Chapter 5

Methodology Decisions

It’s not high tech. It’s not low tech. It’s the right tech.

— Dr. Dudley S. Childress on designing prosthetic technologies (Stadtmiller, 2005, p. 8)

The previous chapters have provided background on the nature of reading disabilities, assistive technologies for reading disabilities, and the process of assistive technology adoption. This chapter synthesizes the insights from those literature reviews and establishes a direction for research. The first section details the multiple challenges inherent in this research topic. The following section discusses the limitations of several research approaches. Value Sensitive Design is then presented, and arguments are presented for its applicability. The research agenda for the remainder of the dissertation is then described.

1 Research Challenges

The previous chapters focused primarily on presenting background knowledge necessary for understanding the factors that influence the adoption and usage of ATs by people with RDs. At times, issues and topics that posed challenges for research were mentioned. Here, these issues are reiterated and expanded upon.

1.1 Reading Disability Diversity

A clear message of Chapter 2 is the complexity and diversity inherent to reading disabilities. An RD can affect multiple levels of the reading process. An RD may also affect other cognitive tasks, and there are implications socially and psychologically for persons with RDs as well. Moreover, the severity of each RD trait may differ greatly across individuals. While one reading-disabled person may have significant memory and attentional issues but little difficulty with phonetics, another individual’s experience may primarily consist of a severe phonological processing deficit.

The research implication is quite simply that a one-solution-fixes-all approach is unlikely to be successful. Different interventions will be needed for different individuals, meaning more technologies must be available. Diversity of ability and large numbers of available ATs mean that the selection and personalization processes
involved in AT adoption must be conducted with great care. The chances of selecting a tool with poor relative advantage will be high, further increasing the chances of rejection or eventual abandonment.

Diffusion will also be affected by this diversity. Assuming that technologies are actually used in public view (discussed below), the diversity of tools may make it more difficult for awareness to diffuse among the potential user population. It all depends on how the technology is understood or presented. If the tool is framed as phonological processing support, then it will likely only catch the interest of those with a phonological processing deficit. If the tool is instead presented as a reading disability support device, then it may garner the interest of a wider range of potential users.

1.2 Limitations of Current Assistive Technology Options

As already noted, though, the current AT options available are quite limited. Not only do said technologies only address a narrow range of RD-related difficulties, the few tools targetted towards reading tend to focus only on early reading skills and acquisition. This lack of tool diversity has likely fostered a poor environment for AT adoption among adults with RDs. The small number of reading support technologies means that many consumers are unlikely to find a device that offers enough relative advantage or a good measure of compatibility to merit adoption into regular usage. Consumer demand as well may be stunted due to the homogeneity in the options. The available ATs are overwhelming TTS-based, and a reading-disabled consumer may become quickly disillusioned with the possibility of other types of tools being available. Further shopping efforts are then abandoned. Another possibility, though, is that the consumer may seek out and repurpose other technologies as a means of receiving assistance with the reading process. Regardless of the consumer’s actions, the implication of this lack of AT diversity is that participant pools will be small. Furthermore, extreme care needs to be taken when deciding what technologies to study.

1.3 Invisibility and Diffusion

A final challenge to conducting research on AT adoption among adults with RDs is the invisible nature of this disability type. As noted in Chapter 2, Section 4.2.7, the social implications of having an RD leads many individuals to conceal their disability from others. As RDs really only become noticeable during reading-related tasks, a sensible hiding strategy is the avoidance of reading in situations around others. The degree to which this hiding may take varies, and some individuals will choose careers involving minimal to no reading whatsoever. Such individuals are unlikely to have any interest in ATs for reading and would probably be poor study participants.

However, some people with RDs will engage in reading activities for purposes such as school, work, civic engagement or pleasure. If these individuals use ATs to support their reading, where and when they do so will influence diffusion of those technologies. If the usage is hidden, such as in an isolated room or office, then observability will be diminished. Because of such actions, talking about the technology will also be avoided.
Public awareness of the technologies will be extremely limited, thus hindering the communication channels that drive the diffusion. Research efforts should address either the hidden nature of RDs or these barriers to innovation diffusion.

