Design of the User Experience for Personalized Mobile Services

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Abstract

This article describes how user centered, and particularly co-design methods can help maximize user experience for personalized services delivered over a mobile device. The specific focus was designing for Chinese spectators at large sports events (such as football matches, swimming galas or athletics meetings). User experience was assumed to comprise user, product, social, cultural and usage context components. Co-design methods were incorporated into a semi-structured HCI design process that comprised content, conceptual, interaction and presentation design, followed by field and lab-based user evaluation. There were two co-design methods in particular which were found to be key to working effectively with Chinese users. Emotion Cards were used to help overcome some of the inhibitions of participants and to encourage them to provide more open and unequivocal design input. The User Advisory Board was a group of participants who mediated the relationship between the designer and other participants at various design stages. They helped to ensure genuine collaboration because the wider participants felt (1) less like the object of study and (2) more able to communicate their needs during the design process.

Keywords: Human Computer Interaction, Large Sports Events, User Participation, HCI, Design Methodology.

1. INTRODUCTION

As mobile IT becomes increasingly ubiquitous and the distinctions between different types of portable products continues to blur, there are ever-broadening opportunities for well designed mobile products and services to impact positively on individuals' lives. One such example is at large sports events (such as football matches and athletic meetings) which are a prime social, cultural, economic and media phenomena (Jacucci et al. 2006). However, it has been shown by a number of authors that the user experience at large sports events is highly variable (Nilsson 2004; Jacucci et al. 2006; Sun and May 2013). Reported problems include: an inability to see clearly and follow the sporting action (especially at multi-events such as athletics meetings), a lack of social interaction with fellow spectators, insufficient relevant information on the events and participants, and general, mass-interest broadcasts which are not tailored to individual interests.

Services delivered over personal mobile devices have the potential to address those problems by supplementing the information environment and increasing the sense of community. For example, at football matches, mobile devices can provide tailored, on-demand action replays, and other content such as mother-tongue commentaries etc. At multi-activity events such as athletic meetings, personal mobile devices can provide tailored current, historical and schedule information on one or more of the events of particular interest to the spectator. Social interaction

between spectators at sports events can be increased by encouraging communication with others, and the incorporation of real and artificial social actors into users' social networks.

From an end-user's perspective, the desired outcomes at a large sports event are best described using a user experience (UX), rather than more functional usability (ISO 1998) approach. It was noted three decades ago that studies of the UX should be considered as an important practice within the product development process (Dewey 1980). The continuing integration of mobile IT within lifestyles has made a UX perspective even more important, but only relatively recently has this broader concept (including motivation and emotion) gained attention within Human-Computer interaction (e.g. Kuniavsky 2003).

Practitioners from different fields of research and design have understood the importance of involving diverse groups of users in the generation phase of novel product, and thus facilitating participation has become one of the cornerstones of designing (Brandt et al. 2005). Researchers have started to see everyday people not only as the recipients of the product of the design process, but as active participants in the design and production process itself, capable of adapting products to better meet their own needs (Sanders 2006). While various articles discuss the emergence and benefits of co-design (e.g. Buur and Bødker 2000; Iacucci et al 2002; Brandt 2006; Ivey and Sanders 2006) there is a lack of studies that concentrate on what actually takes place in co-design situations (Binder 2007). There is little published research discussing how collaborative approaches can be integrated within established processes for user-centered design of mobile IT.

In this research, 'co-design' is used in its broadest sense, to simply mean design activities that bring together end users and designers, so that end users act as more than merely 'informants' or 'objects of study'. The aims of this article are to demonstrate the role that co-design plays in the user centered design of mobile services for spectators at large sports events. The specific user group in this research was Chinese users, who have specific characteristics that present particular challenges for co-design.

In particular, the objectives of this article are to:

- Demonstrate an approach to optimizing the UX for mobile interface design within the constraints posed by the large sports event context.
- Show how different stages within a user centered design process can (separately and cumulatively) target the different elements of UX.
- Demonstrate the applicability of different co-design techniques in relation to UCD of mobile IT, and critique their effectiveness.
- Identify particular challenges and opportunities in relation to the specific user group studied within this research – which in this case was Chinese users.

2. DESIGN APPROACH

2.1 Design for Optimum UX

While spectators at events provide a unique opportunity for developers of mobile products and services, it is currently a challenge for designers to move beyond the relatively narrow bounds of usability, and to design mobile devices/services that optimize the UX for each spectator. There is no single cohesive theory of UX within design (Law et al. 2008, Roto, 2013); rather there is interest in this concept from design, business, philosophy, anthropology, cognitive science, social science, amongst other disciplines. Within these disciplines, there are efforts to understand UX, even though there is little direct support for concept and product design.

Within this research, UX is defined broadly as the subjective experience that a spectator encounters within a stadium. The user experience arises from the spectator interacting with the sporting action, their fellow spectators, the information channels within the stadium, and their mobile device. It includes usability, but is much broader, recognizing that spectators have particular social and cultural norms, and are influenced by the external context of the sports stadium environment.

Sun and May (2013), in investigating user experience with mobile applications, describe five categories of influences on the user experience evoked through interaction with an application. These are user factors, social factors, cultural factors, context of use, and product related factors. They also list specific attributes for each category, such as the motivation, emotional state of the user, norms as cultural factors; perception of social engagement as social factors, time and place as context of use factors; and usability and size as product factors.

Based on a multidisciplinary review of the literature (Arhippainen and Tähti2003, Hassenzahl; Tractinsky 2006, Sun and May, 2013), user experience is assumed to be contingent on a number of quite distinctive components, which can be labeled as user, social, usage context, cultural and product-related.

