

GENERATION Y INTERACTIONS

Making the Office Catch Up

WEI LIU

GENERATION Y INTERACTIONS: MAKING THE OFFICE CATCH UP

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TU Delft
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CREATIVE INDUSTRY
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IDStudioLab

GENERATION Y INTERACTIONS

Making the Office Catch Up

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► **CHAPTER 1:**
INTRODUCTION

GENERATION



Do you recognize the following behavior in your living and working surroundings? People frequently snapping digital pictures with their smart phones, e-mailing them to friends, sending them to their Flickr account and putting them on their Facebook page within seconds? People personalizing their iGoogle homepages, speaking to their iPhones to send messages, choosing which tweets to follow based on topic and creating their own greatest hits collections in iTunes by downloading their favorite songs? Songs that subsequently are shared on several social networks with a large community of 'friends', with whom they have frequent and immediate contact via email, instant messaging and tweets. Along with this explosive change in functionality have come new modes of interaction, characterized by short, expressive gestural interactions like swipes, flicks and shakes, as well as a lower threshold to initiate short activities. These are what we have identified as 'Generation Y styles of interaction'.

1.1 Introduction

The rapid development of information technology (IT) in the past decade has enabled the introduction of a number of highly engaging tools in everyday life, such as online messengers, podcasts, (micro-)blogs and social networks. These tools offer people new ways of interacting, enabling them to create, retrieve and broadcast an enormous amount of digital information, using a large variety of devices, techniques and media [Cruz, 2007; Lloyd, 2007; Oxygen Report, 2010]. As a result of this constant exposure, people are more socially active by quickly exchanging information and are more capable and ready to integrate their virtual world with their physical world [Accenture, 2008; Bassett, 2008; Macleod, 2008; Tapscott, 1998], using highly interactive devices, such as mobile phones, laptops and multi-touch tablets.

The most prominent representative of this kind of behavior is the so-called Generation Y (see Figure 1.1). Roughly born between 1980-2000, this is the first generation of 'digital natives' [Prensky, 2001], who grew up with highly interactive tools, applications and technologies, such as mobile phones, mp3 players and multi-touch tablets. This generation has grown accustomed to new, more expressive and natural ways of interacting with their tools, e.g., shaking an iPhone to shuffle songs.



Figure 1.1. Typical Generation Y styles of interaction: personalizing iGoogle homepages, downloading songs from iTunes, speaking to iPhone to send messages and following tweets

So far these typical Generation Y styles of interaction have mainly manifested themselves in people's home context. In the more public work context, however, the rich interactions that these new technologies are offering do not seem to be supported to a great extent yet [Blain, 2008; Spiro, 2006]. In the domain of office work, 'BlueSpace Cubicle' [Lai et al., 2002], 'Active Badges' [2002] and 'Workspheres Concepts' [2002] envision future offices being filled with intelligent user interfaces and information gadgets, which provide users with natural interactions. However, these designs and visions are created by predicting technology trends, software capabilities and product functions rather than focusing on the actual application and experience that fits a specific context. Whereas office applications have increased sometimes dramatically in functionality, the ways of interacting with all these functionalities have evolved

much more slowly. As a consequence, most office work is still done through the ubiquitous, almost 40-year old, set-up of keyboard, display and mouse, which is often referred to as WIMP: windows, icons, menus and pointer [Myers et al., 2000], a set-up which only supports limited behaviors, such as keyboard tapping and mouse clicking. Even the technological visions of the 80s and 90s, e.g., Xerox PARC [2013] who aimed to create 'the office of the future', have not found their way into everyday offices yet, the bottleneck does not seem to be technological feasibility [see Figure 1.2 for an impression of current office conditions]. The design of intelligent artifacts suggests that the old adage of 'form follows function' is no longer valid [Krippendorff & Butter, 1993], except for the simplest tools. Krippendorff [2005] argues that user centered designer's unique expertise resides in the design of user interfaces with artifacts that are meaningful, easy to use, even enjoyable to experience, be it simple kitchen implements, public service systems, architectural spaces or information campaigns.

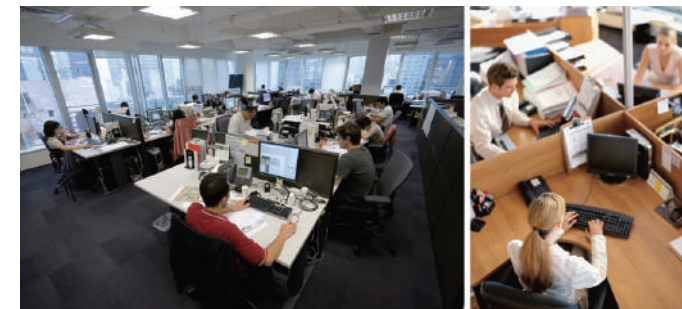


Figure 1.2. Examples of typical office set-up: office applications and tools and the ubiquitous set-up of keyboard, display and mouse



A challenge presents itself therefore in bringing these new Generation Y styles of interaction into the work context. An extensive review of office tools, applications and services reveals that not much has been developed and published on Generation Y styles of interaction, more specifically in the work context). An interactive banking interface, Virtual Wallet, was developed to provide Generation Y customers with seamless access to their finances and intuitive control of their money [IDEO, 2010]. Based on electronic online banking, it is designed to promote banking activities with new features and visual interactions (e.g., sliding on a visual scale interface to break down every dollar and to transfer money in to other accounts) that support Generation Y's needs. Another attempt is Shareworks [2012], which



Figure 1.3. Examples of new ways of interacting from left to right, top to bottom: controlling money in the Virtual wallet, sharing project courses on Shareworks, playing Wii and Kinect games, grouping digital files (Minority Report), browsing name cards (Productivity Future Vision 2019), presenting financial growth by using an iPad and navigating through multi-touch and gestures (Autodesk Medusa)

is a platform for teachers and Generation Y students in higher education. Shareworks turns project courses into Web 2.0 communities by enabling more simple, interactive and media rich ways of publishing, sharing and discussing.