2 Potential Approaches

With these research challenges in mind, a methodological direction can be selected. The challenges need to be satisfactorily addressed while also answering two key questions of this dissertation: (1) what factors influence AT adoption among adults with RDs and (2) how can one best utilize these factors to support the adoption and ongoing usage of these technologies? This section turns to previous AT studies for suggestions of methodological approaches.

2.1 New Technology Development

One obvious direction would be to attend to the dearth of available ATs. The reviews of the literature in earlier chapters suggest several new directions. A new tool could be devised to address an RD trait not currently supported. The SeeWord project (Dickinson et al., 2002; Gregor et al., 2003) did exactly this. Through their own review of RD traits, they identified visual factors of typography as a direction to explore.

Unfortunately, the development and evaluation of a new reading technology would not address the broader questions asked in this dissertation. Although developing more assistive tools for reading is important and likely critical for supporting adoption and usage, there is no guarantee that the technology would be used outside of the research study. Even if a commercial version became available, it is still not known if the factors that prevent adoption and usage are solely issues of the technology. If social and environmental factors are involved, a development and evaluation study would not identify them.

2.2 Participatory Design

Incorporating users into the technology design process may be a means to learn of such social and environmental factors. In recent years, several other assistive technology research efforts have engaged in understanding the interactions between users with disabilities and assistive technologies through the use of participatory design (McGrenere et al., 2003; Moffatt, McGrenere, Purves, & Klawe, 2004; Wu et al., 2005; Massimi, Baecker, & Wu, 2007). Participatory design (PD) is a form of user-centered design that emphasizes involving the users throughout the design process (Floyd, Mehl, Reisin, Schmidt, & Wolf, 1989; Schuler & Namioka, 1993). Working together, technologists and users develop technology decisions though an iterative process of exploration and knowledge sharing. These decisions can take many forms, both intangible and tangible: brainstorming new technologies, formulating plans to address current difficulties, improving existing technologies, and completing the development and implementation of a technology. As PD advocates respect
and mutual understanding for all parties involved, it is particularly appropriate for working with marginalized or disadvantaged groups like people with disabilities (Wu et al., 2005).

Unfortunately, this research approach is perhaps a poor choice for AT development for reading disabilities at this time. One weakness of PD is the difficulty in addressing diversity among the users. Any subset of users with reading disabilities is likely to display a wide and potentially conflicting range of difficulties and needs. Identifying priorities and forming compromises is likely to be difficult and/or lead to ineffective designs (Newell & Gregor, 2000). Previous participatory design efforts for AT development have been stymied in this way (Moffatt et al., 2004; Massimi et al., 2007).

Another challenge is that the type of technology to develop is unclear. In Wu et al.’s work (2005) with amnesia patients, the PDA-based orientation technology they developed was informed by previous effective accommodation approaches. Having a specific task to design a technology towards helps focus the participatory design process. For reading disabilities, however, the existing assistive devices are exceedingly limited. Users in a PD effort may have little to any concept of what an assistive reading tool may be like. Without this foundation, suggesting improvements or new tools is likely to be difficult. To address this, one could engage in a brainstorming-focused participatory design practice like futures workshops (Kensing & Madsen, 1991) to help identify a particular tool to design. However, the diversity of the population again hinders the PD design process.

2.3 Survey of Assistive Technology Usage

At the heart of the difficulties with a participatory design approach is the lack of knowledge about what the technology needs of adults with RDs actually are. What reading tasks do they engage in? What areas of reading are most affected? Have they used any assistive technologies? Why or why not? Are they still using them? What other technologies have they maybe repurposed for supporting their reading efforts?

A large-scale survey would be one means of answering these questions. A survey would provide a perspective on technology usage potentially across a range of demographics, occupations, and RD diversity. Moreover, AT usage surveys do have a rich history in AT adoption research. While surveys by Phillips and Zhao (1993) and others covered a wide range of disabilities types, Wehmeyer (1995, 1998) is one of the few to have focused on a single disability—mental retardation.