2.2 Personalization of Services

Large sports events present particular challenges to designers, in particular due to the highly dynamic environment and the diversity of both the sporting action and the interests and personal preferences of the spectators present. Although mobile devices present an opportunity for designers, they also have specific challenges, and in particular the small screen size and limited means of interaction. As a consequence, personalization of services is important for meeting the individual needs (and hence enhancing the UX) of spectators at sports event. ‘Personalization’ is the capability to adjust the content being provided, based on an understanding of that user and their context of use (Riecken 2000). Personalization can improve the UX by increasing the relevance of available to an end user and can reduce the effort needed to select and interact with those services.

There are various approaches to personalization, for example Wu (2003) makes the distinction between link, content, context, authorized and humanized personalization. This article concerns content personalization, where tailored information is provided at a node within the navigation space. A separate distinction concerns how that personalization comes about, and in this article, it is assumed that both user initiated and system-initiated personalization are viable design options. In the former case, a user will manually define their profile and this will determine what is presented on a device. In the latter case, user and context information is gathered automatically in order to tailor what is presented to the user.

2.3 Co-design and HCI

Instead of just being passive objects of study, the move from a more traditional user centred approach to a co-design or participatory approach changes the roles of users, designers and researchers, as highlighted by Sanders and Stappers (2008). The over-riding rationale within this work was the desire for enhanced user experience, and that the end servant of the design is treated as ‘expert of his/her experience’ (Sanders and Stappers 2008, p12). In addition, some key prerequisites for co-creation identified by Mulder and Stappers (2009) were incorporated within this research, including: diversity of participants, methods that enable a continuous dialogue between participants; a focus on experiences within a broader context; and an emphasis on methods and tools.

Using the UX components as a guide for design objectives, the design process considered four main design phases relating to content, conceptual, interaction and presentation design. These are regarded as the most important in the HCI literature (Cooper and Reimann 2003; Preece, et al. 2002), and are tackled in a roughly sequential manner.

A range of participatory activities were employed in relation to each of the main phases of the design process. The relationship between UX components, design phases, methods and co-design activities is shown in Figure 1. Since the five design phases are sequential (and also iterative), later design stages will incorporate the outputs from earlier stages (and hence UX components more relevant to early design phases).

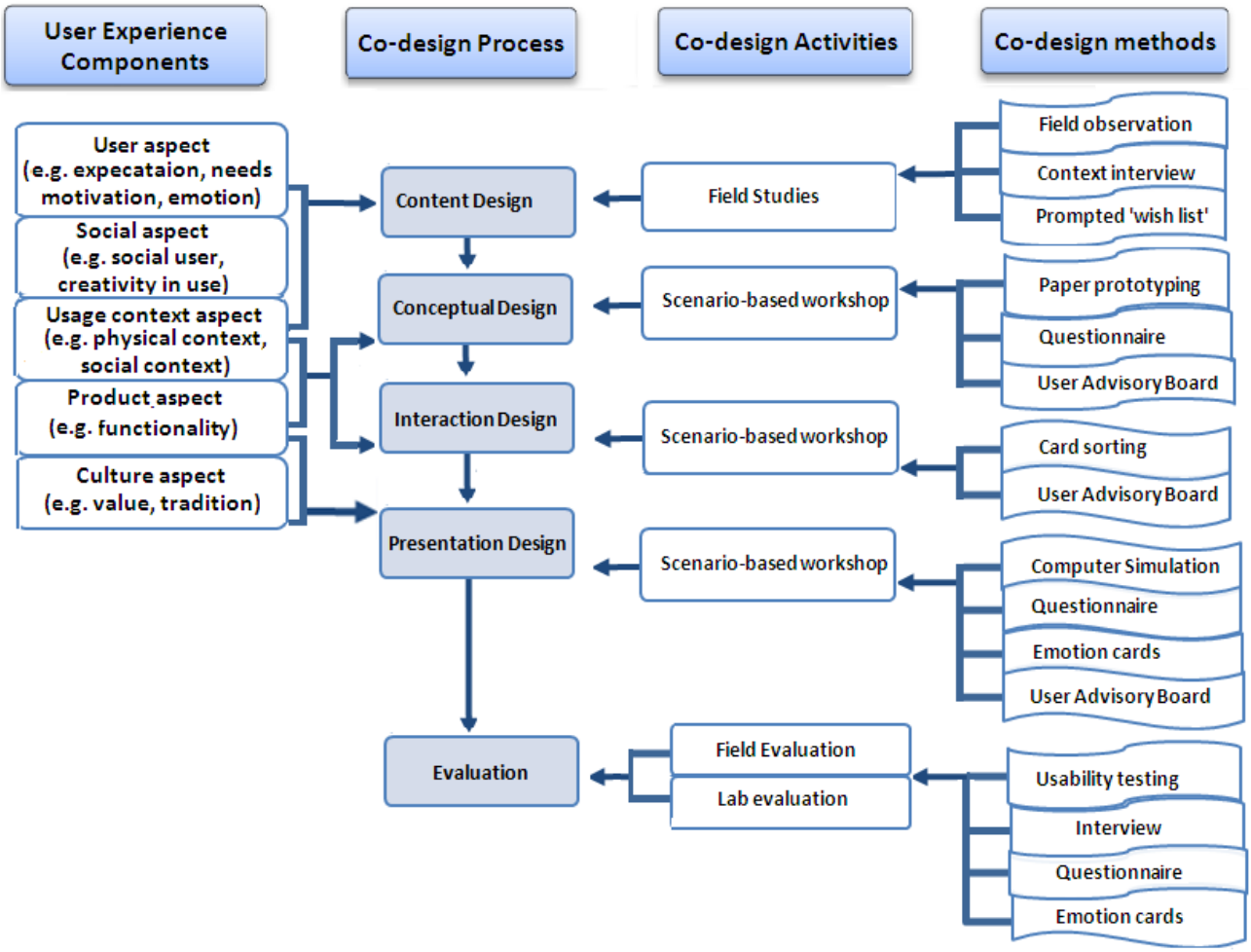

FIGURE 1: The relationships between user experience, design process and co-design activities.

