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Human Technology: An Interdisciplinary Journal on Humans in ICT Environments

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From the Editor in Chief**THE CONCEPTUAL LEVELS AND THEORY LANGUAGES OF
INTERACTION DESIGN**

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In a way, concepts are like friends. Tell me what your concepts are and I can tell what you are. Modifying freely the way Wittgenstein (1921) expressed this important Kantian (1781) point on the limiting power of concepts on one's thinking, the concepts that human–technology interaction designers of different scientific backgrounds use differ from each other and, consequently, they are apt to solve the same tasks in different ways.

Theoretical concepts constrain the kinds of questions specialists can ask and what kinds of things they are interested in. Thus programmers have a different view of users than do psychologists or sociologists. Just as a lay person can understand little about ventricular tachycardia and cannot ask meaningful questions concerning this phenomenon, so an interaction designer with little psychological knowledge cannot know deeply the relevance of the Big 5 personality traits in interaction design. This way in which concepts function in critical thinking has been known for a very long time, and remains important in interaction design since the problems and innovations of this field can be approached by people who have very different disciplinary and conceptual backgrounds.

While the power of concepts in shaping human thoughts has been known for centuries, I have seldom seen its practical consequences considered in interaction design. In this multidisciplinary field, the differences between the various special design languages have not often been addressed, even though concepts form the foundations for the various design languages. All hypotheses and solutions are drawn from concepts either explicitly or implicitly; thus, the contents of concepts define the contents of one's speaking and thinking. Of course, concepts are not cut in stone but, rather, they are dynamic and versatile. While concepts can be formed on the spot, they grow from or respond to some other system of concepts, that is, perspectives needed to be able to formulate propositions or thoughts (Wittgenstein, 1958).

The point of this editorial, however, is to acknowledge that many problems in design and human–technology interaction arise when designers and programmers, among others, attempt to solve specific problems using concepts inadequate for solving those particular problems. One cannot program with only philosophical concepts just as one cannot conduct a user psychological investigation using only concepts from the information systems sciences.

Therefore, one must critically look at which theory languages are appropriate in solving the defined problems. All too often, however, one can observe designers moving outside the limits of their specialization and using what they consider to be common sense in solving problems, solutions that would have been easily achieved with adequate background knowledge in, perhaps, a different conceptual system or discipline. For example, a designer with an engineering background thinking about the emotional and artistic aspects of a design will most probably miss many points that would be obvious to a person with an in-depth understanding of emotions and emotional design.

The field of human–technology interaction includes many different interaction design languages, each with its respective conceptual systems and its own scope and limitations. For example, languages that address the physical or chemical aspects of design provide us tools to address one type of problem. What would be the best way of creating a touch screen which can withstand 300 degrees? Which level of electricity should be used to make text on a computer monitor visible in full sunlight? Without a doubt, this kind of discourse is vital in developing interaction technologies in regard to specific goals, but it is not the only one.

Somewhat different design languages are provided by mathematical machine concepts. For example, Turing’s language describes the commands and the symbols manipulated by the commands in computational devices. The language also may describe the controls and related operations in traditional machines. This language, then, defines what a machine as a system can do.

A different language, however, is applied when we describe the people who interact with computational machines, that is, the users, who have to be able to tell the machine in its unique language what the machine should do. Users decide which instructions are important in one situation and which in another. This means that designers have to define what is relevant from a human point of view. The users’ concern is to understand which button to use, when and how, to get the machine to behave as they want. Therefore, we need a different theory language, one that could be called the *language of use or usability*. This distinct language is as relevant a language as any more technical design languages. For those who doubt this assertion, they should think how considerably more difficult it would be to communicate with a machine in the machine language.

Art design is today recognized as a central element in technology design. Art designers consider the diverse range of the users’ experiences, and thus their work intends to facilitate users liking what they do with the devices and programs they use. Of course, they normally have to solve many issues in collaboration with usability specialists. Nevertheless, the language of art design, as do most other “technology languages,” involves a great deal of tacit rather than explicit knowledge, and opens its own discourse in interaction design.

However, the language of usability or the language of art design is not the same as the language of human–technology interaction. In the usability language, for example, users hold goals for their interactions with machines. They reach those goals by pushing buttons that send signals to sensors, using a microphone, touching a screen, or twisting a control knob—physical actions that result in a reaction by the machine. The basic point is that these operative actions “tell” the machines what the human expects as the outcome of his/her action. The machine cannot “know” what is important to the user: Machines are inanimate and thus without independent goals and intentions. Therefore, designers need a language of human intentions and actions in order to direct machines to act and react in line with human expectations.

Furthermore, the analysis of actions and goals opens immediately a need for another language. On a general level, this language could be perceived as the language of life: Human–technology interaction design is simply addressing what people can and want to do with technology, but also includes the “why” behind the use of a particular technology. Designers have to seek out and consider the motivations for a human being to push a button, to learn how to do it, and to like doing it. They have to ponder the place and role of a technology in a human’s life. These are essential bits of knowledge because technology receives its justification for existence from human life. The effort people invest in technology is motivated by the expectation that it will make life easier.

For this reason, the field of human–technology design needs new theory languages that will help designers and researchers to position technology within the diverse tapestry of human life. These languages would provide the capability to analyze human life and to position technologies in a way that advances life. They would facilitate designers in determining the worth of a technology for people or its ethical value (Cockton, 2008). They also would provide the possibility for designing technologically supported action before the technology exists to realize the goal (Leikas, 2009).

The last condition might seem a bit impractical to some people: How is it possible to design technologies before they have been engineered? Yet Jules Verne and Leonardo da Vinci did precisely that long before it was possible to physically create their technologies. Verne set the concept of a submarine within its place in life decades before anyone could construct such technology. In the 21st century, a good theory-language could make similar design concepts, but based on more solid scientific grounds than those artists from centuries past.

Concepts are ubiquitous. A person can remove him/herself from friends for a time, when needed, but concepts accompany us everywhere. Thus, it is essential to consider seriously their role in one’s life and worthwhile to investigate the limits these conceptual systems bring to one’s perspectives on and decisions in living and interacting. The goal, of course, is to extend them, to find new ways of seeing people, places, and things, and new ways of experiencing one’s own actions. It is worthwhile assessing critically the limits one’s conceptual systems places on the ability to create new concepts and theory languages (Saariluoma, 1997) and innovative solutions to contemporary technical challenges.

Concepts and their respective theory-languages are like tools, as Wittgenstein (1958) so clearly understood. We use saw to cut a tree but need a hammer to hit nails into the tree’s wood. With appropriate and diverse tools, it is possible to work in a very holistic manner in solving the challenges of interaction design. However, designers today, for lack of suitable languages, have to hammer nails with a saw. Such a case is even more likely when programmers are more or less forced think and produce based solely on their own intuitions, when in fact their products should be placed in life amid complex issues such as individual preferences and capabilities, and cultural differences.

It is easy to forget that in solving design problems, the designer must explicitly or implicitly resolve all the task-necessary problems, whether or not the designer is a specialist in all aspects of the design challenge or possesses the required theory-language. Ever since the Stone Age, problems in the levels of interaction design languages have existed. A hand stone used to carve animal woodwork was designed to make the task easier. The stone tool had its ergonomic aspect, its place in life, its material, and its forms. Sometimes it even had its artistic design. Nevertheless, the caveman faced the basic challenges of tool design that

arose from amid the nature of human life and action. That reality remains these millennia later, and, like our ancestors, we have to solve design problems on each conceptual level. To do this, we either draw on our everyday intuitions or we develop our conceptual systems. These are the options available to us in addressing as the basic problems of interaction design that will always be around.

When a designer realizes that design presupposes the use of various conceptual systems, with their associated languages, and that a good design practice unifies these into a whole that eventually solves the challenge at hand, he or she will then logically ask, “How do I unify the different conceptual levels?” This simple question serves as the first step toward the realization that people with different theoretical backgrounds speak differently but equally about unavoidable things.

In the field of human-technology interaction, the human end of the spectrum has been central. The papers published so far have very clearly shown the complexity of the systems of theory-languages people use in investigating ICTs today. The same is true for the papers included in this issue of *Human Technology: An Interdisciplinary Journal on Humans in ICT Environments*. These papers have been written from different specializations. In our first paper, **Lamminen, Leppänen, Heikkinen, Kämäräinen, and Jokisuu** bring in the information systems scientists’ point of view to the analysis of usability. They introduce a new semiautomated quantitative evaluation method for locating Website usability problems through the criteria of search time and search success. **Oinas-Kukkonen and Kurki** explore the perceptions, practices, and experiences of children’s use of the Internet, a different sociological perspective and language than compared with the questions approached from an adult user’s conceptions. The authors find that nine of ten children are regular users of the Internet, but Internet use differs by gender, with girls using the Internet for social interaction and boys for game playing.

Short and McMurray address to the important problem of harassment by way of the mobile phone texting, involving a psychological and sociological viewpoint. In a study that presented vignettes to students taking on, separately, the role of sender and receiver, these researchers find that harassment, as defined in terms of frequency and time, is more prevalent via texting than by other technologies or off-line behaviors, but appears also to be more accepted, despite reports of its distressing nature. Next, **Olatokun and Adeboyejo** explored technology use by reproductive health workers (RHWs) at a university hospital in Nigeria, drawing on concepts of medical care and information systems sciences, usability, and sociology. They find that while progress has been made over the last decade in some areas regarding the implementation of various ICTs in the work, research, teaching and professional development of RHWs, much still needs to be done to increase access to and application of ICTs in the daily responsibilities of the RHWs and to eliminate the digital divide among developed and developing countries. Finally, **Dolezal** considers the function of phenomenological theory-languages in interaction analysis and design from a philosophical perspective. She explores the concept of the body as it relates to telepresence and re-embodiment, particularly in the growing practice of telesurgery, in which the patient and the surgeon are geographically separated. Each of the papers illustrates how different specialists can shed light onto very different aspects of the modern problems in the field of interaction between people and technology.

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A QUANTITATIVE METHOD FOR LOCALIZING USER INTERFACE PROBLEMS: THE D-TEO METHOD

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Abstract: *A large array of evaluation methods have been proposed to identify Website usability problems. In log-based evaluation, information about the performance of users is collected and stored into log files, and used to find problems and deficiencies in Web page designs. Most methods require the programming and modeling of large task models, which are cumbersome processes for evaluators. Also, because much statistical data is collected onto log files, recognizing which Web pages require deeper usability analysis is difficult. This paper suggests a novel quantitative method, called the D-TEO, for locating problematic Web pages. This semiautomated method explores the decomposition of interaction tasks of directed information search into elementary operations, deploying two quantitative usability criteria, search success and search time, to reveal how a user navigates within a web of hypertext.*

Keywords: *D-TEO method, usability, quantitative method, usability testing, log-based evaluation.*

INTRODUCTION

In the last two decades, the World Wide Web (Web) has become one of the most important means of disseminating and searching for information. Companies, government agencies,

municipalities, communities, and individual persons maintain a plethora of Web sites on the Internet, Intranets and Extranets, and the number of sites is increasing explosively (see Netcraft, 2009). Examples of drivers fueling this progress are eGovernment initiatives and programs that foster more efficient and effective provision of government services through the Internet (Cordella, 2007; Wolf & Krcmar, 2008). Web sites are often so large and lacking integration that finding a desired piece of information appears to be quite difficult and time consuming. It is not atypical that users become disoriented and “lost” in this hypertext world (Dillon, McNight, & Richardson 1990). The primary reason for these kinds of problems stem from poor design of Web sites (Nielsen, 1993).

Various principles (e.g., Nielsen, 1993; Schneiderman, 1998; Tidwell, 2005), techniques (e.g., Goldberg, Stimson, Lewenstein, Scott, & Wichansky, 2002), and methods (e.g., Beyer & Holtzblatt, 1998; Mayhew, 1999) have been developed for designing Web sites to satisfy usability criteria. *Usability* means “the extent to which a product can be used by specified users to achieve specified goals with effectiveness, efficiency, and satisfaction in a specified context of use” (International Organization of Standards [ISO], 1998). In our case, the *product* is a Web site composed of Web pages. Beyond the criteria indicated in the definition by ISO 9241-11 (1998), usability is seen to embrace other criteria, such as ease of learning, error rates, memorability, reliability in use, retention over time, throughput, and so on (cf. Constantine & Lockwood 1999; Nielsen, 1993; Preece et al., 1994; Schneiderman, 1992; Seffah, Donyaee, Kline, & Padda, 2006; Shackel, 1991; Wixon & Wilson 1997).

There is also a wide array of techniques (e.g., Chi et al., 2003; Paganelli & Paternò, 2002) and methods (e.g., Blackmon, Polson, Kitajima, & Lewis, 2002; Card et al., 2001) for evaluating and testing Web sites. The objective of carrying out an evaluation can be to test whether a design is appropriate, to compare alternative designs, or to check conformance to a standard (Lecerof & Paternò, 1998). Commonly applied methods are heuristic evaluation, usability testing, and log-based evaluation (cf. Matera, Rizzo, & Carughi, 2006). In a *heuristic evaluation* (Nielsen & Mack, 1994; Nielsen & Molich, 1990), the usability problems are identified in a heuristic fashion by a usability expert. The main concerns about a heuristic evaluation are that it does not include the actual end users (Nielsen & Mack, 1994) and the number of expert evaluators is often too low (Cockton & Woolrych, 2002). In *usability testing* (Dumas & Redish, 1993), the participants represent real end users and everything that they do and say during the usability test is observed and recorded. After the usability test itself, the data are analyzed and suggestions to eliminate the problems are proposed. The concerns regarding usability testing are that this process is based only on observational data and that user interface experience is needed to be able to interpret the data (Lecerof & Paternò, 1998). There is also the problem of cost and the time of the users and the observers (Lecerof & Paternò, 1998). In *log-based evaluation*, information about the performance of the users is collected automatically and stored in log files (e.g., Lecerof & Paternò, 1998). A benefit of this method is that large amounts of data can be collected in an exact form and with reduced work and cost (for more benefits, see Ivory & Hearst, 2001). The weak points of the method are that some handwork (e.g., adding code to the target system) is needed and the use environment is typically restricted to certain applications (Scholtz & Laskowski, 1998).

Usability evaluation and testing apply both qualitative (e.g., user satisfaction, easy to use) and quantitative measures (Mayhew, 1999; Stone, Jarret, Woodroffe & Minocha, 2005; Wixon & Wilson, 1997). The most common quantitative measures are task completion time, the

number of errors, and the success or failure in executing the tasks (e.g., Martin & Weiss, 2006; Masemola & De Villiers, 2006; Nielsen, Overgaard, Pedersen, Stage, & Stenild, 2006). Typically, values derived from the evaluations are compared to the predefined target values. The number of failed and successful attempts and the total number of attempts in each task are used to find out how difficult the task is. Masemola and De Villiers (2006) also use log files to record the number of mouse clicks. Others have combined quantitative measurements with qualitative evaluation to identify usability problems and evaluate the number and severity of the problems (e.g., De Angeli, Sutcliffe, & Hartmann, 2006; Duh, Tan, & Chen, 2006; White, Wright, & Chawner, 2006). Freeman, Norris, and Hyland (2006) have evaluated the navigation processes with the aim of getting a more accurate picture of a product's usability, particularly its efficiency (see more about evaluation methods in Ivory & Hearst, 2001).

Making a careful and in-depth usability evaluation of a large Web site requires significant time and resources (Dumas & Redish, 1993; Mayhew, 1999; Nielsen, 1993). Unfortunately, these often are not available in most situations. Therefore, there should be some means to first distinguish those parts of a Web site that seem to be more problematic, so that scant resources can be applied directly to a deeper evaluation of these areas only.

We propose a novel usability testing method, called D-TEO (Decomposition of Tasks into Elementary Operations), that aims to locate usability problems in the information search process in Web sites. The basic idea in D-TEO is to decompose a user task into elementary operations and define, for each task, an optimal navigation path composed of operations. In order to satisfy usability requirements, the structure and contents of a Web site should guide the users to find the optimal paths and to follow them efficiently. D-TEO helps identify Web pages that cause problems for the users and, based on this information, usability designers can focus their attention on these pages specifically.

This paper is organized as follows: In the next section, we define basic concepts related to Web sites, user tasks, information search, and search metrics. In the following section, we describe the proposed method. Later, we provide an example of the method in use, and then offer a short comparative review of related works. The final section presents a summary and conclusions.

BASIC CONCEPTS

Web Sites and Web Pages

A *Web site* is a collection of Web pages that is hosted on one or more Web servers. A *Web page* is a hypertext document, typically written in HTML or XHTML format. *Hypertext* involves data that are stored in a network of nodes connected by links. The interconnecting nodes form an interdependent web of information that is nonlinear. The nonlinearity enables great flexibility in the selection of information, but at the same time increases risks of disorientation.

There are two primary hypertext topologies (Batra, Bishu, & Donohue, 1993; Bernard, 2002). In the *strict hierarchical structure*, nodes are grouped in a hierarchical arrangement, allowing movement either up or down, but only one level at a time. In the *network topology* it is possible, in the most extreme case, to move through so-called referential hyperlinks from each node to every other node. Between these two types of topologies, there are mixed hierarchies, which allow limited movements from nodes to some other nodes at different levels within the structure.

A Web page consists of *user interface components*, such as titles, text boxes, data fields, tables, check boxes, radio and control buttons, menus, text links and image links, icons, forms, frames, and scroll bars. A user is allowed to make selections through menus or buttons, thus triggering the transmission of requests to the Web server to return the desired information in a new Web page. In the traditional Web application, communication between a client and a Web server is asynchronous, and the whole Web page is returned. In rich Internet applications, communication is synchronous and only part of the Web page can be substituted by a new one (Paulson, 2005; Preciado, Lanaje, Sanchez, & Comai, 2005).

User Actions, Tasks, and Operations

A user deploys an application as an instrument in order to improve his/her abilities to carry out some action (Saariluoma, Parkkola, Honkaranta, Leppänen, & Lamminen, 2009). *Actions* are composed of four kinds of tasks (Lecerof & Paternò, 1998). A *user task* is an action that is exclusively performed by a user, that is to say, without any interaction with the application. An *application task* is completely executed by the application. An *interaction task* is performed by the user interacting with the application. An *abstract task* requires complex actions whose performance allocation has not yet been decided. From the perspective of this paper, we are interested in interaction tasks. They can be further divided into categories, depending on the types of tasks the application makes: information search, on one hand, and information insert, update, and delete, on the other hand. Here, we only consider information search.

The tasks can be at different abstraction levels, ranging from high-level tasks to very low-level tasks. An execution of a task necessitates that all of its subtasks are carried out in a predefined manner. Decomposing a task into subtasks establishes a hierarchical tree in which subtasks on the lowest level are called *operations*; these elementary tasks focus on a single user interface component (e.g., the OK button). The execution of an operation triggers the transmission of a request to the Web server to search for the desired information and return it in a new Web page. An operation can also return a previous page (i.e., back-page button).

Information Search

Web sites show up as webs of hypertext that contain information of interest to the user. Information can be searched for in two ways (Bernard, 2002). The first type is a *directed search*, also called explicit search (Norman & Chin, 1988). The purpose of this type of search is to acquire specific information about a target item (e.g., find the title of the 1953 film that starred Audrey Hepburn and Gregory Peck). The second type is an *exploratory search* that involves the broader goals of finding and integrating information from various nodes in a web of hypertext. This is also called browsing (Canter, Rivers, & Storrs, 1985). A user explores the hypertext by continually refining his/her search until the information goal is satisfied. An example of this kind of search is “Compare the movies *Independence Day* and *Sleepers* by using the information the MovieGuide can give you” (Bernard, 2002). An exploratory search takes more time and causes disorientation more often, partly because it poses more cognitive burden (Kim & Hirtle, 1995; Norman & Chin, 1988; Smith, 1996). We focus on directed searches in this study.

A page containing the target item is called a *terminal node*. Information search proceeds from an entry node to the terminal node through hyperlinks. The shortest route to the specific

terminal node that satisfies a search task is called an *optimal path* (Bernard, 2002; Gwizdka & Spence, 2007; Norman & Chin, 1988). The length of the path depends on how many nodes (Web pages) have to be visited during the search. In a Web site following a mixed or network topology, there may be several optimal paths for one information search.

Metrics

How effectively and efficiently a desired piece of information can be found is influenced by several factors, including size of the web of hypertext, the breadth and depth of hypertext topology and its compliance with the users' mental models, the visualization of Web pages, the understandability of terms used in Web pages, and so on. Generally speaking, the effectiveness and efficiency of the search task depend upon the usability of a Web site. The literature presents a large variety of definitions and taxonomies for usability (e.g., Constantine & Lockwood, 1999; ISO, 1998; Nielsen, 1993; Preece et al., 1994; Schneiderman, 1992; Shackel, 1991). It goes beyond the scope of this paper to discuss them in more detail (see the analysis by Seffah et al., 2006). Therefore, we quote ISO 9241-11 (1998), which distinguishes between three main usability attributes: effectiveness, efficiency, and satisfaction. We are particularly interested in search efficiency.

Search efficiency is commonly measured in terms of search time, navigation accuracy, lack of disorientation, and success in finding the desired page. For instance, Bernard (2002) defined timed accuracy as the number of times a user fails to find the correct terminal node. Search efficiency is measured by examining the number of deviations from the optimal path and by the number of total back-page presses used in reaching the targeted node. Search time means the time taken to correctly complete the given task.

Our metrics of search efficiency is composed of two criteria: search success and search time. *Success* measures the extent to which a user follows the optimal path when he/she is carrying out the task. Deviations from the optimal path, or back and forth movement in the path (e.g., through the back-page button), decreases the measure of success. Usage of the back-page button suggests uncertainty in the navigation paths taken (cf. Norman & Chin, 1988). *Search time* represents the time that it takes the user to complete the task from start to finish. Since a task is decomposed into elementary operations, it is also possible to measure the time required to carry out an operation, that is, how long from the end of one operation to the end of the next operation. For each of these two criteria, a set of measures were defined and used.

METHOD

This section describes the proposed method for locating problems in Web pages. We first describe the objectives and application domain of the method. Then, we detail the steps of the method.

Application Domain

D-TEO is a usability testing method for revealing problems in user navigation in Web sites. The Web sites can be either in the prototype phase or in production. The basic idea underlying the method is to examine how closely a user follows the optimal paths and how fast he/she performs the given interaction tasks. Deviations from the optimal path and/or

delays in executions indicate problems that should be examined more closely with some other usability evaluation methods (e.g., heuristic methods).

The D-TEO can be integrated into a Web application development method or a hypermedia development method. The literature provides a large variety of these kinds of methods (e.g., OOHDM, Rossi & Schwabe, 2006; RMM, Isakowitz, Stohr, & Balasubramanian, 1995; IDM, Lee, Lee, & Yoo, 1998; W2000, Baresi, Garcotto, & Paolini, 2001; UWE, Hennicker & Koch, 2001; WHDM, Lee & Suh, 2001). For example, within the WHDM method, the D-TEO technique can be deployed to test prototypes produced by the design activities of navigation design and interface design.

Steps

The D-TEO method is composed of four steps: (a) define the goals of the test and the user profiles, (b) devise the test tasks and identify the optimal paths, (c) organize the test and collect data, and (d) analyze the data and make the conclusions (Figure 1). In the following subsections, the steps are described in more detail.

Define the Goals of the Test and the User Profiles

The use of the method starts with defining the goals for the test at hand. The goal statements should describe which subset of the Web pages should be tested, which pages in this subset are particularly important, and how the results from the test are to be utilized. The goal setting is affected by whether the Web site is in the prototype phase or already in use, and the reasons triggering the test. In order to define the user profiles, it is important to identify the audience at whom the Web site is targeted. Conducting a survey or interviews among the current and potential users helps to define the typical characteristics (user profiles) of the primary user categories in terms of their skills, motivations, experience, and so on (e.g., Mayhew, 1999).

Decisions regarding which user groups, and to what extent, are included in the test are based on the goals of the test and the resources available.

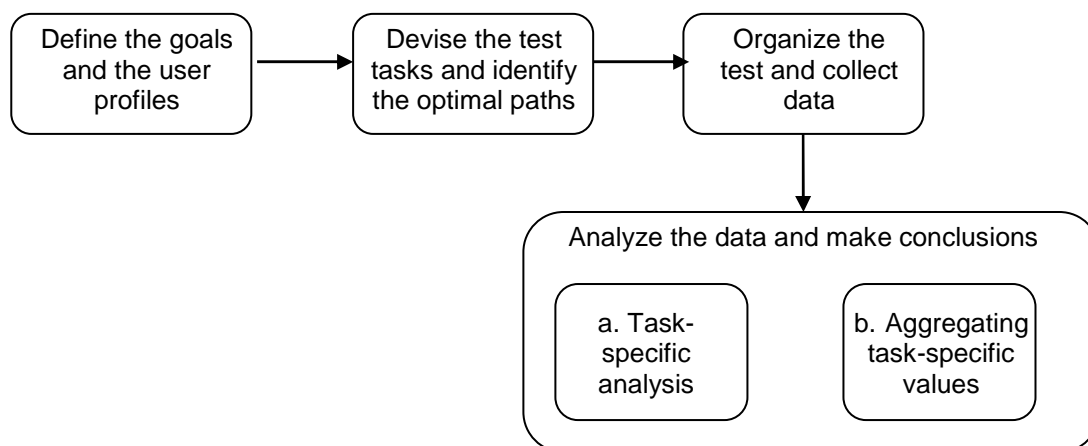


Figure 1. The steps of the D-TEO method.

Devise the Test Tasks and Identify the Optimal Paths

A *test task* is a typical interaction process carried out by a person representing an appropriate user profile. In order to devise a set of relevant test tasks, the overall structure of the Web site has to be outlined and typical interaction tasks should be recognized through a task analysis. If there is a site map describing the Web site, it can be used to ascertain that the test tasks cover a sufficient number of Web pages. Whether the coverage is sufficient or not is determined based on the goals of the test. As an example, let us assume that one of the test tasks is as follows: “There is one ringette team in the Jyväskylä region. What is the name of this team?”

After specifying the test tasks, they are decomposed into operations. As defined above, an operation is an elementary task that focuses on a single user interface component. To establish decomposition hierarchies of test tasks requires that those responsible for testing have good knowledge about the topological structure of the Web site and details of page visualization. For each test task, it is determined which Web pages should be visited and what operations should be performed, in order to reach the terminal page containing the desired piece of information. The shortest path from the entry page to the terminal page is an optimal path. Because the method is intended for testing directed searches, typically only one, or just a few, optimal paths exist for each test task. If there are several paths with the same number of operations, these paths are analyzed as equals.

As an example of the optimal path, let us consider the test task introduced above. For purposes of analysis, each Web page involved by the test tasks is coded with a number reflecting its position in the hierarchical structure of the Web site. By doing so, we have found the optimal path for this test task is as follows:

$$0 \rightarrow 4 \rightarrow 4.11 \rightarrow 4.11.4 \rightarrow 4.11.4.3.$$

In this coding, 0 means the Entry page, 4 refers to the page Services, 4.11 represents the page Sport (under the Services page), 4.11.4 means the Sports Clubs page (under the Sport page), and finally 4.11.4.3 refers to the page containing the information about the ringette team. The optimal path can be described as an ordered set of numbered Web pages visited. It also shows the operations a user must follow in order to complete the test task. The marking $p_i \rightarrow p_j$ denotes the operation by which a user navigates from one Web page (p_i) to another (p_j).

Organize the Test and Collect Data

The test participants are selected to meet the stated goals of the test and the defined user profiles. The number of participants can vary, depending on the goals of the test. Nielsen and Molich (1990) state that 50% of the most important usability problems can be identified with three users. Other authors claim that five users facilitate the discovery of 90% of the usability problems (e.g., Virzi, 1992).

The test tasks are given to the participants on a sheet of paper. No discussion between a participant and the test facilitator is needed during the test. The test equipment should record, with time stamps, all the actions the participant makes and all the Web pages he/she visits. In addition, the test facilitator can make notes on the behavior of a participant, which can be used later in the analysis of time stamped data. This is, however, optional.

To illustrate the data that is collected, let us continue with our previous example. The optimal path was defined as: $0 \rightarrow 4 \rightarrow 4.11 \rightarrow 4.11.4 \rightarrow 4.11.4.3$. Table 1 depicts the unprocessed data collected about operations by three test participants (P1-P3).

We can see in Table 1 that participant P1 followed the optimal path and successfully completed the test task. Participant P3, on the other hand, carried out the operation $0 \rightarrow 4$ successfully but failed to execute the operation $4 \rightarrow 4.11$ (see 00 in Table 1). He/she also failed to complete the operation $4.11 \rightarrow 4.11.4$ and interrupted at 10:23.

Analyze the Data and Draw Conclusions

The collected data is processed and analyzed in two phases. First, the measure values for single tasks and single participants are derived and analyzed. After that, the operation-specific values are aggregated to concern all the tasks and participants. Based on these analyses, conclusions are drawn.

a. Task-Specific Values

The D-TEO method deploys metrics derived from two evaluation criteria, success and search time (see above). The metrics for task-specific analysis comprise two measures, success value and duration time. These are elaborated here.

For each task, and for each participant, the next questions are considered:

- *How successfully did the participant navigate from one Web page to another along the optimal path?*

This is measured by *Success Values (SV)* that are derived by the following rule: If an operation in the optimal path was carried out in the first attempt, then $SV = 1$ for that operation; by the second attempt, $SV = 0.5$; by the third attempt, $SV = 0.33$, and so on. If the participant deviated from the optimal path, without returning to it, the

Table 1. Example of Unprocessed Data.

P1		P2		P3	
ID	T	ID	T	ID	T
0	10:00	0	14:29	0	9:41
4	10:03	4	14:33	4	9:47
4.11	10:10	4.11	15:04	00	9:55
4.11.4	10:15	00	15:16	00	10:04
4.11.4.3	11:27	4.11	15:20	000	10:23
		4.11.4	15:34		
		4.11.4.3	15:55		

Note: ID means the numeric identifier of the Web page. T stands for the clock time (in minutes and seconds) when a participant arrived at a certain Web page. We use the symbol 00 to refer to a Web page that is not on the optimal path. The symbol 000 means that the participant has interrupted the execution of the task.

operation is coded with the number 0. In the event the participant did not find the Web page that is a part of the optimal path, the operation is coded by NA.