Next to these, advanced and visionary interaction techniques from telerebotics and computer games (e.g., gestures in the Nintendo Wii and the Microsoft Kinect), as for example portrayed in movies such as Minority Report and Microsoft Productivity (Future Vision 2019), are beginning to find their way into mainstream and serious platforms, e.g., multi-touch in the Apple iPad or Autodesk Medusa. Apple iPad is used increasingly by managers in meetings. Hoeben (2006) had the observation that a tablet pc, unlike a laptop, is socially acceptable at a meeting of non-geeks, whereas it is impolite to hide behind the social barrier of the laptop screen. Figure 1.3 shows these examples of new ways of interacting based on proven technologies (e.g., Wii) and conceptual technologies (e.g., Minority Report). Yet, often the balance falls through to completely visual interactions. Studies of human cognition, however, show that both visual and verbal thinking modes are important in creative work, and that different people use different styles, sometimes for different work (Spiro, 2006).

1.2 Research Goal, Research Questions and Relevance

To cater to this new generation of office workers and their new styles of interaction, future business tools, applications and services should fit in with richer ways of interactions that go beyond keyboard, mouse and display. The goal of this research is therefore to explore such interactions within the context of office work, to develop new tools that support these interactions and to study in what ways they might affect future ways of working (see Figure 1.4).

From this research goal a number of research questions can be derived, which are grouped into two sections. The first section consists of three questions, aimed at gaining knowledge on how office workers experience user-product interactions in the home and work context.

1. What are Generation Y styles of interaction in home life and office work?
2. What are the interaction qualities that make up Generation Y styles of interaction?

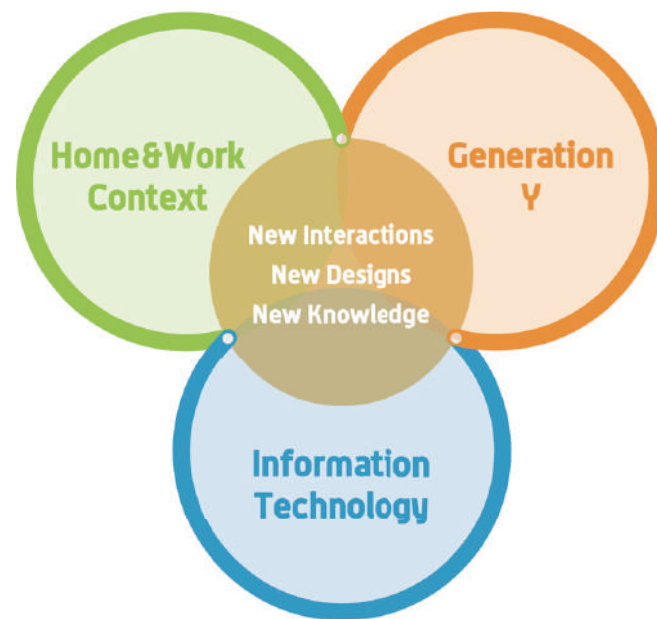


Figure 1.4. Three major components that help explore new styles of interaction

3. How are these interaction qualities experienced within home and office context?

The second section consists of two questions that address the application of this knowledge in developing office tools or services that support Generation Y styles of interaction.

4. What are opportunities to design office tools or services that support Generation Y styles of interaction?
5. How are the interaction qualities of these new designs experienced?

The scientific and social relevance of this research lies in bringing Generation Y, information technology (IT) and work context together with the purpose of finding out Generation Y styles of interaction and how to support future office work in new ways of interacting. By critically comparing interactions experienced in the home and work context, new knowledge can be gained on Generation Y interaction qualities and design opportunities. By designing tools that integrate this knowledge, Generation Y ways of interacting with novel office tools can be demonstrated. The goal is to make IT capable of supporting creative, inspirational and enjoyable styles of interaction, opposed to pushing buttons and staring at screens.

Regarding peers, researchers and designers who focus on understanding the difference between people's home and work context, and designing new styles of interaction would benefit from the result of this research. More specifically, the peers include researchers and designers who work on the computer supported cooperative work (CSCW), human factors in computing systems (CHI), designing interactive system (DIS), design research (IASDR),

designing pleasurable products and interfaces (DPPI), ubiquitous computing (Ubicomp), intelligent user interface (IUI), user interface software and technology (UIST), tangible and embedded interaction (TEI), personal and ubiquitous computing (PUC) and engineering interactive computing systems (EICS) fields. Researchers, designers and developers from the ID-StudioLab and Exact have participated in every phase of this research, not only as users and experts, but also as peers and co-creators. They contributed to this research by giving access to clients and own staff, evaluating new designs and participating in analysis sessions. On most of these occasions the discussions focused on bringing in knowledge from different perspectives, on the relevance of new designs in practice and on the impact of new designs in other fields or other applications.

