview of their wellbeing, and then if they wanted more detailed information they could click into an individual category. Participants stated they would be particularly interested in seeing their trends over time.

3.3. Sharing Wellbeing Information

Across all 3 focus groups it was felt that information should be given back to the person in the first place. i.e. the person whose data is being monitored, unless the person doesn't have the capacity to deal with the information him/herself: "It depends on that person's ability to absorb information and be able to interpret it." All participants stated they would have no problem sharing their information with a health professional, but most said they would not necessarily share with a family member. One participant noted: "The person might not want to feed it back to anyone else." Another said: "I think families would worry unnecessarily." Sharing with a professional was felt to be important. However, there were mixed feelings on whether it should be left to the person to decide whether they contact their clinician, or whether a friendly phone call from a clinician should be initiated if a problem is detected. One person pointed out a potential problem with leaving this decision to the older person: "Here we're talking about moods and emotional wellbeing, a person in that state might not be in the mood or able to ring someone for help 'cos they are kinda lethargic and that." Thus, any feedback provided must be appropriate to the type of wellness being monitored.

4. DISCUSSION

We have decided to initially monitor emotional wellbeing, quality of sleep and social interactions. The latter two topics constituted much of the discussion around important parameters of wellbeing for older adults and it became evident that making older adults more aware of their emotional wellbeing would be beneficial. In determining the sets of questions we will ask that will yield clinically valid measures, we collaborated with a number of clinicians who specialise in these areas of wellbeing, including two geriatricians and a clinical psychologist. We have also integrated capturing and feedback of physiological measures including blood pressure and weight into the app, using the Withings blood pressure cuff and smart weight scale to provide a more complete picture of the person's wellbeing.

When the user opens the YourWellness application they are presented with the option of completing their daily survey or viewing feedback. If they choose to fill in the survey, they are presented with a series of questions asking them to reflect on and report how they are feeling. This information is analysed, a wellness score is calculated for each category of wellbeing and this information is returned to the person as visual feedback. Key aspects of the design of feedback in YourWellness can be seen in Figures 2-4 (though it should be noted that these are in an early prototype stage). At the highest level, feedback is provided as a quick-glance overview of wellbeing. Based on feedback from participants, we have designed a feedback wheel to support this (Fig 2). The wheel is divided into categories, based on what parameters of wellness are being monitored. The interior part of the segment is coloured green if the individual is considered healthy, meaning they don't need to take any action regarding behaviour change for that parameter of wellbeing. If the individual is scoring relatively low in a particular area of wellbeing, the segment is coloured amber - indicating an orange alert and that some action should be undertaken to address this. A red segment means immediate action is required, and the individual will be alerted.

The colour of the segment is based on the person's past 7 days of data. In collaboration with clinical specialists and taking into account existing guidelines such as the NHS NICE guidelines (http://www.nice.org.uk/ including 'Treating Depression in Adults' and 'Mental Wellbeing and Older Adults'), we have determined a scoring algorithm that calculates a wellness score for determining whether a green, orange or red alert should be provided. This wellness score takes into account deviations from the individual's norm. For example, to set a baseline for blood pressure, we currently take two weeks of data from the person and then look at certain deviations away from their average or norm that may indicate abnormal bp (orange alert) or critical bp (red alert).

An individual can also click a particular segment of the overview feedback wheel to get further information, including their trending/historical data presented as a graph, that will be made viewable as weekly or monthly data (Fig. 3). Educational and interventional content is also provided (Fig. 4). Such content has been defined for each type of alert in each category of wellbeing, in collaboration with clinicians and by examining existing guidelines. For example, if an individual is scoring in the orange zone for emotional wellbeing, feedback might include encouraging them to go for a regular walk. It might also involve asking additional questions to assess why the person is scoring low. The overall aim of such feedback is to help the individual to improve their wellbeing - to move from being in the red/orange zone to the green zone.

Figure 2. The feedback wheel with each segment representing a parameter of wellbeing

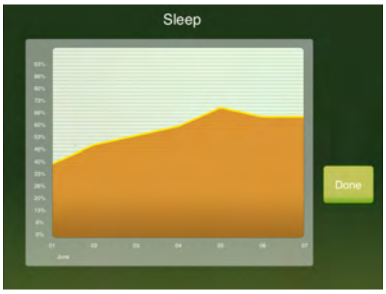

Figure 3. Weekly trend data for a person's self-reported quality of sleep

Figure 4. Examples of educational/interventional messages

Currently, we perceive two high level groups of users for this application - the worried-well who are interested in monitoring for self-awareness and to prevent illness occurring and those who are ill or frailer. The latter group might include individuals recently released from hospital into a home care package, and whose application data will be regularly monitored by their consultant, GP or carer. Thus, a care team can be defined for an individual, each of whom can monitor the data and contribute to providing feedback. The care team will monitor data daily and based on our findings around the sharing of information, the older adult should determine whether a family member can be part of the care team. In the case of a red alert, the individual is contacted directly by a member of the care team. In the case of an orange alert, a message is sent through YourWellness directly from a member of the care team, advising the individual on the action they should take. The backend architecture of the application supports a clinician or carer in adding additional sets of questions and also in scheduling the questions.