The remainder of this article is based around the five design phases shown above. Sections 3 to 7 describe the design activities (including the co-design methods) undertaken within each of the design phases, and outline the design outputs from those phases. Section 8 then discusses the role the specific co-design activities played in the effectiveness of each design phase.

3. CO-DESIGN DURING CONTENT ANALYSIS

Content design is the analysis of the information (and functionality) that should be presented or made available to the end user, within a particular context of use. It is the basis for meeting information needs, and reducing information overload and lack of social interaction at large sports events (Jacucci et al. 2006, Sun and May, 2007), by providing users with personalized functions and information within a dynamic information environment.

The aim of the content analysis phase was to determine the information-based needs for spectators at large sports events, and therefore to discover what content should be provided to a

spectator via a personal mobile device. This phase also investigated what personalization of content was needed – this was based on the rationale that the optimum content for an individual at a sports event depended on a number of key variables, and that mobile devices could be responsive to those variables.

The first phase of content analysis involved taking users to four sporting events (two football events and two swimming events). An observer was placed behind the spectator group. They were able to record, unobtrusively, observable aspects of the user experiences from the user, social, contextual and cultural perspectives. Through observation, it was also possible to record what kinds of information resources were predominantly used - eg stadium-based display and paper programs - and (to some extent) how effective they were. In addition, each participant involved in the studies had a mobile phone that prompted them by SMS to fill in a 'wish list' during the breaks in the sporting action. This method is referred to as a 'beeper study'. As well as being a means of capturing what type of information users were interested in, or were unable to access, at multiple sample points, it can also encourage subsequent interaction between a participant and a designer.

Independent observation was followed by field-based context interviews, with a co-design ethos to investigate users' requirements and their spectator experience at the sporting event. They were conducted in situ and while the participants' memory of the event was still fresh in order to promote recall of relevant detail. Incorporated into this stage was a simple rating by users of their overall user experience, using a five-point Likert scale. This was used to encourage reflection on outcomes, and consideration of how spectators would like to improve their user experience at the sports event.

The second phase of content analysis involved a further three field studies at large sports events. Unlike the previous studies, which treated content as a relatively static requirement, this phase deliberately explored the variance in the sports events and participant interests. The aim of this second phase was to understand the contextual factors at large sports events which can be used as the basis for personalizing content (either by the user or in an automated fashion).

Participants attended these sports events with groups of friends as per normal, and each participant had a simple proforma to record where their needs were not or only partially met, and where the audience experience could be improved. Similarly, context interviews were carried out immediately after participants had watched an hour of the event. Their written requests were discussed in situ and their requirements were grouped into information requirements, functional requirements and social requirements. Participants were then asked about the potential impact of 11 key contextual factors (Dey and Abowd 2001; Sun and May, 2007). For example, participants discussed how the temporal changes in an event influenced the content that they would like to have made available to them.

The output of the content design phase was a list of requirements; these were grouped under UX components, and prioritized according to the number of times they were stated by participants. A matrix of possible content was created by tabulating the system functions based on these user needs (phase one) versus the relevant contextual factors at large sports events which influence the desired nature of that content (phase two). By analyzing the interplay between user needs (including functional and social aspects) and contextual factors, it is possible to prescribe how the mobile device should function and adapt itself according to key influencing factors. Figure 2 shows where users had directly indicated that functions should adapt (automatically or via user input) to specific contextual factors. Three contextual factors and six functions emerged as most important. These are shown in the highlighted portion of Table 1 and were taken forward into the next design stage.