1.3 Research through Design Approach

From the beginning and throughout the whole research, prototypes that are rich in aesthetic, expressive and experiential quality will be built and tested in real contexts. In the first phases of the project emphasis lies in the exploration of new ways of interacting, while later on in the project the focus shifts to applying these new techniques within the domain of office tools. To ensure a high flow of thoughts, ideas and knowledge, a research through design approach is taken, in which the generation of knowledge and the development of applications go hand in hand. Research through design is used as a form of research to contribute to a design activity (Archer, 1995; Zimmerman et al., 2007). It is recognized as a form of action research, defined as systematic investigation through practical action calculated to devise or test new information, ideas, forms or procedures and to produce communicable knowledge (Archer, 1995; Koskinen et al., 2011). Action research is an iterative process involving researchers and practitioners acting together in a particular cycle of activities (Avison et al., 1999; Whyte, 1989). The research through design approach is highly iterative, integrating theory and practice from different fields into working experiential prototypes. These prototypes can be experienced as working artefacts and can be used as research means to demonstrate and explore these theories (Aprile & van der Helm, 2011). Designing and building working prototypes that are rich in experiential quality therefore plays a key role in this approach. The reflection on the action (of designing and building) creates new knowledge. The designing act of creating prototypes is in itself a potential generator of knowledge (Stappers, 2007), leading to new design insights and refinement of research issues.

This research was conducted at ID-StudioLab, which has traditionally been home to various research through topics, such as designing designerly interactions with an informal collection of visual material (Keller, 2005) and merging 2D imaging and 3D modeling in the design of material appearance (Saakes, 2010). This line is also continued in the Designing Quality in Interaction group at TU Eindhoven, such as designing an affective alarm clock to recognize human emotions (Wensveen, 2005), designing rich camera interaction by integrating form, interaction and function (Frens, 2006) and designing ethics and aesthetics in intelligent lamps (Ross, 2008).

1.4 Research Framework Forming

Figure 1.5 shows the research framework of this thesis, which distinguishes three major components: 1) people (Generation Y), 2) technology and 3) context (home vs. work). On the intersections of these three components are the interactions we want to understand. Different research activities, such as interviewing, designing and evaluating, are conducted and connect the components. For example, an extensive literature review benefits to understand what other researchers have done about the Generation Y workforce, while interviews benefit to sensitize how Generation Y users behave and interact in the real world.

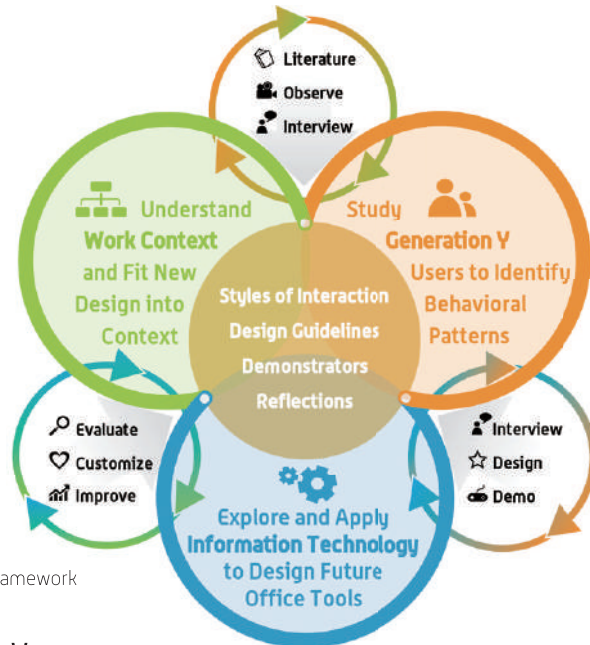


Figure 1.5. The research framework

1.4.1 Generation Y

Fieldwork and analyses of Generation Y styles of interaction in the work context are missing. While most contemporary research on Generation Y, e.g., Litmus, 2006 & Oxygen Report, 2010, mainly focuses on marketing and demographic aspects, we choose not to focus on the Generation Y people, but on the interaction styles associated with this new development. The office is, and will for some time, be populated by people from a mix of generations, X, Y, and what follows. Currently, the Generation Y staff need to put up with Generation X styles of interaction, but new designs based on Generation Y interactions and interactive technologies need to work for other generations, such as Generation X as well as for Generation Y.

1.4.2 Information Technology

Information Technology (IT) is defined as anything related to computing technology, such as networking, hardware, software, the Internet and other means that are used to store, retrieve and manipulate information (Longley & Shain, 2012). The rapid development of IT in the past few decades has also enabled the introduction of a number of highly engaging tools in everyday life, such as instant messaging, podcasting, blogging and social networking. These

tools offer people new ways of interacting, which enables them to retrieve and broadcast an enormous amount of digital information, something they could never have done before (Oxygen Report, 2010). IT creates a (digital) platform for Generation Y to learn, communicate and work, as well as train them as 'intuitive visual communicators' who have strong digital skills (Oblinger & Oblinger, 2005). As a result of being constantly exposed to (digital) knowledge seamlessly, Generation Y is more socially active by quickly exchanging information with other people. They are capable and ready to integrate their 'virtual world with their physical world' (Accenture, 2008). IT makes them multi-taskers who connect themselves perpetually with instant (mobile) channels and work collaboratively with social networks.