▪ *What was the duration of each operation?*

It is important to study the time that the participant spent on each Web page (i.e., performing each operation). *Duration* (D) is the difference between time the participant arrived at the page and the time when he/she left the page (by executing the operation). If the participant realized that he/she made a mistake (i.e., deviated from the optimal path) and returned to the previous page, the duration time is the sum of the duration times he/she spent on the page in each visit.

To continue with the example data, consider Table 2. It contains the durations (D) and success values (SV) for the operations of the task by three participants P1, P2, and P3. The duration values (in seconds) have been derived from the clock times in Table 1. The success values have been calculated based on the aforementioned rules. We can see in Table 2 that the participant P2 spent a relatively long time (31 seconds) in performing the operation 4 → 4.11, although he/she finally completed the task. P2 also had problems with the operation 4.11 → 4.11.4 because he/she could not find the page 4.11.4 until the second attempt (SV = 0.5). The participant P3 managed to carry out only the first operation of the task.

b. Aggregating Task-Specific Values

Here, we consider the two evaluation criteria, success and duration, through the following aggregated measures:

- *Average Success Value* (ASV) for an operation. This is obtained by calculating the average success value for the operation in the task across all the participants. The smaller the ASV, the more probable it is that the concerned Web page contains problems.
- *Average Duration* (AD) for an operation. This is derived by calculating the average duration for the operation in the task across all the participants. A large AD value indicates problems in the concerned Web page.

Table 2. Example Data Expressed in Success Values and Durations.

Operation	P1		P2		P3	
	SV	D	SV	D	SV	D
0 → 4	1	3	1	4	1	6
4 → 4.11	1	7	1	31	0	8
4.11 → 4.11.4	1	5	0.5	26	NA	NA
4.11.4 → 4.11.4.3	1	72	1	21	NA	NA

Note: SV represents how successfully the participant moved along the optimal path. Reaching the correct page on the first try results in 1, by the second try, 0.5, by the third attempt, 0.33, and so forth. D represents the time duration for the participant to successfully move to the correct page, and includes any time spent recovering from poor choices.

- *Standard Deviation of Durations (SD)*. This is calculated from the duration of the operation across all the participants. A large SD indicates problems.

The three aggregated measures calculated for the operations of one task, performed by three participants (see Table 2), are presented in Table 3. We can see that the operation 0 → 4 is the only one that is performed successfully by all the participants. In all the other operations, there have been some deviations from the optimal path or additional attempts.

The critical question to determine is when a certain aggregated value for some operation is so large (for AD and SD) or so small (for ASV) that the concerned Web page should be investigated more closely for usability problems. We approach this question by aggregating the values of the operations and examining the deviating values in the statistical distributions of these three measures. We calculate fractiles to specify the limits that are then used as the criteria for identifying the problematic Web pages.

The next issue is to determine the suitable fractile for each task. Selecting too large a fractile increases the risk of ignoring some problematic Web pages. Conversely, if too small a fractile is chosen, it may lead to selecting too large a set of problematic Web pages, thus increasing the need of resources for a closer examination. The suitable fractile depends on the situation. We recommend the use of probability theory to determine a suitable fractile. The probability that at least one of the three measures recognizes a Web page as problematic is $1 - p^3$ if all of the measures are independent of one another.

In the formula above, p stands for a fractile (decimal number) and 3 is the number of the measures (i.e., ASV, AD, SD). The assumption of independent measures is not exactly true, but we still use this formula as an approximation.

Table 4 presents the probabilities for four different fractiles. We can see that with the 75% fractile about 58% of the Web pages are regarded as problematic. Correspondingly, with the 95 % fractile about 14 % of the Web pages should be selected for further examination. In actuality, the probabilities are a bit smaller than indicated by the formula because the very problematic operations often are identified through more than one measure, due to some correlations between the measures.

Table 3. Aggregate Measures of the Example Data.

Operation	ASV	AD	SD
0 → 4	1.00	9.17	9.37
4 → 4.11	0.67	18.67	15.83
4.11 → 4.11.4	0.63	12.25	9.39
4.11.4 → 4.11.4.3	0.88	28.75	29.32

Note: ASV means average success value, AD means average duration, and SD means standard deviation of durations.

Table 4. Probabilities of Four Fractiles.

Fractile	75%	80%	90%	95%
Probability	$1 - 0.75^3 = 0.578$	$1 - 0.80^3 = 0.488$	$1 - 0.90^3 = 0.271$	$1 - 0.95^3 = 0.143$

The D-TEO method does not prescribe the use of any specific fractile because it depends on the situation and available resources. Instead, we offer some guidelines for selecting a fractile. A large fractile can be selected if

- the number of operations in the test tasks is large
- it can be assumed that there are only a few problems
- there is a limited amount of resources available for further examination

Conversely, a small fractile can be selected if

- the number of the operations is small
- if many problematic operations are expected to appear
- if there are sufficient resources for closer examination of the problem pages.

The final decision on whether to include a particular Web page in a set of problematic pages should be discussed with the user interface designer to avoid misinterpretations. Often, if the measures are calculated based on small samples, exceptional deviations from the standard values may appear. Thus, we emphasize that the values as such do not directly indicate which pages are problematic. The test results are best used to localize those areas in the structure of the Web site that should be analyzed more carefully.

After having determined the set of problematic Web pages, a variety of methods can be applied to identify the reasons for usability problems within specific Web pages. We suggest the use of the interaction design patterns of Tidwell (2005) and van Duyne, Landay, and Hong (2006). If inconsistencies or deficiencies are recurrent in the Web pages, stemming possibly from the applied screen design standards, changes should be extended to involve all the Web pages with similar structures. The screen design standards then should be updated correspondingly. After having made the changes, the improved Web pages can be heuristically inspected, if time and resources are allowed.

AN EXAMPLE OF THE D-TEO METHOD IN USE

In this section, we describe how the D-TEO method was used in testing the Web site of the Jyväskylä, Finland, region.¹ This is not a case study in a strict sense but rather an example for illustrating the application of the method. The description proceeds in a step-by-step manner.

Define the Goals of the Test and the User Profiles

In this first step, we determined who the stakeholders involved with the Web site were, how the results of the test were going to be used, what the stage of development (e.g., completed product, prototype, etc.) of the Web site was, and which parts of the Web site should be tested. It was concluded that the Web site was a finished prototype and that the results of the test would be used to finalize it prior to implementing as the final version. The Web site was to be tested in its entirety, a feasible task because the Web site was relatively small scale (approximately 1,300 pages) and hierarchically compact. When considering the user groups, it was thought that the Web site could be useful, for instance, for tourists planning trips to the Jyväskylä region. Their primary need would be, for example, to find accommodations in the region. We did not define any explicit user profiles.

Devise the Test Tasks and Identify the Optimal Paths

The Web site was aimed at providing information about living, working, studying, and traveling in the Jyväskylä region. The main menu covers living, municipalities, travel, services, recruitment, and events. It was decided that each of the main menu items should be selected for at least one task. We coded the Web pages corresponding to the main menu items with numerical codes instead of the URL addresses in order to make the analysis easier. Therefore, 1 = Living, 2 = Municipalities, 3 = Travel, 4 = Services, 5 = Recruitment, and 6 = Events.

There was no site map available, and hence we had to go through the paths to form a sufficient overview of the hypertext topology. Based on the structure of the Web site, we constructed a test story to include eight test tasks (see the Appendix for a description of the test tasks). We ensured the validity of the test tasks by checking that each of the tasks could be carried out and optimal paths could be specified. In this phase, some of the tasks had to be changed or made more detailed in order to fulfill the objectives above.

Organize the Test and Collect Data

When the aims of the testing were discussed with the client, it became apparent that no specific user group could be identified. Because no specific user group could be identified, the participants were randomly selected from a group of volunteer university students. Eleven native-Finnish-speaking participants participated in the study conducted in Finnish, one of whom took part in the pilot test to elaborate the test tasks. Thus, the results of 10 participants were included in the statistical analysis.

The tests were conducted in a usability laboratory at the university. The test data was collected using Windows Media Encoder, and the results were analyzed with the statistical software environment R. The time stamping was made manually.

Analyze the Data and Draw Conclusions

The data were analyzed in the manner of the instructions given in the Methods section. Problems in the user interface were localized by calculating the ASV, AD, and SD for every task and every operation. Table 5 presents the values for each of the 25 operations within the eight test tasks.

Figures 2, 3, and 4 represent the distributions of the values of ASV, AD and SD, respectively. Frequency in the histograms means the number of operations. In Figure 2, for instance, there are two operations with ASVs less than or equal to 0.4. Problems can be located in those Web pages that are involved by the operations situated at the extreme ends of the distributions (cf. the two operations in Figure 2), indicated by the circled areas.

To decide which Web pages should be selected for closer examination, a suitable fractile had to be determined. In order to avoid rounding problems in defining the critical values, the possible fractiles were 72% (18 of 25 Web pages), 76% (19/25), 80% (20/25) and 86% (21/25). Because we did not want to select too many Web pages, we used the 76% fractile, implying that the probability of recognizing a random Web page as problematic is 0.56 ($1-0.76^3$). Critical values for the three measures were determined according to the selected fractile. The critical limit of ASV is 0.60. The Web pages involved by the operations with smaller values were considered to be problematic. Correspondingly, the critical limits for AD and SD are 23.38 and 17.8.

Table 5. Average Success Values (ASV), Average Durations (AD) and Standard Deviations of Durations (SD) for Each Task and Each Operation.

Task	Operation	ASV	AD	SD
1	0 → 4	0.70	11.80	12.00
	4 → 4.3	0.60	34.90	23.30
	4.3 → 4.3.1	0.75	24.50	3.40
	4.3.1 → 4.3.1.1	1.00	3.12	0.60
2	0 → 6	0.20	19.60	39.00
	6 → 6.66	1.00	42.38	10.60
3	0 → 3	0.80	7.50	2.80
	3 → 3.2	0.80	16.20	17.80
	3.2 → 3.2.3	0.45	10.70	6.80
	3.2.3 → 3.2.3.7	0.70	5.00	2.00
4	0 → 4	0.50	7.70	4.00
	4 → 4.11	0.68	44.10	32.70
	4.11 → 4.11.4	0.50	13.25	5.60
	4.11.4 → 4.11.4.1	0.56	41.63	41.20
5	0 → 4	0.90	8.00	7.30
	4 → 4.11	0.75	17.30	13.90
	4.11 → 4.11.4	0.69	9.50	7.20
	4.11.4 → 4.11.4.3	0.81	23.38	24.20
6	0 → 1	0.40	5.20	4.00
	1 → 1.1	0.80	3.80	1.30
	1.1 → 1.25.6.1	1.00	7.13	3.30
7	0 → 4	0.80	13.30	7.10
	4 → 4.19	1.00	28.00	16.60
	4.19 → 4.19.5	1.00	22.50	16.70
8	0 → 0.100	0.70	21.40	18.40

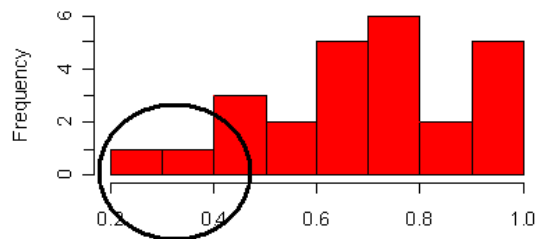


Figure 2. Histogram of average succeed values (ASV).

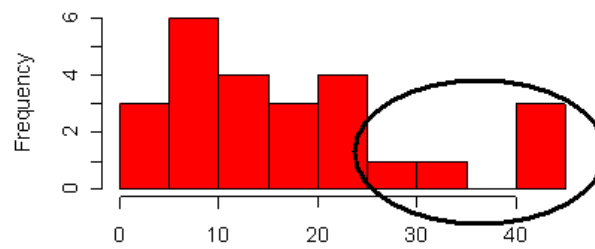


Figure 3. Histogram of average durations (AD).

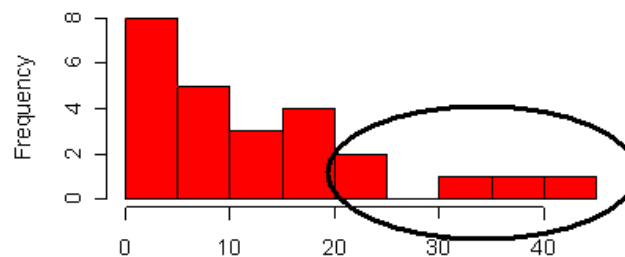


Figure 4. Histogram of standard deviations (SD).

Table 6 shows the numbers exceeding the critical limits in bold (cf. Table 5). The Column # denotes how many of the three aggregate measures suggest that the operation (Web page) is problematic. If more than one of the measures exceeds the critical limits, it is even a stronger indication of problems. The operation 4.11.4 → 4.11.4.1 appears to be a problem candidate based on all three measures. Three operations (4 → 4.3; 0 → 6; 4 → 4.11) appeared to be problem candidates based on two measures. In total, 13 out of 25 operations were selected as problem candidates.

As noted in the Methods section, the aggregated measures are correlated with one another. We calculated Spearman’s rank correlation coefficient (Spearman’s rho):

$$\text{cor}(\text{ASV}, \text{AD}) = -0.01, p = 0.96$$

$$\text{cor}(\text{ASV}, \text{SD}) = -0.187, p = 0.372$$

$$\text{cor}(\text{SD}, \text{AD}) = 0.804, p < 0.001$$

There is no correlation between ASD and AD, and the negative correlation between ASV and SD is not statistically significant. There is a significant correlation between SD and AD, meaning that the operations with high AD values tend to have high SD values. Because of this correlation, probability calculations are only approximations.

Hence, we distinguished 13 problem candidates for more careful consideration. Each problem candidate was mapped to a specific Web page. One of those Web pages was the Sport page (coded with 4.11.4; see Figure 5), which is the target of the operation 4.11.4 → 4.11.4.1 (cf. Table 6). When the Sport page and its UI components were analyzed more carefully interaction design patterns (see Methods section), several usability problems were found. For example, some text fields, labels, and links were not arranged in a systematic manner, the Search button was difficult to notice, and it was difficult to distinguish the labels from the text. The problems could be solved applying UI design patterns (Tidwell, 2005; van Duyne et al., 2006).

Table 6. Critical Values (Boldface) for Each Operation.

Task	Operation	ASV	AD	SD	#
1	0 → 4	0.70	11.80	12.00	
	4 → 4.3	0.60	34.90	23.30	2
	4.3 → 4.3.1	0.75	24.50	3.40	1
	4.3.1 → 4.3.1.1	1.00	3.12	0.60	
2	0 → 6	0.20	19.60	39.00	2
	6 → 6.66	1.00	42.38	10.60	1
3	0 → 3	0.80	7.50	2.80	
	3 → 3.2	0.80	16.20	17.80	
	3.2 → 3.2.3	0.45	10.70	6.80	1
	3.2.3 → 3.2.3.7	0.70	5.00	2.00	
4	0 → 4	0.50	7.70	4.00	1
	4 → 4.11	0.68	44.10	32.70	2
	4.11 → 4.11.4	0.50	13.25	5.60	1
	4.11.4 → 4.11.4.1	0.56	41.63	41.20	3
5	0 → 4	0.90	8.00	7.30	
	4 → 4.11	0.75	17.30	13.90	
	4.11 → 4.11.4	0.69	9.50	7.20	
	4.11.4 → 4.11.4.3	0.81	23.38	24.20	1
6	0 → 1	0.40	5.20	4.00	1
	1 → 1.1	0.80	3.80	1.30	
	1.1 → 1.25.6.1	1.00	7.13	3.30	
7	0 → 4	0.80	13.30	7.10	
	4 → 4.19	1.00	28.00	16.60	1
	4.19 → 4.19.5	1.00	22.50	16.70	
8	0 → 0.100	0.70	21.40	18.40	1

RELATED WORK

In this section, we make a short review of related work and discuss how our method differs from and performs among the existing methods. Our taxonomy for the review is composed of five general dimensions and three specific dimensions. The general dimensions, borrowed from Ivory & Hearst (2001), are UI, method class, method type, automation type, and effort level. UI distinguishes between WIMP (windows, icons, pointer, and mouse) interfaces and Web interfaces. Method classes are testing, inspection, inquiry, analytical modeling, and simulation. Method types include, for example, thinking aloud, log file analysis, guideline review, feature inspection and the like. Automation type is used to specify which aspects of a method are automated (i.e., capture, analysis, critique). Effort level indicates the human effort



Figure 5. The Sports page.

required by a method in use. The options are (a) minimal effort, (b) model development (M), and (c) informal (I) and formal (F). (See more about the options in Ivory & Hearst, 2001). The first specific dimension distinguishes basic concepts and constructs used to conceptualize user behavior and Web sites (e.g., user task, operation, navigation path). The second specific dimension differentiates criteria used to evaluate user interaction usability. The third specific dimension shows how the evaluators interpret the results of the evaluation.

The UI literature suggests a large array of evaluation methods (cf. Ivory & Hearst, 2001, distinguish 75 WIMP user interface evaluation methods and 57 Web user interface evaluation methods). We selected only those methods that are most relevant to our comparative review. The reviewed methods are UsAGE (Uehling & Wolf, 1995), QUIP (Helfrich & Landay, 1999), USINE (Lecerof & Paternò, 1998), RemUSINE (Paternò & Ballardin, 1999, 2000) and WebRemUSINE (Paganelli & Paternò, 2002). The results are summarized in Tables 7 and 8. The D-TEO method is included in the tables to facilitate the comparison.

In UsAGE (Uehling & Wolf, 1995) and QUIP (Helfrich & Landay, 1999), the goal is to automate the detection of serious usability problems by comparing the users' task to the task performed in the "right" manner. What constitutes the "right" manner is defined by the developer of the system. Ivory and Hearst (2001) call this kind of approach Task-Based Analysis of Log Files. In UsAGE and QUIP, the serious usability problems are localized at the level of single actions and the results are shown in a graph of the action nodes. Each node stands for an action defined to be the user action, such as menu selection or clicking the Open button. The evaluator makes the decision on usability problems, based on the graphical data. UsAGE supports only the user interfaces created with the TAE Plus user interface management system, and QUIP requires the modification of the target application source code.

USINE (Lecerof & Paternò, 1998) also deploys automated log file analysis. Ivory and Hearst (2001) call this kind of approach the Hybrid Task-Based Pattern-Matching method. USINE is an automatic usability evaluation method for Java applications, enabling the use of the task models along with log files for analyzing empirical data. Tasks are decomposed into

Table 7. Review of Alternative Methods Based on General Dimensions.

Evaluation method	UI	Method class	Method type	Automation type	Effort level
UsAGE	WIMP	Performance measurement, Usability testing	Performance measurement, Log file analysis	Capture, Analysis	IF
QUIP	WIMP	Usability testing	Log file analysis	Analysis	IF
USINE	WIMP	Usability testing	Log file analysis	Analysis	IFM
RemUSINE	WIMP	Usability testing	Log file analysis	Analysis	IFM
WebRem-USINE	Web	Usability testing	Log file analysis	Analysis	IFM
D-TEO	Web	Usability testing	Performance measurement, Log file analysis	Analysis, (Critique)	IFM

Table 8. Review of Alternative Methods based on Specific Dimensions.

Evaluation method	Concepts and constructs	Criteria	Interpretation of criteria
UsAGE	<p>Supports only the user interfaces created with <i>TAE Plus</i> user interface management system.</p> <p>Each <i>node</i> stands for the action that is defined to be the <i>user action</i>, such as menu selection.</p>	<p>Comparing event logs for expert user and novice user. Designer is also an expert user typically.</p> <p>In addition to a graph, the percentage of expert nodes matched to novice nodes, ratio of novice to expert nodes, and percentage of unmatched novice nodes are analyzed.</p>	<p>Two files (“expert” and “novice”) are automatically compared by the tool and the results are shown graphically. Based on this, a usability analyst figures out where the usability problems exist.</p>
QUIP	<p>Requires the modification of the target application <i>source code</i>.</p> <p>Each <i>node</i> stands for the action that is defined to be the <i>user action</i>, such as menu selection or clicking the Open button.</p>	<p>Comparing task flows for UI designer and multiple test users. The trace of the UI designer represents the expected use. Quantitative time and trace-based information is encoded into directed graphs.</p>	<p>The evaluator makes the decisions based on the graphs by analyzing them manually.</p>
USINE	<p>Developed for usability evaluating of <i>WIMP interfaces</i>.</p> <p>Requires X Window environment.</p> <p>Requires comprehensive modeling and formalization of <i>user tasks</i>.</p>	<p>The accomplished tasks, the failed tasks, the never tried tasks, numerical and temporal information of the user errors, how long each task took to complete, the times for the abstract tasks, the errors occurred instances, task patterns, the test time, number of scrollbar movements, and the number of windows resized.</p>	<p>Evaluators make the decisions about how to improve user interface based on the simulator data. (The suggested interface changes are not drastic; e.g., there should be more difference between button and images.)</p>

RemUSINE	<p>Developed for remote usability evaluating of graphical Java applications.</p> <p>Requires the comprehensive modeling and formalization of user tasks.</p>	<p>Tasks related criteria (single user session): Completed tasks, failed tasks, never tried tasks, errors, task patterns, tasks/time, errors/time, tasks/errors, tasks/completed.</p> <p>Tasks related criteria (groups of user sessions): Completed tasks, failed tasks, never tried tasks, errors, task patterns, tasks/time, errors/time, tasks/errors, tasks/completed.</p>	
WebRem-USINE	<p>Java based tool developed for <i>remote usability evaluation</i> of Web sites.</p> <p>Requires comprehensive modeling and formalization of <i>user tasks</i>.</p>	<p>Tasks related criteria (single user): Completed tasks, missed tasks, never performed tasks, errors, task patterns, error/time, task/time, tasks/errors, tasks/completed.</p> <p>Tasks related average times and standard deviations (number of users): Total time taken by user session, number of completed tasks, number of errors, number of scrollbar movements and change dimensions events.</p> <p>Pages related criteria (single user): Visited pages, never visited pages, scroll and resize, page patterns, download time, visit time, page/access, page/scroll/resize.</p> <p>Pages related criteria (number of users): Average number of accesses in to each page, average frequency of patterns, average downloading time, average visit time.</p>	<p>Evaluators make the decisions based on the rich simulator data (e.g. identify what tasks create problems and what tasks are efficiently performed).</p>
D-TEO	<p>Developed for locating <i>usability problems in directed information search</i> from Web sites.</p> <p>Is based on defining the <i>optimal paths</i> composed of <i>operations</i> needed to navigate from the entry Web pages to the terminal Web pages in order to find the target <i>information items</i>.</p>	<p>Operation-specific values (single participant): success value, duration time.</p> <p>Aggregated task-specific values (All tasks and participants): average success value for an operation, average duration for an operation, standard deviation of durations.</p> <p>Criterion for problematic Web pages: based on fractiles.</p>	<p>Problematic Web pages are identified with quantitative measures. Based on this information, usability evaluators can focus their attention on those pages.</p>

subtasks (sets of activities) that are related to each other within temporal relationships. The results derived by USINE include quite extensive numerical information about the tasks and subtasks, such as which tasks have been accomplished, which have failed, which have never been tried, user errors, and so on. Evaluators make decisions on how to improve the user interface based on the log data related to the tasks and subtasks. USINE does not enable comparing these results across study participants, so it is based on only task-related criteria of single user sessions. This means that it does not aggregate data, such as the average times of

subtasks across the participants or which tasks have been accomplished or failed across the participants. We suggest that a subtask-level comparison between the participants could bring essential knowledge to advance locating usability problems. USINE is also a rather laborious method, requiring the construction of comprehensive task models.

RemUSINE (Paternò & Ballardini, 1999, 2000), as an extension of USINE, enables capturing data remotely and comparing the results across the participants. RemUSINE employs task-related criteria for both single user sessions and groups of user sessions. In RemUSINE, evaluators make decisions regarding how to improve user interface based on the simulator and log data. RemUSINE, like USINE, was originally developed for evaluating Java applications and, as Paganelli and Paternò (2002) state, it is not suitable for evaluating how information is accessed through user interfaces in Web sites.

WebRemUSINE (Paganelli & Paternò, 2002) has its origin in USINE and RemUSINE. WebRemUSINE uses task-related criteria and page-related criteria for both single user sessions and the number of users. In WebRemUSINE, the evaluators make decisions on usability problems based on the rich simulator data. WebRemUSINE is a Java-based tool developed for remote usability evaluation of Web sites, and it requires the comprehensive modeling and formalization of user tasks. However, despite constructing a comprehensive task model and comparing the results across the participants by using rich quantitative data, neither RemUSINE nor WebRemUSINE provide an exact way to locate problematic subtasks. For example, even if the average times of the subtasks are known across the participants, the critical question about when the average time for a specific subtask is too long remains unanswered. We argue that there must be some rules, whether strict or heuristic, for helping determine some limits for crucial measures. Our suggestion is the use of the fractiles.

The D-TEO method is based on the use of two quantitative usability criteria, search success and search time, aiming at revealing how a user performs as a navigator in a web of hypertext. The former criterion is evaluated through operation-specific Success Value, calculated by the number of attempts required to find the optimal path. The latter criterion is expressed by duration time between the executions of two sequential operations. The D-TEO method is engineered to distinguish a part of a Web site that contains the most likely usability problems in directed searches. The results enable usability specialists to concentrate their efforts on making a deeper analysis of that particular area. The method does not aim at giving special guidance on the examination of what kinds of problems there are and how they are solved. Of course, if some Web page appears to be the one in which users tend to get lost, it is justifiable to expect that, for instance, the navigation, search, layout, typography, or content organization on that Web page is insufficiently designed. Similar goals are pursued by a number of interaction design patterns. What makes our method different when compared to other models is the use of heuristic rules for determining critical limits for the assessment of a certain Web page as problematic one. These rules are based on fractiles, which are selected in a situational manner. This semiautomated help is indicated in Table 7 by presenting (in parenthesis) a critique in the column of Automation type.

To summarize, the literature provides a large variety of methods for testing the usability of Web pages by observing users carrying out tasks, whether given wholly for, or as part of, their daily work. Our method differs favorably from them in the following aspects. First, the method is rather lightweight, meaning that instead of constructing a comprehensive task model, as required in USINE, RemUSINE, and WebRemUSINE, only the optimal paths for the test tasks have to be specified in D-TEO. Second, our method supports making decisions

on the limits of critical values. This is particularly beneficial in the situations where explicitly defined goals are not expressed in the quantitative measures. Finally, D-TEO distinguishes those parts of a Web site that are more problematic. As a result, scant resources can be focused on making a deeper evaluation of those areas only.

SUMMARY

The Internet holds an increasingly more important position in today's information dissemination. Diffusion of electronic commerce by enterprises and eServices provided by municipalities and government agencies have advanced the Internet as a daily means for both professionals and diverse audiences for interpersonal interaction and information searches. In attempting to serve these multiple audiences, Web site designers are challenged to meet the needs of a heterogeneous user population, from novices to heavy users, from persons having significant training for use to those with poor skills and low interest in information search. To ensure that all the people can find, with modest effort, what they are seeking, Web interfaces must meet high usability standards.

In this study, we have proposed a novel method, called D-TEO, which supports Website testing to find problematic Web pages. This semiautomated method is based on the analysis of interaction tasks in directed searches within the evaluated Web site. It provides a stepwise procedure that starts with defining the goals and user profiles and ends with analyzing the collected data and drawing conclusions. The method guides a test organizer in devising test tasks, decomposing them into elementary operations, and defining the optimal path for each task. Users are observed as they execute the test tasks and, for each operation, the time spent and the deviations from the optimal path are recorded. Using statistical methods, the collected data are analyzed to reveal which Web pages are problematic. This enables the test organizer to concentrate on more careful examination and analysis of particular small set of Web pages. Compared to most of the existing methods, D-TEO is lightweight because it does not require the comprehensive modeling and formalization of user tasks (as in Lecerof & Paternò, 1998), nor the existence of site maps. What also makes D-TEO beneficial is the support it provides regarding the situationally determined limits of critical measures for considering whether or not a Web page is included within a set of problematic Web pages.

The D-TEO method is still under research and development. At the moment, we are enhancing the method to encompass a wider variety of interaction tasks, not simply directed searches. The current procedure should be engineered toward a more fully automated mode, thus decreasing the need for human resources with required expertise in Web usability for the analysis aspect of the method. At the same time, it should be stated more clearly which type of methods—heuristic, pattern, or rule-based—are recommended as methods (e.g., Nielsen & Molich, 1990; Tidwell, 2005) applied prior to and/or following the deployment of D-TEO. In the future, we will consider how to integrate the method with qualitative methods in order to provide more flexibility for distinguishing problematic Web pages, analyzing them, and finding solutions to them. Until now, we have applied D-TEO in only small cases. To have stronger evidence of its feasibility, we will apply the method in a wider diversity of cases.

ENDNOTE

1. The Web site <http://www.jyvaskylanseutu.fi> was tested for the Jyväskylä region.

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APPENDIX

The test tasks in the case study

1. You want to have a new hobby. What kinds of leisure activities can the Community College of the Jyväskylä region offer you in the spring 2007?
2. You promised your friend that you will take a trip together to Hankasalmi for one day in July. What kinds of events take place there on 21 July, 2007?"
3. You are going to spend the weekend in Hankasalmi and you will need a place to stay overnight. What kind of camping sites are there in Hankasalmi?"
4. Assume that you are living in Petäjävesi. What kind of sport can you exercise in the local sport clubs?
5. There is one ringette team in the Jyväskylä region. What is the name of this team?
6. The southern part of Uurainen is bit more than 20 km from the center of Jyväskylä. Which kinds of properties are there for sale in Uurainen?
7. You would like to contact the project manager of the Health and Special Sport project (TERLI). Find information about the project on the Web site of the Jyväskylä region.
8. Try to find out when the Web site of the Jyväskylä Region was opened.

