Case Study: User Research to Inform the Design and Development of Integrated Wearable Computers and Web-Based Services

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ABSTRACT
The competitive playing field for startup companies often does not allow for the time to understand how user needs can influence the development of a new product. This paper presents a case study of informing the design of a wearable computer with web-based services through user research. We discuss our motivation for choosing to do user research to address our multi-faceted design problem; present the methodology and technique design; and summarize lessons learned in the process of analyzing the data and communicating findings to an interdisciplinary shareholder team.

Keywords: user research, participatory design, interviews, self-documentation, design process, wearable computers, design research

OVERVIEW
The rapid time to startup web-based service companies has made the playing field for new companies more and more competitive. As a result, new startups often rely on gut instinct, rather than the voice of their consumers, when developing new products and services, since having the time to really understand the audience is often a luxury.

BodyMedia is a startup company whose product vision integrates wearable computing technology (SensewearTM) and internet-based services (BodyMedia.COM), in order to provide consumers with the ability to track vital signs, monitor personal health routines, and play a more proactive role in the management of their own wellness.

With less than six months until product launch, BodyMedia was faced with a series of difficult decisions about key points in the product development process. The internal vision of the product needed to be reconciled with the feasible technology in time to market, as did the product story told by the shareholders (internal team and the client investor team) (figure 1). To define the correct product vision, BodyMedia needed a greater understanding of user needs. Therefore, we chose to invest in user research to unify our shared product vision. Despite constraints of time and budget, we successfully identified the most fruitful product opportunities through conducting user research.

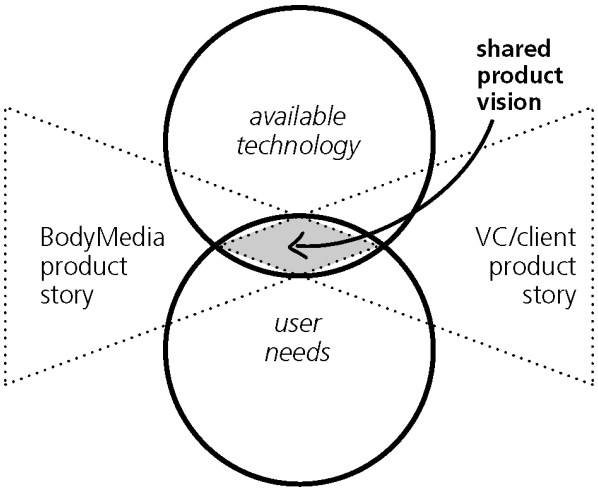

Figure 1. Identifying the problem space that led to the decision to conduct user research.

MOTIVATION AND METHODOLOGY
The primary goal of the research was to prove the SensewearTM vision: to develop knowledge about whether consumers would prefer mobile computers or wearable devices to collect data and deliver information over the internet. Discerning a preference between the two devices would also tell us what kind of information users would find most beneficial to their health and wellness routines: a) information that was delivered at intervals throughout the

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day (supported by a mobile device), or b) information that was delivered continuously (supported by a wearable device).

The secondary goal of the research was to understand if internet-based services were relevant and appropriate to the lifestyles of the target audience, and if they would be understood as a component of a product-service system. Finally, we wanted to understand the lifestyles of our potential audience, hoping to learn about their perceptions and attitudes about fitness and wellness, their activities, and where they found trusted sources of information about health.

Constrained by time and budget, we felt that the best use of our resources would be to first cast broadly for data, then use additional techniques to obtain more detailed information about relevant findings. Our research plan was based on an initial participatory design session (PDS), supplemented by participant self-documentation exercises and one-on-one interviews (figure 2).

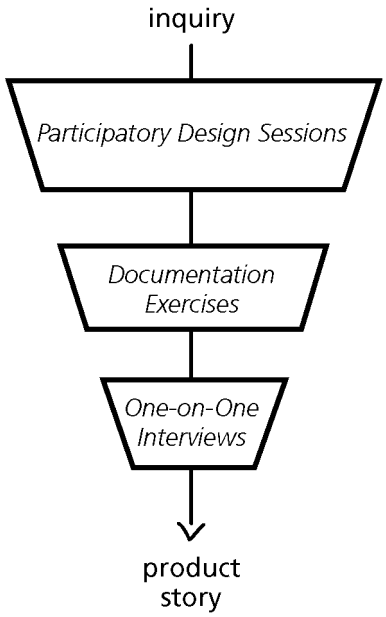

Figure 2. Plan for conducting user research.