1.4.3 Work Context

Work context can be described as surroundings, circumstances, (digital) environment, background or settings that determine, specify or clarify the meaning of working activities. With the rapid development of IT, work context has also changed dramatically during the past few decades as society makes the transition from an industrial age to a knowledge age (Stappers, 2012). During this transformation, new work styles, tools, locations and patterns have changed the ways office workers work today. This creates a more connected, more competitive and increasingly complex work environment. Key trends are increasing collaboration within virtual teams (geographically spread), the changing demand for flexible employment (in time and place) and the increased number of mobile workers. In addition to these trends, office workers have much more choice in products or services that help them to do their work. In the current trend of servicification, suppliers of office products or services need to create added value on top of a commodity offering, e.g., automation is no longer a selling point in itself. In a recent user research workshop among wholesale entrepreneurs at Exact (see Figure 1.6), we found that Generation Y office workers value a smart, pleasant and trustful collaboration between people and information in their network. This gives direct and relevant insight and helps them run their business better. To them, information is the key to collaborate and to deliver the best customer service themselves.



Figure 1.6. A Generation Y entrepreneur presents her interactions of collaboration among offices during the user research workshop

1.4.4 Home Context

As argued above, Generation Y interactions have developed in the home context of gaming and smartphones. Therefore it is important to have a clear picture of what the home context is as well as the work context. The home context can be described as surroundings, circumstances, (digital) environment, background or settings that determine, specify or clarify the meaning of home activities. It is not necessarily only the things people do in their homes, but rather it stands for their private lives. The rapid development of IT has made it possible to let people experience highly interactive tools, applications and technologies, such as mobile phones, mp3 players and multi-touch tablets. These days mobile devices mean that a lot is happening not necessarily only at home and work locations. This creates a more connected, more entertaining and increasingly media rich living environment. More expressive and natural ways of interacting with these new tools (e.g., sliding on an iPhone interface to update Tweets) become popular and accustomed in the home context. Suppliers of consumer products or services need to create added value on top of a commodity offering, e.g., creating pleasant user experience.

1.4.5 Work Context: SMEs

In this research, most interviews were conducted at small medium-sized enterprises (SMEs) companies to help us gain user insights into new ways of interacting and working. Exact has a good history of serving entrepreneurs, but SMEs start-ups are quickly emerging as a new group of customers. These new start-ups are typically Generation Y office workers. Exact is looking for opportunities to understand and support Generation Y ways of working. Exact focuses on serving SMEs, which employ fewer than 250 persons and have an annual balance sheet total not exceeding EUR 43 million (EC Website, 2010). EIM Research (2009) views the average European enterprise employs no more than six people. Solely in the Netherlands, there are approximately 30 SMEs per 1000 inhabitants (CBS Statline, 2012), and more than 90% of them are companies that only employ 1-10 persons. Research indicates that these companies focus on growing their business through entrepreneurial approach by using a less formal structure in managing their companies (Edwards et al, 2005; Oswald, 2003). SMEs play a central role in the European economy and are considered as important drivers of innovation and change in Europe (EC Website, 2010). The industrial partner in this project, Exact, supports entrepreneurial business to SMEs and provides access to their network of clients to participate in this research.

1.5 Research Setting

This Ph.D. research is a collaboration between the design techniques (DT) research group of the Faculty of Industrial Design Engineering and Exact (exact.com). Exact is an internationally renowned developer of business solutions for Small to SMEs. Activities are performed at both places. Research and educational activities are mostly performed in the ID-StudioLab, e.g., building prototypes and teaching courses, while practical activities are

mostly performed at Exact, e.g., understanding Generation Y's work context. This research is supported by Exact, and is funded within the creative industry scientific programme (CRISP), in the project product service systems (PSS) 101 (CRISP Platform, 2014). CRISP is supported by the Dutch Ministry of Education, Culture and Science. CRISP has been initiated to develop knowledge, tools and methods that strengthen the knowledge of the Design Sector and the Creative Industries as a whole, ensuring that they retain their competitive edge.

1.5.1 The DT Research Group and ID-StudioLab

The DT research group focuses on developing tools and techniques to support designers and design teams in the early phase of the design process. In this phase designers create a variety of artifacts and representations, both of verbal and visual form, using traditional and new media, about the past, present and future experiences of people with products. The research of the DT group aims at improving these artifacts and representations (i.e., tools) and the way they can be used in the design process (i.e., techniques). The DT group is part of ID-StudioLab (studiolab.nl), a design research community focusing on human-product interaction.