INTERNET THROUGH THE EYES OF 11-YEAR-OLD CHILDREN: FIRST-HAND EXPERIENCES FROM THE TECHNOLOGICAL ENVIRONMENT CHILDREN LIVE IN

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Abstract: *The aim of this research is to obtain a deeper understanding of children's own views and experiences of using the Internet, and their attitudes towards parental supervision and the technological environment in which they are growing up. This article reports on a survey of Internet use among the fifth-grade pupils in ordinary Finnish schools. The population studied was a selected sample, and the data were analyzed both statistically and by qualitative methods. Nine out of ten children are regular Internet users, and every second child uses the Internet daily. The contemporary Internet seems to be a means for social interaction for girls and for playing games for boys. In more general terms, the Internet serves as a different kind of information vehicle, depending on the user.*

Keywords: *Internet use, Web, children, survey.*

INTRODUCTION

The Internet can serve as a source of information and entertainment, a place for creating and maintaining personal contacts, as well as a way to add a new dimension to studying and learning. However, children can unexpectedly face undesirable content on the Internet. At the same time, new ways of advancing the harmful aspects of Internet technology are taking place continuously. In public discussion, children's Internet use is frequently linked with topics such as pedophilia, Web addictions, declining social skills, emotional impoverishment, failure to distinguish between fact and fiction, aggression, and introverted behavior. It has become clear how important it is for children to learn from an early age to be critical in evaluating and interpreting the credibility of sources of information. Most studies on children's use of the Internet to date have approached it from an adult viewpoint, for example, from legal restrictions. Less attention has been paid to children's own views and experiences. The anxiety of the general audience still lies predominantly in the dangers posed by the Internet's content *per se*, whereas only a few seem to regard children's welfare as being the primary matter (Friedman, Hurley, Howe, Felten, & Nissenbaum, 2002). The aim of this research is to obtain

a deeper understanding of the *children's experiences* of using the Internet and their attitudes towards parental supervision and the technological environment in which they are growing up.

Previously, scientific research has concentrated largely on examining the technical aspects of the regulation of Internet content (Ho & Lui, 2003). Although various technological applications exist for filtering or blocking certain forms of Internet content, parents do not take advantage of these, probably because they either do not know enough about the dangers of the Internet or their technical skills are inadequate for such applications (Shoniregun & Anderson, 2003). In any case, technologies are evolving so quickly that many of the solutions to these concerns available today are quickly becoming outdated.

Chat and instant messaging, for instance, are especially challenging technologies, since they easily lead children to make new friends via the Web while, at the same time, may offer a false sense of security that may induce children into meetings in the real world that are detrimental or even dangerous for them in one way or another (Shoniregun & Anderson, 2003). The content found on the Internet can pose greater dangers to children than even that offered by television, movies, or music; the latter media are subject to at least some degree of supervision and legal regulation, whereas the Internet is largely unsupervised, unrestricted, and open to users of all ages. It also seems that by virtue of its interactive nature, the Web is capable of binding the user to it more efficiently than the traditional media (Mustonen, 2001).

This article will report on a survey seeking a deeper understanding of Internet use among children about 11 years old (fifth-grade pupils in Finnish schools, which corresponds with the 6th grade in the United States) and the dangers that they perceive in it. This article is structured as follows: The related research is discussed in the next section. Next, the research design will be explained, followed by the results regarding opportunities and uses of the Internet and skills in doing. Then, children's experiences of Internet use are recounted. The final two sections address the results, compared with those from related research, and draw conclusions.

RELATED RESEARCH

Rideout, Roberts, & Foehr (2005) studied both quantitatively and qualitatively the media use of 8- to 18-year-olds in the United States.¹ They report that the kids and teens go on-line for an average of 48 minutes per day, spending most of the time playing games, instant messaging, and visiting Web sites. They seemed to identify a significant divide in the quality and nature of the Internet use between major racial and socioeconomic groups. In general, the youth live media-saturated lives, spending daily an average of 6 hours and 21 minutes with media, such as watching television, listening music, using computers outside schoolwork, and playing video games. According to Rideout et al., those who received the poorest grades in school spend more time with video games and less time in reading than their peers. In spite of this, the majority of young people say that their parents do not impose any rules on them regarding their use of computers or other media. Overall, Rideout et al. suggest that not only are all the aspects in the media space constantly changing, but the pace of change is accelerating as well. Media and technology seem to be morphing and merging, forming an ever-expanding presence throughout daily environments. For instance, oftentimes children may be watching a television program or playing a video game while simultaneously working on the computer. Today's youth seem to become masters of multitasking.

Ito et al. (2008) studied qualitatively young people's participation in the new media ecology.² Young people seem to use friendship-driven and interest-driven practices in their on-line participation, which have very different social connotations. The friendship-driven practices extend the friendships of their familiar contexts, such as schools and organizations, whereas interest-driven practices aim at finding new peers outside the boundaries of their local community. The friendship-driven practices, which might be called "hanging out," is always-on communication with existing friends, and it may, for instance, encourage teens to initiate the first stages of a relationship. The integration of friends into the infrastructure of social network Web sites has transformed the meaning of friendship. On the other hand, the interest-driven practices may help distribute the young people's works to on-line audiences and to develop new forms of visibility and reputation. Adult participation is more welcome in the interest-driven practices. In both practices, however, the youth create and navigate new forms of social behavior. In this process, they may start "messing around" with new forms of media and technology, using trial and error approaches to create, share, and customize content, and to receive feedback from others on-line. This immediacy and breadth of information seems to lower barriers in self-directed learning. Messing around is often a transitional stage between hanging out and more interest-driven participation. Others "geek out" and dive into an interest or talent. This is highly social and engaged participation in Internet communities, but primarily not driven by local friendships. Adults are not automatically considered as experts in Internet communities. In general, participation in these social activities seems to have special powers to shape on-line behaviors, and peer-based learning, and development of social norms in negotiation with their peers seem to characterize the modern use of the Internet by young people.

Hagen (2007) discusses questions related to "negotiations" on media use, in particular between children and their parents. Such negotiations involve how much and for what purpose the children seek to use television or the Internet. According to Hagen, new media intensifies the pressure on parents to monitor and regulate their children's media use.

Staksrud, Livingstone, & Haddon (2007) studied European children's use of on-line technologies. They note that most European research concerns teenagers. A high proportion of the research on younger children is qualitative in nature, whereas little research on younger children addresses questions of on-line risk. Too often questions are asked regarding parental regulation only from parents, neglecting children's responses to such regulation. Children's Internet use is a complex phenomenon and children's own perceptions deserve more research. Moreover, research on social networking appears to concentrate on just a few countries. Most research is largely focused on the older generation of the Internet, whereas there seems to be little evidence thus far regarding the Web 2.0 or platforms other than personal computers for Internet access. Even if the field commonly draws on comparisons between off-line and on-line activities, the vast majority of research on on-line activities focuses attention on children's lives off-line. Most importantly, there are still only a few longitudinal studies. Based on the same research project, Lobe, Livingstone, Olafsson, & Simões (2008) suggest best practices for research into children and on-line technologies.

Staksrud and Livingstone (2009) discuss teenagers' learning to anticipate and cope with on-line risks. They suggest that most children seek help from their friends or ignore the bad experiences, in most cases also excluding any adult involvement. Gender and age seem to affect risk management strategies. In another study conducted in the United Kingdom, Livingstone and

Helsper (2007) provide quantitative evidence for the existence of the digital divide, stating that age, gender, and socioeconomic status affect the quality of access to and use of the Internet.

Dunkels (2007) studied qualitatively the perceptions of the Internet use by children in grade six. She concludes that the Internet seems to enhance children's lives rather than to have a negative impact on them. Many children see their opportunities and affordances increase rather than express a great deal of anxiety; other children simply are not as impressed with the Internet potential. Children know what the dangers are but do not express much fear for themselves and think that these downsides are not immediately present in everyday use of the Internet. Negative aspects of on-line activity include unwanted content and technical problems, but children seem to have developed implicit counter strategies against the various downsides. Most often these are developed together with peers or alone, with very little adult input. Young people's Internet use seems to be dominated by local applications linking up with people geographically close to them.

RESEARCH DESIGN

This research focused on the fifth-grade pupils, aged approximately 11 years, at several Finnish schools. Students of this age can be expected to be capable of coping with a written questionnaire and expressing themselves in response to open-ended questions. Before this survey was applied, the conceptual validity of the survey vehicle was addressed by making a careful study of earlier works and the concepts used in them.

The survey was carried out during February and March 2006 in the city of Raahe in Northern Finland. Raahe has 12 elementary schools, with a total population of 264 fifth-grade pupils. The principals (rectors) of these schools were contacted by phone or e-mail and asked about their willingness to take part in the research. Their reactions were favorable and encouraging. They reported that use of the Internet had been discussed frequently at their schools and that it was regarded as both extremely valuable and highly problematic. Eleven of the 12 schools agreed to take part in the study, implying a potential sample of 242 pupils for our survey. Any child, or his or her parents, could opt out of the survey. Thus, the sample is a selected sample rather than random sampling. The data were analyzed both statistically and by qualitative methods.

Instructions were prepared for the teachers and an accompanying letter for the parents. Every effort was made to ensure that the questionnaire was easy to understand and relatively quick to answer. The wording and layout were pretested on a separate group of respondents and then tested on the pupils at one of the sample schools in January 2006. This pilot test demonstrated that the questions were fully understandable.

The survey was conducted after the teachers had obtained signed consent forms from all parents. This was regarded as particularly important in view of the young age of the pupils. It was decided that the children should complete the questionnaire during school time so that the teachers could ensure that the students answered the questions independently. The teacher double-checked the signed consent forms received from the parents and asked the pupils individually whether they were willing to take part. One of the authors attended the questionnaire completion in six of the schools, whereas the teachers took care of this in the other five schools.

The questionnaire contained 19 main questions, most of which included subquestions. The 15 structured questions were aimed at eliciting quantitative information on experiences of Internet use, employing a 5-step Likert scale for the assessment of attitudes, while the 4

open questions were designed to obtain a more profound insight into the children's experiences and to give the children an opportunity to express their views in their own way.

The pupils were encouraged to ask for help if there was anything in the survey that was unclear. They were also told that the authors of the questionnaire were interested in the pupils' own experiences and opinions, and that it was not necessary to answer all the questions. They were assured that it would not be possible to identify individual pupils in the final report. All answers were treated confidentially and they went directly to the researchers without the teachers examining them.

All of the completed surveys were included in the analysis. The few unclear points in the replies concerned mostly situations in which the pupils were asked to choose just one alternative. We deleted from analysis those responses to individual questions in which more than one alternative was indicated. The other challenge in interpretation was mainly isolated cases of illegible handwriting. In general, the pupils managed to answer the questionnaire very carefully. The replies to open questions were copied word for word into a separate program and then categorized by using qualitative methods of content analysis. The questionnaire was in Finnish, and all the children were fluent in Finnish. The responses presented in this article as results are English translations from Finnish completed by one of the authors, but they attempt to be faithful to the students' meanings.

We could not find evidence that the teacher or researcher in the classroom influenced the results. The metrics employed appeared to be well-suited to the group of subjects and thus to measure what had been intended. Although the children did not appear nervous at the data collection time, it is impossible to exclude the influence of this or of occasional carelessness. Admittedly, some factors connected with the measurement of children's opinions, attitudes, and beliefs in numerical terms can detract from the reliability of the results to some extent. Children are not always conscious of their own feelings and perhaps have never stopped to think about their feelings with regard to certain matters prior to seeing them in the questionnaire. Their interpretations of their own opinions can also vary with their moods, their environment, or the point in time. Children may also be inclined to consider whether their answers are socially acceptable, whether they conform to the expectations of the person designing the questionnaire, or whether they might prove too shocking. Thus, the results should be regarded as indicative of trends rather than as the basis for deriving far-reaching conclusions.

OPPORTUNITIES, SKILLS, AND USE

The questionnaire was completed by 229 pupils, giving a response rate of 94.6%. The responses were fairly equally divided between girls (50.7%) and boys (49.3%).

Opportunities

Almost all respondents (94.8%) had access to an Internet connection at home, mainly somewhere other than their own room (72.2%). Four of five students (80.3%) used the Internet primarily in a room that was open to the whole family.

Almost half of the respondents (48.2%) used the Internet at least once a day, and 88.9% did so at least once a week. Only 6.2% claimed that they rarely ever used it. The most typical

duration of use was 30–60 minutes a day (44.6% of the respondents), while 8.6% spent more than 2 hours a day on-line. The duration of use was slightly lower with girls than with boys ($\chi^2 = 8.969, p = 0.030$).

Even if the Internet is most often used in a room that is open to the whole family, most of the kids report being alone when using the Internet almost always (54.4%) or at least rather often (79.9%). Nevertheless, some of them also use the Internet at times with their friends (39.2%) or with siblings (24.2%). Very few of them use it often with their father (3.3%) or mother (3.3%).

Parents' absence from their children's Internet use simply may be related to parents being busy with work or home-related activities. Another partial explanation would be that parents feel that they have not yet learned to use the Internet well enough.

Skills

The children often claimed that they were better at using the Internet than their parents. Two thirds of them (66.8%) believed that they were more skilled than their mother, and half (50.9%) were of the opinion that they were more skilled than their father. Moreover, 93.8% of respondents claimed that the Internet was easy to use; 92.0% felt that it was easy to learn to use.

The respondents had a fairly clear picture of what content was not appropriate for their age and what details about themselves they should not reveal. Many of them were wary of contacts with unknown people. A few also realized that safe Internet use involved proper data protection in a technical sense, including virus elimination, firewalls, and careful handling of spam e-mail. A selection of opinions on this is presented in Table 1.

Use

The pupils were well versed in using the latest forms of communication to contact their friends. While little use was made of e-mail, a great deal of communication took place via instant message services, such as MSN Messenger or the ii2 community.³

More than half of the children (52.1%) talked to their friends via chat or message services daily, whereas 73.0% talked to their friends over the Internet at least twice a week. The median was twice or more times per day. One fourth (27.0%) talked with their friends over the Internet once a week or less. Meanwhile, girls made more frequent use of e-mails ($\chi^2 = 11.600, p = 0.003$). More than a half of the respondents (53.2%) used e-mail less than once a week, comprising 42.5% of the girls and 64.5% of the boys.

Practically every second child (48.0%) played games on the Internet on a daily basis, whereas three out of four did so at least on a weekly basis (72.6%). The boys played Internet games more frequently than the girls ($\chi^2 = 14.200, p = 0.001$), with 60.4% of the boys playing daily as compared with 35.7% of the girls. Thus, the boys would appear to lean towards social interaction through game playing, whereas the girls use the Internet more often for communication purposes than for games.

Almost half of the respondents (47.3%) surfed the Internet at least once a day. About one fourth (24.1%) surfed the Internet less than once a week.

A fourth of the respondents (25.2%) listened to music on the Internet on a daily basis, including one in three of the boys (33.3%) and one in six of the girls (17.0%). The boys made more use of the Internet for their music interests than the girls ($\chi^2 = 10.333, p = 0.006$).

Table 1. “What things do you think you should bear in mind so that using the 'Net will be as safe as possible?”*

Girls:	<p><i>“I would follow the rules of the Internet and not go to all kinds of pages.”</i></p> <p><i>“I don't give my contact data to anyone else.”</i></p> <p><i>“I don't talk to strangers.”</i></p> <p><i>“I only go to pages that I know are not shocking.”</i></p> <p><i>“Switch the continuous anti-virus program on to check the computer when using the net.”</i></p> <p><i>“I mustn't download anything that seems suspicious or which I know nothing about without permission.”</i></p> <p><i>“Whenever I go anywhere I must know how to get out again.”</i></p> <p><i>“I mustn't give any data on myself, and Mommy comes to look from time to time to see what pages I'm on.”</i></p> <p><i>“My parents should keep an eye on what I'm doing.”</i></p> <p><i>“I mustn't go to stupid or dangerous pages that might have viruses.”</i></p> <p><i>“I mustn't promise to meet people I don't know.”</i></p> <p><i>“I don't go chatting; I only talk with friends I know.”</i></p>
Boys:	<p><i>“I don't give names, addresses or passwords.”</i></p> <p><i>“I only visit pages I know.”</i></p> <p><i>“I mustn't download games, music or programs from the 'Net, because of viruses.”</i></p> <p><i>“I mustn't go to pages that are unsuitable.”</i></p> <p><i>“The child lock, firewall, and anti-virus program.”</i></p> <p><i>“I mustn't go to strange pages or open spam mail.”</i></p> <p><i>“I mustn't go to foreign pages.”</i></p> <p><i>“Keep hackers under control, viruses away and avoid information from the wrong places”</i></p> <p><i>“I mustn't give away personal data or go looking at violent pages or videos.”</i></p>

* In Finnish, the word 'Net is often used to refer to the Internet. In practice, this most often refers to the Web.

One in five (19.8%) searched for information not related to schoolwork on the Internet on a daily basis and almost a half (46.2%) did so at least once a week. Here again the frequency of use appears to be sex dependent, the boys searching for information slightly more frequently than the girls ($\chi^2 = 7.404, p = 0.025$).

The children nevertheless made relatively little use of the Internet to obtain information related to their hobbies or interests. Only 15.5% did this once a day or more frequently, and they did this less than once a week in 69.1% of cases. Finding information related to hobbies or other interests was more common among the boys ($\chi^2 = 10.999, p = 0.004$) than among the girls (21.7% vs. 9.6%, respectively).

Children of this age made rather little use of the Internet to support their schoolwork, with only 5.9% of the respondents doing so on a daily basis. The vast majority, 79.0%, did so less than once a week or not at all.

A small number of pupils discussed the other uses they made of the Internet. In doing so, the girls mentioned the construction and update of home pages, and searching, storing and editing of pictures, as well as their interest in horses. Meanwhile, the boys mentioned game and software development as well as watching videos.

EXPERIENCES OF INTERNET USE

Enjoyable Experiences

The activities that the children evidently enjoyed most were chatting with their friends, looking at picture galleries, playing games, e-mail, searching for facts, listening to music, and watching videos. Table 2 provides some of these interests in the students' own words.

Frightening and Shocking Experiences

One in five children (19.7%) said that he/she had found some frightening material on the Internet. Some (4.5%) reported that they had been in this kind of a situation often. Thirty-three children replied to the open question on frightening experiences (i.e., "I was frightened when ..."). For representative replies, see Table 3. Most of the frightening experiences were connected with death, violence, and crime, often in the form of videos, but also stories circulating as e-mails. Some had been frightened by seeing edited pictures of themselves or others that they know that had been placed on the Internet without permission. The boys were also worried about viruses and the fact that using the Internet costs money.

Almost a third of the children (29.9%) had found some shocking material on the Internet, but they reported this was a rare occurrence. There were 53 children who replied to the question "I was shocked by the fact that ..." (see Table 4). The greatest numbers of shocking experiences

Table 2. "What is there about using the 'Net that is pleasant, amusing, or interesting?"

Girls:	<p><i>"There are lots of things especially for young people: picture galleries, games pages, the Messenger and so on."</i></p> <p><i>"Games and chatting with friends are fun when you know the people."</i></p> <p><i>"You can look for information about things that interest you."</i></p> <p><i>"It's great fun to chat on the MSN Messenger, play games on the 'Net and search for pictures and edit them. PS. I don't mean making fun of them."</i></p> <p><i>"You can visit your own pages and your friends' pages or open your e-mail."</i></p> <p><i>"Games and the Messenger, ii2 and the Habbo Hotel."</i></p> <p><i>"You can watch videos."</i></p> <p><i>"Amusing games, interesting stories, you can find information, and it's fun to do extra exercises for school."</i></p> <p><i>"You can listen to music and find the words to the songs or other information, and you can play games."</i></p> <p><i>"You can find out all sorts of things / learn to use the net better."</i></p>
Boys:	<p><i>"Watching films, watching sports etc., playing games, looking at the sports pages"</i></p> <p><i>"You can download music, find things out, learn things and chat with your friends."</i></p> <p><i>"The Messenger and ii2, and games."</i></p> <p><i>"You can go and look at funny pictures and videos."</i></p> <p><i>"Well, the games, for instance, and the forums where you can meet other people."</i></p> <p><i>"Habbo Hotel, for example, where you can have fun or chat with friends."</i></p> <p><i>"Among other things I read the news and look at my own e-mail."</i></p> <p><i>"When you can learn English and find out information for school."</i></p>

Table 3. "I was frightened when ..."

Death, Violence and Crime:	<p><i>"When a horror video came."</i></p> <p><i>"When people kill each other and things like that."</i></p> <p><i>"It showed pictures of accidents in which people died."</i></p>
Stories Circulating as E-mails:	<p><i>"There were some chain messages that were frightening."</i></p> <p><i>"An e-mail in which you had to find differences between pictures and then a monster suddenly appeared, but I'm not frightened of it any longer!!! ☺"</i></p> <p><i>"A man appeared in the middle of an e-mail, for instance, and his mouth was bleeding."</i></p>
Edited Pictures Placed on the Internet Without Permission:	<p><i>"There was once a picture of a car that was driving along when suddenly an awful head appeared on it."</i></p> <p><i>"Some sort of awful wallpaper picture."</i></p> <p><i>"A monster attacked the screen, and it was a girl who had been attacked by an animal."</i></p> <p><i>"When some pictures had been edited without permission."</i></p>
Viruses and the Fact that the Internet Costs Money:	<p><i>"When I thought the computer had a virus, but it was only a joke."</i></p> <p><i>"When the computer got a virus."</i></p> <p><i>"That it might cost money to look at something."</i></p>

were reported in connection with random browsing, in particular, related to sex and pornography. The girls had also been affected by accounts and pictures of cruelty to animals, and some children had been shocked by attempts at bullying and other forms of unnatural behavior. Many had suffered surprises due to Web addresses that closely resembled each other.

Altogether, 125 children answered the question "What is there that is shocking, frightening, misleading or unpleasant about using the 'Net?" A representative selection of replies is given in Table 5. Although this question was not asked directly in connection with the one on the frequency of shocking and frightening experiences, the pupils still mentioned sex and pornographic material as the most unpleasant things. The boys had more experiences of this kind than the girls. They also mentioned viruses and other forms of computer crime as disturbing features. Unexpected or unnatural behavior, such as bullying, death, violence, and crime, often in the form of video material, were once again reported.

Telling Others About Unpleasant Experiences

The children clearly wished to share their unpleasant experiences of Internet use with someone. Only one in eight of them (13.2%) said that they would not tell anyone about the things that frightened or horrified them. The pupils preferred to share their unpleasant experiences with their friends (82.2%), the girls much more often ($\chi^2 = 20.379, p < 0.001$) than the boys (93.5% vs. 69.1%). It may well be that these 11-year-old boys were behind the girls in their social development to such an extent that unpleasant experiences were not an "acceptable" topic of open conversation among them. Most of the children were also prepared to tell their parents about such experiences, even though 60.2% of the parents had not

Table 4. "I was shocked by the fact that ..."

Pornography:	<p><i>"Disgusting pictures, that is, all those porn pictures and the like."</i></p> <p><i>"When I was playing games with a person I didn't know he offered me sex on the 'Net."</i></p> <p><i>"Once when I sent out a search for my own name on the Google I suddenly got a porn picture. I shut it off straight away and haven't gone there since."</i></p> <p><i>Even ordinary pages have porn on them, if you search under 'animals' or 'the world of animals,' for instance."</i></p>
Other graphics:	<p><i>"There were horrible, violent pictures there."</i></p> <p><i>The pictures were crude."</i></p> <p><i>"They show such stupid pictures on the 'Net."</i></p>
Cruelty to animals:	<p><i>"I got a chain e-mail telling how to put kittens into bottles for the rest of their lives to make decorations out of them."</i></p> <p><i>"Some sort of pictures of cruelty to animals."</i></p> <p><i>"It was about having fun murdering and being cruel to animals."</i></p>
Bullying or unnatural behavior:	<p><i>"The pages belonging to people who had been bullied at school had stories with threats to kill somebody."</i></p> <p><i>"Some people are bullied in the conversations."</i></p> <p><i>"One weirdo asked me personal things that don't concern other people, and there are pedophiles there."</i></p>
WWW addresses:	<p><i>"I was going to one picture page but made a mistake in the address and got a lot of really stupid pictures."</i></p> <p><i>"When I was going to ii2 I wrote iii2 by mistake and it was some kind of sex page."</i></p>

asked their children to tell them of unpleasant experiences connected with Internet use. Three fourths of the children (74.0%) indicated that they would tell their mother, the girls more often than the boys ($\chi^2 = 7.264$, $p = 0.007$). Slightly fewer were willing to share these experiences with their father (65.8%). Only one out of twelve of the children (8.2%) thought that they would inform the police about illegal material discovered on the Internet, whereas one out of ten (10.6%) would be prepared to tell about this to their teacher. For some reason, the Internet seems to be thought of as a virtual world only in which illegal or harmful deeds become more acceptable than in the real world.

As many as 78.8% of the respondents reported visiting very rarely or not at all pages that their parents would not have wanted them to visit, and even the others only infrequently or sometimes. The girls visited these pages less often than the boys ($\chi^2 = 13.683$, $p = 0.008$). Four of five children (82.2%) visited very rarely Web pages that, in their own opinion, were not worthwhile visiting, and nine out of ten (89.9%) reported that they would very seldom return to such pages of their own accord.

The more frequent Internet users told their mothers about their experiences less frequently than did those who used it less often ($\chi^2 = 8.917$, $p = 0.030$). About two thirds (65.6%) of those who used the Internet on a daily basis told their mothers of their shocking or frightening experiences, as opposed to 80.2% of those who did so on a weekly basis and 90.9% of those who did so one to three times a month.

Table 5. “What is shocking, frightening, misleading, or unpleasant about using the 'Net?”

Pornography:	<p><i>“There are also things on the 'Net that are not for people of our age.</i></p> <p><i>“All the stupid adult things, like the over-18 pages.”</i></p> <p><i>“It’s unpleasant and upsetting to go by accident to a page where there is someone naked.”</i></p> <p><i>“Sex (pages), porn pages, stupid pages, viruses.</i></p>
Viruses:	<p><i>“Spam mail and viruses.”</i></p> <p><i>“Viruses are unpleasant, for example, and sometimes frightening.”</i></p> <p><i>“Hackers, viruses, and hidden advertising.”</i></p> <p><i>“Viruses can come from there.”</i></p> <p><i>“There are people on the net that copy other people’s pictures and spread viruses.!”</i></p>
Unexpected or unnatural behavior:	<p><i>“Someone could fool me into giving my own name or address or something by pretending to be someone else.”</i></p> <p><i>“Deception, at least, and pointless messages.”</i></p> <p><i>“There can be people who might take advantage of my data.”</i></p> <p><i>“Some people on the ii2 make nasty remarks.”</i></p> <p><i>“One frightening thing about the net is that there are strange people around who can send nasty messages and so on.”</i></p> <p><i>“All the people who ask for pictures and the like on the net, that’s something unpleasant.”</i></p>
Death, Violence, and Crime:	<p><i>“If you go to the games pages they can lead to other pages that are frightening or violent.”</i></p> <p><i>“There are frightening videos on it.</i></p> <p><i>“Horror games.”</i></p> <p><i>“Horror films such as those for people over 15 or over 18.”</i></p> <p><i>“You sometimes find brutal videos or wrong information.”</i></p> <p><i>“There are pedophiles around and all sorts of drug pushers.”</i></p>

There was also a difference in reporting based on the duration of an average use situation. Six of seven (86.5%) of those who used the Internet for less than half an hour at a time told their mothers of their experiences, whereas only every second (50.0%) of those who used it for more than 2 hours at a time would do so ($\chi^2 = 9.083, p = 0.029$). Those who spent less than a half an hour on the Internet told their fathers more often about their experiences than those spending more than two hours ($\chi^2 = 12.015, p = 0.007$), the figures being 74.3% and 30.8%, respectively.

PERCEPTIONS OF PARENTAL ATTITUDES AND CONTROL

Parental Controls

According to the children, a little less than two in five parents (37.6%) at least sometimes taught their children about using the Internet, whereas only 9.2% of the parents taught them frequently. Meanwhile, less than a half of the respondents (47.5%) fully agreed that their parents knew what they were doing on the Internet, whereas four of five (79.8%) agreed fully

or to some extent. Most of the children (78.9%) reported having discussed their Internet use with their parents rarely (extremely rarely 50.2%, rarely 28.1%), whereas only 6.3% reported such discussions to have taken place rather often. Only 5.1% of the children had a parent with them rather often when they were on the Internet. For 80.5% of the children, this happened rarely (extremely rarely 60.6%, rarely 19.9%).

Finally, 11.4% of the children indicated that their parents frequently checked what pages they had visited on the Web, while 56.2% said that this happened extremely rarely or not at all. These checks were more common among boys than girls ($\chi^2 = 15.989, p = 0.003$).

Restrictions of Internet Use

Almost half of the children (45.5%) reported that their parents restricted some of their Internet use, whereas 28.6% said there were no restrictions at all for them. Every second child (48.8%) was convinced that they could, in practice, decide for themselves how they used the Internet.

Two thirds of the children (65.0%) reported that a time limit had been placed on their use of the Internet. Quite interestingly, on-line time was restricted more often for girls than for boys ($\chi^2 = 8.253, p = 0.004$; 73.9% vs. 55.6%, respectively). Half of the respondents (50.2%) reported that their parents allowed them to contact only people on the Internet whom their parents also knew. However, in conjunction with another question, more than half of the respondents (55.3%) reported that their parents allowed them to communicate with unknown people for them on-line but not to meet them in real world. The girls (62.2%) reported this latter situation slightly more often ($\chi^2 = 4.310, p = 0.038$) than the boys (48.1%).

According to the children, 80.3% of their parents had forbidden their children to visit certain pages, and almost a third of the respondents (29.4%) reported that their parents used filters on the browser on the home computer to prevent access to pages of certain types. Most of the parents (79.5%) had forbidden them to give any personal details, this being more common ($\chi^2 = 9.519, p = 0.002$) for the girls than the boys (87.6% vs. 70.8%, respectively). The children were relatively well aware of the risks involved in revealing their identity on the Internet: As a result, 88.7% of them said that they very rarely or never gave information that they felt to be personal, the remaining 11.4% having done this rarely or sometimes.