A smaller theme that arose related to motivation and compliance, with participants noting that it might get quite monotonous answering the same questions every day. Participants felt that receiving beneficial feedback would be a motivator to continue to fill in the survey. Another potential way of encouraging compliance might be to ask participants a multiple choice trivia question at the end of their wellbeing survey, but not provide them with the correct answer until they complete the next day's survey. A trivia quiz would also have the benefit of keeping the person cognitively active. Deployment of the application will allow us to examine and evaluate further motivational methods such as goal setting, virtual rewards, or a friendly leader-board for the trivia section.

5. CONCLUSION AND FUTURE WORK

This paper presented issues around the design of a wellness application for older adults that includes support for monitoring and managing emotional wellbeing. Emotional wellbeing is an important indicator of overall health in older adults, but despite this, it is not an area that older adults immediately see as being directly important to their overall wellbeing. Furthermore, it is often overlooked within the space of technology design for independent living. In designing this application, it was critical to involve older adults, to understand their attitudes towards wellness, as well as assessing the effectiveness of various types of input and feedback visualisations. The feedback we have gathered will help to ensure that the YourWellness application will assess appropriate aspects of wellbeing as well as deliver useful and beneficial feedback that is easy for the older adult to interpret.

In terms of on-going and future work, we are currently usability testing the application with older adults and plan to deploy the application as part of two field studies in coming months. One study will involve 16 older adults living in aware homes who will use the application over the course of one year. The second study will involve deployment of the application as part of a larger telehealth trial that will be deployed to over 100 homes around Ireland over a period of 3 months. During such longitudinal deployments, we will assess the effectiveness of YourWellness in helping older adults to manage and improve their wellbeing, as well as examining issues around motivation and compliance.

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Design and evaluation of a VR-user-interface based on a common tablet-PC

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Virtual Reality systems are an essential element of the product development process, but common VR-user-interfaces still need intensive practice to be effectively used to solve tasks within Virtual Environments. This keeps especially non-expert-users from using the full potential of VR for evaluating virtual models during the product development process. In this article, we present a concept for an intuitive to use VR-user-interface based on a common tablet-PC. A rudimentary evaluation performed as a preliminary study showed an initial tendency for the usability of the implemented prototype.

Virtual Reality, Virtual Environment, Tablet-PC, VR-user-interface, Usability

1. INTRODUCTION

Virtual Reality (VR) is an important tool to support the rapid development of new products (Straub & Riedel 2006). Especially where huge and complex products are created – for example in aviation and automotive industry – VR is used since several years (Ottosson 2002).

Driven by the idea to replace physical mock-ups – which are expensive and take a long time to create – by virtual ones within the not so distant future, especially people from the aviation and automotive industry are investing many efforts in developing VR to make the technology more suitable for the product development process.

Through the fast IT-hardware and software development over the past years it is now possible to create, display and interact with almost entirely realistic virtual mock-ups and environments. This helps to visualise new products at a very early stage of the development process and evaluate the product for example in matters of producibility or aesthetics.

Although the highly developed technology provides lots of possibilities, VR is mainly used for basic evaluation during the early working process, but not for the last evaluation of the future product. For this purpose usually physical mock-ups are used, which leads to the assumption that virtual mock-ups don't receive a full acceptance during the product development process. Considering the literature, one can find a correlation between interaction and technology acceptance:

Davis (1989) identified the **perceived ease of use** of a technology as one of two main attributes that influence the acceptance of information technology.

Semi-immersive VR-systems are commonly used by expert-users who are creating the Virtual Environment (VE) and non-expert-users who are evaluating the VE under certain aspects. The interaction with the VE is mainly done via special VR-interfaces which are complex to use and need a long time for acquisition. Intuitive and easy to use interaction devices for non-expert-users do hardly exist. A common solution to offer interactivity within the VE for example for evaluation purposes for non-expert-users is to use an operator who navigates within the virtual world based on commands from the non-expert-user.

This form of interaction often leads to misunderstandings and frustration during the evaluation process, which may reduce the acceptance of VR for the development process.

A basis for increasing the acceptance of VR for evaluation purposes within the product development process is the possibility of an individual interaction within VEs for non-expert-users.

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2. INTERACTION IN VIRTUAL ENVIRONMENTS

Virtual Environments differ from common "desktop-computing" environments. Thus researched and proven guidelines and heuristics for user-computer-interaction can't easily be adopted for interacting in VEs. Bowman et. al (2001) state that there is a sample of universal interaction tasks in VE:

- Navigation
- Object Selection
- Object manipulation
- System control

To offer those interaction tasks and fulfil user's needs, a huge amount of VE input devices were developed and implemented for various VR-Systems. Those are for example spacemouse or ordinary keyboard and mouse devices which are commonly used for the interaction within semi-immersive VR-systems or Flysticks or Cybergloves for the interaction with highly-immersive VR-systems.

Gabbard (1997) as well as Poupyrev and Kruiff (1999) give a detailed overview of different input devices.

3. DESIGN AND IMPLEMENTATION

For the conceptual design and the implementation of the prototype the concept of Object Engineering (see fig. 1) by Rupp (2002) was used as a methodical process. The development process was divided into five different stages, beginning with the definition of specific goals and the identification of possible users. This step was followed by the definition of necessary requirements and possible use-cases. Afterwards the different software classes and state diagrams were created followed by the main implementation of the prototype. In the end the prototype was tested under the perspective of usability. Therefore, evaluation criteria were defined.