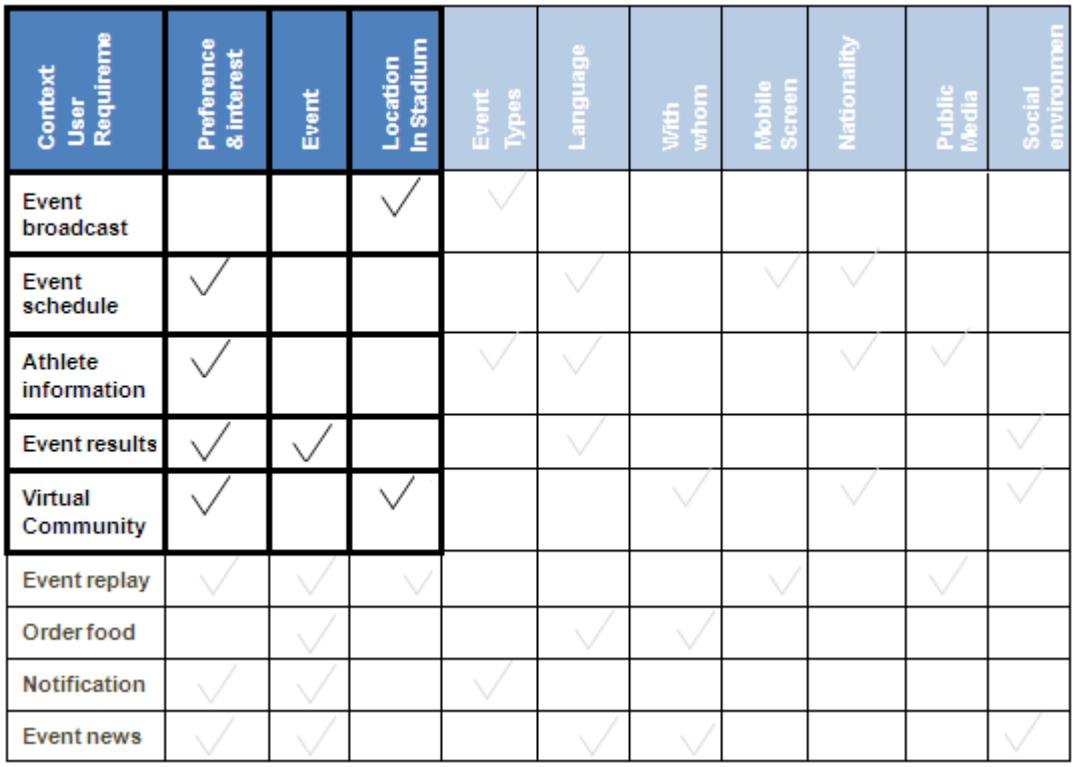

FIGURE 2: Design possibilities based on contextual influences on system functions.

4. CO-DESIGN DURING CONTENT ANALYSIS

The conceptual design phase investigates what the mobile 'system' comprises and how it fits into the broad context of use required by its users (Cooper and Reimann 2003). Conceptual design considers UX by envisioning an understandable system which is compatible with the context surrounding a sports event – i.e. it is most relevant to the product and usage context factors. This design phase accepts that there are multiple forms that a 'system' can take, and that appropriate concepts are (at least in part) dependent on the content and functionality that is being made available to the user. Within HCI, there is usually scant attention to conceptual design (Sener and Wormald 2008).

The conceptual design phase investigated several key aspects of the mobile 'system', including how users: personalize the mobile device; receive information notification; have content displayed to them; interact with the device; and 'carry' the device. The first stage of the conceptual design phase was a brainstorm of different design solutions by a small team of HCI researchers. A range of different options was generated, based on technological feasibility (e.g. Moizio et al. 2007; Rukzio et al. 2006).

Scenario-based participative methods, with 10 participants were then used to select appropriate design solutions. Scenarios were generated based on chosen design content and relevant contextual factors (from the content design phase – see Figure 2). For example one scenario centered around how to set personalization preferences having just arrived at an athletics event in a large stadium.

Paper mock ups were presented after each scenario stage to walk through conceptual ideas with users. Concepts were hand drawn to allow users to visualize the design without drawing attention to the (as yet unspecified) details of the interface. Semi-structured questionnaires identified patterns in users' preferences for aspects of conceptual design, based on the scenarios they had

just experienced. Interviews were then used to allow users to expand on, and explain their preferences.

In order to encourage users to think aloud during the design workshops, the research also created a User Advisory Board that was involved throughout the whole design cycle. This method was based on the notion that Chinese participants would work better with those familiar to them (Yeo 2001). The board consisted of a group of four additional users who (like all participants in this research) had experience of personalizing mobile devices and had watched a large sports event in an open stadium within the last half year. The User Advisory Board is a way of achieving continuity of users throughout various iterations within the design process, and encouraging a greater level of participation by end users in the design process. Although it has been recommended as a design aid (Cooper and Reimann 2003), there have been few reports of its use or effectiveness.

Figure 3 shows different concepts that were generated for: (a) personalizing the device (and also general interaction with the device); (b) notification of new content; (c) displaying new content; (d) carrying the device.