According to the children, less than half of the parents (44.4%) expected their children to tell them when they were going to use the Internet. And only about one in five (22.5%) said that they were expected to tell the reason why they were going to use the Internet.

Opinions About Restrictions

The question eliciting the children's opinions of their parents' attempted restrictions resulted in 184 replies (see Table 6). The majority of the comments were in favor of some form of restriction. The children understood that using the Internet should not be the focal point of their lives and that they should do other things as well in their free time. The children also mentioned both security issues and health concerns, such as the danger of headaches and insomnia from excessive computer use. Many of them also understood the reasons behind the restrictions, even in cases where they felt that they were motivated partly by prejudices of their parents. The children who were against restrictions on Internet use justified this in terms

Table 6. “What do you think about attempts at restricting children’s use of the ‘Net?’”

“It could be restricted. It’s not a good thing to be hanging around on the net all the time.”

“It’s quite right that children shouldn’t go to pages that are unsuitable for them!”

“It’s not a bad thing at all, as the computer produces radiation and can damage our growing brains.”

“Quite right that we should be able to do just what we like on the ‘Net.’”

“Quite right, because a lot of children spend many hours a day on the ‘Net.’

“It’s a good thing, because otherwise you get a headache and your brain cells die off.”

“Quite reasonable, but annoying that you can’t play whenever you want.”

“It’s a good thing, but I don’t always obey it.”

“It’s good that there’s a restriction, as there’s some time left for other things, like reading and sports.”

“It’s a good thing, as you can’t get to sleep afterwards and then school suffers....”

“It’s necessary, of course, but sometimes parents get prejudices about quite harmless things.

“It’s nice when you can play every day until late into the night. ☹ ... It’s a bad thing if you can only play a little and even that is restricted... ☹.”

“It’s a good thing, otherwise the world would be full of idiots.”

“No! I don’t approve. I think all the pages on abuse and that sort of thing should be taken away.”

“I think children should be able to go to whatever pages they like, but we should think a bit first because they’re not all worth going to.”

“There shouldn’t be any restriction, except if a child never does anything else but surf the net or play on the computer.”

“Down with it!!”

“A WASTE OF TIME”

of retaining the power to decide on what they do and proposed that the restrictions should be on the content placed on the Internet rather than on the use of the Internet.

Every fourth child would have liked his/her parents to be more interested in their Internet use (27.0%), whereas two of five (39.2%) only agreed to some extent with this idea. The boys hoped for their parents to be more interested in their Internet use slightly more ($\chi^2 = 10.494, p = 0.033$) than the girls (31.5% vs. 22.8%, respectively, and with those that fully agree 15.7% vs. 5.3%, respectively). Children may have their own reasons to avoid having their parents know what they are doing on the Internet, fearing that parents will remove or add more restrictions to their access.

DISCUSSION

Our study revealed that eight of nine of the 11-year-olds (88.9%) use the Internet on a weekly basis. This figure has grown rapidly in recent years. In comparison, only 37% of Finnish children less than 11 years had been weekly Internet users in 2003 (Spedaro, 2004).

According to our study, 19.7%–29.9% of the children had been faced with frightening or shocking experiences when using the Internet, and one in nine children (11.4%) had revealed personal information that they regretted sharing. Results show that older children have higher incidents of such experiences. In their study of 9–19-year-old British young people, Livingstone and Bober (2005) found that over half of them had seen harmful material on the Internet, and 46% had given their personal details to someone whom they had met only on the Internet. This seems to demonstrate that the dangers of the Internet grow when one becomes a teenager.

In our study, two of three of the children (65.0%) reported having time limits on their Internet use, which is in line with the European parental survey conducted in 2006 (SAFT, 2006), which reported 54% in this regard. However, according to our study, only one in nine children (11.4%) reported that their parents regularly checked the Web pages where their children visited. This finding, which is based on the children's own perceptions, is in sharp contrast with the result from the European parental survey (SAFT, 2006), according to which 56% of the parents reported that they checked from the browser what pages their child had visited. This may be partially explained by the fact that parents do not inform their children every time they check the history. Notwithstanding this likelihood, the difference between the results in these two studies is so remarkable that simple unawareness that their parents are checking cannot explain fully the discrepancies in the statistics. So, even if parents are doing many things proactively in controlling their children's access to and behavior on the Internet, the actual control is probably less than the parents think it is. On the other hand, 80.3% of the Finnish children reported that their parents had forbidden them to visit certain pages, whereas the European parental survey reported only 25% in this regard. There may also be some differences between the Finnish and other European regions in parental control attitudes toward and practices for Internet use.

This study suggested that four in five children (79.9%) were often alone when using the Internet. This is in line with the survey among Finnish schoolchildren of 8–10 years of age by Suoranta, Lehtimäki, and Hakulinen (2001), according to which 84% of children usually use their computer alone. According to Oksanen and Näre (2006), the Finnish children differ from their counterparts in Norway and Sweden in their predominantly solitary use of the Internet.

Oksman (2002) suggests that families consider the computer as one of the instruments of the information society, a command of which will help their children to manage in their work when they are grown up. In many cases the command of computers and networks originally obtained through playful on-line behaviors may lead into an important know-how in the modern information society. In our study, the children typically regarded the Internet as easy to use and easy to learn and more of a toy than a tool. Moreover, many of the children, both boys and girls, perceived that they could use a computer better than their parents, with 66.8% regarding themselves as better users than their mothers and 50.9% better than their fathers. However, parents do not lose their authority over their children's activities merely because their Internet skills are not up to the standard of their children (Parikka Altenstedt, 2004).

CONCLUSIONS

The Internet has become an integral part of the daily and weekly activities of young children. A deeper understanding of children's own views and experiences of using the Internet and their attitudes towards parental supervision and the technological environment in which they are growing up is badly needed. This article reported on a survey of Internet use among the fifth-grade pupils in Finnish schools, that is, children about 11 years old.

Most of the children seem to have an Internet connection at home and most of them tend to use the Internet at least on a weekly basis. More than half of the children chat with their friends on the Internet at least once a day, the median being at least twice a day. About a half of the children play games on the Internet at least once a day, this being more common

among the boys than among the girls. Children of this age seem to make relatively little use of the Internet to support their schoolwork or search for other information. To simplify, the contemporary Internet seems to be a means of social interaction for girls and of playing games for boys.

The majority of the children claim that they are better at using the Internet than their parents. They teach their parents to use the Internet more often than the parents teach them. However, this happens still only occasionally.

Less than a half of the children think that their parents really know what they are doing on the Internet. Some of the children would like their parents to be more interested in their use of the Internet, whereas some do not want their parents to show an increased interest. About half of the children are convinced that they could, in practice, decide for themselves how they will use the Internet. Yet, the majority of the children are in favor of some form of restriction. Many of them also understand the reasons behind the restrictions, even in cases where they feel that they are motivated partly by prejudices.

The children have a fairly clear picture of what content is not good for visiting and what details about themselves they should not reveal. In spite of this, many of the children have found some shocking material on the Internet. The shocking experiences are oftentimes reported in connection with surfing the Internet, and they are related in particular to sex and pornography. Most of the frightening experiences are connected with death, violence, and crime, often in the form of videos.

The children clearly wish to share their unpleasant experiences of Internet use with someone. They prefer to share them with their friends rather than with their parents. Nevertheless, most of the children are also prepared to tell their parents about such experiences, even if most of the parents have not explicitly encouraged them to do so. Those who use the Internet more often are less willing to tell their parents about shocking or frightening experiences than those who use it less often. Unfortunately, this suggests that children gradually get used to the shocking, frightening, misleading, and unpleasant material found on the Internet.

In sum, the Internet appears to be a different kind of information vehicle for different individuals. Most of the use experiences are perceived to be positive, even if also negative experiences do exist. Recently, social networking applications and mobile appliances have become popular among the youth, which has changed the way that they perceive the Web. Further research should be carried out with longitudinal approaches and with regarding the many facets of these new kinds of Web-based systems and services.

ENDNOTES

1. Rideout et al. (2005) studied media use more broadly, including the Internet use as a part of their study.
2. Ito et al. (2008) nicely depict the trends among the young people's Internet use, even if much of the research reported in it concerns older than 11-year olds.
3. See <http://www.ii2.org/>

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MOBILE PHONE HARASSMENT: AN EXPLORATION OF STUDENTS' PERCEPTIONS OF INTRUSIVE TEXTING BEHAVIOR

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Abstract: Limited research has explored the link between mobile phone use and harassment behaviors. This paper details the findings from a preliminary study that examined perceptions of unwanted communication, with one focus group (7 participants) and two vignettes presented to 145 students. The vignette participants were asked to respond to hypothetical questions about continued and unwanted contact being maintained as if they were both a sender and recipient of the contact and if they had actually been harassed. Response options allowed for intended behavior to be measured against generally agreed thresholds of duration and frequency used to identify harassment. Findings indicated that harassment by text is more prevalent than other forms of off-line stalking and, despite recipients reporting being distressed, there was still a higher level of acceptance of this form of harassment than other forms. Furthermore, responses to text harassment were associated with a high frequency of behaviors perceived as not actively discouraging further texts, therefore having the effect of prolonging unwanted contact. These results are discussed in relation to intervention strategies and future research.

Keywords: texting, mobile communication, cyberstalking, harassment.

INTRODUCTION

Mobile phone ownership has increased worldwide in the last decade. In the United Kingdom, 27% of households owned a mobile phone in 1998/1999, rising to 79% in 2004/2005 (National Statistics [UK], 2006). The rapidity of this communication revolution means we are only just beginning to objectively observe the various impacts it has produced on human behavior and relationships.

Typical Mobile Phone Use

Continued technological advances, changing tariffs, and cultural and individual differences have influenced the explosion in the number of the short message service (SMS), or texting, that people send and receive, which has increased with each subsequent year (National Statistics [UK], 2006). The term *text*, or *texting*, used throughout this paper refers to SMS messaging. Some researchers have suggested that texting could have been rejected as a slow, more cumbersome method of communication compared with talking on the phone (e.g., Reid & Reid, 2004). However, it is apparent that the benefits of texting must often be considered to outweigh these drawbacks, with texting now being a primary communication tool for young people. Indeed, 61% of children aged 8 to 11, and 87% aged 12 to 15, sent text messages at least once a week, whilst 94% adults aged under 25 years sent text messages (National Statistics [UK], 2006).

A variety of unique benefits of texting have been considered by other researchers. As a communication option, texting provides the user an instant means of communicating with another person who may be distanced by either location or time (Green, 2002). Madell and Muncer (2007) identified that one benefit of texting, e-mailing, and instant messaging is that any of them can be used asynchronously as well as synchronously, in contrast to face-to-face communication and phone conversations, which can only be synchronous. Texting gives individuals an opportunity to take time to think and consider the response that they want to give, generally without interruption. Madell and Muncer's (2007) study supported previous research that highlighted the perceived value of being able to plan, think about, and edit text communication as providing the sender with increased control, compared to communication in a spontaneous conversation (Kiesler, Zubrow, Moses, & Geller, 1985; Levine, 2000).

Individual differences have been associated with certain mobile phone behaviors. Socially anxious, shy, and introverted people, as well as neurotic individuals, have been reported to be more likely to use texting as the preferred alternative to talking on a mobile phone (Reid & Reid, 2004). In a study investigating individual differences and mobile phone use, younger people have been found to demonstrate significantly higher usage of mobile phones than older participants (Bianchi & Phillips, 2005). Moreover, high levels of extraversion and low levels of self esteem were found to be significant predictors of problem mobile phones use, which the authors suggested may be attributed to behavioral addiction (Bianchi & Phillips, 2005).

Sending and receiving texts also acts as a social and emotional pick-me-up, to remind both parties that someone is thinking of them. This has been found to be particularly salient for couples in a romantic relationship, where texting may provide a medium of being connected to someone when other forms of communication are inappropriate or unavailable (Pettigrew, 2007). The increased accessibility to others that texting provides also has the potential of removing social barriers that may serve a protective function.

Thus, a crucial research question is, when does texting behavior extend beyond a normal and accepted range and start to be experienced as a problem behavior for either the sender or recipient? Does the remote aspect of texting act as a positive feature for shy, socially anxious individuals since they can experience more control over the management of their own output but, conversely, allow them to become less aware of the impact their actions may be having on others? Despite steady coverage by the popular media, there is very little academic

research that has examined the direct link between new technologies and this problem behavior. An emerging debate in this field has started to question whether “cyberstalking” reflects the same profile as proximal stalking.

Stalking and Cyberstalking

Although stalking has been prevalent for more than a century, it has been within the last two decades that it has evolved into a social issue (Mullen, Pathé, & Purcell, 2001). This problem moved beyond the social sphere and onto the political agenda in the 1990s, when new stalking legislation was introduced in the United Kingdom in the form of the Protection from Harassment Act 1997. The act does not offer an exact definition of stalking or harassment, but “prohibits conduct that has a particular effect on the victim” (Petch, 2002, p. 20).

Stalking and harassment are unusual in criminal law since the offending behavior is recognized only when the victims identify themselves as being distressed as a result of the unwanted behavior that they believe is threatening to them. Therefore, the “victim’s” perception of the offending behavior is crucial: The perpetrator or stalker must have been made aware by the victim that his or her behavior is causing distress, but continues to make this unwanted contact with his or her victim.

The Protection from Harassment Act does state that “a person must not pursue a course of conduct- (a) which amounts to harassment of another, and (b) which he knows or ought to know amounts to harassment of the other” (Protection from Harassment Act 1997, Section 1). In parallel, the psychiatric literature has defined stalking as a course of conduct by which one person repeatedly inflicts on another unwanted intrusions to such an extent that the recipient fears for his or her safety (Mullen, Pathé, & Purcell, 2004.). Repetition and persistence are also characteristics of this behavior. In an attempt to define when repeated intrusion becomes problem behavior, an accepted cut-off point for “normal”/“abnormal” contact is suggested by Pathé, Mullen, & Purcell’s (2000) criteria for persistence and repetition (over 4 weeks and/or more than 10 occasions). Due to the subjectivity of the legal definition, this paper will draw on Pathé et al.’s (2000) definition.

Cyberstalking can be defined as “threatening behavior or unwanted advances directed at another using the Internet and other forms of online and computer communications” (National Center for Victims of Crime, 2003). While specific inclusion of mobile phone harassment has been largely overlooked, the advent of smart phones may make this distinction less important, since on-line communication and mobile phone communication are increasingly conducted through the same mobile device.

The nature and diversity of both stalking and cyberstalking mirrors the variety of emotional responses that victims have reported (Mechanic, Uhlmansiek, Weaver, & Resick, 2000). Nevertheless, what is clear is that the victims’ reactions are of a negative nature and include fear, depression, stress, anxiety, lowered self-esteem, and a loss of trust in other people (Mechanic et al., 2000). Although the psychological impact of stalking and cyberstalking is similar, within the United Kingdom, proximal stalking is situated legally within the Protection from Harassment Act 1997, whereas cyberstalking can be considered under the Harassment Act 1997 and, in addition, in the Communications Act 2003. Specifically, Section 127 of the Communications Act relates to the sending of improper messages by means of a public electronic communications network that are grossly offensive,

obscene, indecent, or menacing. That section also defines a separate offense for acts in which public electronic messages cause annoyance, inconvenience, or needless anxiety to another; messages that the sender knows to be false (or causes it to be sent); or for a person who persistently makes use of a public communications system. Furthermore, the Malicious Communications Act 1988, Section 1, makes it an offense to send an indecent, grossly offensive, or threatening letter, electronic communication, or other article to another person with the intention that it should cause them distress or anxiety.

The growing debate on whether cyberstalking is a new phenomenon (Bocij & McFarlane, 2002) or simply another method by which to harass (Meloy, 2007) includes consideration of whether communication via new technologies is more than just an intention to make or maintain contact rather than the behavioral action of texting being a means for an individual to support a compulsion to text or e-mail (Bianchi & Phillips, 2005). Another suggestion is that some cases of cyberstalking are principally extensions of or a prelude to off-line stalking, while others represent a distinct harassment subtype (Sheridan & Grant, 2007).

Incidence and Prevalence

Establishing prevalence rates of cyberstalking is still problematic, due to the diversity of operationalized definitions of cyberstalking and the variety of methods employed in gaining data. Within the UK, harassment accounted for 20% of police-recorded violent crimes in 2005/2006, although a breakdown of types of harassment was not noted (Walker, Kershaw, & Nicholas, 2006).

For the purposes of this paper, previous research into the prevalence of cyberstalking is reviewed. The literature can be divided into two parts according to the samples that were investigated. This paper reflects that division by firstly looking at studies that have observed the prevalence of cyberstalking in samples of self-reported stalking victims. The second approach has observed the prevalence of proximal stalking behaviors (both on-line and off-line) in normative samples.

Sheridan and Grant (2007) collected data from 1,051 self-defined stalking victims, 83% of whom were women, from the UK, USA, and Australia. They found that nearly half of the sample (47.5 %) reported being harassed via the Internet, and 7.2 % of the participants were considered to have been cyberstalked. Individuals who continued to be harassed by their ex-intimates were found to represent the most common stalking type. This reflects findings from proximal stalking data, which has been found to comprise 50% of ex-intimates (Sheridan & Boon, 2002).

As recently as 2000, empirical data on the prevalence of cyberstalking was not available (Ogilvie, 2000), although concerns were raised about the increasing incidence of the phenomena. Since this time a number of studies have drawn data from a general population of Internet or mobile phone users.

Spitzberg & Cupach (2007) conducted a meta-analysis of 175 studies in order to ascertain the prevalence of stalking, as well as descriptive information such as sex differences, origins of stalking, and the type of threat. They found that a quarter of the studies reported some form of victimization that lasted for up to 22 months. Moreover, between 60% and 80% of the victims (depending on the study) were females. In terms of prevalence, between 25% and 50% of all participants across the studies stated that they had been harassed at some time. However the authors suggested that these figures may underestimate electronic

forms of harassment, such as texting or mobile phone behavior. Therefore, the risk of harassment is possibly increased with the additional channel of communication provided by mobile phones. This has implications for the receiver-individual's psychological well being; in addition, social and commercial consequences could exist.

In their study, Finkelhor, Mitchell, and Wolak (2000) found that 6% of 1,501 regular Internet users, aged 10–17, had experienced repeated on-line intrusions that had caused them to feel threatened, worried, or embarrassed. The reported prevalence was similar for boys and girls, and 28% of the group knew their harasser. Similarly, levels of harassment were identified in 10% of 1,504 cases of a survey exploring negative Internet experiences that had been reported to mental health professionals (Mitchell, Becker-Blease, & Finkelhor, 2005).

However, on-line or phone intrusive behavior may not always be experienced as threatening as off-line intrusions. Spitzberg and Hoobler (2002), in the development of a measure of cyberstalking victimization, found that a third of respondents (235 communication undergraduates) had reported some form of cyberharassment, which was judged to be benign. However, 18% reported that they had been “undesirably and obsessively” communicated with.

Alexy, Burgess, Baker, and Smoyak (2005) found that 3.7% of students had experienced cyberstalking. This represented 31.5% of a group who had identified themselves as having experienced some form of harassment. Similarities between the subgroup and the group who experienced off-line stalking were identified. Most notably, cyberstalkers were classmates or former intimates of the victim. Cyberstalking victims were also likely to have been intruded upon off-line. However, some differences between the groups were noted: The authors identified that women were significantly more likely to report having been stalked (proximally), but men were more likely to report having been cyberstalked. When compared with proximally stalked victims, cyberstalked students were more likely to not respond to communications and were less likely to call the police.

The research introduced here describes a diverse range of on-line behaviors under the umbrella term of cyberstalking. The current paper focuses on persistent intrusive behavior via mobile phone texting, specifically exploring students' experiences of negative texting behavior. It provides perspectives from both recipients and senders of unwanted text messages.

Research Aims

The goal of this research was to identify the prevalence, experience, and nature of what is viewed as harassment through mobile technologies. To guide the research into the student's experiences of negative texting behavior, four aims have been articulated:

1. To ascertain the incidence and prevalence of text harassment, as compared to norms from proximal or off-line stalking;
2. To gain an understanding of the experiences and impact of text harassment;
3. To identify behaviors and reactions by the harassed individual, including any that might unintentionally prolong such unwanted contact.
4. To identify how senders may view their own continued contact, particularly when it has exceeded the threshold of harassment (e.g., Pathé et al., 2000).

METHOD

This preliminary investigation employed a mixed methods design, incorporating both qualitative and quantitative methods, to gain an insight into mobile phone use and intrusive behaviors. The methods consisted of one focus group and a paper-based survey. Ethical approval was obtained from the Psychology Department Ethics committee at the University of Bedfordshire and all participants were informed of the aims of the study before gaining their consent. No names or contact details were taken to ensure participant anonymity was preserved. Participants were provided with an identification number and informed that they could withdraw their data at any time. Participants were invited to speak to the research team after taking part in the focus group or completing the survey and also directed to appropriate services if they felt that they had been affected by any of the issues raised by the research. Two participants did contact the research team to ask for such advice.

Sample Characteristics

A convenience sample of students volunteered to take part in this study. Seven female psychology undergraduates, aged between 19 and 45 years (mean age 29 years and two months), participated in the focus group. In addition, 145 psychology students from one university (32 males and 113 females), aged between 16 and 50 years (mean age 22 years and 10 months), completed the survey. The gender and age breakdown reflect the overall psychology student population in this location.

Materials, Procedure and Data Analysis

Focus groups

Focus groups have been increasingly used within the social sciences to elicit attitudes, values, and experiences from either vulnerable groups or when discussing sensitive issues (Krueger & Casey, 2000) and are useful at the exploratory stages of the research process. Because this is still a relatively new area of inquiry and included questions that may be sensitive, it was felt that this was the appropriate method to generate a snapshot of students' lived experiences and perceptions of texting behaviors. Undergraduates in lectures were invited to take part in a focus group related to unwanted texting behaviors. Seven female students volunteered to take part. A semi-structured schedule was adhered to, commencing with general questions relating to participants' texting behavior, such as, who the participants sent texts to and what was the style and frequency of the texts they sent. This was followed by questions that addressed negative texting behaviors. Examples of questions asked include, "Have you ever received texts from someone you don't want to text back?" and "When does inappropriate texting start to become a problem?" The findings of these final questions presented particular focus on negative texting behaviors.

The focus group lasted 45 minutes and was audio recorded and transcribed verbatim. The data were then analyzed using thematic analysis. This process involved the two researchers reading through the transcripts together on a line by line basis and then identifying themes in the margin of the transcript. The researchers agreed on the three general themes and worked together to establish the theme names. A benefit of this method is that it is not necessarily linked to a pre-

existing theoretical framework (Braun & Clarke, 2006), which differs from both grounded theory and interpretive phenomenological analysis, but it can still be an inductive approach.

Survey

In addition to the focus group, a survey was conducted to gain insight into how a large group of individuals consider they might act in hypothetical situations. Pre-undergraduates and undergraduates volunteered to complete a survey in their lectures. In each case, all students who attended took part. The survey consisted of four sections. The first section asked respondents to provide demographic details and information regarding the frequency of texts they sent and received on an average day using their mobile and the average daily landline phone usage, and details regarding their use of the Internet as a form of communication. The second section included different vignettes aimed at illuminating how participants might respond to normal texting behaviors within a relationship. These findings are not reported in this paper. The third section of the survey was designed to ascertain how respondents might behave in two similar vignettes based on the break up of a romantic relationship by text message. Romantic relationships were chosen as the topic for the vignettes since the majority of stalkers (based on Pathé et al.'s, 2000, definition of 10 times or over 4 weeks) have been identified as ex-intimates (Sheridan & Boon, 2002). Moreover, this method of breaking up a relationship has been found to be surprisingly common, with more than half of the respondents in one study indicating that they would end a relationship in this way (Short, McMurray, & Jackson, 2007). The final section of the survey included a few questions relating to individuals' actual texting behavior. The survey had been developed over 2 years and this version was the third iteration.

In the first vignette, participants were asked to imagine themselves from the perspective of a person being told unexpectedly that a relationship is over (they will be referred to as the "lefts"; Emmers & Hart, 1996) by a romantic partner after being in a relationship for a few months. The retreating partner has stated that the reason for the break up was that he/she did not consider "you to be the one." Participants were initially asked if they would continue to make contact with their ex-intimate and, if so, the frequency of communication via mobile phone that they would use to make this contact and the justification for behavior.

The second vignette was almost identical, but on this occasion participants were asked to put themselves in the position of the individual who was ending the relationship (they will be referred to as the "leavers"; Emmers & Hart, 1996). Specifically, they were to imagine they had been going out with their partner for a few months and, although there were no major problems, they felt that this partner was not the one for them, and therefore informed their partner that they did not want to see them again. This time, the participants had to state how they would react if their ex-intimate continued to contact them after varying periods of time and frequency. A threshold for unacceptable behavior was calculated based on Pathé et al.'s (2000) framework of harassment.

These vignettes were aimed at identifying whether people might continue to make contact when, in fact, it could be classed as harassing behavior. Moreover, we hoped to detect any behaviors on the part of the harassed individual that were unintentionally encouraging or prolonging unwanted contact. Hypothetical vignettes are often used in survey research so that researchers can gather respondents' beliefs on how they would intend to behave if they were involved in a similar situation, yet with the benefit of being less obtrusive than asking individuals to recount their actual behavior (Eifler, 2007). However, the validity of this

method could be brought into question since intended behavior may not necessarily reflect an actual behavior. Eifler (2007) referred to Abelson's script theory (1976), and hypothesized that by applying Abelson's rules, behavioral intentions and actual behavior are more likely to converge if the vignettes are presented in simple language, that is, structured in a way similar to every day experiences.

The final section of the survey included questions relating to actual rather than hypothetical behavior. Firstly participants were asked, "Have you ever found yourself in a similar situation in real life?" (receiving unwanted texts from an ex-boyfriend or girlfriend). Then they were asked "Did this cause you any worry," "irritation," or "fear." Participants were given the options to answer "yes" or "no" to each of these questions. Additionally, there were questions to ascertain the duration and frequency of contact. These question items were designed so that Pathé et al.'s (2000) threshold for harassment could be identified. The frequency counts of how people would respond throughout the survey were entered into SPSS version 16 and the frequencies of the responses were generated.

RESULTS

In the first instance, in order to gain a picture of the survey participants' mobile phone behaviors, several demographic data were tabulated: the frequency of texts sent and received per day, as well as the mobile phone calls made and received per day. As can be seen in Table 1, the younger age group (aged between 16–19 years) in most cases sent and received more texts than the older age group. However, young females sent and received more texts than younger males. Overall there was an average of 9.5 texts sent per day per user, and that was the favored method of communication, as compared to mobile phone calls, instant messaging, e-mails, and landline phone calls.

Focus Group Findings

The transcribed focus group data were analyzed and three themes were identified: the infatuated harasser, the impact on their lives, and the importance of keeping records. These findings are discussed below. In order preserve anonymity the names of the participants have been replaced with the letter 'F' for female followed by an identifying number.

Table 1. Average Daily Frequency of Different Types of Mobile Communication for the Survey Group.

	Males <i>n</i> = 32		Females <i>n</i> = 113		All participants
	Age 16–19	Age 20–50	Age 16–19	Age 20–50	All ages
Texts sent per day	7.3	9.7	13.6	7.6	9.5
Texts received per day	12.8	7.7	14.1	6.4	10.2
Mobile phone calls made per day	3.7	4.4	4.4	3.8	4.1
Mobile phone calls received per day	11.6	5.5	5.2	4.6	6.7

Focus groups, like other qualitative methods, do not aim to generalize to a larger population but rather to provide an insight into the lived experiences of the participants. Every member of the focus group stated that she had sent and received negative texts, typically in arguments with current intimates. The regularity of this form of communication suggests that it was perceived as cultural norm. Each member of the group also indicated that she had received unwanted texts. On further investigation, four of the seven members of the focus group reported experiencing texting harassment as defined by Pathé et al. (2000).

The Infatuated Harasser

The first theme identified by the researchers was the type of harasser that the women had encountered. In the case of proximal harassment, the harassers were usually found to be an infatuated individual or an ex-intimate (Sheridan & Boon, 2002). The four women in this study experienced harassment via text messages by an infatuated harasser and had not had a previous intimate relationship with their harassers. The experience of being pursued by an individual who is intent on establishing an unwelcome level of intimacy can distress and frighten. Indeed the pursuer may cause alarm by being “oblivious to their victim’s feelings and in practice often reinterpret(ing) the most blunt of rejections as a positive response” (Mullen, Pathé, & Purcell, 2000, p. 11). However, each woman had a different story to tell. For example, one woman had known her harasser through her sister’s romantic relationship with his twin brother. This participant described how the aggressive behavior of her sister’s boyfriend had led to her sister requiring the involvement of the police and the ending of the relationship. Nevertheless, although this family tie had been severed, the infatuated man continued to harass the participant, stating to her that it was more than just a small issue.

F1: *“It is more than problem; He just doesn’t stop!...He even came to my house. I felt quite scared, actually.”*

Another member of the focus group described her experience of being harassed by text messages from a man who worked in her building.

F3: *“I had this guy who got my number from work. He actually went through the phone book and got my number and started texting me and I didn’t even know who he was, sort of thing. I was just being polite answering him at first, you know like....”*

F1: *“Yeah, you would.”*

F3: *“And then I went to Australia and he got hold of my sister’s number.”*

This participant described how her harasser became so infatuated with her that he started to text her sister; he also sent letters to her home. The infatuation in the incidents of participants F1 and F3 started as harassment by texting on a mobile phone and then progressed onto proximal stalking. In addition, both cases included attempts by the harasser to have discussions about them with their female siblings.

A third woman in the group reported that her experiences were “nothing like that, thank God!” She had started to become friends with a man but, when she realized that he had quite a manipulative character, she asked him to stop contacting her. However he continued to do so.

F4: *"...but he didn't take the hint even when I didn't reply to his texts. He used to ring about 10 times a day just trying to just try to get me to call or text."*

Again, what started as texting transformed into other forms of harassment. In this case, the man started to leave messages on the participant's blog. Other members of the focus group felt that this was a quite common occurrence, evidenced by the prevalence in just this small group.