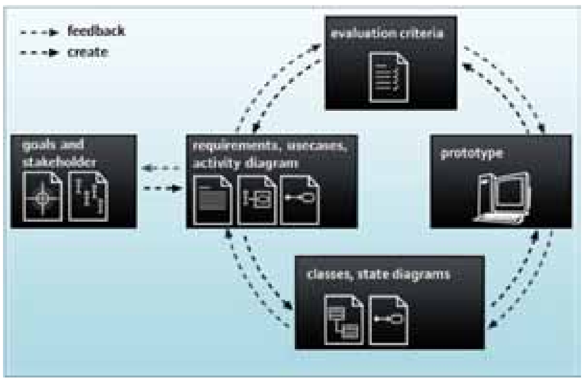

Figure 1: *Process model Object Engineering from Rupp (2002)*

3.1 Goals and Stakeholders

The goal of the project was to create the possibility for non-expert-users to interact individually with a semi-immersive VR-system. The investigated system is used in the automotive industry to evaluate the look-and-feel and the quality of a future car in a late state of the product development process.

The main focus was set on the appropriate gathering of requirements for the user-interface from the different non-experts using the VR-system for the above mentioned evaluation purpose.

In addition a tendency of the usability of the designed user-interface had to be measured. Hence the usability characteristics **effectiveness** and **user-satisfaction** as well as a fundamental measurement of the **efficiency** were evaluated during a preliminary study.

The investigated semi-immersive VR-system is used by different roles. These roles contain VR-operators as expert-users and members from the production planning, development, design, quality assurance and top-management as non-expert-users.

While the tasks of the expert-users contain building and updating the virtual model, the non-expert-users exclusively evaluate the virtual model under certain role-specific aspects. These aspects are all considering the future product concerning its look-and-feel and its quality. In this context mainly the evaluation of the size and visual parallelism of gaps as well as the visual homogeneity of surfaces – for example regarding possible inaccuracies during the development as well as future production processes – is done. These evaluations are mainly undertaken with respect to certain viewing-perspectives which are custom-relevant perspectives.

The target group for the planned user-interface are the mentioned non-expert-users of the investigated VR-system, as we believe that the direct interaction of the evaluators will raise the acceptance of the investigated virtual model for evaluation purposes.

3.2 Requirements

To gather necessary requirements for the design of the user-interface, two different methods were used. On the one hand field studies were done to get an overview over specific functions which were used within the VR-system to solve the current evaluation tasks. On the other hand interviews with 16 participants from the different involved roles (6 participants from production planning, 4 from development, 2 from quality assurance, 3 from design and 1 from top-management) who are using the VR-system for evaluation tasks, were performed to

(i) gather information about non-functional requirements considering the design of the user-interface
(ii) identify functional requirements the user-interface has to offer to effectively and individually perform future evaluation tasks

The collected information has been interpreted with respect to functional and non-functional requirements which are relevant for the user-interface. The following non-functional requirements have been subsumed:

- The elements of the user-interface have to be self-explanatory at first sight and intuitive to access
- The user must not have to acquire special actions for interacting with the virtual model (e.g. gestures, use of special devices, etc.)
- The user must always have the impression of having full control over the VE (e.g. not be able to make mistakes and therefore make a fool of himself)

The functional requirements have to make the actual evaluation possible for non-expert-users. Since the non-expert-users just evaluate the model and do not create them, the set of universal tasks by Bowman et. al (2001) can be reduced to **navigation** and **system control**. The following functional requirements for navigation-tasks have been identified during the performed interviews:

- unrestricted navigation within the VE
- restricted navigation (Fly to a predefined Point Of Interest (POI))
- Reset to predefined position

In addition the following functional-requirements for system-control-tasks have been identified during the interviews as essential ones for the evaluation of the look-and-feel and the quality of the future product:

- Define different viewing heights (customer-relevant perspectives)
- Change to colour of the virtual model (gap evaluation)
- Switch to analytical representation of the virtual model (surface evaluation)
- Rotate the virtual model (general impression of the virtual model)

3.3 The prototype

A main demand for the prototype was an intuitive-to-use and fast-to-adopt user-interface. Since common consumer tablet-PCs are widespread, it is assumed that potential users are likely versed in interacting with those devices. In addition the functionality with respect to the technical potential (e.g. latency) as well as the variability in terms of realising interactive user-interfaces on one device is an advantage characteristic.

Figure 2: *The final prototype*

Therefore a tablet-PC using the android operating system was used as the physical interaction device. On this device a graphical-user-interface (GUI) with the demanded functionality with respect to the non-functional requirements has been implemented as the actual prototype. Figure 2 shows the final prototype as it was implemented on a standard consumer tablet-PC.

The user-interface acts as a remote control for the investigated VR-system. By performing an action with the user-interface, the certain function within the VR-system is triggered and executed.

To access the different functions, the GUI was designed with two different tabs which contain the elements for navigation and for system control.

Since the navigation within the VE is the main requirement, the first tab contains the functions for navigation. These are the restricted as well as the unrestricted navigation. The restricted navigation is triggered via different buttons that show the certain POI. These buttons can also be used as a reset function in case the user gets lost in the VE while interacting with it. To reduce the complexity of the unrestricted navigation, an image of the actual virtual model is displayed. Via direct manipulation of this image, the navigation within the VE is performed. This reduction of complexity avoids the acquisition of special actions (e.g. gestures) to interact with the virtual model. In addition to that, the pinch-to-zoom gesture is used to zoom into or out of the scene.

Within the second tab the additionally requested four different system control functions are accessible. These functions were requested to be able to not only inspect but also evaluate the virtual model with respect to its look-and-feel and its quality.