Given the prevalence of RDs, conducting such a survey of adults with RDs would appear to be straightforward. However, recruiting survey participants is a key issue. In other surveys, the researchers recruited respondents through disability organizations. For example, Phillips and Zhao contacted disability interest groups and distributed surveys at regional and national conferences. Wehmeyer worked primarily through a large organization concerned with mental retardation to recruit individuals who had a family member with the condition. Similar organizations exist for RDs, such as the British Dyslexia Association and the
International Dyslexia Association. However, these organizations cater mostly to teachers and parents of children with RDs. The actual proportion of reading-disabled adults in these groups is unclear. Moreover, consider again the known tendency for adults with RDs to attempt to leave their condition behind as they move into adulthood. Membership in an RD organization is in tension with this trend. Finding participants may thus be difficult, similar to the difficulties experienced by Johnson as mentioned in Chapter 4, Section 3 (see Table 4.2).

Furthermore, consider what the survey data would provide. Essentially, a survey only provides information asked by its questions. A survey would definitely reveal what ATs are and are not used. However, this binary view of technologies being used or not used neglects the complex process that underlies adoption and could perhaps overlook technologies that have been re-invented as assistive devices (Duwe, 2006). Additional questions would be needed to discover repurposed technologies, such as with the survey by Riemer-Reiss and Wacker (2000). Moreover, a survey may find it difficult to capture the myriad influences that context and task have on technology usage unless it asks questions covering the various possibilities. Such a survey would likely be lengthy and unwieldy. Moreover, asking open-ended or exploratory questions would require the respondents to write out their responses, a potentially difficult task for people with RDs.

2.4 Technology Biography

While surveys offer a broad, generalizable perspective, they lack finer details. A smaller qualitative study can better explore the nuances of AT usage across different tasks, contexts, and devices. For example, a study by Shinohara and Tenenberg (2007) provides a vivid picture of a young blind woman’s technology choices and usages. To gain such insight, they use the technology biography approach in which the user presents and talks about the technologies in his or her life and answers additional questions posed by the interviewer (Blythe, Monk, & Park, 2002). One of the key aspects of the technology biography approach is that the interviewee determines the topics and technologies to discuss, thus highlighting their importance to the user.

For studying technology usage by reading-disabled adults, the technology biography seems advantageous. The approach would not only reveal what technologies are important to the user but also what reading tasks the user regularly engages in. However, such insights are not readily generalizable. A more critical concern is that a technology biography would require a participant with RD who uses at least some ATs. As mentioned earlier, K. Johnson experienced great difficulty in attempting to find just such a participant for a pilot study on AT usage among college students with RDs (personal communication, October 2009; see Table 4.2).

3 A Different Approach: Value Sensitive Design

Of course, any research approach has its limitations. The criticism of potential approaches presented above highlights the complexity and difficulty of exploring this dissertation topic. The research questions are not
simply about what features should a reading-support device have but push deeper and explore the very nature of technology usage among adults with RDs. This suggests a need to go deeper and explore fundamental aspects of technology and culture. At the same time, any research approach should utilize, when possible, the methodologies used in other AT research. Such a framework needs to permit the synthesis of multiple approaches from different disciplines. One such research framework is Value Sensitive Design.

**Value Sensitive Design (VSD)** (Friedman, Kahn, & Borning, 2006) is an established design methodology crafted to explicitly include and account for human values throughout the technology design process. To accomplish this, VSD views people and technology as mutually influential. Social systems shape the development and usage of technology, and technology influences the lives and decisions of people. The VSD framework also brings in concepts, knowledge, and methodologies from multiple disciplines such as philosophy, law, social sciences, and engineering.

### 3.1 Values

A key component of VSD is the concept of values. Throughout history, *value* has been defined in many ways (Friedman, Kahn, & Borning, 2006). For the purposes of VSD, a useful definition is what a person or group of people judge to be important in life. In this sense, a value is not the economic worth or monetary equivalent of an item. Instead, values capture the various standards, philosophies, and principles viewed as key to living life beyond mere subsistence.

Values include both the tangible and the intangible. Easily measured notions such as freedom from physical harm and the right to own property are examples of values. Abstract and moral concepts such as trust, privacy, autonomy, and identity are also considered as values. Differentiating between what is and is not a value is not necessarily straightforward, but one rule of thumb is that a value contains elements of moral or ethical import.