F4: *"He wrote on that [blog] saying he was still interested in what was going on in my life and stuff like that."*

F2: *"I think this modern technology is just being misused. It is quite common; you are always hearing about this sort of thing."*

F3: *"And look how many it has happened to out of us. There is just a few of us here."*

The final woman who had been harassed stated that she had been harassed via e-mail from a fellow student. Although she had met him socially on one occasion, she did not share any classes with him. Nevertheless, he had started to send her joke e-mails. But the number of e-mails he was sending made her feel uncomfortable. All of these examples demonstrate the diversity, but also the similarity, of harassment that appeared to be viewed as almost the norm in this small sample of undergraduates.

Impact on the Lives of the Women and Their Families

Participants described how they tried to make sense of this behavior, and appraised it on a continuum somewhere between an irritation and a violation. All of the women who had been harassed reported that they were fearful and felt powerless to know what action to take in both stopping the harassers' behavior and in supporting their own emotional needs. They questioned what their options would be and felt that reporting it to the police was not necessarily the best option, stating that they felt their complaint would not be viewed as legitimate by the police.

F7: *"I didn't know who to go to. It felt silly because he hadn't done anything that bad. But I spoke to my dad and he was really angry and he said he was going to sort him out. I told him [the harasser] this and he just stopped."*

Phoning the police was considered as a last resort. This has parallels with proximal stalking, where individuals often go to the police only when threats of or actual violence occurs. Therefore, in order to regain some form of self-empowerment, to stop the negative behavior of the harasser, or just to avoid the harasser, often the victim of harassment makes changes to her/his own life rather than have expectations that any action will be taken that may have an impact on the harasser's conduct, as the following comment exemplifies:

F1: *"Well, I have changed my number now. It used to be if I saw him in the road, I would cross over, and he would start to text or call me and then never stop."*

The Importance of Keeping Records

For the most part, the dialogues in the focus group centered on each woman describing her individual experiences; there were only limited interactions in the group as a whole. However,

one area where other members of the group did ask questions and offer advice was in relation to the importance of keeping records, as the following quotes demonstrate.

F2: *“Did you keep a record of any of this? You should keep a record. This is serious!”*

F5: *“Write down what you already remember, and then whenever you see him and anything happens, then just jot it down.”*

F3: *“So my sister was really good. She kept every single text that he sent, every letter, everything. And then they went to the police, and they [the police] went 'round, and he actually got arrested because he was doing it to loads of different people. So you should keep a record of it and then they can do something about it.”*

These findings suggest that it was a common assumption that records should be kept to verify valid evidence in case the situation escalated. These records would be essential in involving external agencies.

Survey Findings

Vignette One: Perspective of the Person Who Has Been “Left”

As described in the first vignette, participants were asked to imagine themselves from the perspective of a person being “left” unexpectedly by a romantic partner after being in a relationship for a few months. A total of 94% of the sample stated that if they were told by their ex-intimate not to contact them again, they would cease making contact with them. The remaining 6% of the sample reported that they would continue to contact their ex-intimates, even if they had been told it was unwelcome. More telling, these 6% of participants stated they would continue this communication for more than a few weeks, which according to Pathé et al. (2000) constitutes harassment.

The next question in the vignette asked the participant to consider if their ex-intimate had said contact was unwelcome but still continued to allow communication. That is, the ex-intimate initially stated that contact was unwelcome, but did respond intermittently. Sixteen percent of the sample responded that they would continue to contact their ex-intimate for a few weeks or months, and a total of 39% of the sample noted that they would continue this contact for a few days or more. Therefore, these data suggest a 10% increase in the number of people maintaining contact when receiving intermittent responses from an ex-intimate over those who do not receive any responding communication. The questions did not state what the content of the communication might be. It may be of interest to investigate the effects of different content on prolonging contact at a later date.

The final question in this vignette aimed at finding out the reasons why these individuals would persist in communicating with their ex-intimate if their correspondence was unwanted. Respondents of the survey stated several reasons why they would continue to contact their ex-intimate. Half the participants chose the response option of “wanted to be friends,” 24% felt that they “want closure or more information about why the break up has happened,” 23% “couldn’t resist the urge,” and 3% felt that they belonged with their ex-intimate. The 6% of participants who suggested that they would continue to contact their ex-intimates even after they had been told that their communication was unwanted reported response patterns similar to the entire sample of why they wished to continue contact.

Vignette Two: Perspective of Person Who Has Ended the Relationship

In the second vignette, participants were given a scenario regarding the end of the romantic relationship as well. However, on this occasion, they were asked to put themselves in the position of the individual who was leaving the relationship.

Firstly, participants were asked how they would respond if their ex-intimate continued to contact them a few days after the dissolution of the relationship. Eleven percent of the sample stated that they would ignore the communication completely. Half of the sample (52%) indicated that they would accept the contact, but would reply making it clear that the relationship was over. A further 22% suggested that they would answer any questions that their ex-intimate asked them but would not initiate contact. Finally, 15% of the sample would answer communication they received from their ex and would also occasionally make contact.

Participants were then asked how they would respond if their ex-intimate continued to communicate with them a few weeks after the initial break up, the point at which continued communication can be described as harassment (Pathé et al., 2000). A total of 12% would completely ignore the communication. Whereas 24% stated that they would accept the contact but respond only to make it clear that the relationship was over, this was nearly half the number of participants would have responded in this manner in the initial few days. However, 28% of the sample reported that they would answer any questions but not initiate contact, and now 36% said they would answer communication and contact their ex-intimate occasionally. Table 2 provides the respondents hypothetical reactions to contact, over time.

In order to ascertain if there might be any change in behavior between a few weeks and a few months, participants was asked the same questions, but how they would respond after a few months. The results showed that there was a rise from 12% to 23% of the sample who would ignore the contact from an ex-intimate. As can be seen in Table 2, the number of individuals who answered the contact by making it explicit that the relationship was over was now 20%, less than half of what it had been immediately after the breakup. Furthermore, 19% stated that after a few months they would answer questions but would not initiate contact. Of the individuals who would answer the communication and also make contact occasionally with their ex doubled from the number of respondents who would do so within a few days of the breakup.

The final question of the second vignette asked participants how repeated contact might make them feel. A total of 69% of this sample answered that it would upset them, or cause them to feel uncomfortable or distressed. This finding would suggest that some people who

Table 2. Leavers' Responses to Continued Communication.

How leavers would respond to repeated communication from an ex-intimate	After a few days	After a few weeks	After a few months
Ignore communication completely	11%	12%	23%
Accept contact and inform the ex that it was over	52%	24%	20%
Answer questions but not initiate contact	22%	28%	19%
Answer communication and also sometimes initiate contact	15%	36%	38%
Total	100%	100%	100%

indicate that they would be distressed by continued contact would actually still be responding and initiating contact. This adds a further level of complexity within texting behaviors.

Analysis of the final questions relating to actual behavior showed that just over half (52%) of those participants that completed the survey had experienced similar behavior in real life (see Table 3). Examining the duration and frequency of this contact, 35.4% of people met Pathé et al.'s (2000) criteria for harassment. Analysis of the levels of distress that these individuals faced showed that 44% responded that this behavior made them feel worried, 75% felt irritated, and 21% responded yes to feeling fear.

DISCUSSION

The current paper presents the results of a preliminary study exploring pre-undergraduates and undergraduates' perceptions of texting behavior. The distinctive feature of the research design offers insights into the perspectives from both recipients and senders of hypothetical unwanted and/or harassing texts.

The final questions relating to the prevalence of actual experienced text harassment was found to be consistent with previous findings (Spitzberg & Cupach, 2007), with 35.4% of our sample stating that they had experienced this behavior. As detailed in the results section of this paper, this behavior had caused three quarters (75%) of this group to be irritated, 44% having felt worried, and 21% having experienced fear as a result. What is striking from the findings of this investigation was the perceived normality of text harassment behavior, both by victims as well as by those imagining their behavior. Stalking was not viewed as a serious offense in this form, despite the distress that it caused to the victims, or expected from potential victims.

The acceptance of intrusive texts may be in part explained by the sheer weight of texting traffic, suggesting that the receipt of text messages is a very commonplace event for the majority of this sample. The preference for texting as a mode of exchange above other forms of electronic communication and the high volume of use in the current research is consistent with findings from previous research, which specifically documents high levels of texting activity in young adults (Bianchi & Phillips, 2005).

Established research consistently reports that a third of all stalkers in the off-line stalking population have the kind of pathology that is associated with delusional or sadistic harassers (Sheridan & Boon, 2002). The remaining groups were found to comprise mostly infatuated acquaintances or ex-intimates, the former of who often are not cognizant of the impact of their behavior on the object of their attention. This lack of awareness has often been attributed in part to poor social skills on behalf of the pursuer. Furthermore, the very nature of

Table 3. Actual Experiences of Receiving Intrusive Texts After Ending a Relationship.

Have you ever found yourself in a similar situation in real life?*	After a few days	Up to 4 weeks	After 4 weeks	After a few months
Duration	4%	28%	12%	56%
Frequency	< 10 Times 23%	> 10 Times 15%	15-20 Times 7%	>20 Times 53%

*These data are based on the 52% of survey respondents who answered yes to the fourth section of the survey regarding actual experience with harassing behavior.

remote communication may compound the situation, due to the absence of recognized social cues that are overt in face-to-face interactions. Moreover, although there are some mutually understood social rules of mobile phone behaviors in specific contexts and between established groups (Reid & Reid, 2004), general social etiquette in mobile phone behavior is still nascent and not based on shared understandings of what is appropriate behavior. It is appreciated by the authors that shared meanings and understanding of what is appropriate behavior will be enormously diverse and influenced by historical and cultural contexts. This is certainly an avenue for future research. Preventative strategies that raise awareness about the acceptability of one's own behavior, as well as recognition of what might encourage unwelcome behavior, may be one effective intervention.

Impact of Text Harassment

The focus group's discussion revealed the negative psychological impact that texting harassment had on the participants, including frustration, fear, and powerlessness. In addition, results from the survey showed that 69% of the respondents would expect continued unwanted communication to make them feel upset, uncomfortable, or distressed, which is consistent with previous research (Mechanic et al., 2000). Material generated by the focus group also highlighted incidences of the transmission of impact to other members of the recipients' family, which is a recognized phenomenon in electronic and on-line harassment. Sheridan and Grant (2007) found that although patterns of off-line stalking behaviors were more likely to result in negative changes in work and social routines, electronic stalking was more likely to result in loss of family and friends of the victim as a direct effect of repeated contacts made to them by the victim's harasser.

The survey yielded some complex results in terms of how the recipient might respond if their ex-intimate continued communication over a longer period of time. In the first instance, as time progressed, the ex-partner was more likely to ignore contact. So even though 69% of participants indicated that they would be upset, uncomfortable, or distressed by this contact, half of participants, at least initially, would accept contact but make it clear that it was unwelcome. However, over time they were less likely to reinforce this message and more likely to respond to the communication. This act, then, could suggest to potential harassers that, if they keep up the contact, eventually they will get a response.

The design of this study also intended to record the perceptions of participants when they were the senders of unwanted continued contact. The majority of participants (94%) noted that they if they were asked by their ex-intimate to cease contact, they would do so. The remaining 6% of the sample stated that they would continue communication for as long as a few weeks, constituting harassment behavior, according to Pathé et al. (2000). These individuals attributed their supposed behaviors to either a compulsive urge to continue contact, because they felt that the individual was the "one" for them, or wanting to remain friends. Whatever the degree of contact or persistence, both the 6% who would continue communication and the 94% who would cease communication provided similar justifications for their behavior.

This research suggests that there is potential for harassing behavior in all groups. Individuals seem to be aware when they are being harassed but provide some what rational justifications when they are the ones that continue hypothetical intrusive contact. Predicting actual behavior from intention continues to be a debate within the discipline of psychology in

general and the accuracy of whether this behavior can be predicted in a texting context is uncertain. However, there does appear to be some parallels between previous empirical studies and our exploratory investigation.

Limitations of this Study

The current study indicated that 52% of students have experienced unwanted texts from someone they had ended a relationship with, 68% of which met Pathé et al.'s (2000) criteria for harassment. This meant that 35.4% of the whole sample had experienced intrusive texts, 44% were worried by this behavior, and 21% had a feeling of fear. In an attempt to understand the phenomenon of problem text communication in more depth, this research detailed some of the experiences that seven students have had of intrusive text messages and details of hypothetical accounts from the perspectives of both the harasser and the harassed. However, the authors recognize the limitations of this study.

In terms of sampling techniques, it is appreciated that a larger random sample would be required to undertake statistical tests, explore effect sizes, and make generalizations to a larger population. Furthermore, the authors acknowledge that there may have been a social desirability effect that influenced responses to the question referring to continuing contact, had the respondent perceived this behavior to be inappropriate. Attempting to control for social desirability needs to be considered in designing future investigations. The cost of using mobile phones has also become more affordable in recent years; cost implications could also be a factor in whether intrusive texts occur.

CONCLUSIONS AND FUTURE DIRECTIONS

The results of this study have implications for both future academic research and applied interventions that could support all individuals involved in harassment of this kind. Such research or interventions could be useful to the communication service providers and police as well.

In terms of academic research, the design of this study by way of the vignettes has been a useful methodological tool in eliciting the frank accounts of individuals' supposed negative texting behaviors. Work that is currently being conducted by the authors involves amended vignettes in order to capture in more detail a jealous emotional response, which has been found to be a predictor that typifies the stalker in ex-intimate relationships (Mullen et al., 2000). These studies are currently exploring these aspects in a wider population, alongside the role that individual differences play in continued intrusions on others through mobile communication. These investigations will explain actual as well as intended behavior with the hope that results would provide an insight into the antecedents of this type of harassment and contribute to the debate on whether cyberstalking is a new phenomenon or just another means of harassment.

The authors appreciate that, in the first instance, breaking up a relationship via a text message produces a polarization of beliefs about the acceptability of this behavior. In a previous small-scale study, the authors found that over half of the sample would use texting as a method to end a relationship (Short et al., 2007), whilst others indicated that they considered this a major breach of

social etiquette. This polarization in beliefs may increase the likelihood of misunderstanding such a communication and the distress it may cause, and therefore requires further study.

The findings of this study can provide a foundation from which to build solutions for the problem behavior of text harassment. As a general rule of thumb, individuals who are experiencing harassment should always make it clear that the communication is unwanted and, in no circumstances, should the receiver respond to subsequent attempts for contact. Further communication of any kind may give the caller the perception that it is acceptable to continue the contact.

A variety of support networks are available for support victims (see, e.g., The Network for Surviving Stalking¹). However, support for borderline stalkers is less readily available; indeed the authors are not aware of any specific education or advice currently in the UK. Once a harasser's problem behavior is identified, and determined to be related to a behavioral addiction, lack of social skills, or an infatuation toward the victim, and then appropriate psychological and educational interventions to discourage borderline intrusive behavior can be put in place.

Actual texting harassment has serious implications for providers of mobile phone services, particularly under the 1999 Management of Health and Safety regulations in the UK (Rick & Briner, 2000). A recommendation arising from these findings is that a well-resourced risk assessment of incidences of psychological harm for those who are unable to cease intrusive behavior, as well as those who are experiencing the intrusion, should be undertaken. Furthermore, the authors of this paper suggest that communication service providers could work in a closer association with the police to create a more consistent response to this problem. For example, the current situation in the United Kingdom sends out conflicting advice. Victims are advised to keep any evidence of unwanted communication (perpetrators can be charged after two or more incidents of unwelcome and intrusive behavior; Protection from Harassment Act, 1997). At the same time, however, victims are also advised to change their mobile phone number, which often results in the loss of the records of communication. It may be of benefit to identify a more appropriate guide in association with CSP (communication service provider) so that evidence is preserved without undue inconvenience to the victim.

ENDNOTE

1. This organization can be located on-line at www.nss.org.uk

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INFORMATION AND COMMUNICATION TECHNOLOGY USE BY REPRODUCTIVE HEALTH WORKERS IN NIGERIA: STATE OF THE ART, ISSUES, AND CHALLENGES

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Abstract: *This study investigated reproductive health workers' (RHWs) use of ICTs, the effects of ICTs on their job functions, and the challenges limiting full exploitation of ICTs. The study adopted a descriptive survey design. Stratified sampling technique was used to select a sample of 360 RHWs of the University College Hospital, Nigeria. A questionnaire obtained the data, and frequencies and percentage distributions were the analytical techniques adopted. Findings revealed that RHWs indicated extensive use of ICTs in their job functions. Faster access to relevant medical information, easy exchange of information with colleagues, and increased efficiency were the major impacts of ICT usage on their activities. The information accessed through ICTs was primarily educational, health, and research. Findings equally revealed that the major challenges in ICT use were erratic power supply and inadequate access to ICT facilities. Based on the findings, recommendations were made towards enhancing better utilization of ICTs by RHWs.*

Keywords: *reproductive health workers, University College Hospital, information and communication technology, Nigeria.*

INTRODUCTION

The emergence of information and communication technologies (ICTs) and their role in stimulating rapid development in all sectors of the economy, and in the inseparable sociocultural and political spheres of life, is widely acknowledged (Ajayi 2003; Akanbi 2005; Idowu, Ogunbodede, & Idowu, 2003). According to Ajayi (2003), ICTs are redefining the way almost everything is done and are a ready tool for all strata of society. Previous studies, like those of Idowu et al. (2003) and Akanbi (2005), have highlighted the strategic disadvantages that nations, institutions, and industrial sectors would face if they did not position themselves to harness and implement ICTs as tools for leveraging their activities in the emerging global economy. In the health sector, for instance, ICTs are being applied to facilitate the delivery of appropriate health services to the populace (Mechael, 2005). ICTs also

contribute to health education, knowledge sharing, health monitoring, statistics gathering and analysis, the delivery of care, and in meeting internationally agreed upon health targets with respect to a number of diseases (United Nations Development Programme [UNDP], 2003). ICTs' impact on health care have been particularly significant in developing countries and in rural settings, where long distances and the quality of the infrastructure hinder the movement of physicians and patients (Geissuhler, Ly, Lovis, & L'Haire, 2003), reducing the quality of the health services delivered.

Health workers play important roles in a nation's socioeconomic and political growth. ICTs are vital tools that help them to access and use relevant information in their jobs. ICT usage can be highly effective if health workers harness the opportunities it offers to meet their needs. Ibegwam (2004) observed that the Internet has become an important component of the electronic services in academic institutions and has permeated all aspects of life, breaking down barriers to communication and information access worldwide. The Internet is a particularly valuable resource for information relating to health care. However, in spite of the potential contributions of ICTs to the activities of health workers, some constraints exist that prevent their widespread utilization. Some of the more obvious constraints common to developing countries include the limits of physical access to ICTs, the high cost of providing access for nations trying to balance multiple financial priorities, and the exclusion from access of large segments of the population due to inadequate infrastructure (Chandrasekhar & Ghosh, 2001).

One specific area of health is reproductive health, which represents a crucial part of general health and a central feature of human development. Globally, both epidemiological data and the expressed wishes of diverse constituencies indicate that reproductive health interventions are most likely to include attention to the issues of family planning, sexually transmitted disease (STD) prevention and management, and prevention of maternal and perinatal mortality and morbidity. Reproductive health should also address issues such as harmful practices, unwanted pregnancy, unsafe abortion, reproductive tract infections that include STDs and HIV/AIDS, gender-based violence, infertility, malnutrition and anemia, and reproductive tract cancers (United Nations Population Information Network, 1995). Reproductive health workers (RHWs) need timely information to discharge their duties effectively, to collaborate with colleagues and apply ICTs on their job. However, they are also constrained by the same factors that limit the general body of health workers from exploiting ICTs. Of major concern is the fact that many RHWs who live in rural areas, particularly in developing countries or emerging economies, do not have information on current developments in medicine because of their inadequate access to ICTs, nor are they able to collaborate with geographically distant colleagues, as their counterparts in other parts of the world can. For instance, in developed countries, health workers conduct on-line consultation with colleagues that is only possible through the use of ICTs. Thus, health workers with inadequate access to ICTs, such as those at the University College Hospital (UCH), Ibadan, Nigeria, are less likely to be able to collaborate with peers, to gather current or timely information, or to be skilled in the use of various ICTs.

This study seeks to investigate the extent to which RHWs at the UCH use ICTs in the discharge of their duties, and the types of activities for which they access and/or employ ICTs. We also sought to evaluate the effects of ICT usage on the RHWs' job functions and to identify the challenges hindering full exploitation of ICTs at the UCH. The study was guided by the following research questions that were formulated based on the objectives of the study.

1. What types of ICTs are used by the RHWs at the UCH, and what specific activities are they used for?
2. In what ways have the use of ICTs by the RHW impacted medical services delivery at the UCH?
3. What factors constrain the RHWs' from fully exploiting ICTs in the discharge of their duties?

Although previous studies in the Nigerian context (Idowu et al., 2003; Adeyemi & Ayegboyin, 2004) have considered ICT use in the hospital environment, neither of these studies specifically focused on ICT use by RHWs. Herein lies the basis for the formulation of the research questions.

The remainder of this paper is structured as follows: The next section is a brief review of previous studies, followed by the methodology employed in this research with the survey implementation scenarios. A presentation of the survey results and discussion of the findings are then presented, while the conclusions, recommendations and further research finalize the paper.

REVIEW OF LITERATURE

The production of quality health-care delivery in a country is guided by the level of the ICT infrastructure possessed and used by that country. A good ICT infrastructure, therefore, is a condition for enhancing the well-being of a country. Gates (1999) reported that intra- and inter-organizational networks in some advanced countries function like a digital neural system of the organization. Thus, he said, communication for health purposes has shifted from the largely manual or physical documentary method to digital communication. He further stated that such access to ICTs has helped disseminate information to the rest of the world. In the medical field, Gates reported, American doctors are able to collaborate as often and as quickly as they want with other medical doctors in other parts of the world through the use of ICTs. For example, while examining a patient, a medical doctor might be able to send an electronic x-ray of a patient to a leading expert in another country who could readily interpret and provide more details of the disease or condition, as well as send feedback to the medical doctor all within a few minutes. RHWs, in their research and application processes, can use the Internet to identify research issues, search literature databases, seek out information on surveys and clinical trials, and publish research results (Eysenbach & Wyatt, 2002).

Several studies have reported on ICT use among RHWs. Idowu et al. (2003) reported that while ICT capabilities (personal computers, mobile phones, Internet) were available in Nigerian teaching hospitals, mobile phones were spreading fastest. Their findings also revealed that computers and mobile phones were in use in all the teaching hospitals but not much Internet connectivity was available, meaning that most of the medical experts used external (nonhospital) Internet services, such as cybercafés, for even rudimentary Internet access, such as e-mail. They further explained that while just 1.4% of the medical staff did not use the Internet in any fashion, the vast majority (70.7%) of those using the Internet did so only for e-mail. In addition, Adeyemi and Ayegboyin (2004), in a survey involving four general hospitals, 10 primary health-care centers, and six private hospitals in Nigeria,

reported that none of the institutions had e-mail access or a Web site, only 5% of the workers possessed personal computers, only 7% of the health-care workers were computer literate, only 2% had any measurable computer skills, and just 65% had access to a mobile phone, but not necessarily their own. This was in spite of the fact that the state of Lagos has the largest concentration of Internet service providers, telecom operators, and cybercafés, intended to create a reasonable platform for ICT use.

The Tucker and Chetty (2004) case study series on ICT-enabled development initiatives illustrated the possible benefits when health workers use ICTs successfully to overcome development obstacles, and thus narrowing the digital divide gap. In their study, a wireless local area network (LAN) was set up in 1999 to connect the hospital in Sulenkama in Cape Town, with a clinic, local school, community center, and police station in Tsilitwa, South Africa. The LAN used wireless fidelity (WiFi) signals, with a booster between Tsilitwa and Sulenkama since Sulenkama lies in a slight valley. The clinic and hospital used the system in a telehealth project pioneered by researchers at the University of Cape Town. The system worked in such a way that a nurse at Tsilitwa focused a web camera on a patient and the picture was displayed on a computer in Sulenkama. In Sulenkama, the doctor opened up his computer that had been configured to load a Web page associated with the IP address of the Web camera that was focused on a patient in Tsilitwa and thus access the image. Simultaneously, the nurse, doctor, and patient could speak to one another using a Voice over Internet Protocol (VoIP) program on the LAN. The doctor was then able to advise the nurse regarding a course of treatment or could refer the patient to a specialist elsewhere, thus improving care while saving time and money.

In addition, Braa, Macome, Mavimbe, and Jose (2001) conducted a study of actual and potential usage of ICTs at the district and provincial levels in Mozambique, with a focus on the health sector. They demonstrated that computers and Internet access were rapidly becoming available in all provinces and major districts in Mozambique, although most of the health workers were using the computers only as advanced typewriters, that is, for word processing. The National Health Information System of Mozambique was said to be among the very first computer applications in the provinces. The study also revealed that while it was still rare to use application software developed in order to address particular needs, the health sector was a forerunner with such an innovation.

Meanwhile, an Academy for Educational Development-Sattellite (2009) study determined the extent of use of HealthNet by health workers. The study revealed that HealthNet was used by 1,950 health-care workers in more than 150 countries worldwide, and that the development impact of HealthNet had been most prevalent in Africa, where the model has contributed to increased rural and urban connectivity, capability building, increased demand for IT services, and, in some cases, commercially viable IT service enterprises. The study further explained that surgeons from Mozambique, Tanzania, and Uganda used HealthNet to consult regarding patient treatments and to learn new reconstructive surgery techniques. In Zambia, health-care workers who once traveled 700 kilometers each week to collect data for clinical trials now used HealthNet to send this information via e-mail. Physicians in Ethiopia used HealthNet to schedule consultations, making it unnecessary for ill patients to travel long distances with no guarantee of seeing a physician. Health workers in the Democratic Republic of Congo used HealthNet to report progress on treating trypanosomiasis to public health organizations in the north of the country

while, in Gambia, malaria researchers used HealthNet to submit data to European medical schools for clinical trials. The study concluded that many physicians in developing countries relied on HealthNet as their sole source of information on the treatment of AIDS and tropical diseases, essential drugs, pediatrics, and public health promotion (Academy for Educational Development-Sattellife, 2009).

Taylor and Lee's (2005) study on occupational therapists' use of ICTs in Western Australia revealed that e-mail and the personal computer were the most frequently used ICT-enabled services. Furthermore, regarding competency in the use of ICTs, 58% of therapists rated their competency level as good or better, although competence was rated lower for Web searching (48.5%) and searching for electronic articles (29.8%). Additionally, approximately one third of respondents were dissatisfied with the level of technical support available to them, and only 38.4% of the therapists had participated in basic computer training provided by their current employer. Rural therapists had less access to a computer in their work environments in comparison to their metropolitan peers but they proportionately used e-mail, teleconferencing, and videoconferencing more frequently than their metropolitan counterparts.

These studies provide a useful backdrop for the current study on ICT use by RHWs at the UHC in Nigeria. The following sections introduce the method adopted for the study including design, sampling, instrument administration and its results and outcomes.

METHOD

The quantitative survey research design was adopted and the target population comprised RHWs at the UCH, Ibadan, Nigeria. The 800-bed hospital is a tertiary care center established in 1957, and provides specialists as well as general medical services. In addition, it is a center for research and training of research and for training of health-care personnel in various medical disciplines at the undergraduate through postgraduate levels. Patients are referred to the UCH from several health-care facilities both within and beyond Nigeria. The hospital consists of clinical buildings, laboratories, administrative blocks, lecture rooms, students' residence halls, staff quarters, mini-markets, water and sewage treatment plants, commercial banks, and a filling station (Sangowawa et al., 2005). According to the UCH 2007 register, the total population of RHWs in UCH was 1,726 workers. Of this figure, 569 were pharmacists, 789 were medical doctors, and 207 and 161 were trained nurses and nurse/midwives, respectively. A sample of 360 was drawn across the RHWs as follows: 33% from pharmacists, 46% from medical doctors, and 21% from nurses and nurses/midwives, respectively, to ensure proportional representation. A questionnaire, containing structured questions, was the data collection instrument used. The instrument was divided into five sections, as indicated in Figure 1.

Prior to use, the questionnaire was examined by experts in ICT research and their comments were used to arrive at the final version. A Cronbach alpha reliability co-efficient of $\alpha = 0.70$ was achieved. Copies of the questionnaire were administered using the face-to-face approach in the respondents' offices in the months of June and July 2007. From a total number of 360 questionnaires administered, 342 (95%) were returned. The response rates differ among the categories of reproductive health workers, being highest among the medical doctors and pharmacists, each with 99.4%. The lowest response rate of 78% was recorded among nurses and

Section A elicited demographic data from the respondents.

Sections B and C collected data on the use of ICT facilities, the extent of use, and the nature and activities ICTs of ICT use. These sections were structured to gather data for Research Question 1.

Section D elicited data on the impact of ICTs on the respondents' job functions. This section was meant to collect data for Research Question 2.

Section E collected data on factors that constrain the RHW in their use of ICTs. Questions in this section were structured to gather data for Research Question 3.

Figure 1. The questionnaire structure used to gather information of ICT use by RHWs in rural Nigeria.

nurse/midwives collectively. Analyses were performed using the Statistical Package for Social Science (SPSS) software, and descriptive statistics, namely frequency and percentage distributions, were the techniques used to report the data analyzed.

The results presented in Table 1 show that the RHWs were concentrated in Obstetrics and Gynecology (O & G), with a frequency of 71 (20.7%), followed by the option "others" (which are relatively independent units that also provide reproductive health and related services, such as the Sexually Transmitted Infection Clinic), with a frequency of 22.8%, and nursing, with a frequency of 18.3%. Other areas/units where health workers were concentrated include the children's clinic (10.2%), pharmacy (8.2%), family planning (3.5%), and medical social work (2.9%). Results in Figure 2 show that the bulk of the respondents were females (60%). This could result from the fact that reproductive health issues were traditionally the major preoccupation of the female gender, except in more specialized cases, such as medicine and surgery.

Table 1. Frequency distribution of the RHWs Across Departments and Units.