3.4 Evaluation criteria

A rudimentary evaluation of the effectiveness of the prototype as a preliminary study was the main evaluation criteria for the designed VR-user-interface. Since the non-expert-user weren't able to interact individually with the VE before, the concept for the prototype would be rudimentary positively evaluated if the subjects were able to perform basic navigation tasks, using the implemented functions for system control and being satisfied using the user-interface while performing the defined tasks.

4. USABILITY EVALUATION

To gain information about the prototype a rudimentary usability evaluation as a preliminary study with respect to effectiveness, efficiency and user-satisfaction was performed. Therefore 27 subjects (2 female, 25 male, average age of 39 years) belonging to five different roles (15 subjects belonging to production planning, 3 to design, 4 to development, 2 to quality assurance, 3 to top-management) were asked to evaluate the designed VR-user-interface.

To get information about the effectiveness the subjects were asked to solve a set of basic tasks with the use of the different implemented functions. To get information about the efficiency the time for completing these tasks was measured.

Finally the subjects were asked about their former experience with tablet-PCs. To measure the experience, the subjects were asked to rate their usage of the different systems on a five-item Likert-scale from 1 – never, 2 – rarely (less than monthly), 3 – occasionally (monthly), 4 – regularly (weekly) to 5 – frequently (daily).

In addition to that, the subjects were asked whether they experienced joy-of-use (possible answers: yes/ no) while using the user-interface as well as if they perceive an increase of the evaluability of the virtual model (possible answers: yes/ no). In the end the subjects had the possibility to recommend necessary improvements of the prototype to make it more usable for the evaluation of the virtual model.

4.1 Usability tasks

To get information about the usability of the VR-user-interface and a possible usage within the specified context, tasks which meet the actual performed tasks for the stated evaluation purposes had to be designed. Therefore, two different subsets of basic tasks have been generated.

The first subset of tasks was given to get the subjects used to the user-interface and to gather information about the usability of the restricted navigation as well as the system control functions. Therefore the subjects had to

(i) Navigate to three different POIs
(ii) Use three different system control functions (Change colour, Define viewing height and switch to analytical representation)

The second subset of tasks was given to gather information about the usability of the unrestricted navigation within the VE. Therefore the subjects were asked to navigate to four different POIs and search for different geometric primitives. These primitives were hidden under different parts of the car as illustrated in figure 3.

The first task was used to get the subject known to the unrestricted navigation. The time from the start of the searching until the subject found the

Figure 3: *Different tasks for unrestricted navigation and searching within the VE – white circles weren't visible during the test*

geometric primitive has been measured to gather additional information about the efficiency of the user-interface.

4.2 Results

Analysing the subjects experience with the tablet-PCs, 27% stated they had never used a tablet-PC before. 15% stated they had rarely used, 15% occasionally used, 12% regularly and 31% frequently used tablet-PCs. Figure 4 shows the stated experience of the subjects with the different systems in an overview. Getting a conclusion concerning the effectiveness and a possible usage of the user-interface, the different mentioned tasks had to be accomplished successfully. The result of both subsets of tasks was throughout positive. 100% of the 27 tested subjects were able to solve the first subset of tasks for restricted navigation as well as the use of the system control functions.

The second subset of tasks for unrestricted navigation as well as searching for geometric primitives by inspecting the virtual model individually was accomplished by 100% of the 27 subjects – all of the subjects were able to individually navigate unrestricted within the VE and were able to find the hidden geometric primitives.

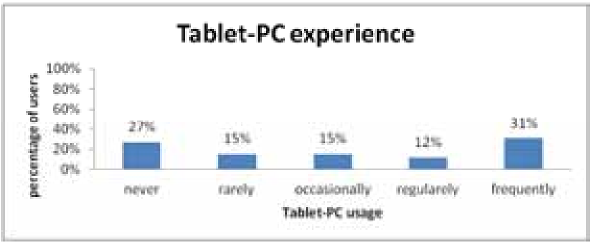

Figure 4: *Distribution of the subjects stated experience with tablet-PCs, VR-systems and CAD-systems*

Considering the efficiency of the user-interface, the time from the beginning until the subject found the geometric primitive was measured. The subjects who stated they never used tablet-PCs needed an average time of 45.9s (*SD*=33.2) to complete task A. To complete task B they needed an average time of 19s (*SD*=15.2) and to complete task C an average time of 15.9s (*SD*=9) was needed. The time consumption for subjects who stated they rarely use tablet-PCs, the completion of task A took in average 37s (*SD*=22.4), task B in average 25.5s (*SD*=9.8) and task C in average 20.3s (*SD*=4.2). Subjects who stated they occasionally use tablet-PCs needed an average time of 17.3s (*SD*=9.3) for task A, 13.5s (*SD*=3.9) for task B and 15s (*SD*=13.4) for task C. Subjects who stated they regularly use tablet-PCs needed an average time of 15s (*SD*=2.6) for task A, 19.7s (*SD*=13.4) for task B and 14s (*SD*=8.7) for task C. Subjects who stated they frequently use tablet-PCs needed an average time of 17.3s (*SD*=6.6) for the completion of task A, 14.3s (*SD*=5.7) for task B and 17.5s (*SD*=11) for task C. Figure 5 shows the time consumption for finding the object for the three different tasks with respect to the stated tablet-PC experience of the subjects.

Considering the user-satisfaction, the subjects were asked whether they experienced joy-of-use while using the user-interface for performing the tasks. 100% of the 27 subjects stated they experienced joy-of-use while performing the tasks.