1.5.2 Exact

With their slogan 'And it all comes together', Exact provides enterprise resource planning (ERP) services with information technology by delivering business solutions (Exact, 2014). Exact supports SMEs in being in control of their business and in having the freedom to concentrate on what is important to them. Their solutions provide their customers the freedom to successfully address challenges and opportunities, creating value for their customers and ultimately for themselves. For example, Exact Online is a product that sees at a glance how SMEs stand financially and helps them collaborate online with their accountant(s). Exact serves local and international companies in more than 125 countries and offers solutions in more than 40 languages. The company was started by students in Delft in the Netherlands in 1984. Exact is interested in this Ph.D. research because it is looking for opportunities to understand and support Generation Y ways of working. The company has a good history of serving entrepreneurs, but SMEs start-ups are quickly emerging as a new group of customers. These new start-ups are typically Generation Y office workers.

1.6 About the Work

The work in this research continuously relies on three layers of theoretical research and design research activities (see Figure 1.7): 1) analysis, 2) synthesis and 3) design. The analysis, synthesis and design layers are connected. Analysis is formulated from multiple angles, e.g., interaction qualities. Synthesis is conducted to gain new knowledge. Designs supported by interactive technologies are created to demonstrate the effects of both analysis and synthesis. Furthermore, the designs are used in expanding knowledge of analysis and synthesis.



Figure 1.7. Timeline of this Ph.D. research activities. The twist between 2011 and 2012 means a transition between theoretical research and design research activities

This thesis is constructed mostly from the researcher's publications along this Ph.D. research. These publications are assigned into different chapters. Therefore each chapter can be read individually. Although the introduction sections may overlap in the start of chapters, they are always written for different peers and audiences with different perspectives. This thesis follows a chronological order, but some of the design and research activities were done in parallel or developed over a longer period of time.

1.7 Thesis Outline

Chapter 1 introduces the research background, goals, approach and research framework. Chapter 2 answers research questions 1 and 2 through analysis and synthesis. This chapter presents literature review, as well as field studies on exploring Generation Y styles of interaction, behaviors and interaction qualities. Chapter 3 focuses on interactive technology design, designing and developing a number of experiential prototypes as a first exploration. This chapter describes and discusses Generation Y ways of interacting, their interactions in the work context, preliminary implementation of interaction qualities and the lessons learned from that. Chapter 4 answers research question 3 through synthesis, e.g., interviews. This chapter describes a series of contextual interviews conducted with office workers, sensitizing them on interaction qualities experienced in their home and work context. The study results in a number of design guidelines for designing Generation Y styles of interaction. Chapter 5 answers research question 4 by implementing the interaction qualities into a new design, which uses the knowledge and experience gained from the previous chapters and integrates them into a working prototype. Chapter 6 focuses on synthesis again to answer research question 5. This chapter presents findings on the prototype's performance on the interaction qualities in a lab setup and in a real office work context. Chapter 7 reflects on the answers on the five research questions from the previous chapters. This chapter also concludes with a general discussion of the research on what has been learned and the possible impact of its results. Figure 1.8 shows the outline of this Ph.D. research.