	Frequency	Percent
Obstetrics and Gynecology	71	20.7
Pharmacy	28	8.2
Medical records	3	0.9
Radiology	3	0.9
Surgery	9	2.6
Delivery	1	0.3
Population and family health	5	1.5
Family planning	12	3.5
Chemical pathology	7	2.0
Microbiology	9	2.6
Hematology	2	0.6
Children clinic	35	10.2
Medical social work	10	2.9
Nursing department	60	17.5
School of midwifery	9	2.6
Others	78	22.8
Total	342	100.0



Figure 2. Gender distribution of respondents.

As presented in Table 2, all the respondents were well-educated and were specialists in their different areas of endeavor. This was expected, given the fact that all of them work in a teaching hospital with the entire nation and beyond as the scope/coverage of its operations. All the general medical practitioners had the basic qualification of bachelor of medicine and surgery (MBBS) degree, while the nurses and nurses/midwives were all registered with relevant professional bodies. The qualification with the least percentage was the doctor of philosophy (PhD) degree (6.1%). Those with a master of science (MSc) degree numbered 79 (23.1%). A quest for knowledge among the RHWs is evident since a considerable number of them had qualifications beyond the minimum required to practice.

Table 2. Frequency distribution of Respondents' Highest Educational Qualification.

Highest educational credentials	Frequency	Percent
MBBS	123	36
M.Sc.	79	23.1
Registered nurse/midwife	52	15.2
Registered nurse	46	13.5
Ph.D.	21	6.1
Others	15	4.4
No response	6	1.8
Total	342	100

Key: MBBS = Bachelor of Medicine and Bachelor of Surgery;
MSc = Master of Science; PhD = Doctor of Philosophy.

MAJOR FINDINGS

Use of ICTs by RHWs

The response pattern to the question on the use of ICT facilities by the respondents is summarized below. ICT facilities, such as computers, scanners, fax machines, and so on, recorded a generally high level of usage across the RHW groups.

Multimedia projector

Results revealed that the usage level of this technology by the pharmacists was highest, with 100%, followed by the medical doctors, the nurses and nurse/midwives, with 95.4%, 71.7%, and 66.2% levels, respectively. This might be due to the fact that pharmacists and medical doctors were more likely to deliver public lectures and seminars using multimedia projectors than would the nurses and nurse/midwives.

Computers Linked with Internet Service Provider (ISP)

Nurses and pharmacists scored the highest percentage, with 100 percent usage level, followed by the medical doctors with 98.1% and the nurse/midwives with 96.2%. This showed a considerably high presence of Internet connectivity at the UCH showing some contrasts with previous studies (Idowu et al., 2003) and Adeyemi & Ayegboyin, 2004) that reported little connectivity and no connectivity in the surveyed hospitals respectively.

Electronic Mail Facilities/Services

The use of e-mail facilities/services was highest among the medical doctors (95.4%). This was not unexpected, given the fact that this facility affords them the opportunity to access, exchange, and receive large volume of information, as well as by the fact that the RHWs (medical doctors, in particular) need to upgrade their skills and obtain the result of new discoveries in their fields. The level of use was also high among the nurses (89.3%), nurse/midwives (86.5%), and pharmacists (75.0%).

World Wide Web (WWW) Access

Response to the question on the use of the WWW was lower, compared with the other questions, with just 260, or 76%, of the respondents answering the question. Of this number, medical doctors had the highest proportion (59.9%), followed by nurses/midwives (20.4%), nurses (14.2%), and pharmacists (5.5%). This was surprising considering the high percentage levels recorded for the use of computer linked with ISPs and electronic mail among the RHWs.

Video Conferencing

Results also revealed that 208 (63.4%) of the respondents indicated using videoconferencing. Medical doctors were in the majority at 49.7%, followed by nurses (27.3%), nurse/midwives (20.2%), and pharmacists (3.8%). Majority of those who did not respond to the question were females in the different categories of RHWs.

Sex Differentials in Usage Level of ICTs

Figure 3 presents the differentials in usage of ICTs between male and female RHWs at the UCH. The average usage level of all the facilities and services was higher among male respondents than their female counterparts, although the disparity varied among technologies. For example, more than 99% of the male respondents in the UCH indicated using the computer linked with ISP compared to their female counterpart at 97.4%. However, the usage level of multimedia projector among the male gender was 95.1%, compared with 77.2% among the female gender. The usage levels of the WWW, e-mail, and video conferencing technologies followed a similar trend, with e-mail showing the greatest disparity of all measured technologies.

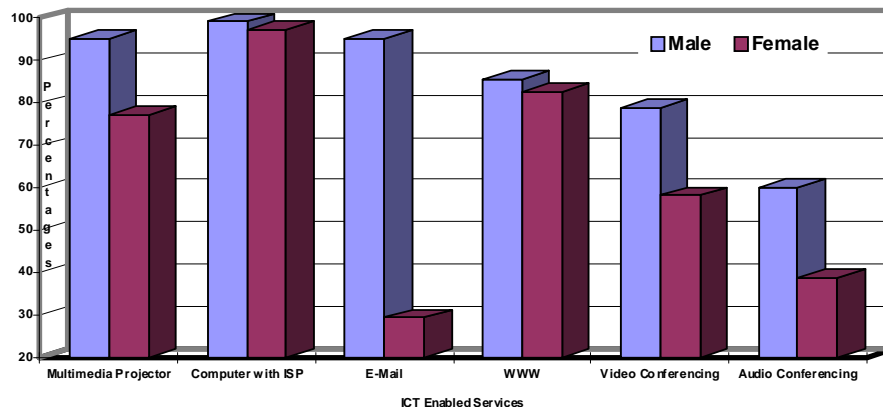


Figure 3. Gender and usage level of ICT services.

Common Places the RHWs Access ICTs

The results of the analysis of the common places of access to ICT by the RHWs are presented in Table 3. As shown, 74.6% of the RHWs claimed to use ICT in cybercafés. This high proportion of users in cybercafé confirm that RHWs who wish to access ICTs often have to be flexible in finding sources of access, and it could be attributable to the inadequate ICT facilities at their places of work or the persistently erratic power supply experienced generally in the country. The erratic power supply often cripples on-line activities in most public institutions in Nigeria, and a government teaching hospital, such as the UCH, is by no means an exception. Most of the cybercafés are commercial centers that have standby electric generators to supply electricity in cases of public power supply interruptions. Two-hundred and eleven (61.7%) respondents claimed that they use ICTs in their offices, while 52.6% used it in their homes, perhaps for comfort and privacy. One hundred and six (31%) used it in schools (both secondary and tertiary), while the remaining 9.1% chose the category “other,” specifically churches, hotels and friends’ homes.

Activities for Which RHWs Use ICTs

Table 4 presents the result of analysis of the form of activities in which RHWs used ICTs. The results presented in Table 4 revealed that a clear majority (90%) of the RHWs always use ICTs for communication. This cannot be disconnected from the nature of the medical profession, where

Table 3. Frequency Distribution of Places of Access to On-line Applications by the RHWs.

	Yes		No Response	
	Number	%	Number	%
Cybercafé	255	74.6	3	0.9
Office	211	61.7	-	-
Home	180	52.6	-	-
School	106	31	-	-
Other	31	9.1	-	-

Table 4. Frequency Distribution of RHWs' Activities in Which ICT Are Used.

	Never		Rarely		Always	
	Number	%	Number	%	Number	%
Communication	5	1.5	30	8.8	308	90.0
Research	13	3.8	38	11.1	291	85.1
Networking/linking with peers	23	6.7	40	11.7	279	81.6
Skills acquisition	12	3.5	51	14.9	279	81.6
Presentations	18	5.3	51	14.9	273	79.8
Collaboration with colleagues	25	7.3	45	13.2	272	79.5
Teaching/instruction	50	14.6	50	14.6	242	70.8
Data/records management	45	13.2	72	21.1	225	65.8
Medical diagnosis	45	13.2	88	25.7	209	61.1
Other					7	2.0

new discoveries are made everyday and, in order to remain current in their field, medical personnel must communicate with colleagues quite frequently. This was followed by 85.1% and 81.6% who use ICTs for research and presentations, respectively. Also, a significant proportion (81.6%) indicated ongoing use of ICTs for skills acquisition, showing that majority of RHWs desired to upgrade their knowledge by acquiring new and relevant skills. This was followed closely by 79.5% who used ICTs for collaboration with colleagues. Two hundred and forty-two (70.8%) used ICTs for teaching/instruction, while the lowest percentage 61.1% used ICTs for medical diagnoses, indicating that this is not yet a widespread practice, which may not be disconnected with the fact that they did not have adequate access to ICTs.

Nature of information RHWs access via ICTs

The result of the analysis of the types of information accessed by the RHWs with the use of ICTs is presented in Table 5. The results showed that educational information was the most sought knowledge by the RHWs, with 85.1% of the responses, followed by 84.5% who used

Table 5. Frequency Distribution of the Type of Information Accessed by the RHWs Via ICT Facilities.

Type of Information	Yes		No		No response	
	Freq	%	Freq	%	Freq	%
Educational information	291	85.1	51	14.9		
Health information	289	84.5	53	15.5		
Research information	289	84.5	52	15.2	1	0.3
Clinical information	284	83.0	58	16.9		
Career information	252	73.6	90	26.3		
Administrative information	182	53.2	160	46.8		
Other	22	6.4	320	93.6		

ICTs to seek health information and an equal proportion used it to access research information. Closely followed was the 83% who claimed to use ICTs to access clinical information. It could be inferred that the RHWs were very conscious of their academic/research activities, owing to the nature of their profession that requires them to continually update themselves. It could also be noted that the RHWs weigh their professional educational growth as equally important as seeking information most readily applied in their current work situations.

Impact of ICT Use on Job Functions

Presented in Table 6 is the result of analysis of the impact of ICT use on the job functions of the RHWs. The results showed that, in general, the RHWs' perceptions on the impact of ICT use on their job functions were very positive. Nearly 90% of them indicated that ICTs had increased their efficiency of their job; about 85.4% said that it had enabled increased faster access to relevant medical information, and 83.9% indicated that it had ensured easy exchange of information with colleagues. In addition about 80.7% submitted that it has made collaboration with colleagues easier, while 66.1% indicated that it had bettered the number of papers they submitted for publication.

Constraints on ICT Use and Measures for Enhancing ICT Use Among RHWs

Table 7 presents the data results of the challenges hindering effective use of ICTs by the RHWs. From the technical standpoint, the results in Table 7 reveal that about 84.5% of them indicated that there was some level of inadequate ICT facilities, while an erratic power supply (94.7%) and the continual breakdown of equipment (90.6%) constituted a somewhat or major challenge. On the usage issue, 87.1% of the respondents indicated that security and privacy issues, and their insufficient knowledge of ICT use (78.9%) created various levels of barriers to ICT implementation. Moreover, the costs for hardware, software, and access services serve as at least some type of barrier for over 30% of the RHWs, and as a serious barrier for 57.6%.

Table 6. Frequency Distribution of the Impact of ICTs on RHWs' Job Functions.

Impacts	No extent		Little extent		High extent	
	Freq	%	Freq	%	Freq	%
Increased efficiency	21	6.1	23	6.7	298	87.1
Enabled faster access to relevant medical information	21	6.1	29	8.5	292	85.4
Easy exchange of information with colleagues	26	7.6	29	8.5	287	83.9
Easy research collaboration among colleagues	24	7.0	42	12.3	276	80.7
More avenues for research grants	43	12.6	43	12.6	256	74.9
Has facilitated remote consultation, diagnoses, and treatment	45	13.2	47	13.7	250	73.1
Quicker medical diagnoses	41	12	61	17.8	240	70.2
Increased number of publications	58	17	58	17	226	66.1
Other	16	4.7	1	0.3	17	5.0

Table 7. Frequency Distribution of the Challenges of the Use of ICTs by RHWs.

Challenges	No response		Not at all		Low extent		High extent	
	Freq	%	Freq	%	Freq	%	Freq	%
Poor power supply	8	2.3	10	2.9	36	10.5	288	84.2
Inadequate access to ICT facilities	12	3.5	11	3.2	113	33.0	206	60.2
Cost of ICT facilities & services	16	4.7	15	4.4	108	31.6	203	59.4
Constant breakdown of equipments	9	2.6	23	6.7	114	33.3	196	57.3
Security/privacy issues	17	5.0	27	7.9	119	34.8	179	52.3
Lack of adequate ICT facilities	8	2.3	45	13.2	117	34.2	172	50.3
Insufficient knowledge on use of ICT	9	2.6	63	18.4	104	30.4	166	48.5
Other			1	0.3			3	0.9

Table 8 presents the results of the measures the RHWs identified for enhancing ICT use by themselves and their peers. The results reveal the varied measures identified by the respondents to enhance better use of ICTs. About 90% of them felt that the provision of adequate power supply and enough ICT equipment/services would enhance ICT use among RHWs at the UCH. Equally important, the respondents felt, are regular training for the staff (88%), the implementation of an effective system tailored toward health-care needs (87.4%), and easy access to the Internet (85.4%). These hardware, software, and access issues are the foundation for the ability to take advantage of other on-line resources, such as on-line distance education (82.2%) and ready access to on-line medical journals (73.7%).

Table 8. Frequency Distribution of the Measures for Enhancing ICT Use Among RHWs.

Measures for enhancing ICT use	Yes		No	
	Freq	%	Freq	%
Adequate power supply	308	90	34	10
Provision of enough ICT equipment/services	308	90	34	10
Organizing ICT training regularly for staff	301	88	41	12
Implementing an effective health information system of the UCH	299	87.4	43	12.6
Facilitating easy access to internet services	292	85.4	50	14.6
Proper maintenance of ICT equipments	281	82.2	61	17.8
Organizing on-line distance education	281	82.2	61	17.8
Free access to on-line medical journals	252	73.7	90	26.3
Other	17	5	325	95

DISCUSSION OF FINDINGS

In this section, the findings from the study are discussed in line with the research questions formulated for the study. Generally, the results showed variations in the degree of access among the RHWs, and the cybercafé was identified as a notable alternative source of access to ICTs. Also, ICT use provides a positive impact on health-care particularly improving

collaboration among the RHWs and access to research information. The results also showed erratic power supply as a major challenge hindering full exploitation of ICTs by the RHWs. Details of the findings are discussed in the succeeding sections.

The Types of ICTs and Their Purposes of Use

Research Question 1 sought to establish the current picture of ICT usage by RHWs at the UCH. Results showed that the RHWs make reasonable use of the various ICT facilities available, including e-mail, access to the World Wide Web, videoconferencing, and audio conferencing. However, the data also showed variation in the degree of access to the facilities by the RHWs. The availability of ICTs, to some extent, could be said to stem from the statements in 2006 by the then-president of Nigeria Olusegun Obasanjo that Nigerians have waited patiently long enough to enjoy qualitative health-care and that the UCH cannot afford to fail the nation because of lack of equipment and access.¹ Findings also revealed that male respondents used the ICT facilities more often than the females at varying degrees, particularly e-mail, videoconferencing and audioconferencing, which gives some credence to results of previous studies that technology is a male sphere, and research has also shown that boys have greater interest in technology than females (Enochsson, 2005). Also, according to the Women's Learning Partnership (2009), the typical Internet user worldwide is young, male, and wealthy—a member of an elite minority. However, while earlier research indicated males use the Internet more than the females (Noguchi, 2005), more recent findings show that girls and women are as frequent Internet users as men (Enochsson, 2005; Fallows, 2005). Women represent 42% of Internet users in the world although the gender divide gap is narrowing in certain countries: 47% of users in Brazil are women, 49% in Thailand, and 51% in the United States and Canada. However, the differential in usage of e-mail (95.1% for men, 29.4% for women) as a major finding from this study was particularly striking, and surprising, when one places the result side-by-side with this study's findings on Web usage (85% for men, 82% for women), and the previous studies that have shown the primary cybercafé (an alternative source of access for RHWs) usage in Nigeria is e-mail (Venkataramani, 2005). This huge disparity in males' versus females' use of email calls for more probing, particularly since most of the nurses indicated they had connectivity to the Internet. The data collected in this study cannot account for this wide disparity. Undoubtedly, this is one of the limitations of this study since there seems to be no plausible reason that could explain this paradox. Future studies should aim at unravelling what might account for this huge disparity.

Noteworthy also was the fact that the cybercafé was the major alternative place of access to on-line ICTs, which supports the notion that the majority of Internet users in developing countries use the cybercafé (Jagboro, 2003; Sairosse, 2003; Wahid, Furuholt, & Kristiansen, 2006), a finding in line with Venkataramani (2005), who established that, for most people in Nigeria, the cybercafé with its fixed times of operation and shared usage model, is a major means of Internet access. According to Venkataramani's (2005) study, the primary use for most cybercafé users is e-mail. However, some users rely on the operators to create, print, and manage documents—both when they are on site and when they are not. In some cases, trust between the operator and the users is strong enough that the operator takes on a quasi-secretarial role for the user, performing tasks such as checking and sending e-mail or getting documents printed and sent. Thus, there is a high tendency for a sizeable number of the RHWs to move some office jobs to the cybercafés, which could impact negatively the

confidentiality of some health data being exposed to the public in cybercafés. Moreover, given that cybercafés are the alternative site for official duties, the efficiency and effectiveness of such locations within health care delivery or critical care cannot be high because of the remote access. In the same vein, because inadequate access at the hospital forced the RHWs to find alternative means of access, there is no doubt that the digital divide is far from being bridged. This situation, in turn, will impact negatively any collaboration with colleagues around the country, in other parts of Africa, or on other continents.

It was discovered that the activities topping the list of what ICTs were used for were communication, skills acquisition, collaboration with colleagues, and research. These practices are in line with Eysenbach and Wyatt (2002), who reported that RHWs can use the Internet across the medical research process, such as identifying research issues, using databases for literature searches, using the Web for surveys and clinical trials, and publishing research results. The activities that ICT were seldom used for were teaching and instruction, medical diagnosis, or records management, implying that the use of Computer Aided Instruction (CAI) software and expert systems was very low among the RHWs at the UCH. Indeed, as the majority of respondents indicated, the infrastructure to make use of such systems possible was not available. This particular finding is significant when viewed against the backdrop of what Yamuah (2006) identified regarding the benefits of ICT among health-care professionals. Yamuah noted that (a) efficient and effective sharing of health information and skills among health professionals, (b) easy dissemination of research results and options for disease treatment and disease control, (c) reduced costs and inconvenience for patient transfers, (d) disease surveillance information and interventions accessible by all, and (e) databases of health management information system (HMIS) for efficient planning and policy formulation are all essential elements of a modern health-care system.

From these findings, it could be said that some progress has been made in the types of ICT tools and facilities that RHWs at the UCH currently use in their job functions and the level of access to health-care information, especially when compared to what had been found earlier this decade (see Adeyemi & Ayegboyin, 2004; Idowu et al., 2003). However, the capacity that will sustain and better the ICT infrastructure available at the UCH and other teaching hospitals in the country needs to be enhanced. Achieving this will require a better understanding of the local conditions peculiar to the UCH and other teaching hospitals, improved training of health workers, and the appropriate choice of ICT tools.

How ICT Use by RHWs Impacts Medical Services Delivery at the UCH

The second research question sought to understand how the use of ICTs impacts medical care for patients receiving service through the UCH. Findings revealed that the major effects of ICTs on the job functions of RHWs included faster access to relevant medical information, easier exchange of information with colleagues, and increased efficiency. Findings further showed that the RHWs understand and value how ICTs could facilitate access to all types of relevant information, as well as enhance health care by linking them to their peers and practices on important health issues. This corroborates Mansell and Wehn's (1998) view regarding how ICT applications support an efficient exchange of information between health professionals, enable the transfer of patient records between sites, and support improvement in clinical effectiveness, continuity, and quality of care by health professionals. Providing access to reliable health information for health-care

workers in developing countries is potentially the single most cost-effective and achievable strategy for sustainable improvement in health care (Pakenham-Walsh, Smith, & Priestley, 1997). Much of this could be achieved through use of the Internet. Espinoza (2005), in her evaluation of the impact and affordability of ICT in rural primary health-care centers of Peru, confirms the perceptions voiced by the RHWs in this study that ICTs provide a positive impact on health care. Findings from her study showed that participants' perceptions about the impact of ICTs on improving their work were very positive. Nearly all (93%) responded "Yes" when asked if they thought that using ICTs at work would help them make better medical decisions and improve the quality of health care (Espinoza, 2005). The same proportion responded positively when asked if they thought that having better access to medical information via ICTs would help reduce medical errors related to reproductive health. Eighty-six percent of them also thought that having real-time access to reproductive health information would make their jobs easier. Findings from Espinoza's study showed that, generally, there was a consensus regarding the usefulness of using the Internet or e-mail in improving the quality of the health-care services provided. Internet and e-mail use, in particular, as noted by this study's RHWs and supported by Espinoza (also, see Information for Development Program, 2003; Martinez, Villarroel, Seoane, & Pozo, 2005), can make long strides in improving the overall quality of the health-care services provided. Yet findings from Espinoza's study also revealed that while health workers saw specific benefits from ICTs, such as ease of coordinating meetings with the community, they failed to see how other, indirect benefits, such as increased patient retention from better quality health care, could make ICTs profitable or cost effective overall when compared to less expensive alternatives, such as pay phones or personal visits (Espinoza, 2005).

In addition, the impact/benefits of ICT use on reproductive health programs have been reported. Dentzer (2008, p. 1) noted that

sophisticated information and communications technology in health care—sometimes dubbed "e-health"—is no longer a futuristic fantasy for the developing world. In low and middle-income countries, there's growing use of everything from electronic health records to mobile phone-based systems of ensuring drug adherence. The challenge is to optimize the use of these technologies in ways that translate into gains in fighting disease and improving population health.

In the area of research, RHWs use the Internet across the research process, including identifying research issues, using databases for literature searches, using the Web for surveys and clinical trials, and publishing research results (Eysenbach & Wyatt, 2002; Morris, 2006). They also use e-mail to share information and consult or collaborate with other professionals (Idowu et al., 2003). The increased availability of on-line publications and databases for literature searches improve research quality.

Regarding networking and advocacy, the expansion of communication networks and e-mail has markedly enhanced the development of professional networks and on-line communities of practice by making it possible to reach across geographical boundaries and communicate with someone or many people quickly and easily. This was the concept proposed by Castells (1996, 1997, 1998, 2000) through his network society theory. Castells proposed the idea of networking information and communication resources to better benefit from the opportunities offered by the Information Age. This idea of networking for better exploitation of the opportunities offered by ICTs is also widely reported in previous studies.

For instance, the Satellife discussion groups were reported to reach more than 10,000 health professionals in developing countries (Academy for Educational Development-Satellife, 2009). Membership in electronic discussion groups was meant to be self-selecting and might be active or passive, allowing anyone with a genuine interest to participate at the level of activity they chose (Kanyengo, 2003; Vyas, 2002). Moreover, on-line discussion groups, in conjunction with face-to-face interaction at conferences or trainings, enrich professional relationships and reinforce new learning. Perhaps the most tangible benefit of connectivity had been in enhancing regional and international links, thereby increasing knowledge-sharing and reducing isolation (Pacific Institute for Women's Health, 2002). All of these examples are tied to the idea of networking. In addition, advocacy groups use e-mail networks to build alliances, discuss strategies, and share experiences in efforts to build support for their issues (World Bank, 2003). These benefits/opportunities of networking could be explored by the management of the UCH in a bid to make ICTs serve the RHWs better.

In addition, Lucas (2006) noted that there is growing consensus that the impact of ICTs on health systems could be substantial, or even revolutionary. Although the precise nature of the impact is much more difficult to predict, it seems that the health sector will benefit from advances in mobile telephony and Internet services. He cited a few instances of such outcomes:

- Patients and informal providers in Bangladesh routinely seek advice from doctors supporting HealthLine, a subscriber service implemented by the Grameen mobile telephone company.
- Health information systems for HIV/AIDS services in Rwanda—including TRACNet, a mobile phone-based system that allows tracking the use of anti-AIDS drugs through text messaging—are widely regarded as having been improved by the introduction of data transfer via mobile phones and personal data assistants.
- Medical staff worldwide have many opportunities to update their skills through Internet-based advice and training initiatives. For example, Moorfields Eye Hospital in London provides an Internet-based consultancy service for ophthalmology patients in a number of African countries (Lucas, 2006, p. 1).

Lucas (2006) noted further that a shift in the power balance in the provider-patient paradigm can be offered by “expert-systems” software, which offer “best practice” clinical protocol information to the public to guide health diagnosis, recommend treatment, and monitor implementation. “It could transform existing power relations within the health sector by circumscribing the behaviour of professional staff,” writes Lucas (2006, p. 1). The services of connecting patients and families and informing the public are already ICT functions.

ICTs could also transform informal regulation by providing people with the knowledge they require to challenge existing practices and make more rational health care choices. Communications networks that allow those facing health problems to share information, identify trustworthy providers, seek advice or campaign for improved treatment are central to such forms of empowerment. (Lucas, 2006. p. 1)

However, Lucas (2006) cautioned that there may be an attraction to the potential power stemming from being a “trusted intermediary” in an unregulated health advisory network that could attract those looking for financial advantage, prestige, or support for religious or other convictions. Also, there is a risk that the most high profile health conditions and advocates may receive the most resource allocations. He concluded with the warning that,

Those working on health systems have traditionally encouraged “evidence-based planning and priority setting” in order to address both equity and efficiency concerns. A world in which multiple disease-specific networks, possibly funded by international drug companies, use ICTs to compete for the attention of governments, donor agencies and private enterprises, may undermine the approach. (Lucas, 2006, p. 1)

In the area of training, ICTs present important new opportunities to enhance training for health workers both far and wide. Curricula on CD-ROMs, tapes, and Web sites reduce barriers associated with distance, allowing health workers to learn in their own workplace and within their own time constraints. E-mail provides learners with opportunities for interactive communication with trainers and other learners. ICTs also offer opportunities to generate and disseminate health information at the periphery and to inform practice and policy at the center (Ntiro & Mrema, 2003). ICTs assure quality learning, empower learners, and offer potential cost-effectiveness (Long & Kiplinger, 1999). When electronic tools are carefully integrated with face-to-face learning, they can enhance development opportunities for health-care professionals (Management Sciences for Health, 2003). In the area of improving health systems, providing connectivity among decentralized health systems is cost-effective and may significantly improve health outcomes (WideRay Corporation and Satelife, Inc., 2003). The ability to communicate quickly and directly by cell phone, e-mail, or walkie-talkie has improved supply and referral systems, improved epidemiological monitoring systems, and reduced isolation. Automating systems may provide additional efficiencies, with the reduction of duplicate paperwork, thereby saving time for both staff and patients (Pan American Health Organization, 2001; Rotich et al., 2003).

In the context of Nigeria, and the UCH in particular, current resource allocation does not seem to give adequate funds to the collection and documentation of health information, the invisible resource in the complex health systems. Yet, paradoxically, the health sector has long been recognized as the most information-intensive sector (Economic Commission for Africa, 1999). In order for the acknowledged impacts of ICTs on reproductive health identified above to make continued impacts on RHWs at the UCH, there is a need for future action to enable the uptake of ICTs as a means to improve health and the health-related millennium development goals in Nigeria. This would require policymakers and other decision makers in the Nigerian health sector to set priorities appropriately and to ensure that ICT issues are prioritized with a view toward improving care and advancing equitable access to health care by all patients.

Factors that Constrain RHWs’ Full Exploitation of ICTs

The final research question sought to surface areas where progress could be made in improved use of ICTs in the RHWs’ many duties. On the challenges hindering full exploitation of ICTs by the RHWs, the study showed that erratic power supply was a major challenge. Other challenges identified include lack of ICT facilities, insufficient knowledge on use of ICTs, inadequate access to ICT facilities, high cost of ICT facilities & services, constant breakdown of equipments and security/privacy issues.

In Africa, on-line connectivity is still very poor and unreliable. It can typically take several minutes to download a single article on a 56K dial-up connection; connectivity is often unstable, so that an attempt to download may be frustrated by a loss of connection during the download process (Bukachi & Pakenham-Walsh, 2007). The Access to Research

Initiative (HINARI; World Health Organization, 2009) data confirm that Internet usage levels seem to depend more on good connectivity than, for example, on the relative economic strength of the country. Some of the biggest ICT users are in Ethiopia, Nepal, Sudan, and Vietnam, all of which are among the poorest countries in the world (Aronson, 2004). Also, the cost of telephony, Internet services, and computer hardware and maintenance remain relatively high in Africa compared to other parts of the world (Jensen, 2001). Furthermore, local expertise and human resource capacity, as well as the organizational structures to support these ICTs, remain major challenges in Africa.

Specifically, Smith et al. (2007) noted that the capacity to use electronic devices, including computers, is low among health professionals, especially those working at primary and district levels, generally because of lack of exposure. Even among higher level professionals, a recent survey (Smith et al., 2007) showed that some researchers in Africa still prefer books to information accessed on the Web. Finally, Africa is traditionally an oral culture, and the reading culture is still growing. The central message learned in the last decade about communications and access and the use of health information in Africa is that cultural contexts vary and require different models and approaches. Thus, to harness the full potential of ICTs in the health field will require an intricate mix of old and new technologies.

According to Bukachi and Pakenham-Walsh (2007), the following technologies have been identified as being potentially useful in alleviating barriers to rural access: satellite technology, wireless Internet connectivity, and cellular networks (see also Iluyemi, 2007). These technologies are suggested as superior alternatives for bypassing inefficient landlines. As a low-cost alternative to landlines for Internet access, mobile phones have not yet lived up to this expectation because they are driven by voice communication, with data transmission limited only to short text messaging. Nevertheless, mobile phones have become ubiquitous and are already used as widely by health workers as by the rest of the population, despite the fact that they are more expensive than fixed lines (Gray, 2005). High-frequency radio links also have been used in some parts of Africa (Musoke, 2002) as a means of voice communication, but seem likely to be superseded by mobile telephony and other wireless technologies. In most rural areas in Africa, the issue of electricity supply is often not given priority attention due to the limited penetration of the electricity grid in most countries, but also because of its unreliability, even when present (Jensen, 2001). Solar power is one solution, but the scaling up of this technology has been limited by cost (Bukachi & Pakenham-Walsh, 2007).