In addition the subjects were asked if they believe that the perceived evaluability of the virtual model was increased by the user-interface and the given opportunity if the individual interaction. 81% of the subjects stated they believe that the perceived evaluability of the virtual model has been increased by the possibility of the individual interaction.

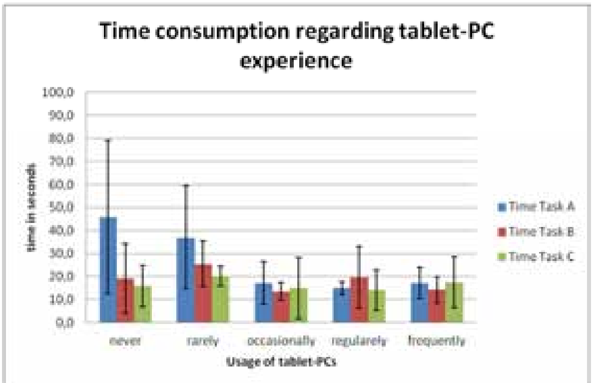

Figure 5: *Time consumption for finding the hidden geometric primitives with respect to the subject stated tablet-PC experience*

5. DISCUSSION

The goal of this work was to design, implement and evaluate a prototype of an intuitive user-interface for non-expert-users of a semi-immersive VR-system. The concept was evaluated with a rudimentary usability evaluation as a preliminary study.

To define the prototype, a subset of functional and non-functional requirements for the user-interface in the context of the evaluation of the look-and-feel and the quality of a future product were identified.

A common tablet-PC was used as the interaction-device, since it was assumed that the experience of such devices by potential users is quite high. This assumption applied since over 50% of the subjects stated that they at least occasionally (monthly) use tablet-PCs.

The identified functional requirements with respect to the non-functional requirements have been implemented on the user-interface and finally evaluated in a preliminary study.

As stated earlier the sample of universal interaction tasks mentioned by Bowman et al (2001) was reduced to navigation and system control for the specified task evaluation of the look-and-feel and the quality of a future product by non-expert-users within the investigated VR-system. In further studies it should be investigated whether the sample of universal interaction tasks still contains **object selection** and **object manipulation** for different tasks.

Referring to the rudimentary usability evaluation, since 100% of the subjects were able to solve the given tasks on the one hand there is a possibility that the task for evaluating the user-interface was too easy. On the other hand it may be possible that non-expert-users are able to solve real evaluation tasks within a VE individually with an appropriate user-interface.

Considering the results of the time measurements for the task completion, subjects who stated to have never or rarely used tablet-PCs show a drop in the time needed to solve tasks A to C. However, the standard deviation was enormous during the performed tasks. These results as well as the efficiency measurements of the subjects with more experience can just be taken as a tendency for a fast acquisition and intuitive-to-use user-interface. This tendency has to be evaluated during further usability tests.

Since the design of the user-interface is **work in progress**, the designed user-interface will be extended by a few improvements – for example the translation of the focus point – as recommended by the subjects after the usability evaluation.

After these improvements, a broad usability study of the final user-interface with more representative tasks as well as an evaluation under real working conditions have to be undertaken to investigate the actual usability of the designed user-interface.

Nevertheless, this study shows a systematic approach to design an intuitive VR-user-interface for non-expert-users using a standard “Commercial off the shelf” device contrary to the common development of user-interfaces for VR-systems where new devices are created instead of using common existing devices. This approach shows that there is a possibility for developing intuitive user-interfaces for non-expert-users of VR-systems which could raise the acceptance for the use of Virtual Reality during the product development process.