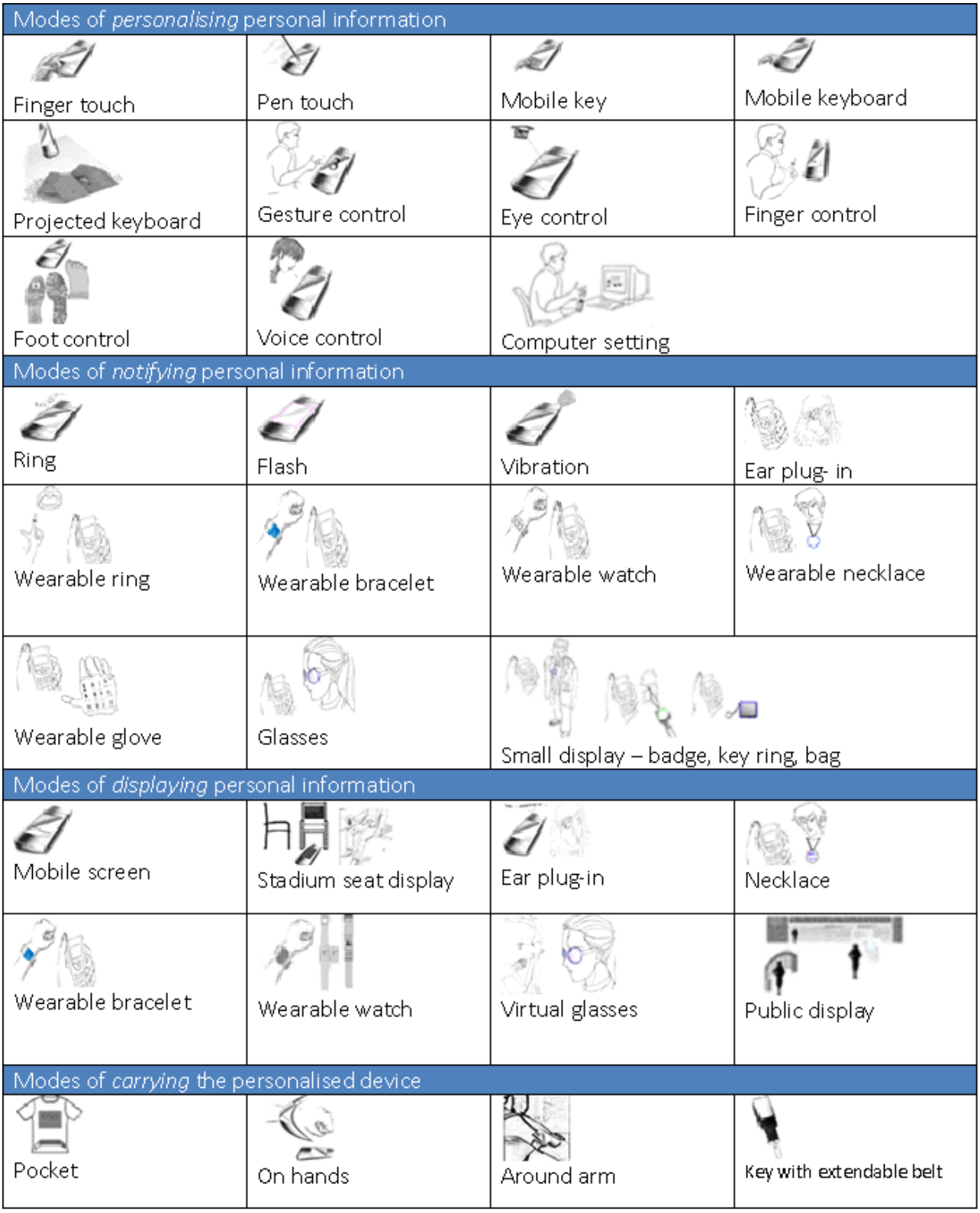

FIGURE 3: The range of product concepts considered.

The conceptual design phase led to a design based on a touchscreen that enabled direct manipulation, with vibration-based notification of new content. This reduces the need to keep

visually checking the device, is less intrusive than auditory notification and is more effective in noisy environments. An obvious design conflict was the desire for large-scale visual presentation on a small mobile device, and this was addressed during presentation design in Section 6.

5. CO-DESIGN DURING CONTENT ANALYSIS

Interaction design tries to optimize the UX by matching the information architecture of the 'system' with the users' mental model of how information and functions are organized in the context of the intended usage (Kuniavsky 2003). A user's mental model is an internal theory of the causal behavior of a system, or the basic way in which it works (see e.g. Cooper and Reimann 2003). Understanding the users' mental model of a 'system' can help lead to a user interface design based on simple interaction requiring minimal user attention. Since the UX is created primarily by the sports event itself, co-design activities within this context minimize the cognitive and physical effort required for interaction with the device.

Twelve users took part in the interaction design phase. Five scenarios were developed which incorporated a series of tasks based on specific device functions, and key contextual variables, derived from the content analysis phase. A series of scenario-based workshops were conducted to create an early 'top down' vision of the users' mental models within a large sports event context. The consideration of contextual variables allowed both user-initiated and system-initiated personalization to be investigated. For both of these personalization approaches, the scenarios were used to prompt user discussion of how the system might behave, how they might interact with it, and the benefits/drawbacks of each approach.

Card sorting was then used during the scenarios. The chosen design content was written on small cards according to each scenario, which were given to the users without any pre-established groupings. The cards were used to prompt discussion between the participants and the designer, with the users sorting cards into groups, and labelling those groups, according to personal preferences.

Patterns arising from the card sorts were initially created by mounting the cards onto a whiteboard (see Figure 4). An affinity diagram technique (Hackos and Redish 1998) was then used to establish further groupings and sub-groupings within the data. The patterns within the data represented sensible structures for the users. It is important to note that areas of difference (as opposed to consensus) also provided useful insights. These can help identify: content that participants haven't understood well; content that could belong to more than one area; alternative paths to content; and how different types of participants attach meaning and groupings to information.

The interaction design stage resulted in task diagrams of how content information should be arranged and presented; a summary is shown in figure 4.