A PDS is a one-time, extended activity session with a small group, conducted during key phases of the product design and development process. A range of objectives can be addressed by this qualitative research technique, including data collection, user-directed assistance with analysis of a body of data, generation of new product concepts, or evaluation of a body of existing concepts. We wanted to both gather data and evaluate existing product concepts in the same session.

The PDS emerged directly from the field of Participatory Design (PD), a research method that examines the use of technologies in homes and workplaces. [7] Diverse in practice and theory, PD was first used in Scandinavia in the 1970s, capitalizing on the opportunity to allow workers to influence the experiences they might have when using new technology products. Gradually, methods were expanded upon, and brought to the U.S. [9] Currently, a number of methodologies have emerged to increase the direct and effective involvement of users in software and technology product design. [1,2,6,8]

We chose the PDS for several reasons: we could interact with a group of users in the span of a few hours; we could gather data about target users' lifestyles through conversations and stories shared about health, fitness and wellness products; and we could quickly assess the desired product functionality by showing participants features that were feasible to create in time to market.

Figure 3. Participatory Design Session.

Self-documentation exercises are used to get information about the perceptions; beliefs and habitual activities of target users, by having them document and describe what they find important. The use of these kinds of exercises, although new, has been valuable in identifying new product opportunity areas. [3] For the self-documentation exercises, we issued our potential audience logbooks and disposable cameras, asking them to write about life goals they were currently trying to attain, to define what health, wellness, and fitness meant to them, and to catalog products that they relied on daily.

We chose the self-documentation exercises because they would give detailed data without needing a researcher present to facilitate data collection. In addition, they gave

us good product descriptions and detailed information about user-product interactions.

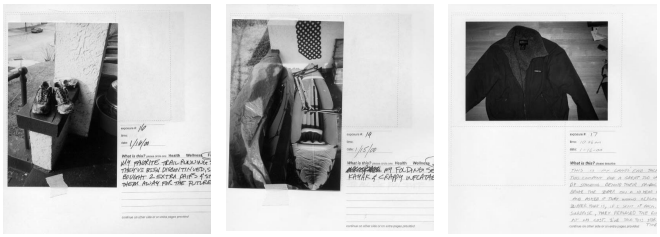

Figure 4. Self-documentation Exercises.

Interviews are detailed, one-on-one conversations that take place in the context of where a participant lives or works. Although a protocol is developed for qualitative interviews, it is often used for thematic, rather than specific, guidance. We chose to do one-on-one interviews to follow-up with specific data on two key themes: privacy and barriers to adoption.

Our first PDS was conducted in Pittsburgh, with four skilled athletes (two male, two female) ranging in age from 29-43. The session took place in one of the participant's homes; all the participants in the session were friends. This was to provide a comfortable environment where people could freely discuss personal health, fitness, and wellness issues.

The sessions ran about three hours in length, and were comprised of four basic sections: introduction, discussions of self-documentation exercises and products (meant to understand target market and lifestyle issues), interactions with prototypes (meant to understand desired functionality as a subset of feasible functionality), and wrap-up. The sessions were videotaped and prototype interactions were documented with a still camera. An initial analysis was performed on the data using keywords coded into a relational database.

In addition to the PDS participants, four additional participants completed logbooks. The second group was comprised of one male and three females, ranging in age from 35 to 60, which exercised moderately but were not considered athletes. The logbooks were converted into digital format. Thematic information was compiled across categories and product interactions were catalogued.

We recruited three participants for interviews, one male aged 40 and two females aged 40 and 55. These participants were new to exercise programs, and answered questions related to health and wellness goals, lifestyle, and the issues of trust and new product adoption.

All participants were pre-screened prior to data collection. We conducted a short telephone interview with them to explain what was going to happen and to get them excited about influencing the direction of our product. We also asked them to bring a favorite product to talk about, and to think of a story about receiving good service and one about receiving bad service. The phone interviews helped construct preliminary profiles, which helped prepare the data-gathering team and inspire the development team before data gathering occurred.

FINDINGS

At the end of the data gathering, we were able to emerge with a shared product story. Due to direct feedback from our potential audience, we had data that clearly supported the mobile and wearable product concepts, reaction to physical prototypes and the product as a "system," and a directed idea of our best target audience.

A shared product story

The research results allowed us to challenge our product vision, and emerge with a shared story about what the product might be. Surprisingly enough, the places where the greatest learning occurred was not related to product form or functionality, but instead to how people would find the product personally meaningful. Three key issues emerged: community, motivation, and personalization.