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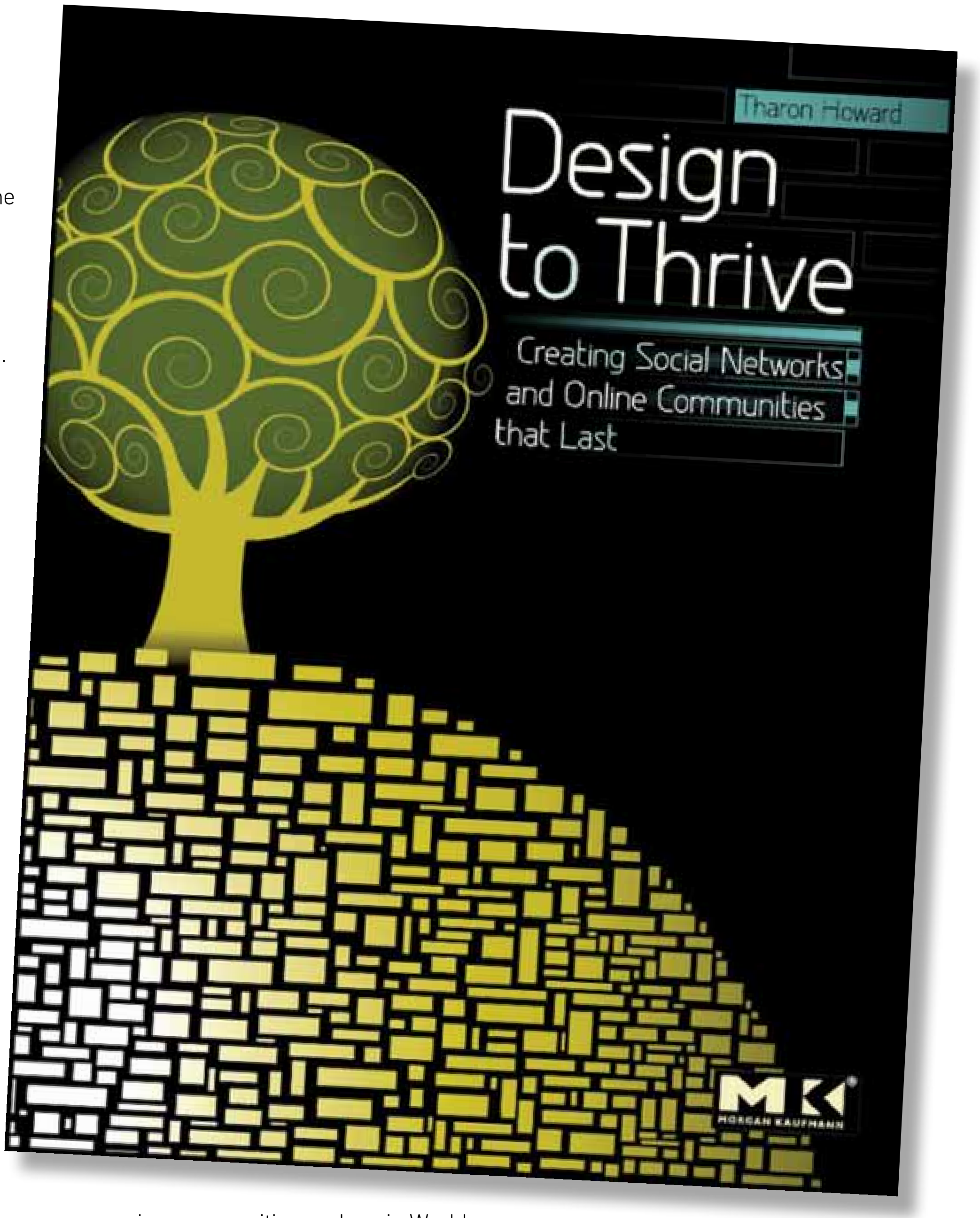
Design to Thrive: Creating Social Networks and Online Communities that Last



With the growth of social software such as wikis, blogs, and social networking platforms such as LinkedIn and Facebook, there is an increased focus on the concepts of 'social networking' and 'online communities' in academia and in practice. Almost all of us have had the experience of online groups through our participation in discussion forums, mailing lists, etc. and so 'online communities' is not entirely a new phenomenon that has come forth with the growth of social media. The aspect that is unique of this phenomenon in the social media age is that it's more prevalent now and pervades people of all ages, skills and backgrounds.

Online Communities
Researchers in a variety of disciplines such as in HCI, psychology, social sciences, social anthropology, and in domains as diverse as education, health, games and virtual worlds are investigating the factors that facilitate the creation and sustenance of online communities. Online communities are useful spaces for collective action, for virtual collaboration and team working, for sharing and creating knowledge, for supporting one another, and can also help overcome social isolation such as amongst the elderly (see **tinyurl.com/d5lv2gt** and **tinyurl.com/ccpkx97**).

The book *Design to Thrive: Creating Social Networks and Online Communities that Last* is a thoroughly researched book based on the author's own experiences of managing and participating in online communities since the early 1980s. The first chapter of the book outlines the benefits of social networking and online communities through anecdotes from both academia and practice. It lists and describes the different kinds of online groups such as to support project and professional development teams, communities of practice around a particular profession or discipline, networks across disciplinary boundaries, brand communities and user group communities for organisations to interact with their customers or for customers to interact amongst themselves, and gaming communities such as in World of Warcraft. In this chapter, the author also introduces four key principles, based on his experiences and empirical research, which are necessary for the long-term success of online communities. These principles are encapsulated in a framework called RIBS: Remuneration, Influence, Belonging and Significance.

The RIBS framework
The first principle is **Remuneration**, which implies that people need to believe that they will get value and some positive return in response to the time and energy that they will invest by participating in the community. As per the author, **Influence** is the most important principle but also the most overlooked. Influence means giving the members a clear sense that they have a voice in the community and control over how their voice will be heard. **Belonging** is another aspect that the author claims is often ignored but aspects such as special icons, symbols, colours, etc., can help members identify with one another and develop some emotional attachment to the community. **Significance** is the fourth principle of the RIBS framework and

implies that a community has to be seen as significant in order to be successful.

The RIBS framework is an analytical tool that can help guide design and evaluation of social networks and online communities. So, these elements can help think about how the social network should be designed, how the new members will be inducted and supported, how the network should be moderated, how the network can be run so as to provide value to its members, and so on. If a social network or an online community is already in place, then this framework can be applied to assess how the benefits to the members could be improved, and what, if any, measures, need to be taken to sustain the network or community.

However, the author ends chapter 1 with a cautionary note that there is no simple solution that would fit all. For example, communities for the elderly are quite different from those focused on mothers or young parents, and from the networks that are cause-driven and are set up to support a particular campaign or a short-term initiative. So RIBS may not have solutions for all kinds of online communities and social systems on the Web, but RIBS offers a guiding tool/framework and a repository of strategies for each of the principles in the framework which can be adapted, used as tools for thinking about issues and for brain-storming, and can be applied when designing and assessing online communities and social networks.

Well designed

Each chapter of this book is very well designed: a synopsis provides the gist of the chapter; the section headings are mostly posed as questions which a reader might expect to get answered; models and concepts from the literature are highlighted in coloured boxes that stand out from the rest of the text; and tips and techniques are encircled or suitably highlighted for easy reference. Each chapter has its own set of references, which can easily be looked at while reading the chapter instead of going to the end of the book and searching for the papers/resources.