### 3.2 Stakeholders

Another key component of VSD is its attention to *stakeholders*. The term ‘stakeholder’ was deliberately chosen instead of the more common term ‘user.’ First, stakeholder may apply to either a single person or a group or organization. Additionally, VSD takes an interactional viewpoint that argues that society and technology influence each other. Therefore, designers should be concerned with more types of people than just the intended user population. VSD thus specifically distinguishes itself from other user-centered design methodologies (Nesset & Large, 2004; Friedman, Kahn, & Borning, 2006).

In practice, VSD recognizes two types of stakeholders. The first, *direct stakeholders*, are the target users of the technology being designed. The second type of stakeholder are *indirect stakeholders*. These are individuals who are affected by the technology despite never directly interacting with the technology. To understand the difference between the two, consider the patient database software at a hospital. The direct stakeholders are the doctors, nurses, and staff who enter and retrieve information from the database. Patients are indirect
3.3 Tripartite Methodology

An implementation of VSD is thus about identifying the relevant values and stakeholders and understanding how the technology of interest both influences and is influenced by them. This is scaffolded through a tripartite methodology (see Figure 5.1) consisting of three investigations: conceptual, empirical, and technical. Conceptual investigations involve discovering and understanding the values relevant to the matter under study and are informed through studies of ethics, law, and philosophy. Empirical investigations refine the understanding of values and stakeholders through both quantitative and qualitative studies of the surrounding social context and the users’ interactions with the technology. Technical investigations concern the design, performance, and properties of the technology under study and can range from evaluations of preexisting technologies to the development of a new technology.

Although the above description of the three investigations may suggest a linear progression from conceptual to empirical to technical, VSD does not mandate any specified order for the investigations. VSD is an iterative and integrative process. The different investigations may be repeated as is necessary and may occur in any order. Investigations may also overlap in time. For example, an “in the wild” technology deployment may include both an evaluation of the product performance (technical) while also observing the effects it has on the various stakeholders (empirical).

During investigations, techniques specific to VSD may be applied. One common technique is to identify value tensions (Friedman, Kahn, & Borning, 2006). A tension occurs when supporting one value impinges and hinders supporting another and may involve different stakeholder groups. Another VSD technique is to recognize explicitly supported values which are values important to the goals of the designer but may not be
as critical to the stakeholders (Borning et al., 2005). Value dams and flows are another technique that aims to identify values that can either greatly promote or hinder the usage of a technology (Miller et al., 2007). A flow is a value that if handled properly will significantly improve the chances of adoption and usage, while a dam is a value that if handled poorly will greatly impede adoption and usage. Together, these VSD methods (and other methods) refine understanding of the dynamics between technology, society, values and stakeholders.

4 Applicability of Value Sensitive Design

As a research framework, Value Sensitive Design has been previously applied to a wide range of technologies and topics: browser security and privacy (Millett et al., 2001); urban planning and simulation (Borning et al., 2005), and groupware in the software industry (Miller et al., 2007). To the best of my knowledge, Value Sensitive Design has yet to be applied to either assistive technologies or AT adoption. However, multiple reasons motivate its use in this dissertation.

4.1 Interdisciplinarity

One of the clear strengths of VSD relative to this dissertation is that VSD intrinsically embraces working from multiple disciplinary perspectives. Knowledge from any one field is not privileged over another. The tripartite approach integrates multiple research techniques from different fields in a principled manner. Moreover, the focus on values and stakeholders forms an infrastructure to connect and manage the multiple knowledge bases, insights, and methodologies.

The benefit of such an interdisciplinary approach has already been demonstrated in this dissertation. The three preceding chapters showed that a broad array of disciplines were necessary for understanding AT adoption issues surrounding RDs. Education, the science of reading, and disability studies shape the understanding of the disability. Discussions of assistive technologies tapped into these fields and argued as well that there are rich problems for computer science, engineering, and usability studies to tackle. Understanding technology adoption tapped into communication studies and the social sciences. This dissertation has thus already had to integrate background knowledge across multiple disciplines. The usage of VSD techniques will thus further help scaffold such efforts.