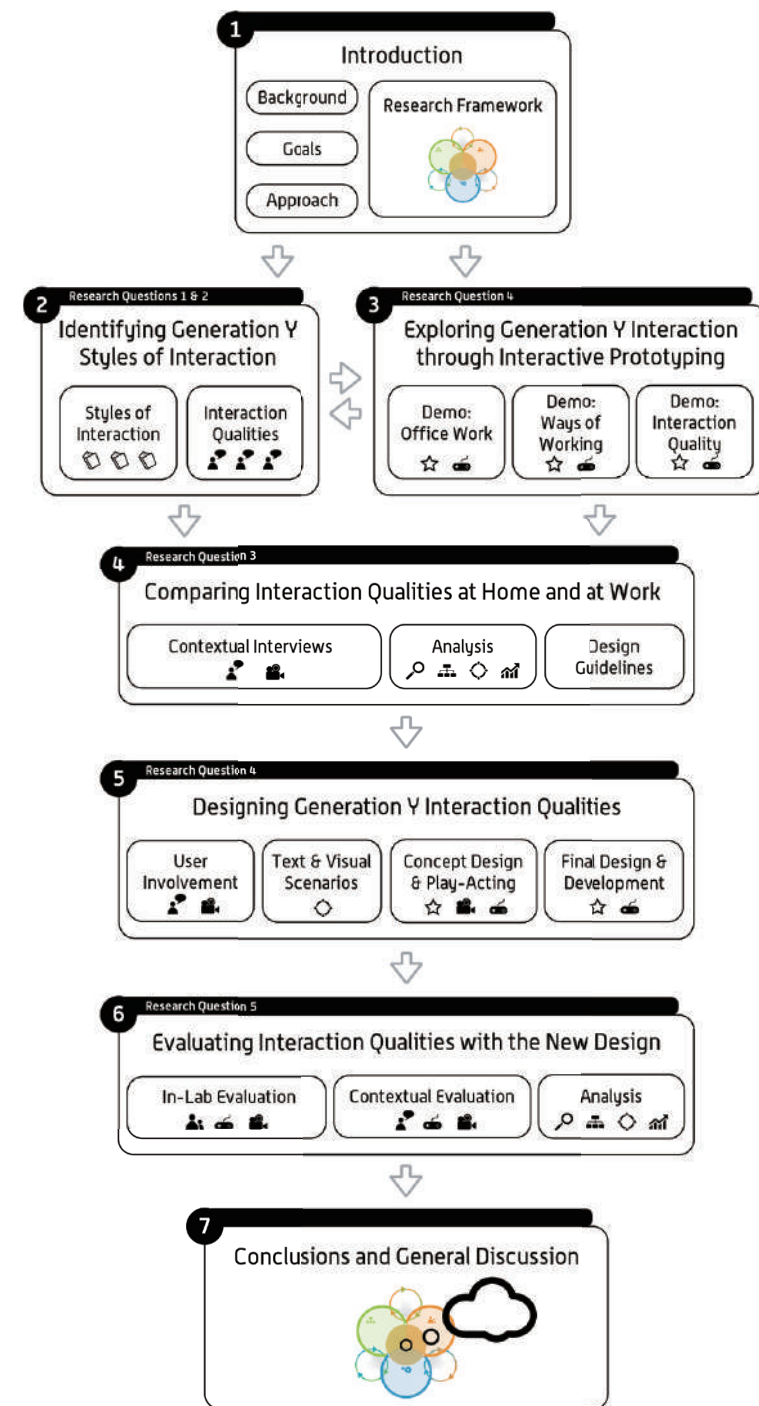


Figure 1.8. Research outline

► **CHAPTER 2:**
IDENTIFYING GENERATION
Y INTERACTION QUALITIES



Research questions 1 and 2 are central in this chapter: What are Generation Y styles of interaction in home life and office work? What are the interaction qualities that make up Generation Y styles of interaction? This chapter provides literature review, theoretical background and a field study, to understand Generation Y ways of interacting. Section 2.2 explores Generation Y styles of interaction by reviewing behaviors of generations, making interaction style posters and understanding IT impact. Section 2.3 describes a series of contextual interviews with Generation Y office workers and specifies Generation Y interaction qualities.

This chapter is based on:

Liu, W. (2012). Generation Y interactions. Proceedings of the ACM 2012 conference on Intelligent user interfaces (IUI). New York: ACM Press.

Liu, W., Stappers, P. J., Pasman, G. & Taal-Fokker, J. (2011). Supporting generation Y interactions: Challenges for office work. Proceedings of the ACM 2011 conference on Computer supported cooperative work (CSCW). New York: ACM Press.

2.1 Introduction

The previous chapter presents the general introduction to this Ph.D. research and ends with a number of research questions. This chapter tackles research question 1 and 2 by studying literature and sensitizing (Sleeswijk Visser et al., 2005) target users. The aim is to understand Generation Y ways of interacting and to propose guidance for Generation Y interaction design.

2.2 Exploring Generation Y Styles of Interaction

This section presents literature review, analysis, IT impact on Generation Y and their typical behaviors. In the field of industrial design and interaction design, the concept of style is used to ‘achieve an aesthetic coherence with the predominant thinking’ (Buur & Stienstra, 2007). This concept is based on an understanding that styles are defined ‘within social groups and essentially dynamic both in form and function’ (Ylimaula, 1992; Øritsland et al., 2003). Styles of interaction provide researchers and designers with visions, directions and a sense of how people behave in designing new interactions (Øritsland & Buur, 2000). Styles of interaction can benefit interaction design greatly by providing designers with strong visions and a sense of direction in designing new user interactions and interfaces, e.g., Schmidt et al. (2012) designed a novel cross-device style of interaction for mobiles and surfaces that uses the mobile for tangible input on the surface in a stylus-like fashion, and Bjørneseth et al. (2008) introduced new styles to make the interaction more efficient and less faulty in both standard operations and in safety-critical situations within the maritime environment and on maritime equipment.

2.2.1 Behaviors of Generations

Today’s workforces include the Traditionalists, Baby Boomers, Generation X and Generation Y (Bassett, 2008; Spiro, 2006). These generations are not only diverse in age and cultures, but also in behaviors and styles of interaction. To gain knowledge about trends and the state-of-the-art of IT tools and interactions for Generation Y, a list of descriptions on how different generations behave in the home and the work context are described below:

- **Traditionalists (Pre - 1946)** - Traditionalists grew up during the World War II. They are familiar with hardship and value consistency (Spiro, 2006). They believe in earning their own way through hard working, and they are known for staying with one company for their entire career. In general, they adapt new technology slower than the younger generations. As technology evolves, they may struggle to learn the new user product interactions in both home life and office work.
- **Baby Boomers (1947 - 1963)** - Baby Boomers are confident, independent and self-reliant. They are goal-oriented, dedicated and career-focused. They

welcome challenging projects and strive to make a difference (Carlson, 2008). Believing in growth, changes and expansion, they seek promotion by working hard and demonstrating loyalty (Accenture, 2008).

- **Generation X (1964-1979)** - Generation X have a desire to invest in their own development. They highly rank constructive feedback, coaching and mentoring (Oxygen Report, 2000). The number of people staying in a job for 5 to 10 years decreased dramatically, they often lack loyalty to their employers (Spiro, 2006). They see work-life balance very important and treat community (e.g., family) above work requirements.
- **Generation Y (1980 - 2000)** - The term Generation Y appeared for the first time in history in the Ad Age magazine (1993). Litmus (2006) argues that Generation Y was born between 1980 and 2000. Generation Y are also known as a number of terms including Millennials, Echo Boomers, New Boomers and the Net Generation. This group of people is children of the so-called Baby Boomers and siblings of Generation X, which made them use to interact with multi generations (Cruz, 2007; Deloitte, 2008). Being the first generation of ‘digital natives’ (Prensky, 2001), they grew up with mobile phones, mp3 players and multi-touch tablets. At the workplace, they demand a creative environment where independent thinking is encouraged. They are eager to get learning opportunities and positive recognitions for jobs well-done (Blain, 2008; Erickson, 2008).