The second chapter of the book is one of the most useful parts. Often we confuse social networks with online communities. Through a table, several examples and a variety of concepts, the author describes how an online community is different from a social network, and how online groups such as CHI-Announcements or the Interaction group mailing list can't be classified as communities, *per se*.

The third chapter of the book focuses on the rationale for designing and maintaining social networks and online communities. It lists ten different reasons or benefits that online social systems can bring to organisations, such as knowledge management within an organisation, or saving travel costs, or enhancing and sustaining intellectual capital and social capital. These reasons can be used to justify setting up an online group and also to evaluate whether those objectives are really being met once the group is up and running.

RIBS framework forms the core of the book, with each of the chapters 4–7 covering one principle in detail with lots of useful strategies and tactics for creation and sustenance of online communities. The various tips and techniques are easy to understand and to relate with, but would have been difficult to identify without this guiding framework and book.

Challenges

The final chapter of the book discusses aspects which are pertinent with the growth of social media in the last decade, such as how mass collaboration and collective action through social media can effect change, the copyrights and intellectual property issues, disciplinary control and its effect on an individual's creativity, 'new' digital literacies that are required for emerging technologies, creating and maintaining virtual identities, and how we need to look at the past to learn about how people behave online because 'technology changes rapidly; people don't'. This final chapter throws up a number of challenges for designers, moderators and the participants of online communication and collaborative systems.

Roadmap

I would have liked a roadmap in the book, which could lead me, without having to read the book from cover to cover, to useful tactics and strategies specific to moderators and facilitators, or guide me to a section on ethical principles and digital professionalism as a participant of a network or online community. Or, as a designer, I could learn how the tools can be combined in complementary ways when setting up a social network, for example combining a mailing list with a Facebook group.

I would have also liked to know more about how online communities can give rise to offline communities, and vice versa. However, this well-structured book (via the RIBS framework), written in a very readable and conversational style with lots of anecdotes, and with focus on both the people and technology, is a very useful resource for both researchers and practitioners of online social systems.

ABOUT OUR REVIEWER

Dr Shailey Minocha is a Reader in Computing in the Centre for Research in Computing at The Open University. Her recent research has focused on how emerging technologies can support pedagogy and digital scholarship: for example blogging and reflective practice, wikis and virtual team collaboration, 3D virtual worlds and training and skills development, and the role of social media in research dialogues and research skills training and development.

Shailey's paper 'An empirically grounded study on the effective use of social software in education' was the Highly Commended Award Winner at Emerald Literati Network Awards for Excellence, 2010. Her paper 'Designing navigation and wayfinding in 3D virtual learning spaces' received the Gitte Lindgaard Award for best paper at OzCHI 2011. Shailey's publications are listed on: **oro.open.ac.uk/view/person/sm577.html**.

THE BOOK

Design to Thrive: Creating Social Networks and Online Communities that Last
Tharon Howard
Morgan Kaufmann
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2010

Please contact me if you want to review a book, or have come across a book that you think should be reviewed, or if you have published a book. I very much look forward to your comments, ideas and contributions. If you would like *Interfaces* to include reviews on a particular theme or domain, then please also let me know. Many thanks.

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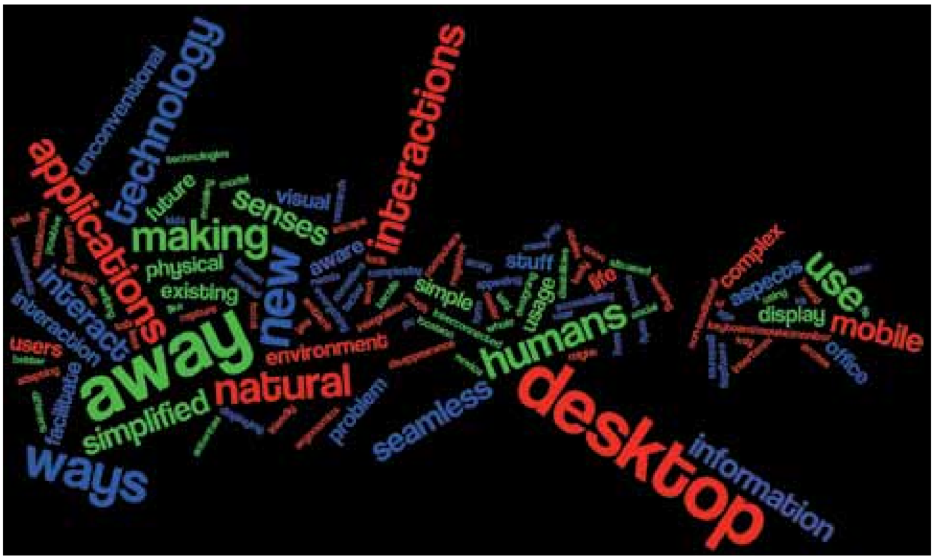
AWAY FROM THE DESKTOP



Dan Fitton, University of Central Lancashire, argues that technology use is moving ever closer to 'away from the desktop'.

In the closing plenary of HCI 2011 Gregory Abowd made the comment that everything is becoming 'away from the desktop' and joked that in the future there would be conferences about the 'desktop'; this was something that resonated with me (the joke helped too). While all present in the room, and the conference too, had a general understanding of what was being referred to by 'away from the desktop' as a term, this has not yet been clearly defined. Those words and phrases without an agreed definition naturally attract meanings situated inside a group and context, sometimes driven by interests, motivations and understandings; they are essentially appropriated.