Figure 5. Paper and foam prototypes used for PDS and interviews.

We found that all of the participants, from novices to expert athletes, relied on a community of practice. For novices, peers were used to maintain motivation and stick to a healthy fitness program; for experts, peers formed communities who spent a significant amount of time together whether involved in physical or social activities. We suspected that community would play a part in how the product fit into consumer's lives, but were not prepared for how important it was to participants. We also found motivation, related to a community of practice, to be extremely important for potential consumers. The product could serve as a motivator when the consumer was isolated from her community; additionally, the product could become a place to share stories, successes, and performance logs.

Finally, participants found the ability to obtain context-sensitive, personalized information about their "own" bodies very compelling. Many expressed that if this system could tailor information to personal needs, it would provide useful information, rather than the overload they experienced on the web. They expressed that they would wear the SenseWearTM products if it told them something "...about me."

> "...I don't want anymore stuff... I don't wanna have to go to a bunch of search engines. But... this is smart, that's good"

> "...links right there that tell me what I don't already know..."

> "...for the me the hook is the personalization…"

> "...it's gotta be my personal data and not some generic calculators…"

Reactions to physical form

A key finding was that our potential users would embrace the mobile and wearable product concepts. The experienced athletes felt a wearable device would be the best way to collect data during workouts, and that real data, rather than calculations based on standard norms, would be the most useful information. All the participants also felt that a wearable device for information display of status would be valuable, although they expressed a need to be able to have hands free access to the display without taking time out from their workouts.

> "I want to see it here, so I know how I'm doing... if I'm in the right range... and if I should keep on going..."

> "If this could tell me things like why I'm lightheaded like I'm dehydrated or something... sure I'd wear it during the day even when I'm not exercising."

All of the physical form prototypes in the session were strongly influenced by the Design for Wearability guidelines. Wearability is defined as the design of the physical shape of the wearables and their active relationship with the human form: "Wearable computer design involves a great deal of compromise, inevitably encountered when integrating issues of human form and human-computer interaction with the constraints of technology and the context-of-use." [4]

Figure 6. Four physical forms presented (wearable armband, mobile handheld, wearable neckwrap, and wearable chest strap)

We learned that what worked best, to get an appropriate level of feedback, were gray foam forms, with minimal functionality and details indicated. At that level of detail, participants could intuit how the device might be worn and predict whether it would be comfortable or intrusive, without becoming overloaded by seeing and imagining the full functionality of the device.

Receptivity to the product as one "system"

Despite the fact that physical form and screen components were presented separately, participants demonstrated no problems in understanding the "product as system" concept. In fact, participants expressed that it was the integration of wearable computers and internet based services that actually made the product meaningful and desirable.

> "...I wouldn't just buy the product or just use the web, it's both pieces that make it really worthwhile and different."

Directed idea of best target audience

Exposure to a variety of participants, from novices to expert athletes, allowed us to have critical discussions about how age and lifestage issues factored into the uptake of the product. We placed potential users in four categories, and focused on two of the four categories as early adopters.

This customer continuum diagram was used as a communicative tool across all roles in the team (figure 7).

Figure 7. Customer continuum diagram used as communication tool for the team.

COMMUNICATING RESULTS

During the data collection, and soon after, we could see a great desire among the shareholders for communicable results. We knew it would be critical to serve the interests of our range of audiences on the team, from interaction designers to product designers, to marketers, senior officers of BodyMedia, and venture capital shareholders.

We found that creating profiles of the participants was perhaps the best way that we communicated findings to the rest of the team. The profiles contained varied types of demographic, lifestyle, and attitudinal information, inspired by "thick descriptions" from work in anthropology and social science. [4]

The profiles took two forms: large mobile boards displayed in shared physical spaces in the BodyMedia offices, and slideshow presentations that were used in meetings, and issued to remotely located shareholders. In addition, we shared the logbooks with members of the internal team. All forms of information served the critical function of allowing the shareholders to get to know their future customers. We knew that we had successfully achieved this goal when team members referred to our participants by name, during meetings to characterize scenarios and inform technical, design, and business decisions.

Figure 8. Mobile Profile boards displayed in the BodyMedia offices.

CONCLUSIONS AND NEXT STEPS

This paper shows that investing time and resources for user research is critical, even when moving at the speed of a startup technology company. Our motivation to find a solution to a difficult problem, our choice of methodology, data analysis, and process of communicating findings enabled our team to emerge with a shared product vision. Our future research will include more user studies, as we make more decisions about the form and features, service component, and brand of our new product.

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