4.2 Interactional Viewpoint

Another important strength of VSD is its interactional viewpoint regarding humans and technology. As noted by Friedman and Kahn (2003), different opinions have been expressed as to how humanity and technology influence each other (Latour, 1992; Orlikowski, 2000). The embodied position argues that designers imbue technologies with specific intents and that human behavior is then directly determined by the technologies’ designs. The opposing view, the exogenous position, is that society shapes and forces how a technology will
be used. The interactional position, the one taken by VSD, is that while the design of a technology directs and refines how it should be used, the goals and motives of a user can and may transcend the designer’s intended usage scope. Integrating the insights from both the embodied and exogenous positions, the interactional approach emphasizes understanding the intents and goals of designers as well as the sociocultural and political contexts where the technology is used.

This interactional viewpoint has been embraced already in this dissertation. My PATTC framework looks at the many interactions between technology, people, and contexts. No direction of influence is privileged in this framework. Put simply, social context’s influence on technology usage is just as important as the opposite.

4.3 Technology Diffusion

Similarly, Rogers’s diffusion of innovations (Rogers, 2003) is itself an interactional approach. The relative advantage and compatibility features put into a technology by its designers are critical influences in the adoption process. At the same time, communication and social networks drive diffusion. Technology diffusion is both about what technology can do and the sociocultural factors that shape if and when technology is used. The VSD interactional perspective is well-suited to understanding and supporting the adoption of a technology.

Moreover, some precedent has been set for using VSD to study why technology is used. Miller et al. (2007) used VSD to design and deploy a groupware system for knowledge sharing at a software company. Their intent was to identify the factors that would support or hinder adoption of the system among the company’s organizational levels and groups. Value and stakeholder analyses were used to identify key features needed in the groupware software, and analyses additionally identified how company policies influenced usage decisions. Although their study concerned a single technology in a very specific context, Miller et al. demonstrated VSD’s ability to explore technology diffusion.

4.4 Integration with Disability Models

The interactional approach of VSD is also well-suited to working within disability theory. Two of the dominant models of disability are the medical and social models (Lane, 1997; Clough & Corbett, 2000; N. Matthews, 2009). The medical model frames disability as an aspect of a person—a flaw, imperfection, or problem that requires fixing. On the other hand, the social model posits that disability is just an aspect of human diversity and that most problems experienced by a person with a disability are due to lack of accessibility in the environment or society. Extreme stances have been made by scholars. Some advocate that disability is only a social construction (McDermott, 1993; McDermott & Varenne, 1995; Lane, 1997), while others focus only on the medical aspects of disability (Mobahi & Karahalios, 2005).

It is my experience and philosophy that both viewpoints offer useful insights into disability, an opinion echoed by N. Matthews (2009). In the PATTC framework, knowing about the conditions typical to a disability is useful to a designer, yet a person’s own experience and the context help shape how the disability impacts
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5 Research Agenda

Given the aforementioned applicability, Value Sensitive Design is the primary research methodology for this dissertation. Specific research approaches and decisions can be made towards answering the two key research questions. What factors influence the adoption of assistive technologies by adults with reading disabilities? Additionally, how can one support and promote the adoption and usage of said technologies?

5.1 Frameworks

By choosing Value Sensitive Design as the overarching research framework, the nature of the research is focused on human values and how they influence and are influenced by technology. A wide view of stakeholders is also taken, thereby considering effects beyond those experienced by just end users. Specific studies and inquiries are framed in relation to the tripartite methodology. The research agenda is further refined through the use of two other frameworks: PATTC and Rogers’s diffusion of innovations.

5.1.1 PATTC

The PATTC framework provides further support and insight due to its origins in studies of AT adoption—an aspect not shared by VSD. PATTC is primarily used to constrain the scope of the research by specifying some of the components while keeping others open. This instantiation is shown in Figure 5.2.