Moreover, some of the challenges identified in this study clearly showed that the digital divide is still very much present in Nigeria, and at the UCH in particular. Statistics on the digital divide in Africa, a continent where nearly 15% of the world's population (more than 1 billion people; BBC News, 2009) lives, indicate that ICT products and services are scarce and expensive, and where the services do exist, they are often erratic and unreliable, just as the findings from this study underscored. Africa, therefore, is hampered in its ability to contribute its research knowledge and perspectives, as well as the wisdom of its indigenous knowledge and societies, with the rest of the world.

Even within Africa, the disparity is dramatic (see Figure 4). For example, Egypt, Nigeria and Morocco account for over a third of all Internet users on the African continent (Internet World Stats, 2009). While being the world's most rapidly growing market for mobile telephony and also home to the fastest growing fixed telephony markets in the world, Africa still has the world's lowest penetration rates (Lange, 2009a). Explosive growth in the mobile sector has meant that, by

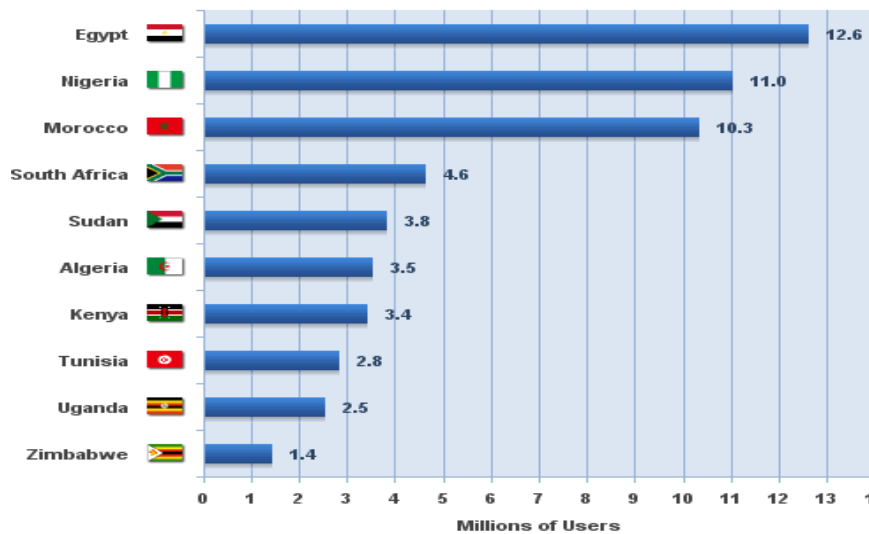


Figure 4. Africa's top ten Internet countries (June 2009).

Reprinted from the Internet World Statistics site for June 2009; Used with permission.

early-2005, mobile users constituted around 80% of all African telephone subscribers. Overall Internet and broadband penetration is very low due to limited fixed-line infrastructures, but growth in Africa's Internet and Broadband sector has accelerated in recent years due to improvements in infrastructure, the arrival of wireless access technologies, and lower tariffs. Broadband is rapidly replacing dial-up as the preferred access method, and this process is already virtually completed in the continent's more developed markets (Lange, 2009b).

In addition, most African countries now have commercial Digital Subscriber Line (DSL) services, but their growth is limited by the poor geographical reach of the fixed-line networks. The rapid growth of Internet access has therefore been mostly confined to the capital cities so far. The introduction of mobile data and 3G broadband services is changing this, with the mobile networks bringing Internet access to many areas outside of the main cities for the first time (Lange 2009b). International bandwidth is extremely expensive in Africa because access to international submarine fiber optic cables has been monopolized by national telecoms in most countries, while others depend entirely on satellite bandwidth. This is expected to change dramatically with the arrival of several new international cables to the continent's shores beginning in 2009. To accommodate the growing data traffic, national fiber backbone networks are being rolled out at an increasing pace. Many African countries are undergoing sectoral reform and foreign investment is flowing in as privatization and deregulation are progressively being introduced. Overall, the future technologies of Africa's telecoms offers great opportunities to service providers, equipment vendors, and investors (Lange, 2009a).

Africa holds only 3% of the world's mobile subscribers, yet Africa is the first place where mobile subscribers outnumbered fixed-line subscribers. The total African mobile subscriber base is roughly 280.7 million people (30% of total) and is expected to reach 561 million (53.5%) by 2012. South Africa, Nigeria, Morocco Egypt, Algeria and Kenya constitute the key mobile markets in Africa in terms of potential growth (Kujawski, 2009).

Specifically in the case of Nigeria, there is no doubt that government is making policies geared at bridging the digital divide. Notably are the Nigerian National Policy for

Information Technology (2003), the Nigerian Communications Act (2003), and the recent passage into law of the National Information Technology Development Agency Act. All these efforts are with a view to bridging the digital divide and, no doubt, they will bring about opportunities for enhancing the quality of life by increasing access by RHWs to medical knowledge and state of the art medical interventions. Sharing and comparing health information, increasing communication through the Internet, and the use of telemedicine are also some of the far-reaching benefits that developments in the Nigerian ICT sector could bring into the health sector. Telemedicine in particular has increased the potential for improving access to care by underserved populations and point the way to a future when distance will no longer impede care. In addition, it could enable the RHWs have access to ICT facilities that they need to do their job better, such as Personal Digital Assistants (PDAs) that could be used by the RHWs to reduce paperwork, increase data accuracy and ensure availability of data in electronic form. Also PDAs could be used to transmit data through wireless communication and enter it into database using the Internet. This will also increase access to e-mail leading to increased communication with professional colleagues in far and wide, hence improvement in collaboration among the RHWs.

According to Espinoza (2005), although ICTs cannot directly address urgent needs such as lack of qualified personnel or equipment, they can help to increase the active time that health workers spend in their health posts, while also improving the qualifications of the current workers. Currently, attending training courses or searching for health information outside the workplace facility requires a health professional to leave the health center. With ICTs, on-site and on-line distance education could help satisfy the need for staff training yet keep needed staff at the facility. Regarding the financial feasibility of ICTs, although investment in ICT acquisition and staff development could be high, the potential increase in the productivity in actual health-care activities could help to cover the expenses of acquiring such ICT services.

In sum, it is hoped that in view of the increased global attention on the need to strengthen health systems in general, and human resources in particular, the Nigerian government will rise to the occasion and roll out health policy reforms that will make the challenges of ICT exploitation by the RHWs highlighted above a thing of the past. There is, thus, the need for a “seismic” paradigm shift on the part of the Nigerian government, and indeed the management of the UCH, to address the diverse needs of RHWs in skills, equipment, information, structural support, medicines, incentives, and communication facilities (Pakenham-Walsh, Bukachi, & Stancliffe, 2006). This paradigm shift will make applications of ICTs more meaningful to the activities of RHWs at the UCH and Nigerian health workers in general.

CONCLUSIONS, RECOMMENDATIONS, AND FUTURE RESEARCH

This study was undertaken to investigate the use of ICTs by RHWs in a teaching hospital (UCH) in Nigeria. It also aimed to identify the impact of ICT use on the job functions of the RHWs and the challenges they face in using ICTs. Findings showed that the RHWs use various ICT facilities to varying degrees in their work, and that erratic power supply, inadequate access to ICT facilities, insufficient knowledge on use of ICTs, as well as constant breakdown of equipment constitute major challenges. The study also revealed that the measures that topped the list of what could be done to enhance ICT use among RHWs in

UCH were provision of enough ICT equipment/services, implementing an effective technology-based health information system at the UCH, and facilitating easy access to the Internet. Additional requirements were found to be an adequate power supply, proper maintenance of ICT equipment, organizing on-line distance education, and free access to on-line medical journals. These findings rebut those of Idowu et al. (2003) and Adeyemi and Ayegboyin (2004), who generally reported, just a half a decade ago, low ICT facilities and usage in the hospitals and health workers surveyed having few measurable ICT skills. Findings showed that the health workers now have access to Internet facilities, although the access is erratic because of the poor power supply and maintenance issues.

Our findings however confirm those of Braa et al. (2001) and Academy for Educational Development-Sattellife (2009), who reported a high uptake of ICT usage among health workers in their studies. It also confirms those of Taylor and Lee's (2005), who found that rural therapists had less access to a computer in their work environments but contradicts their finding that rural health workers used e-mail, teleconferencing, and videoconferencing frequently. Thus, resulting from the findings of this study and building on those of earlier research, the following recommendations are made:

- The problem of low generation of electricity needs to be addressed for RHWs to better benefit from ICTs. The poor state of the energy infrastructure in Nigeria has been endemic for a long time. Correcting this problem requires a holistic approach on the part of the Nigerian government. Currently, about 3,000 megawatts are being generated nationwide (Alexander's Gas & Oil Connections, 2009; James, 2009; Oxford Analytica, 2009), which leads to load shedding across the country, and therefore cannot in any way lead to full exploitation of ICTs by any segment of the Nigerian society. Thus, RHWs can never avail themselves fully of the opportunities offered by ICTs if the energy situation in the country remains erratic. In addition, as an interim solution to a national problem, the management of the UCH must invest in alternative sources(s) of power generation for the health-care delivery system. When this is achieved, the RHWs would undoubtedly reap the benefits offered by ICTs: maximum use of the knowledge, improved application of ICTs in the discharge of their job functions, and overall increased health benefits for the citizens of Nigeria.
- In order to ensure better exploitation of ICTs, the management of the UCH must invest in acquisition of ICTs, both hardware and software, in sufficient numbers. Investment in maintenance also is required, as is the expectation of updating the hardware and software from time to time. Systematically harnessed ICTs have been shown to improve the health of populations in many developed countries through empowering those who access and use information—from the individual homemaker and working mother to the highest-ranking policymaker (Ajuwon & Rhine, 2008). These technologies also have been shown to democratize the public space by fostering freedom of choice and expression, as well as rapid access to and sharing of information. These highly-cherished values of participatory democracy have in turn clearly helped to engender better health in individuals and communities (Odutola, 2003). Yet, as fascinating and beneficial as these technologies may sound, the deep-rooted factors militating against access to information and the daunting challenges thereto within developing countries are well known (Edejer, 2000; Ogunyade &

Oyibo, 2003). Developing countries generally have not invested in access to information as much as they should, even within their available means. Indeed, many developing countries are being left behind (resulting in the so-called digital gap or digital divide). Very little benefit from the incredible and bountiful digital world is accruing within developing nations. And these countries need to benefit (see, e.g., Bongo, 2005; Dentzer, 2008; Jensen, 2007; Lucas, 2006; Mercer, 2001; Oberski, 2004; Opit, 1987; Reisman, Roger, & Edge, 2001; Simba & Mwangi, 2004; UNDP, 2001; World Bank, 2001; World Health Organisation, 1997) for many good reasons.

- RHWs need ongoing ICT-related training, which will assist in significantly developing their ICT skills, improve access to needed information, and enhance efficiency in their job function. The introduction of continuous medical education (CME) programs for all practicing physicians and health-care workers would certainly assist in ensuring maximal utilization of the innumerable advantages offered by ICTs. Health is an information-based, ever-evolving discipline and, as such, the provision of structured ICT training for all members of the health-care team would equip them with the skills and knowledge they need to practice up-to-date and evidence-based medicine. This is essential for improving the quality of medical care.
- Finally, provision of adequate and state-of-the-art ICT equipment and services relevant in the health industry should be ensured by the Nigerian government in conjunction with leading medical hospitals, with a view toward increasing availability and access to ICTs in particular, and to improving the health-care delivery in the UCH in general. Such access to health-specific software is expected to enhance production, gathering, storage, and dissemination of and wider access to health information among the RHWs. It will also be a long-term strategy that could assist the institution in bridging the digital divide among the practicing RHWs around the world, and for health-care workers in general.

This study investigated only RHWs at the UCH – a teaching hospital in Ibadan, Nigeria. Due to the small sample size, one cannot assume that the results of this study could be generalized to RHWs across the country, or to any other country. Thus, future studies should investigate other populations of health workers around Nigeria and confirm, rebut, or disprove the findings from this study, or relate these findings to RHWs in other developing nations or emerging economies in Africa or around the world. Future studies could also be conducted to examine ICT use along gender dimensions among the RHWs, particularly the use of e-mail where the findings from this study reports wide disparity along gender lines. Deeper analyses would be needed to unearth the reasons that account for this wide disparity. All these will contribute to the efforts towards bridging gender digital divide among the RHWs in particular and in Nigeria health-care professionals in general.

ENDNOTE

1. The comments were made by Nigeria's then-President Olusegun Obasanjo as part of a speech during the commissioning of hospital equipments at the University College Hospital, Ibadan, on January 2, 2006.

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THE REMOTE BODY: THE PHENOMENOLOGY OF TELEPRESENCE AND RE-EMBODIMENT

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Abstract: *Exploring the phenomenology of remote practices made possible by recent technological advances, such as telesurgery, will reveal the role of proprioception in agency and ownership of action and furthermore delimit the possibility of re-embodiment through technological interfaces. An understanding of the lived body, viewed through the philosophical paradigms of theorists Husserl and Merleau-Ponty, will demonstrate the role of the corporeal schema and intercorporeality in an agent's interaction with the immediate environment and hence elucidate the limits of achieving a seamless remote interaction as good as the "real thing." These considerations are fundamental for grounding the bioethical, legal, and epistemological issues that arise in remote interaction, particularly in the case of telesurgery.*

Keywords: *telepresence, re-embodiment, remote environment, telesurgery, phenomenology.*

INTRODUCTION

Telepresence is a relatively recent term, coined to describe a wide range of experiences that pervade human life in the technologically advanced and affluent developed world. Jonathan Steuer has defined telepresence as "the experience of presence in an environment by means of a communication medium"; it is the mediated perception of a "temporally or spatially distant real environment" through the means of some sort of telecommunications technology (Steuer, 1995, p. 36).¹ Most citizens of the developed world are familiar with this experience of a window opened up onto a distant environment through their engaging everyday activities such as watching live television footage, accessing webcams, or using video conferencing technology.

Telepresence technologies share many characteristics with the technologies that have been developed for use in virtual reality (VR). VR is distinct from telepresence in that it involves the use of three-dimensional computer graphics technology to generate artificial environments in which one is immersed (Murray & Sixsmith, 1999, p. 316). However, VR and telepresence are similar in that one of the main aims of both of these technologies is to create the sense of presence, of "being there," in the environment (remote or virtual) with which

which the user is engaged (Murray & Sixsmith, 1999, p. 324). For presence to occur, the technological interface and the immediate surroundings must recede from the user's awareness, enabling the transparency of the hardware to provide access to the remote environment. In this case, one does not feel as though he/she is just interacting with a technological medium that gives mediated access to a virtual or remote environment; rather, the user feels as though he/she is really *there*.

Presence in telepresence and VR was initially equated with a capacity to adequately see and examine the remote or virtual environment through the medium of sight. Optical technologies provided observational access to the distant or virtual environment; the olfactory, haptic, and auditory senses were neglected. As a result, the development of these technologies reflects a cultural habit of the Western sciences to privilege vision as the most important perceptual sense (Ihde, 2002; Murray & Sixsmith, 1999). Indeed, optical technologies, such as the telescope, microscope, and camera, have long been considered the means through which scientific truths can be accessed and presented, and imaging technologies are frequently employed to present scientific evidence in visual form when it is beyond the realm of the human visual field (Ihde, 2002). Early telepresence technologies reflect this implicit bias in science: Access to other environments has primarily been visual and the rest of the body's senses and motor capacities have been neglected, ignored, or considered of marginal significance.

The privileging of vision in technological developments for telepresence and VR demonstrates the extent to which they have been developed under the implicit assumptions about the nature of selfhood under a certain philosophical paradigm, namely the Cartesian-Lockian model (Malpas, 2000). This philosophical model considers the subject to be a metaphysical psychic and intellectual entity housed inside a physical substrate and causally connected to the outside world through the sense organs and the body, controlled in a mechanistic manner and described by the laws of the natural sciences.² Under the Cartesian-Lockian model, all knowledge is representational; that is, it is as if "each of us was locked within a single, solitary cell and connected to the world beyond by nothing more than a combination of video, audio and other information systems, coupled perhaps with some device for remote manipulation" (Malpas, 2000, p. 112). Many advances in technologies, particularly in communications and entertainment, have been achieved following this philosophical paradigm, resulting in many new and innovative ways to present representational knowledge.

However, recent advances in telepresence technologies, which have extended the experience of being present in a remote environment to one of physically interacting with that environment, have demonstrated that the Cartesian-Lockian model is particularly inadequate to account for the embodied experience of the subject exerting physical motive force in order to perform precise and deliberate movements in a distant environment, far beyond the crude causal mechanisms of remote control. Indeed, recent developments in robotics have made it possible to displace very precise intentional motor actions into remote locations. In this paper, I will specifically draw on the example of telesurgery, where surgical operations are performed at a distance by a surgeon remotely manipulating robotic arms.

It will be seen that the notion of the self as a disembodied entity with mediated and representational access to the world through a causally manipulated physical body will not serve to adequately describe the experience of telesurgery, or other telepresence activities for that matter. The Cartesian-Lockian model, which initially served as a philosophical paradigm for the developments of technology, has been disputed with the phenomenological investigations

of embodiment and situatedness from philosophers such as Husserl and Merleau-Ponty. Hence, I will draw on their work, as well as that of some contemporary commentators, to address some pressing philosophical issues that arise in telepresence, such as the limits of the corporeal schema, motor-intentionality, agency and ownership of action, the possibility of re-embodiment, and the role of intercorporeality. Acknowledging that the body is not merely an appendage to the self, but rather is the means through which any meaningful engagement with the world is possible, calls for a careful understanding and rethinking with regard to the development and success of telepresence technologies.

UNDERSTANDING TELEPRESENCE

Distinguished from the concept of presence in virtual reality, telepresence is an experience that covers a wide range of phenomena involving interaction with a real, yet remote, environment.³ There are four basic types of telepresence that can be schematized as follows: (a) Observational Telepresence, involving a passive observation of a remote environment (e.g., via a Webcam); (b) Simple Telepresence, involving basic physical interaction with a remote environment through a remote control device, and where the physical input does not necessarily correspond to the physical output (e.g., remote missile launch); (c) Enriched Telepresence, involving multisensory feedback, where movements of the user are precise and intentional and, to an extent, mirrored in the remote environment (e.g., telesurgery); and (d) High-Fidelity Telepresence, perhaps a future reality involving total multisensory immersion, affecting a seamless immersion of the user in the remote environment.⁴ In this paper I will primarily consider the experience of enriched telepresence, where perception of a remote environment is coupled with the ability to provide motive force to act on or manipulate that distant environment. Some early examples of simple and enriched telepresence that have provoked philosophical discussion are *Legal Tender*⁵ and the *Telegarden*.⁶

Legal Tender was the first publicly accessible telerobotic website, where users, after agreeing to take full responsibility for their actions, could destroy or deface two allegedly real US\$100 notes. Damaging legal tender is a criminal act defined by the United States Legal Code⁷, but a crime is committed only if the notes are real, the damaging acts are actually performed, and the Website is authentic. This experiment was an attempt at inducing on-line corporeal risk. When questioned, most participants in the experiment responded that they did not believe that the notes and the experiment were real, and hence did not feel as though they were placing themselves under any risk (Dreyfus, 2000). The *Telegarden* was another Web installation, where remote users could plant seeds, water, and care for a real garden located in the Ars Electronica Museum in Austria. In the case of the *Telegarden*, issues of the authenticity of the garden could be assuaged since it could be viewed and visited on location in the museum; however, doubts still remained about whether user input was authentically linked to performance output.

Philosophical discussion that has arisen as a result of these and other examples of telepresence has primarily focused on epistemological issues addressing questions of authenticity and reality. *Telepistemology* is the stream of philosophical investigation that deals with these issues in the specific case of telepresence (Dreyfus, 2000). Although the epistemological considerations that arise with telepresence are important and of philosophical interest, I will not address them in this paper.⁸ Instead, I will focus on the phenomenological

questions that arise when considering telepresence, in particular questions regarding agency and ownership of action, the limits of the corporeal schema, situatedness, the possibility of re-embodiment and intercorporeality. The case of telesurgery, where invasive surgical procedures are performed remotely, will be examined in order to demonstrate the quality and characteristics of these phenomenological issues.

Telesurgery is perhaps one of the most striking and tangible examples of enriched telepresence, where surgical operations are performed from a remote location using a surgical system⁹ that provides limited multisensory feedback, usually auditory, visual, and sometimes haptic, to the surgeon (Satava, 2005). A useful description is offered by van Wynsberghe and Gastmans (2008):

In most general terms, in a telerobotic procedure, the physician is seated at a surgeon console at a distant site and manipulates remote controls. The joystick or remote control movements are converted into digital signals which travel via the telecommunication network to the robotic system on the patient side. These signals are received by the surgical column and translated from their digital form into movements of the robotic surgical arms within the surgical field (i.e., inserted into the patient). The surgeon oversees these movements through the monitor of the surgeon console which transmits the video of the endoscopic camera, also inserted into the patient. (pp. 1–2)

Telesurgery is part of an ever-growing field in biomedicine, termed “telemedicine,” that utilizes electronic communication to provide clinical and medical care for patients located at distant sites (Silverman, 2003, p. 67).

In the case of telesurgery, the patient and doctor need not be located in the same room, building, or even hospital. In fact, in 2001, the first trans-Atlantic telesurgical operation was performed successfully by a surgeon in New York operating on a patient in France. In this operation, Dr. Jacques Marescaux in New York removed a gall bladder from a 68-year-old woman in Strasbourg, France. The operation was successful and the patient was discharged from the hospital two days after the operation (Marescaux, Leroy, & Rubino, 2002).¹⁰ The considerable distances between patient and surgeon afforded by telesurgery provide opportunities for care and treatment in remote, rural, or hostile environments, such as at sea, on the battlefield, or conceivably extra-terrestrial environments, such as in space stations. Furthermore, using robotic arms allows surgeons to perform minimally invasive surgery (MIS), overcoming limitations of scale and achieving unprecedented degrees of control and accuracy (van Wynsberghe & Gastmans, 2008, p. 1). As a result, the numerous benefits for the patient include reduced recovery time and pain, significantly decreased risk of infection, and, aesthetically, minimal scarring (Hanly & Broderick, 2005).

However, despite the obvious benefits that come as a result of telesurgery, a range of unresolved practical, ethical, and legal concerns arise when considering these procedures. Using robotic systems for surgery can reduce dexterity and haptic feedback for surgeons, resultantly requiring a great deal more training. Biomedical ethicists question whether telesurgery will diminish or augment the level of patient care from an ethical standpoint. Among their concerns are whether telesurgery obscures valuable traditional and social practices, such as the doctor-patient encounter, whether the quality of care is compromised, and whether the patient is dehumanized and objectified (van Wynsberghe & Gastmans, 2008). From a legal standpoint, health policy theorist Ross Silverman highlights four main areas of concern for the regulatory bodies in the USA and Europe when considering telepresence practices in medicine: the establishment of the doctor-patient relationship and consent;

malpractice and cross-border licensure; standardization of practices and patient privacy; and monetary reimbursement for remote exchanges (Silverman, 2003, p. 67).

The legal and ethical concerns that arise as a result of telesurgery must be carefully considered and addressed as improved robotic systems are being developed with the hopes of making telesurgery a routine application (van Wynsberghe & Gastmans, 2008, p. 1). In this paper I will offer a philosophical and phenomenological analysis of telesurgery and, more generally, telepresence. As stated, I will focus on the phenomenological issues concerning the lived body engaging with such technologies. Through exploring and elucidating the qualities of these phenomenological features of telepresence, some insight will be gained that can aid in grounding or resolving the practical, ethical, and legal considerations that arise in telesurgery and other types of telepresence.

PHENOMENOLOGY: THE LIVED BODY, TRANSPARENCY, AND THE CORPOREAL SCHEMA

Advances in telepresence technology that are concerned with experiences of multisensory feedback and physical situatedness have implicitly acknowledged the fact that the Cartesian-Lockian paradigm for selfhood is insufficient in explaining the replete and embodied nature of subjective experience. In cases of enriched telepresence, such as telesurgery, the user does not relate to the technological interface in a merely representational manner, that is, as a disembodied gaze. In contrast, user interaction involves the body interacting with the remote environment through learned and skilled motor behaviors.

As a result, the phenomenological understanding of the lived body as investigated by theorists such as Husserl, Merleau-Ponty, and their commentators, is instrumental to understanding how these technologies work and how interaction with them can be successful. In this section, I will describe the key phenomenological features of embodiment that are of interest when considering how the body interacts with technology. I begin with an overview of Husserl's phenomenological description of embodiment, and how it has been taken up and developed by Merleau-Ponty's existential approach. Subsequently, the themes of bodily transparency, motor intentionality, and the corporeal schema will be explored.

Husserl's Phenomenological Description of Embodiment

Husserl's phenomenological description of the experience of embodiment was, for the most part, published posthumously in the volume *Ideen II: Phänomenologische Untersuchungen zur Konstitution* (Husserl, 1952).¹¹ Husserl, in this work, endeavors to elucidate how the body is not merely a "material thing," but rather that which constitutes the "psychophysical subject" (Husserl, 1952/1989, p. 151).¹² Thusly, he provides a description of the body as a lived entity, identifying several features of the body that render it distinct from other material objects. These characteristics can be schematized into four main features of embodied subjectivity.

Firstly, the living body is distinguished from other material worldly objects because it is sensitive: "Obviously, the Body is also to be seen just like any other thing, but it becomes a *Body* only by incorporating ... sensations" (Husserl, 1952/1989, p. 158–159). Husserl argues that the localization of sensation, which is absent in inanimate material objects, constitutes the

unity of the body and, furthermore, delimits its boundaries. Secondly, we find that, in contrast to other material things that are moved only in a mechanical and mediate way, the living body is immediately expressive and mobile: It is “an *organ of the will*, the *one and only Object* which ... is *movable immediately and spontaneously* and is a means for producing a mediate spontaneous movement in other things” (p. 159). The body, as freely movable, is what allows consciousness to be characterized by Husserl as an “I can” (*Ich kann*), in contrast to the usual Cartesian formulation of an ‘I think that’ (p. 159).

Thirdly, the living body is the “zero point” (*Nullpunkt*) through which all spatial orientations are understood. The body is “a here which has no other here outside of itself, in relation to which it would be a ‘there’”; additionally, all spatial orientations are conceived with respect to the size, shape, and orientation of the body. As such, the body is the center of the realm of possibility and experience, and “I do not have the possibility of distancing myself from my Body, or my Body from me” (Husserl, 1952/1989, p. 167). Lastly, the body is the organ of perception and, Husserl argues, it is necessarily involved in all acts of perception (p. 61). As such, the body makes all experience of the external world possible and manifest. Through setting out these four main phenomenological characteristics of the body, Husserl is able to contend that, under the phenomenological attitude, the body is primarily revealed as a living and expressive organism or psychophysical subject (*Leib*) and cannot be reduced to a mere material thing (*Körper*).

Merleau-Ponty’s Lived Body

It is Husserl’s description of the body and perceptual experience through embodiment that Merleau-Ponty takes up and develops in his highly influential work *Phénoménologie de la Perception* (1945).¹³ Employing Husserl’s main characterizations of the phenomenal body, Merleau-Ponty, writing in the 1940s, gave a richer and more holistic description of the lived body as it is in relation to its lived environment, in particular developing the ideas of the body schema and motor intentionality.¹⁴ Following Husserl, Merleau-Ponty regards the body first and foremost as *Leib*, that is, as a living and expressive organism.

Merleau-Ponty argues that rather than being an object in the world, housing and controlled by the mind, the body is our means of communication with the world: It is permanently engaged with its environment. Arguing against the prevailing empiricist and rationalist views and following Husserl’s characterization of the body as the *nullpunkt*, Merleau-Ponty claims that this engagement is prereflective and necessarily from the perspective of the lived body: Spatiality is constituted through the body’s relation with its surroundings. He writes,

The word “here” applied to my body does not refer to a determinate position in relation to other positions or to external coordinates, but the laying down of the first coordinates, the anchoring of the active body in an object, the situation of the body in the face of its tasks. (Merleau-Ponty, 1945/2002, p. 115)

Hence, the human subject is an embodied subject, woven into the fabric of the world; it is inextricably and prereflectively in relation with the physical context in which it finds itself. As such, it is not the case that I find and experience my body first, and then employ it to explore the world. Rather, my body and the world are in an inextricable tangle, such that in matters of perception and experience one cannot be said to precede the other.

Additionally, Merleau-Ponty argues that it “is never our objective body that we move, but our phenomenal body” (p. 121). The lived body’s engagement with the physical world is not entirely conscious, but largely based on phenomenal prereflective experience. Faced with a pair of scissors, as a result of previously sedimented skills, I do not need to consciously reflect on their form and shape and come to some abstract conclusion about what they are for before I grasp them and begin to use them. The lived body does not move in a simply reflective and mechanical way, but rather engages intelligibly with the world—the space and objects in its proximity—in a prereflective and immediate manner:

The subject, when put in front of his scissors and needle and familiar tasks, does not need to look for his hands or his fingers, because they are not objects to be discovered in objective space ... but potentialities already mobilized by the perception of scissors or needle. (Merleau-Ponty, 1945/2002, p. 121)

Indeed, “My body has its world, or understands its world, without having to make use of my ‘symbolic’ or ‘objectifying function’” (Merleau-Ponty, 1945/2002, p. 162).

Furthermore, following Husserl, Merleau-Ponty argues that consciousness is necessarily intentional. Therefore, since the lived body *is* already consciousness, intentionality cannot be restricted to a cognitive act, but instead envelopes and involves the whole body. This bodily intentionality implies that through motility the lived body is permanently engaged in some physical situation: “My body appears to me as an attitude directed towards a certain existing or possible task” (Merleau-Ponty, 1945/2002, p.114).

Through this intentional attitude, the lived body has a constant and ever-changing relation to the physical objects and people in its proximity. However, it is important to understand that this physical relation to objects is not a discrete interaction: I do not engage with objects as though they were objects of the natural sciences. My physical interaction with objects and with other bodies can be described by the physical laws of science, but it cannot be reduced to that description.