Metaphor for rebellion

For me, away from the desktop is a metaphor for rebellion against the constraining and ill-conceived technologies that live in and around the desktop, technologies that, in interactions terms, are remarkably similar to the very first PCs. Technologies that, 30 years on, still leave us struggling to find the right button to press. Technologies imbued with waves of dissatisfaction that trough with acceptance and peak with the desire to jettison hardware out of nearby windows. Away from the desktop is an alluring interaction metaphor that embraces unrestrictive technologies that fit in with the ways we decide to live our lives. Particularly for me, away from the desktop builds upon new technologies that enable new possibilities.

There is currently a glorious interplay between the newer HCI research areas (such as embodied interaction, tangible interaction, multi-touch interaction) and the off-the-shelf technologies we can use to begin exploring them (such as Xbox Kinect, Wiimotes, Arduino, Microsoft Surface). Away from the desktop interaction is not a independent research theme but is now part of the fabric of HCI and its associated disciplines; in this way it is more of identifying a trend than defining something new. If we needed a definition we could say it is an ideology that rejects mundane restrictive technologies and embraces new possibilities that enable a synergy between humans and technology, moving towards Mark Weiser's vision of ubiquitous computing.

Away from the desktop is an alluring interaction metaphor that embraces unrestrictive technologies that fit in with the ways we decide to live our lives.

Pragmatic debate

In my Design Away from the Desktop MSc module we begin by exploring what away from the desktop means and its implications. The word cloud **www.wordle.net/show/wrdl/5496211/Untitled** shows the salient terms from this discussion last year and helps to define what away from the desktop encompasses. Part of this debate centred on the negative points of away from the desktop, something to which I'd given little consideration in comparison to my excitement about new possibilities. My students found five key negative points which really focused on the pragmatics of away from the desktop being in the near future, and of the move away from what we now call the desktop:

- The windows desktop as we know it is mass produced and very cheap and the supporting infrastructure is relatively uncomplicated and homogeneous; surely moving away from it would have a prohibitively high cost and complexity?
- If children become experts at using desktop technologies from an increasingly early age won't they become adept at dealing with its limitations and lessen the need for change in the future?
- If we could interact with computers from anywhere with extremely low effort would this make humans even more lazy?
- Away from the desktop interactions may be great for novice users and simple interactions but can they adequately support expert users who need more rapid high-bandwidth interaction methods?
- Would users be able to construct meaningful mental models when there are numerous possibilities for interactions across different modalities?

For me these concerns highlight issues on an impressive range of levels, with some currently being addressed and others more open. This consideration of the more negative aspects of shifting and advancing is something that, perhaps naturally, is not often considered. Clearly these issues will all need to be addressed as technologies move forward out of research labs and into spaces such as homes and schools.

The progress towards away from the desktop interactions and technologies is definitely here to stay, and I hope this article has helped to highlight this, clarify the term, and prompt discussion around it. For me as an interaction designer it raises exciting new possibilities and opportunities to, using the words of Mark Weiser, create seamless interactions and calm technologies; in more contemporary terms we could also call this 'Life-centred Design'. In the short term it is helpful to use the term 'away from the desktop' to help convey the ethos of what it embodies. Perhaps a better term to introduce would be '¬desktop'; then we can just remove '¬' when the time comes.

CALLS AND COMMUNICATIONS

Digital technologies for research dialogues

Dr Shailey Minocha, The Open University, UK, has developed a handbook for postgraduate and early career researchers who want to learn about the role of social media in research dialogues; and for supervisors and managers who want to expand their understanding of what social media offers, and the risks and opportunities involved. The handbook aims to assist researchers and their supervisors to adopt and use social media tools in the service of their research, and, in particular, in engaging in the discourse of research. It presents an innovative suite of resources for developing and maintaining a social media strategy for research dialogues.

The new handbook is the result of a one-year project funded by VITAE, **www.vitae.ac.uk**, which investigated whether and how postgraduate and early career researchers are using social media tools in their research dialogues. The project's specific aims were to develop a suite of resources to assist researchers to evaluate and choose social media tools, and to develop a social media strategy for research discourse with peers, supervisors and the community at large.

During 2011–2012 over 105 researchers in the UK, USA, Europe and Australia, from a variety of disciplines, were surveyed via mailing lists, discussion forums and through their presence on social media. Some researchers who are using mobile apps to support their research were also interviewed; and 45 supervisors were surveyed about their use of technology for formal dialogues and meetings with their postgraduate and early career researchers, for informal interactions, for document authoring and for document storage. Their concerns and apprehensions about social media use by their researchers were investigated.

In addition, a review was conducted on a number of related topics: how social media tools can help in research and the development of research skills; how individual tools such as Twitter, YouTube and LinkedIn could support research dialogues; issues of digital professionalism and the risks of social media; legal and ethical issues; the impact of cloud computing on research practices; and the concepts of digital literacy and digital scholarship.

The output of these investigations is a *Handbook of social media for researchers and supervisors: Digital technologies for research dialogues*, co-authored by Shailey Minocha and Marian Petre, Centre for Research in Computing, The Open University, UK, which is available from **www.vitae.ac.uk/policy-practice/567271/Handbook-of-social-media-for-researchers-and-supervisors.html**.

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