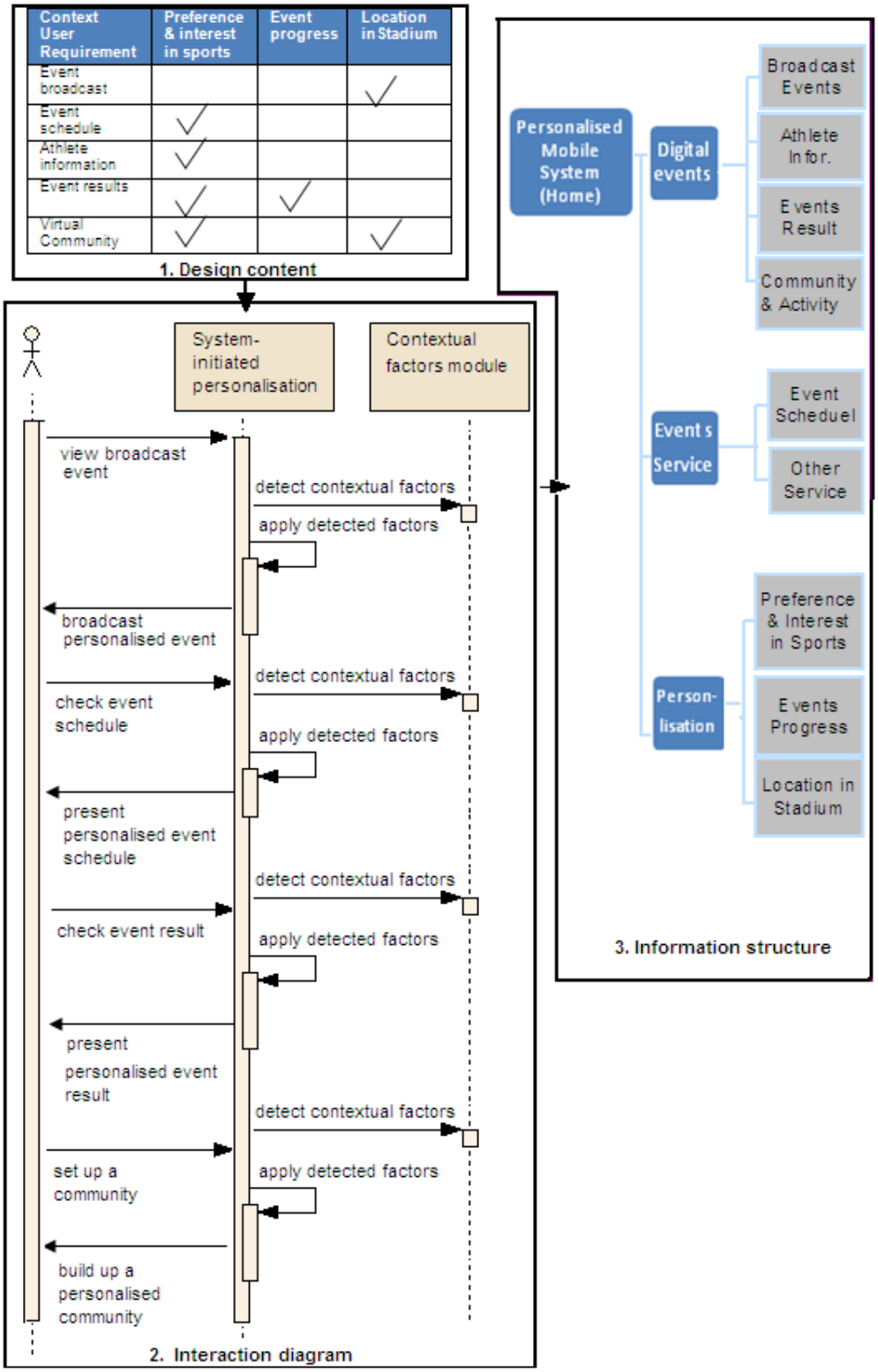

FIGURE 4: The range of product concepts considered.

6. CO-DESIGN DURING PRESENTATION DESIGN

Presentation design refers to the visual design of the content categories and menus that the user would interact with, including the means of navigating the interface. Presentation design impacts directly on the product factor of UX, but also builds on conceptual design, content analysis and interaction design to maximize the other components of UX. This phase took into account established mobile design guidelines (e.g. Shneiderman and Plaisant 2005; Weiss 2002), and also key cultural considerations such as the importance of privacy within Chinese society.

The same scenarios as before were used during presentation design. Part simulations were presented after each scenario stage to walk through design ideas with users. Interviews, supported by Emotion Cards (Desmet 2000) were then used to allow users to expand on, and explain their preferences. Emotion Cards are a group of cards depicting cartoon faces with eight distinct emotional expressions (Schlosberg 1952). These expressions vary according to two psychological dimensions of emotion: 'pleasantness' and 'excitement'. Rather than being used as a data collection tool, Emotion Cards were used to help the participants objectify their experiences and to serve as an aid for starting a conversation with the researcher.

Resulting from the presentation design phase were two separate designs, with similar look and feel. For one design, personalization was user-initiated and could be either pre-set or undertaken in real-time during the event.

The design also featured extended tree structures and menus to reduce interaction steps and promote recognition over recall (eg (Shneiderman and Plaisant 2005), and semi-transparent menus (Figure 7) that promoted parallel processing of visual information, helping to integrate function and content within a small single view.

For system-initiated personalization, several addition design features were incorporated. These included: a highly visible system status; mechanisms to deal with contextual ambiguity (Bellotti and Edwards 2001) such as being able to switch off system-driven control; being able to update personalization preferences; and ensuring interfaces were consistent, predictable and transparent.

In addition, a key issue for automatic (system-initiated) personalization was privacy. This refers to 'the claim of individuals or groups to determine for themselves when, how, and to what extent information about them is communicated to others' (Minch 2004). Privacy is particularly important in connection with virtual communities (Gong and Tarasewich 2005). Although information about the preferences, activities, and context of people can be collected to personalize the services for individuals and groups of users, this information is often regarded as personal data, and the use of personal data raises privacy issues. The use of personalization appeared to decrease user's trust which supports findings that personalization can conflict with privacy (Thomas and Krogsoeter 1993). The design attempted to mitigate the privacy issue by the allowing the sharing of group information instead of individual information, and enabling easy management of shared data as suggested by Hawkey and Inkpen (2006).

7. CO-DESIGN EVALUATION

The final stage of the co-design process was a validation of the design process through a set of structured user-centered evaluation activities. Phase 1 was a field-based evaluation that investigated the impact of personalization of content on a mobile device. Phase 2 was a lab-based study comparing user and system-initiated approaches. In both cases, a scenario-driven approach was used, with participants asked to complete specific activities that had been identified within the earlier requirements phases. Multi-item questionnaires were used to measure the overall UX for each of the scenarios, and to differentiate the impact on the separate UX components. The evaluations were conducted using a typical experimental approach, ie controlled settings, manipulations of independent variables, and measurement of outcomes. However, the evaluations also included a discursive element, and the Emotion Cards were also used during this phase to encourage the participants to think of themselves less as experimental

subjects, and more as partners in the process. The ratings obtained with developed scales were triangulated with participants' verbal reports during the evaluation sessions, and non-parametric statistics were used to identify significant differences due to the main independent variable in each phase.