The Transparent Body

Merleau-Ponty’s (1945/2002) account describes the phenomenological experience of the body as it is engaged with its surroundings in a prereflective and immediate manner. From the perspective of the performing subject, Merleau-Ponty and others argue that successful motor-intentionality induces a certain sort of bodily transparency where the body does not explicitly appear in the field of perception when it is intentionally directed to the world. In *L’être et le Néant* (1943),¹⁵ Jean-Paul Sartre (1943/1969) offers the example of writing to illustrate this phenomenological experience of bodily transparency. In the act of writing, he argues, “I do not apprehend my hand ... my hand has vanished” (Sartre, 1943/1969, p. 323). Of course Sartre does not mean this literally: My hand is still present while writing, and I *know* this, but I know it with a prereflexive type of awareness that does not involve regarding the body in a separative way, as an object of perception.

Shaun Gallagher (2004, p. 278) terms this the experience of the “absently available body.” He writes,

When the lived body is “in tune” with the environment, when events are ordered smoothly, when the body is engaged in a task that holds the attention of consciousness, then the body remains in a mute and shadowy existence and is lived through in a non-conscious experience. (p. 277)

In this sort of “successful” bodily experience, the body seamlessly facilitates the subject’s relation to the external environment and, as such, it is largely unnoticed or, to use Sartre’s (1943/1969, p. 330) oft quoted expression, “passed by in silence.” Implicit in this experience is a preconscious awareness of the position of the body and the ability to spontaneously move the body to act on the world without it “getting in the way.” Hence, in what many theorists categorize as “normal” or “healthy” functioning, there is no need for the subject to attentively perceive his or her own physical structure, and it remains the silent, tacit background to projects and interactions in the world.¹⁶

Another feature of bodily absence or transparency is that, in acts of action and volition, I also do not need to know how my body does something in order for me to do it successfully:

I do not need to know “how in the world I can do it” to perform Bodily activities. Research in physiology is indeed always possible when one adopts the appropriate natural-scientific attitude and method, but no knowledge of physiology is presupposed for me to make use of my powers of bodily movement in the “I will.” (Behnke, 2004, p. 243)

As Husserl (1952/1989, p. 297) indicates, “I execute my ‘*fiat*,’ and my hand moves.” But even when I explicitly will my body to perform a certain action, I rely on a silent and tacit bodily know-how, a general capacity to move responsively and coherently.

As a result, the lived body is not moved in a simply reflective nor mechanical way; for a majority of healthy and able-bodied adults, posture and movement occur without the need for conscious reflection. Therefore, when the lived body is functioning without interruption or distraction due to pain, fatigue, or other body occurrences, it engages with the world—the space and objects in its proximity—in a prereflective, albeit conscious, and immediate manner.¹⁷

Body Schema

The concept of the *body schema* is useful for understanding the automatic way in which one can move the body.¹⁸ Gallagher and Cole designate the body schema as a system of motor and postural functions that are in constant operation below the level of self-conscious intentionality: “Body schema can be defined as a system of preconscious, subpersonal processes that play a dynamic role in governing posture and movement” (1998, p. 131). The body schema makes it possible to move and control the body in a conscious and aware manner, without the need for deliberate and calculated intention.

Furthermore, the body schema not only regulates and controls the body’s posture and motility, but also how the body interacts with the objects and environment that constitute its immediate milieu. To illustrate this point, Merleau-Ponty (1945/2002, p. 175–176) gives the example of a blind man who uses a walking stick to aid in his maneuvering within the physical world. Over time, the blind man uses the stick as though it were an extension of his own body. His corporeal schema envelopes the stick: “Once the [blind man’s] stick has become a familiar instrument, the world of feel-able things recedes and now begins, not at the outer skin of the hand, but at the end of the stick.”

As an extension of the body schema, a tool such as the blind man’s stick is best understood as being incorporated within the perceived bounds of the body or “within the body’s focal disappearance” (Leder, 1990, p. 180). The tool modifies the intentional attitude of the lived body, expanding and transforming its scope of possible activity. Don Ihde (1990)

offers the example of eyeglasses, a simple technology that is absorbed by the body schema. The weight of the glasses on the ears and the bridge of the nose become imperceptible: “My glasses become part of the way I ordinarily experience my surroundings; they ‘withdraw’ and are barely noticed, if at all” (p. 73). The relation of mediation between “I-glasses-world” becomes “(I-glasses)-world” (p. 73). Additionally, as an object becomes part of the body schema, the subject modifies his or her actions to accommodate the extension:

A woman may, without any calculation, keep a safe distance between the feather in her hat and things which might break it off. She feels where the feather is just as we feel where our hand is. If I am in the habit of driving a car, I enter a narrow opening and see that I can ‘get through’ without comparing the width of the opening with that of the wings, just as I go through a doorway without checking the width of the doorway with that of my body. (Merleau-Ponty, 1945/2002, p. 165)

The subject, once familiar with an object, will interact and engage with it in a prereflective and preconscious manner, as though it were an extension of his or her own body. As an object is enveloped within the body schema, it modifies the intentional attitude of the lived body, expanding and transforming the scope of possible activity. Furthermore, the apparent transparency experienced by the body extends to the manipulated object. In the act of writing, as described by Sartre (1943/1969), it is not merely my hand that “vanishes,” but also the pen; it is to the writing where one’s perceptual attention is fixed.

The achievement of transparency in the case of manipulating a technological object is of particular interest in the case of telepresence. Inducing a sense of presence requires the receding of the mediating technology that transports awareness and motor-intentionality to the remote location. In VR, only when the head-mounted display, data gloves, and body suit, which enable the user to interact with the virtual environment, are absorbed by the body schema will a sense of presence be induced (Murray & Sixsmith, 1999, p. 318). Likewise in telepresence, mastery of the peripheral devices (i.e., joystick, hand controls, head display, etc.) will ensure a smoother engagement with the remote environment. With telesurgery and other telepresence activities, the subject, with sufficient skill and practice, should feel the controlling apparatus to be a seamless extension of his or her own physical body. Furthermore, as part of the corporeal schema, engagement with the object will occur in a seamless and prereflective manner, corresponding to the mediated sensory feedback that provides information about the remote environment.

It could be postulated that this interaction with the remote environment is a further extension of the corporeal schema. However, an interesting ambiguity arises in the case of remote manipulation, such as telesurgery: The device in the remote environment performing the action, for example a robotic surgical arm, is not a proximate extension of the surgeon’s physical body. However, it is clear that this apparatus is being directly manipulated by the surgeon’s motor-intentional actions and depends on the precise and skilled motor movements of a particular surgeon, not just the crude mechanisms of remote control, such as in the *Telegarden* or *Legal Tender*. The remote surgical system enables an expansion of the surgeon’s physical capabilities, abnegating the obstacles of distance. Hence, is it sensible to consider the remote device, the robotic apparatus, an extension of the surgeon’s corporeal schema?

This question must be considered carefully when regarding the characteristics of telepresence systems. Firstly, the doctor does not have a sense of the robotic arms in the same

way as I *know* the width of my car and the woman *knows* the length of her hat's feather due to their adjacency to the body. Indeed, a surgeon may never see the apparatus he or she is controlling, and furthermore will not have an embodied sense of the machine's dimensions and capabilities: Often visual feedback from a telesurgery system is magnified or modified in some way in order to facilitate minimally invasive procedures, where the scale of the procedure may be beyond the visual field encountered in open surgery (Wynsberghe & Gastmans, 2008, p. 3). In considering the limits of the corporeal schema, the example of telesurgery leads us to consider precisely what role proximity and scale play in the sense of ownership of action. Does it still make sense to say that *I* performed an action, or that a particular physical event as far away as France is from New York belongs to me?¹⁹

AGENCY AND OWNERSHIP OF ACTION

As was seen in the example of *Legal Tender*, doubt about ownership of action can cause a remote user to feel as though there is nothing physically at stake in the remote activity that is being performed. Despite the circumstances of *Legal Tender* being highly contrived and arguably incomparable to a phenomenon such as telesurgery, the philosophical issues that arise when considering telepresence systems such as *Legal Tender* and the *Telegarden* are still important to consider with respect to telesurgery. In the case of *Legal Tender*, the real remote environment accessed through telepresence becomes confused with a virtual environment, in which phenomena such as risk, responsibility, and interpersonal interaction, among others, do not have meaningful physical consequences. However, with the example of telesurgery, it is apparent that concrete physical consequences are fundamental for a successful surgical procedure. It is overwhelmingly pragmatic to ascribe ownership of action to the surgeon performing the operation, since there is a clear causal link between the user and the event, where a successful operation depends on the refined motor skills of a trained and practiced surgeon. However, despite conceptually ascribing ownership of action to the surgeon, phenomenologically it is important to establish whether the surgeon feels as though the actions observed through the visual feedback provided are his or her own; that is, whether a sense of presence, and hence an embodied sense of motor-intentionality in the remote environment, has been established. Indeed, establishing this sense of ownership is not only important for assigning responsibility and culpability, it is generally acknowledged by researchers in the areas of telepresence and VR that a sense of presence in a remote or virtual environment has a positive effect on task performance. It is argued that what is driving developments in presence technology is the "pervasive belief that presence is causally related to performance" (Welch, 1999, p. 574). Turning now to consider the issues of agency and ownership of action will elucidate a manner in which a qualitative distinction can be made between telepresence and normal actions, and begin to understand how an action can be felt as "mine" without necessarily having physical proximity.

While considering what constitutes the minimal self, Gallagher (2000) draws a useful distinction between agency and ownership. Gallagher writes that a *sense of agency* is the "sense that I am one who is causing or generating an action, for example, the sense that I am the one who is causing something to move" (p.15). In contrast, a *sense of ownership* is the "sense that I am the one who is undergoing an experience" (p. 15).²⁰ In normal action, where

volitional drives are in equilibrium with the external environment, Gallagher argues that, “the sense of agency and sense of ownership coincide and are indistinguishable” (p. 16).

However, agency and ownership of action are two phenomenologically distinct aspects of an experience. It is possible to have a sense of ownership of an action or movement without a sense of agency:

In the case of involuntary action ... I may acknowledge ownership of a movement—that is, I have a sense that I am the one who is moving or is being moved—and I can self-ascribe it as *my* movement, but I may not have a sense of causing or controlling the movement. (Gallagher, 2000, p. 16)

For example, when I am pushed on a crowded bus, or when a doctor picks up my arm to examine it, I do not provide any motive force for the movement; however, I experience the movement as belonging to me.

In contrast, there is a sense of agency in telepresence; that is, I sense that I am the one who is causing something to move or some event to happen. However, since I am not undergoing the experience of the action, I may not feel that it is necessarily mine. Dissociation from ownership, induced by a lack of presence, has many ethical and epistemological implications and, furthermore, has phenomenological consequences in which the subject feels alienated from the actions he or she is performing. Developments in telepresence technology that aim for high-fidelity telepresence, where interaction with the remote environment would be indistinguishable from interaction with reality, hope to induce a sense of bodily presence and ensure the coincidence of agency and ownership of action (Reintsema, Preusche, Ortmaier, & Hirzinger 2004). In effect, these technologies hope to create a sense of re-embodiment, displacing the motor-intentional behavior of the body without rupturing the phenomenological coincidence of agency and ownership. However, it will be seen that an understanding of the role of proprioception in motor-action will elucidate the limitations of the possibility of re-embodiment through telepresence.

PROPRIOCEPTION AND THE POSSIBILITY OF RE-EMBODIMENT

Proprioception is a term that has appeared in physiological, psychological, cognitive scientific, and philosophical literature, and has taken on various meanings.²¹ Proprioception is usually thought to include the kinesthetic and somatic sensations that permeate the body and give information regarding position, posture and movement. Gallagher explains,

Proprioception is the bodily sense that allows us to know how our body and limbs are positioned. If a person with normal proprioception is asked to sit, close his eyes, and point to his knee, it is proprioception that allows him to successfully guide his hand and find his knee. (2005, p. 43)

As Gallagher indicates, some theorists characterize the information given by these sensations as a form of conscious awareness, where we are said to be proprioceptively aware of limb position and movement. On the other hand, other theorists characterize proprioception as a subpersonal and nonconscious function, where the body processes the information given by proprioceptive and kinesthetic sensations without any need for conscious or reflective awareness.

Hence, Gallagher offers a distinction between “proprioceptive information” and “proprioceptive awareness” in order to elucidate the various levels of function. Proprioceptive awareness, Gallagher argues, involves an awareness of the body’s position but without the need for conscious perception (2005, p. 46). Proprioceptive information, by contrast, is information “generated at peripheral proprioceptors and registered at strategic sites in the brain ... [operating] as part of the system that constitutes the body schema” (Gallagher 2005, p. 46). Proprioceptive information consists of the somatic experiences that guide the body schema below the threshold of conscious experience. Hence, the aforementioned transparency of the body as experienced in successful intentional action is made possible by the body schema that uses proprioceptive information through proprioceptive awareness in order to correctly discern the posture and position of the body and the quality and aspect of motor movement.²²

Gallagher and Cole (1998) refer to the pathological case of Ian Waterman (IW), who, as a result of large fiber peripheral neuropathy, has lost the sense of touch and proprioception from the neck down. Despite suffering from almost total deafferentation, IW was not paralyzed and retains the ability to move his body. What is interesting about the case, however, is that at the onset of his illness, IW experienced a complete loss of motor and postural control, but did not experience paralysis. He had to painstakingly relearn how to move and perform everyday tasks by conceptualizing his movements and using visual cues about body position. For IW, even after relearning a repertoire of body skills, movement and posture require constant mental concentration and visual information (Gallagher, 2005, p. 43–45). He has lost the experience of body invisibility, which characterizes the normal and healthy experience of movement.

Hence, the importance of proprioceptive information in the successful operation of the body schema is made evident by the experience of IW and other deafferented cases (Cole & Paillard, 1995). Proprioceptive and tactile information within the body *and* the ability to feel and sense one’s own body are important for successful motor movement and perception. Proprioception is a fundamental element in the experience of agency and ownership of action. In fact, it is argued by theorists that the coincidence of proprioceptive sensations to visual feedback of motion is the mechanism that induces a sense of ownership of action (see, e.g., Martin, 1995). Indeed, Tsakiris and Haggard write, “Both action and body cues need to be integrated in order to generate the normal experience of will, agency and body-ownership that we entertain in our daily lives” (2005, p. 397). This phenomenon is confirmed by IW, who along with Jonathon Cole and Oliver Sacks, was “re-embodied” in a robot using telepresence technology at the Johnson Space Center in Houston, Texas:

The robot’s arms have joints that move like those of human arms, and three fingers on each hand. The arms are viewed by the human subject through a virtual-reality set placed over the eyes, with the robot cameras set in the robot’s “head” so that the subject views the robot arms from a similar viewpoint as one views one’s own arms. No direct vision of one’s own body is possible, while one sits across the room from the robot. A series of sensors are placed on one’s own arms, which in turn control the movement of the robot’s arms. Then when one moves, the robot’s arms move similarly, after a short delay. Thus one sees and controls the robot’s arms without receiving any peripheral feedback from them (but having one’s own peripheral proprioceptive feedback from one’s unseen arms)... Making a movement and seeing it effected successfully led to a strong sense of embodiment within the robot arms and body. This was manifest in one particular occasion when one of us thought that he had better be careful for if he dropped a wrench it would land on his leg! (Cole, Sacks, & Waterman 2000, p. 167)

The authors write that, “after a few minutes we all became at ease with the feeling of being ‘in’ the robot” and they hence suggest that the sense of ownership of our bodies and actions “is plastic and fragile” (Cole et al., 2000, p. 167).²³ Their experience leads them to suggest that ownership of action can be transferred to other bodies that provide visual feedback of motor movements that, to a large extent, matches the proprioceptive feedback within the body, even though the physical aspect of the new body, in this particular experience “a set of steel rods and stubby robotic [three-fingered] hands,” does not correspond to a human aspect (Cole et al., 2000, p. 167). However, the roughly anthropomorphic shape of the robot (in contrast to the myriad of forms that a body can take in a VR environment, e.g., an animal form such as a lobster or snake) may be what induces this correspondence of action. Indeed, it has been long argued in VR research that a visual and sensorial match of the virtual body to the human form is what induces a sense of embodied immersion (Murray & Sixsmith, 1999, pp. 325–326; Slater & Usoh, 1994).

Additionally, the experience of a sense of embodied risk mentioned by the authors suggests that it is possible to phenomenally have the sense that the physical body, and its concomitant concerns, can be transferred to a remote device. It is also interesting to note that this sense of risk arose even though the subject could not feel the weight of the wrench and despite a short time delay. Furthermore, IW, who lacks proprioceptive feedback and who participated in this experiment, also had the sense of being “re-embodied” in the robot. However, IW’s extensive re-training to move his body according to visual cues may account for this (Cole & Paillard, 1995).

Hence, it may be that with future technological developments that offer more replete sensory feedback, smaller time delays and a seamless matching of visual feedback to proprioceptive awareness, surgeons will increasingly feel as though they are actually physically present in the remote operating theater in which their motor movements have been displaced. An obvious benefit of inducing this sense of re-embodiment would be a seamless correspondence of agency and ownership of action, which would render issues such as epistemological doubt and responsibility, among others, meaningless, as well as enhance a sense of presence and, correspondingly, improve task performance. However, when considering the possibility of re-embodiment, Husserl’s (1952/1989, p. 167) claim that “I do not have the possibility of distancing myself from my Body, or my Body from me” must be thoughtfully examined.

Re-embodiment as envisioned under a philosophical paradigm such as the Cartesian-Lockian model would involve a shifting of the essential psychic component of the human subject from one mechanistically controlled physical body to another. However, as has been shown, the subject as a lived body, as described by Merleau-Ponty (1945/2002) and Husserl (1952/1989), is not merely a metaphysical entity encased arbitrarily within a physical substrate, but rather is composed of its material form and the intentional and volitional motor-movements that give it a meaningful existence.

Re-embodiment, therefore, would entail not merely a shifting of the visual sense to a remote body, providing observational access (as provided in early telepresence and VR technologies). Rather, re-embodiment, if we are to consider the essential phenomenological features of embodiment, would entail a transfer of the body schema, motor-intentionality, and perception, where successful intentional action would induce a transparency of not only the technological interface with which one engages, but also transparency of the body in the remote environment.

However, it must be remembered that one of the essential features of what constitutes a body, and differentiates it from other material objects, is its sentience, its capacity for sensation

and feeling. Yet, the body as a field of sensory experience is often left aside in phenomenological considerations of embodiment that are primarily concerned with intentionality. Indeed, Leder notes that, phenomenologists of the body, such as Merleau-Ponty, are “most interested in the phenomenology of perception and the functions of motility and expression with which it intertwines” (1990, p. 36). Leder proceeds to argue that the body as a unique field of sensory experience is often overlooked in phenomenological investigations.

These two aspects of the body, that is, the intentional body and the sensory body, are described in a distinction offered by Tsakiris and Haggard (2005, p. 389) between the “acting self” and the “sensory self.” The acting self is “the author of an action and also the owner of the consequent bodily sensations,” whereas the sensory self is “solely the owner of bodily sensations that were not intentionally generated, but ... passively experienced” (p. 389). Distinguishing between the acting self and the sensory self is useful in understanding the phenomenological characteristics of re-embodiment and to what extent the Husserlian (1952/1989, p. 167) idea of the body as an absolute here (*nullpunkt*) is challenged.

As has been demonstrated with Cole, IW, and Sack’s robot experience and the example of telesurgery, it is distinctly possible to displace the acting self. That is, it is possible to transfer bodily intentionality to a remote apparatus and have precise and skilled motor movements mirrored in a distant setting. The body schema is to some extent transferred to the remote apparatus, subject to modifications of scale and function.²⁴ Furthermore, the experience of a feeling of re-embodiment on the part of the user can be induced as a result of a high correspondence between visual and proprioceptive feedback. Hence, Husserl’s claim that the body “is a here which has no other here outside of itself, in relation to which it would be a ‘there’” is challenged by these particular types of experiences, as the acting self, immersed in a remote environment, is distanced from the sensory body (1952/1989, p. 166).

Hence re-embodiment, although possible in this limited sense, must be carefully qualified. The sensory body remains an absolute here, from which the acting self is displaced through the mediation of some sort of communications technology. Furthermore, the sensory body as an absolute here, located in a specific spatial and temporal context, cannot be distanced from itself, implying that even the most seamless experience of high-fidelity telepresence will remain qualitatively different from that of engagement with one’s immediate surroundings, since even though a sense of bodily risk in the remote environment may be induced, it will never be a reality. Stone (1992) argues this point, speaking of VR. She writes, “No refigured body, no matter how beautiful, will slow the death of a cyerpuck with AIDS. Even in the age of the technosocial subject, life is lived through bodies” (p. 113). Hence, if a fire breaks out in a distant operating theater, the surgeon manipulating the surgical apparatus from some remote location may receive sophisticated fire sensations through a sensory feedback device and feel an embodied sense of risk, but his or her skin will never suffer the risk of burn.

CONCLUSION: INTERCORPOREALITY AND THE “REAL” THING

As technological advances in telepresence become more pervasive in the day-to-day functioning of the modern world, a careful consideration of these technologies and their effects and implications must be undertaken. These technological advances have moved far beyond ordinary remote control and more sophisticated online experiments, such as *Legal Tender* and

the *Telegarden*, which explored the limits of epistemological concerns that arise in remote interactions. As has been demonstrated with the example of telesurgery, the phenomenological and philosophical issues that come as a result of embodied interaction in enriched telepresence, such as agency, ownership, the corporeal schema, and re-embodiment, transcend the Cartesian-Lockian paradigm for selfhood and can be understood with regard to the investigations of phenomenologists of the body such as Husserl, Merleau-Ponty, and their commentators. It has been argued that a sense of presence and re-embodiment can be provoked using technology that offers a high correlation between visual and proprioceptive feedback, maintaining a coincidence between agency and ownership. Furthermore, re-embodiment, in this sense, refers to a displacement of the acting self, distinct from sensory self, transferring the corporeal schema and motor-intentions to a remote environment. As has been shown, a reconsideration of the body as an “absolute here” is necessary in order to adequately account from these experiences arising from distinct social and cultural developments.

While advances in technology continue at a rapid rate, taking telepresence devices to previously unimagined levels of sophistication, it is not surprising that one of the prevailing questions among the technological and philosophical communities engaged in the developments of this technology is whether remote interaction will really ever be as good as the “real thing.” Even the most sophisticated technological interface, which would provide seamless multisensory feedback inducing a flawless sense of presence, could not, as has been discussed, compensate for the lack of embodied risk. However, it is not merely a lack of bodily risk that poses what at present seems like an insurmountable qualitative difference between the experiences provided by telepresence and VR as compared to real-world interaction.

A further important element overlooked in the Cartesian-Lockian model of selfhood, and hence in the technological developments made under this paradigm, is the importance of intercorporeal relations. Indeed, recent developments in telepresence, artificial intelligence, and VR technology have recognized the fundamental need to take into account bodily interactions, such as communication through gestures, expression, and other body cues in order to accurately reflect interpersonal human interaction and hence make these technologies user-friendly and successful (Canny & Paulos, 2000). Physical contact and proximity between human subjects constitutes an important qualitative aspect of intersubjective relations that may never be obviated by technological mediums. As Dreyfus writes, “Even the most gentle person/robot interaction would never be a caress, nor could one use a delicately controlled and touch sensitive robot arm to give one’s kid a hug. Whatever hugs do for people, I’m sure telehugs won’t do it” (2000, p. 62). This leaves us to ponder if the aims of these technological developments should be to ultimately replicate the real thing, or whether we should regard telepresence as a distinct experience in its own right, with its own set of phenomenological characteristics. Indeed, it is hard to imagine that the comfort and reassurance brought about by the simple physical presence and contact of one’s own doctor will ever be induced in a remote interaction, no matter how refined the surgical and medical expertise provided.

ENDNOTES

1. The term *telepresence* was originally coined in 1980 by Marvin Minsky, who applied it to remote object manipulation applications and their teleoperation systems (Campanella, 2000).
2. Descartes considered the mind to be connected to the body and the outside world in a mediated manner. He writes that “the mind is not immediately affected by all parts of the body, but only by the brain, or perhaps just by one small part of the brain” (Descartes, 1996, p. 59).
3. The phenomenology of embodiment in virtual reality systems has received theoretical attention from several theorists (see, in particular, Ihde, 2002; Murray, 2000; Murray & Sixsmith, 1999).
4. Campanella describes the varieties of telepresence as “low telepresence,” as afforded by a webcam, and “high telepresence,” which involves “a transparent display system” and “multiplicity of feedback channels.” In addition, he describes mediums that give some degree of “telerobotic interactivity” (Campanella, 2000, pp. 27–30). It is from Campanella framework that I have schematized the four distinct types of telepresence.
5. See <http://www.counterfeit.org>
6. See <http://www.telegarden.org/tg/>
7. See United States Code, Title 18, Section 333, “Mutilation of national bank obligations,” available at http://www.law.cornell.edu/uscode/html/uscode18/usc_sec_18_00000333----000-.html
8. For further discussion of telepistemology, see Goldberg (2000).
9. There are three leading surgery systems currently used by surgeons in the USA and Europe. They are the Da Vinci Surgical System, ZEUS Robotic Surgical System, and the AESOP Robotic System (Bonsor, 2000).
10. Furthermore, Dr. Mehran Anvari, a Canadian telesurgeon, has performed more than two dozen remote surgeries on patients who were up to 250 miles away (Fleming-Michael, 2006).
11. When quotations are drawn from the translated foreign-language texts, it is traditional in the discipline of philosophy to provide page references for both the original text and the translation. In the APA notation system, however, that becomes quite convoluted. Therefore only the translation pages are cited, but the original text was investigated for each point. In this case, the original text is Husserl (1952).
12. The distinction between the body as a physical object and the body as a living organism is reflected in Husserl’s use of the German terms *Körper* and *Leib*. *Körper*, etymologically related to the English word *corpse*, is understood to mean “inanimate physical matter,” and refers to the materiality of the body, that is, the body as a physical object extended in space. *Leib* refers to “the animated flesh of an animal or human being” and is usually translated as *lived body*, carrying in this meaning the complexity of the experiential and subjective aspects of the body. In the “Translator’s Introduction” in *Ideas II* (Husserl, 1989, p. xiv), these are distinguished orthographically, with *Leib* appearing as “Body” and *Körper* as “body” (I will preserve this distinction in citations, but I will not use it myself).
13. Again, while only the translation is cited here, Merleau-Ponty’s (1945) original text in French was consulted.
14. For a discussion of specific innovations Merleau-Ponty made to Husserl’s description of embodiment, see Smith (2007).
15. Sartre’s (1943) original text in French was consulted, although just the English translation is cited here.
16. Phenomenological corporeal absence is taken up by Drew Leder (1990) in his work *The Absent Body*, where he explores the fact that while “in one sense the body is the most abiding and inescapable presence in our lives, it is also essentially characterized by absence” (p. 1).
17. It must be acknowledged that the intentional relation to the world and the apparent transparency of the body can be disrupted as a result of disability, pain, illness, and other routine and periodic bodily occurrences, such as pregnancy and menstruation. In these cases, a seamless perceptual and intentional relation to the external milieu can be disrupted or modified and the

body is brought to one's attention. Instead of flawlessly facilitating a relation to the external world, the body can "get in the way," so to speak. Sartre (1943/1969, p. 331–332), again, offers an example: When I am reading, I am not aware of my eyes. It is only when my eyes start hurting that I become aware of them and realize that it is in fact my eyes that stand between me and the page. Many theorists agree that the body usually is noticed only in instances in which, for example, it breaks down, fails, or loses equilibrium with its surroundings (see, e.g., Gallagher, 2005). They argue that, in normal circumstances, the body remains absent to consciousness unless there is a forced reflection brought on by some sort of pain or discomfort. As might be expected, this characterization of the normal body as one that does not suffer from disability, pain, and inevitable body occurrences such as pregnancy and menstruation has come under criticism from disability and feminist theorists (see Leder, 1990).

18. There is some confusion about the term *body schema* in the English translation of *Phénoménologie de la Perception*. Merleau-Ponty (1945) uses the term *schéma corporel* (body schema), although it is regularly translated by Colin Smith (Merleau-Ponty, 1945/2002) as *body image*. (See, for example, Merleau-Ponty, 1945/2002, p. 113.)

19. See Dennett (1981) for a thought experiment that discusses the issue of responsibility with respect to remote action.

20. *Ownership* in this case refers to ownership of action, rather than body ownership. See Martin (1995) for a discussion of body ownership.

21. For a discussion of these various meanings see Gallagher (2003). Furthermore, it is important to note that proprioception is a term used by Merleau-Ponty (1945) in the *Phénoménologie de la Perception*, although it is lost in Colin Smith's English translation (Merleau-Ponty, 1945/2002). For example, Smith translates Merleau-Ponty's original French text: "On entendait d'abord par «schéma corporel» un *résumé* de notre expérience corporelle, capable de donner un commentaire et une signification à l'interoceptivité et à la proprioceptivité du moment" (1945, p. 128) to the following English passage: "'Body image' was at first understood to mean a *compendium* of our bodily experience, capable of giving a commentary and meaning to the internal impressions and the impression of possessing a body at any moment" (1945/2002, p. 113). In Smith's English translation of the French original, it can be seen that proprioceptivity [proprioceptivité] has been rendered the "impression of possessing a body," which loses much of the significance of the original term.

22. Vestibular and other information from the body's systems also inform the body schema (see Gallagher, 2005, p. 47).

23. The authors suggest that a possible reason for this plasticity with regard to ownership of the human body results from the fact that, during a lifetime, the body will alter significantly, from infancy to old age or due to illness or accident. They write, "Corporeal changes must be assimilated. If we did not have this ability to alter our mapping of a sense of ownership and of agency onto altered bodies we might be at risk of alienation from them" (Cole et al., 2000, p. 167).

24. The development of PRoPs (Personal Roving Presence Device) as remotely controlled robotic devices that can be present in a remote environment exemplify the transferral of the body schema and this notion of re-embodiment of the acting self. They are intended to provide "the ultimate prosthetic" or a "full body replacement," a user can interact with other PRoPs or real human subjects in a distant environment, ultimately incorporating body cues such as "gaze, back channelling [and] posture" (Canny & Paulos, 2000, pp. 280, 278).

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