2.2.2 Style Posters

To summarize the historical inheritance and comparing alternative design expressions for Generation Y, a series of style posters was created (see Figure 2.1). Style posters have been previously used to inspire user interface design by coupling interaction and industrial design (Buur & Stienstra, 2007). They proved to work well for gaining visions, directions and a sense of how people behave in designing new interactions. The posters describe and illustrate the styles of interaction and their impacts from four categories of generations and four perspectives of developments. The four categories include Traditionalists, Baby Boomers, Generation X and Generation Y. These four categories were chosen because these generations represent main workforces in modern society. They are presented vertically on the posters. The four perspectives include society, interactions, characteristics and technology. These four perspectives were chosen because they impact these generations to form their styles on interaction. They are described and illustrated horizontally on the posters.



Figure 2.1. The posters that describe and illustrate the styles of interaction among generations. The four vertical categories include Traditionalists, Baby Boomers, Generation X and Generation Y. The four horizontal perspectives include society, interactions, characteristics and technology

From studying styles of interaction among generations, we found that IT impacts Generation Y to form new ways of interacting with everyday (digital) things in the home context. In the home context, these 'digital natives' (Prensky, 2001) are a tech-savvy or Internet-savvy generation due to the ubiquitous and global nature of the Internet, which has been used as a publishing and marketing tool (Accenture, 2008; Venkatacharya, et al., 2009). Little research has been done on these new ways of interacting in the work context, where lies the challenge in bringing these new interactions. Compared with technologies exposed to all generations, typical relevant technologies to form Generation Y styles of interaction are summarized below:

- **The Internet** - The Internet has influenced the way Generation Y communicate, work and spend spare time. Their personal experience of the 'participatory Web' (e.g., forums and blogs) is very high (Felix, 2007; MacLeod, 2008), thus they have the highest levels of participation compared with any other generation. With the development of the Web 2.0, the Internet provides Generation Y with more free choices to communicate, interact and collaborate with each other in a social media of user-generated content in a virtual world (O'Reilly, 2005).
- **Online Communication** - Online communication becomes possible and popular through use of the Internet and mobile technology, such as email, texting and instant messaging (IM). Generation Y prefer this immediate way of communication with their colleagues, friends and family because they value instantness (Cole et al., 2002).
- **Mobile and Wireless** - From the mobile phones Generation Y carry to make calls for roadside help and the iPod they use to listen to music on their ways to work, to the BlackBerry they use to keep connected to office and email on the go, these wireless devices have revolutionized the way Generation Y live, work and entertain (Litmus, 2006). The advancement of wireless communication means, mobile applications and the convergence of the Internet standards in mobile devices keep them using, learning and adapting to the most updated mobile and wireless technology (Lloyd, 2007).
- **Social Networking** - A form of new media appeared through the Internet such as Facebook, Foursquare and Twitter in recent years. This new media enables Generation Y with a peer-oriented communication and collaboration style (Erickson, 2008; Martin et al., 2002). Self-expression and social acceptance by peers are highly important to them. The Oxygen Report (2010) points out that the core elements of social networking technology are profiles, 'virtual friends' who create a self-defined social group, and comments from interactions with other 'friends'. Communication in a wider network creates opportunity for them to get to know a larger and more diverse group of 'friends' than they would meet face-to-face in real life.

2.2.3 Behaviors of Generation Y

Specifying Generation Y styles of interaction to behaviors can benefit researchers and designers with strong visions and a sense of direction when designing new user interactions and interfaces in the home and the work context. Generation Y behaviors helped setup and conduct user research. The term Generation Y in this research is defined by behaviors, thus the research focus goes beyond demographic and ethnographic studies. Typical behaviors and characteristics relevant to Generation Y and IT are summarized below:

- **Integrating IT and Life** - Generation Y regard IT as an integral part of their lives. They spend considerable amounts of time interacting with digital technology. They easily communicate with others and access information quickly and instantaneously. Generation Y use personal computers, surf on the Internet, watch DVDs, play video games and use mobile phones more often than any other generation. They spend fewer amounts of time reading offline magazines and newspapers than any other generation. Generation Y integrate IT into life, as well as bring life into IT. A more intimate understanding of how they lead their lives is becoming part of designing how IT is offered.
- **Connecting through Mobile Technology** - Mobile phones mean much more than just talking to Generation Y. They spend a great amount of time using mobile devices to search for information on the Internet, listen to music, text messaging, instant messaging, communicate on social network sites and interact in virtual communities.
- **Working Socially and Collaboratively** - Generation Y are a social and collaborative workforce. They prefer working as a team to accomplish independent tasks as they use the skills, knowledge and resources of team members to satisfy individual needs. Self-actualization and a balanced work and personal life are considered essential to Generation Y. Therefore, they want to have more control in doing their work with the freedom to execute the task in their own way and eventually leave a personal mark on the work. They are eager to communicate, work with personal preference, being in control and being more productive and creative than any previous generation.
- **Multitasking** - By using technology, Generation Y have trained themselves in the ability to handle more than one task at a time without feeling overwhelmed. They are used to multitasking, they can also manage what and when things should be done. Even more, they look forward to the challenges of performing and completing several tasks at the same time.
- **Balancing Life and Work** - Generation Y strive for flexibility and balance in their day-to-day life. They want to work, but they do not want 'work to be their life' (USA TODAY, 2007). Compared with Baby Boomers, who prioritize career first in their life, today's youngest office workers tend to make their jobs accommodate their family and personal lives. Therefore, they have a higher value on self-fulfillment. Generation