Results showed that mobile devices incorporating personalization of content enhance all aspects of the UX, when compared to either a mobile device with non-personalized content, or a standard paper-based program (Sun and May, 2014). The role of mobile personalization at large sports events is summarized in Table 1 below:

UX component	Demonstrated impact
User factor	Fulfilled expectations; sense of control; personal attachment; increased enjoyment
Product	Perceived usefulness and ease of use
Social	Improved social interaction; 'ice-breaker' for introductions; reflection of personal identity; feeling of acceptance amongst peers
Cultural	Reflection of group identity; sense of belonging
Context	Provision of location-sensitive information; development of community with shared values and interests

TABLE 1: The impact of personalization on user experience at large sports events.

8. DISCUSSION

The aim of this article is to demonstrate the role that co-design activities can play throughout a UCD process, when optimizing the UX for a specific mobile design challenge. The term 'co-design' is used broadly, and in line with Sanders and Stappers (2008) is used to describe collective creative activity which can take many forms, and that spans the whole spectrum of a design process.

The content design phase was based around user requirements definition drawn from a series of field studies, which were an effective method for understanding situated action (Dourish 2001; Suchman 1987) including the contextual influences on the user experience encountered by individuals. Observation was used because it was an unobtrusive technique that helped the designer to engage in subsequent co-design activity with the participants, while not unduly influencing either their behavior, or aspects of their user experience. Within the field studies, participants acted as both informants and co-designers. The 'beeper study' was effective in this sporting context because although this method is relatively intrusive, it directed participants' attention away from the sporting action and ensured that they provided information to the designer during this stage. It also encouraged participants to be more expressive when being interviewed, since the beeper study provided 'provocations' in terms of the participant-designer relationship.

Participants were influenced by many aspects of their dynamic environment and although the observer could be confident that they were having little influence on the spectators (and hence were observing 'real' behaviors), it was not easy to understand the reason for, or meaning implied by, observed acts. For example it was observed that spectators were talking to some people, and ignoring others; it was only through discussion post-observation that it became clear that this was dependent on the sense of mutual group belonging between them and the other individuals, created through supporting the same athlete or team.

Focus on the desired UX outcomes (within the constraints of the study) required the use of a simple observation schema that was based on the UX components; this is shown in Table 2 together with examples of the observational data made.

UX component	Typical observations
User factor Behavior / emotion / expectations	Watching; looking for information; talking; taking pictures; cheering; being excited/distracted/bored
Product factor Use of mobile device/interaction with device	During peak sporting moments: taking photos; video recording. During breaks: sending messages; taking photos; best positioning for creating multimedia records
Social factor Interaction with events/friends	Cheering; creating multimedia records; talking to friends nearby; glancing at other spectators
Cultural factor Characteristics/value	Emphasis on creating group image: spectators wearing the same uniform; interaction limited to within group
Context factor Stadium layout/ audio info./visual info. /physical objects	Stadium shape and layout; seating arrangements; movement restrictions; sound quality of audio broadcasts; legibility and content of visual display screens; temporal quality of information

TABLE 2: Data collected using an observational proforma.

The SMS prompting of participants during the field studies was an in situ method designed to overcome shortcomings of post-hoc techniques. Although it successfully prompted participants to complete their 'wish list' at particular sampling points, participants were not universally receptive towards it. In particular, although participants were willing to complete their wish list during lulls in the sporting action, they were much more reluctant (to the extent of annoyance) if they received prompts during highlights in the sporting action. The context interviews (immediately after watching the event) worked well since they enabled easy recall of relevant contextual factors by participants. However, the diversity of the sports environment meant that it was difficult to establish clear stopping rules for this phase, and to prioritize the resulting output.

The conceptual design phase was based on the generation of paper mockups, and a range of methods that enabled participants to explore different mobile product concepts – ie a traditional participative design approach. The paper mockups were time and cost effective. By combining the paper mockups with the scenarios, it was possible to construct additional meaning from the contextual information contained within the scenarios, and provide greater information on those situations within a stadium where personalization of a mobile device could result in improved UX.

The conceptual design phase introduced the User Advisory Board to the participants. This helped to overcome the natural reluctance of Chinese participants to work with those unfamiliar to them (Yeo 2001). As noted by Lee and Lee (2009) - in developing tools for more effective focus groups - there are challenges in promoting participatory discussion amongst East Asian participants. As well as facilitating participation of end users, the User Advisory Board has the added advantage of ensuring familiarity with the ongoing issues with the product, and hence enabling a focus on new ideas with each design iteration. The presence of the User Advisory Board created a free and open atmosphere during design activities; this encouraged the users to verbalize their thoughts and discuss aspects of the design.

The main interactions between participants, the User Advisory Board and the designer are shown in Figure 10. The User Advisory Board members were comfortable working with each other, and with the designer, since they did not feel they were the object of study. The participants tended to get to know and develop close working relationships with one or more members of the User Advisory Board. The Board therefore acted in a mediating role between the participants and the designer, as shown in Figure 10 below, and this mediating role was key in enabling genuine design input from the participants.