Given the focus on ATs for people with RDs, Person and Ability are obviously constrained to people with reading disabilities. However, Person is further refined to focus on adults with RDs, with a particular emphasis on people enrolled in higher education. The focus on adults is in response to the previously noted lack of ATs for that age group. The additional emphasis on postsecondary education is motivated by several reasons. First, students with RDs are estimated to comprise nearly 50% of university students with disabilities (L. Lewis et
al., 1999), indicating a large population of potential AT users. Being enrolled in educational programs also helps ensure that these individuals frequently engage in reading. This is a concern given that research suggests people who struggle with reading when young tend to read less as adults (Cunningham & Stanovich, 1997; Edwards, 1994). Additionally, the age of this population tends towards being young. These individuals will have more experience with using digital technologies. Moreover, many of these university students are at a transitional stage of maturity—becoming more and more responsible for personal decisions. For students in K-12 in the United States, the Individuals with Disabilities Education Act (IDEA) (1997) holds schools responsible for providing disability services to students with disabilities. Upon graduation, the student falls under the auspices of the Americans with Disabilities Act (1990; 2008) and is now personally responsible for requesting accommodations. Thus, this age group is at a critical time of development during which AT benefits and hindrances are likely to be evident (Scott, McGuire, & Shaw, 2003; Cory, 2005; Burgstahler & Cory, 2008).

Further constraint is found with the Task concept of the PATTC framework. Only tasks involving reading are considered, but this is still a broad category. What reading activities are engaged in by adults with RDs is open for exploration. For this reason, both informal (e.g., reading the newspaper, surfing the web, enjoying a novel) and formal (e.g., class assignments, work, legal) are of research interest. Coupled to this are the constraints placed on Context. Only contexts in which reading may occur are considered. What these contexts are, however, is uncertain and thereby also open for study.

Finally, the Technology concept is kept open and is abstracted to the notion of a reading widget: a digital device designed to support the process of reading. The only assumption is that a user with an RD chooses to use the device. The widget’s actual features, function, and form factor are intentionally ignored. Abstracting away the details of the device avoids getting bogged down in the specific features of a device, thereby emphasizing the relationships between the device, the user, and the relevant social contexts. This abstraction also readily allows for the consideration of both existing and future ATs.

5.1.2 Diffusion of Innovations

Rogers’s diffusion of innovations is another important component of this research. Particular interest will be placed on known influences on adoption. One of these is the notion of compatibility. Understanding the tasks and goals of the user are key for designing reading widgets that mesh well with the users’ lives. However, VSD’s emphasis on indirect stakeholders suggests other aspects of compatibility to explore. For example, depending on the usage context, the reading widget may need to meet the values and practices of others in that context. This could include policies at school or a place of work.

Observability and communication channels are two other important aspects from Rogers’s model of concern in this research. Understanding the values that influence public usage of reading widgets is necessary
for understanding diffusion. The nuances of when, where, and why adults with RDs choose to disclose or hide their RDs must also be investigated. The communities that reading-disabled adults participate in are also important. Not only are these communities important for facilitating diffusion, they also contain the various stakeholders and value systems that shape and are shaped by technology usage.

5.2 Studies and Analyses

With the frameworks settled upon, the remainder of this dissertation discusses various studies and analyses I performed. In line with the VSD approach, the methodologies are presented in terms of the tripartite methodology. Although the following descriptions are presented in a linear fashion, considerable overlap existed among the investigations.

5.2.1 Conceptual Investigations

VSD studies begin with the initial identification of relevant values and stakeholders. Previous studies have typically begun this identification with a conceptual investigation, although nothing would preclude using an alternative investigation. This effort follows previous practice, though, and engages in such a practice in the next chapter. Stakeholders and values are identified using a thematic literature analysis. Value tensions, dams and flows, and explicitly supported values are also initially explored.

5.2.2 Empirical Investigations

Two empirical investigations are then presented that support and refine the initial value analysis. Online discussions about reading disabilities and technologies gathered from discussion boards and newsgroups are analyzed in Chapter 7. Case studies of adults with reading disabilities and the technologies in their lives are presented in Chapter 8.

5.2.3 Technical Investigations

Three technical investigations follow and conclude the research conducted for this dissertation. The value and stakeholder analyses are used to evaluate existing ATs in Chapter 9. General design guidelines are imparted in Chapter 10. Chapter 11 then provides a detailed blueprint for a reading widget that I hypothesize would help address the various value concerns and design guidelines from the previous investigations/chapters.

6 Chapter Summary

Research methodologies for the remainder of the dissertation were discussed in this chapter. After specific research challenges were elucidated, previous methodologies in AT research were found to be not sufficient. Value Sensitive Design was introduced and established as a strong approach for studying AT adoption among adults with RDs. A specific research agenda was then established using VSD, PATTC, and diffusion of innovations as frameworks.