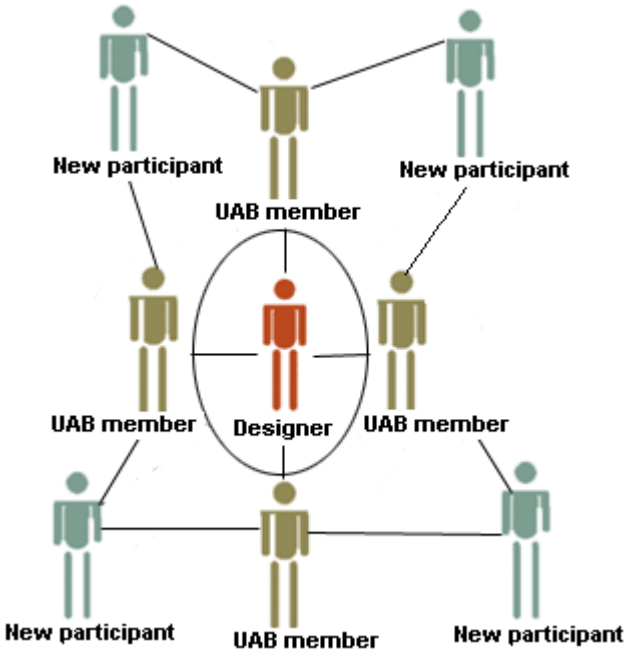

FIGURE 5: The mediating role of the User Advisory Board.

The main drawback of incorporating a User Advisory Board (who were still essentially participants) was that as they became more familiar with the designer and the emerging design, they started to contribute more as a designer/developer, rather than as an impartial end-user. As a consequence, they become less able to focus on meeting user needs and providing user-focused input. This concern was addressed by recruiting additional participants to take part throughout the design process.

The interaction design phase involved scenario-based design and card sorting methods to determine content structure. These were highly effective co-design methods, since they encouraged a high degree of interactivity between the participants and the designer. The scenarios themselves were effective in prompting discussion of how the system might behave, and how users might interact with it in the context of that scenario. The card sorting aspect also fitted well with the relational-contextual interaction style of Chinese users (Kim 2004). This describes how individuals classify information according to the natural relationships between objects - participants understood and classified information according to this type of relationship. The card sorting enabled user needs to be expressed in terms of the multiple, concurrent requirements relating to a particular sporting event.

The major drawback with the card sorting was that participants initially found it difficult to sort the pre-defined cards (which were based on the content design phase). There was discussion over the meaning of some of the cards. This phase would have been improved by allowing more flexibility for participants to create their own card labels and content description (ie treating them as genuine co-designers), rather than having these imposed on them by the designer.

The presentation design phase involved iterative and participative design/development of high fidelity simulations. This design phase required close cooperation between the designer and participants, and multiple design iterations based on user feedback. The Emotion Cards were essential at this stage to ensure that users were open and direct with the designer. The natural tendency of Chinese users is to promote harmony within a situation (Peng 1997), not to communicate their thoughts (Kim 2004) and to observe a hierarchical relationship between individuals within society (Lin 1997). This would normally severely limit the input of Chinese users within a co-design process, and if pushed for a response to a particular design proposal, they

would typically state that 'it was OK'. The Emotion Cards were useful in helping to overcome some of the inhibitions of participants and create a more collaborative design environment.

The evaluation phase took an experimental approach, but also made great efforts to minimize the perception by individuals that they were participants in an experiment – ie a subject of study. Again, the Emotion Cards were important communication aid. For Chinese users (typically reluctant to communicate their thoughts), the lab-based experimental approach in particular (second evaluation phase) did not allow them to feel relaxed. Participants acted politely during the study, and they were uncomfortable expressing negative feelings about the applications. The Emotion Cards were useful in overcoming these inhibitions. In one example, when interviewing a participant about a design, he generally stated that it was 'fine'; however, when presented with the Emotion Cards, he tended to pick up one emotion face and would talk about his concerns over the colour and navigation needed to personalize the application, without feeling that he was being overly critical. This influence of the Emotion Cards was apparent during the evaluation phase as well as during earlier design phases.

Although the Emotion Cards were effective as a communication aid, they had several limitations (which prevented their use as data collection tools) : (1) they were sometimes difficult to interpret by users and some participants interpreted the emotions of male and female faces on the Emotion Cards differently, even though they are supposed to represent the same emotional response; (2) the Emotion Cards are static facial expressions, and dynamic facial expressions are recognised better than static facial expressions (Collier 1985); (3) 'emotion' is a much more complicated construct than the expressions conveyed on the Emotion Cards; (4) due to cultural variation, the same facial expression may mean different things to individuals with different cultural backgrounds. Despite these limitations, it has to be remembered that the Emotion Cards were used as communication prompts, rather than data collection tools, and therefore misinterpretation of the meaning on individual cards does not necessarily reduce their effectiveness. If the Emotion Cards were to be used as a data collection tool, then instead of cartoon faces, they can be adapted to something more familiar to the Chinese culture. A good example of cultural adaptation is the emotion ticket (Chavan and Munshi 2004). The emotion ticket is a technique that allows users to express their feelings towards technologies in India. It was designed to resemble cinema tickets, where each ticket stands for a specific emotion, in the traditional Indian culture. The Rasa appears explicitly in Hindu theatre, and the design of emotion tickets reminds Indian users of theatres, a place where they feel more comfortable about expressing emotions.

9. CONCLUSION

This article has shown how a range of co-design techniques can be integrated into a typical HCI design process consisting of content, conceptual, interaction and presentation design, together with a user centred and participative evaluation phase. There were three particular challenges in this design problem: (1) the multidimensional and theoretically ambiguous nature of UX; (2) the dynamic and diverse nature of large sports events; (3) the specific cultural requirements of Chinese users. Several techniques were key to engaging users with the designer. In particular the User Advisory Board and the Emotion Cards were successful in promoting genuine co-design input from a cultural group which would normally be reluctant to actively participate. Future research will continue exploring the role of culture in HCI design methods and process.

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