Y feels that they deserve the freedom to work fewer hours while still taking jobs that are challenging. They want to work flexible and have the ability to do part time jobs, or even leave the working environment temporarily when there is a need from their friends and family. As an example, they may want to work at home one day per week to take care of their children.

- **Sharing** - Generation Y write and talk openly about themselves and friends both online and offline. Compared with older generations, they like to show off their taste, always looking for new ways to entertain themselves, to spend more time having fun with friends and family. Generation Y are much more influenced by what they perceive to be trendy and fresh than other generations, they are also more willing to try new things, they value peers' advice, and they are inclined to seek for input from friends and family.
- **Learning** - Generation Y are always seeking for new knowledge and are eager to learn new technologies both in work and life. They want to try out all kinds of new product interactions, which they can learn very fast based on their previous and similar use experiences. They do not like to fall behind of modern technologies. Instead, they like to pursue state-of-the-art (digital) interactive products and exchange their learning experiences with their peers.

2.3 Identifying Generation Y Interaction Qualities

This section deals with the intersection in the middle of the research framework (see Figure 1.5) by identifying the interaction qualities that people experience at both home and work through a number of contextual interviews. From these interviews six interaction qualities are derived, which together specify the ways of interacting associated with the previously described Generation Y behaviors and characteristics. Generation Y styles of interaction is associated with these interaction qualities. Styles of interaction and interaction qualities are different things. Typically, a certain interaction will have only one style, but can have a combination of qualities. These interaction qualities will be used as guidance to compare, design and assess the experience of user interactions in the home and work context.

2.3.1 Interaction Qualities and Related Work

Interaction is not a piece of material. It appears only in use, which can be defined and afforded by form, material and other properties. Löwgren [2006] and Rullo [2008] propose to think about interaction design in terms of interaction qualities as a language to talk about desirable design outcomes, i.e., certain properties of a (digital) design that are experienced in its use. They only come about through actively engaging with a product, system or service [Locher et al., 2010; Ross et al., 2009; Øritsland et al., 2003]. Interaction qualities are also called experiential qualities [Hult, 2003; Frens, 2006], denoting the experienced attributes of artifacts-in-use [Arvola, 2010; Ross et al., 2010]. It is about what the user experience a user can get with a design.

There have been several research projects aimed to design and enhance user product interaction. First, the projects related to interaction qualities in the home and work context were reviewed. Secondly, how they relate to the research question was discussed, i.e., in what way they are about Generation Y and about interaction qualities.

In the home context, Strong and Gaver [1996] designed 'Feather' for the context of one person who is traveling while another is at home. The traveling person triggers the feather's movement by holding a picture frame, causing the feather to ascend and descend expressively as it catches the wind. Wensveen [2005] applied a tangible approach to design and built an alarm clock prototype, which recognizes human emotions. The prototype has a round shape and features twelve sliders circularly divided. The interaction design with the sliders allows for a myriad of setting the alarm time, e.g., more fluent settings: calmer alarm, more random and far-spread sliders: nervous, urgent alarm. Frens [2006] designed a camera prototype that is operated by means of richer actions than normally seen in conventional interactive products. The design enables users to experience rich camera interaction by integrating form, interaction and function. Visser et al. [2011] designed an interactive lamp that creates interpersonal awareness between users in two different homes. The lamp displays movement of a remote user by glowing itself. Users exchange nudges by shaking their lamp in order to making the remote lamp blink. Rittenbruch and McEwan [2009] suggested that tangible interaction, opposed to screen-based interaction, would be more effective in the home context, because tangible interaction is more intimate, simple, emotionally meaningful and aesthetically pleasing. Figure 2.2 gives an impression of the research projects mentioned above.

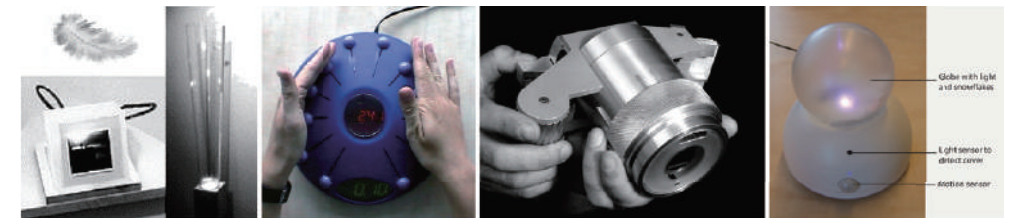


Figure 2.2. The research projects related to interaction qualities in the home context. From left to right: 'Feather', emotional alarm clock, camera of rich actions and lamp of awareness

In the work context, Keller [2005] designed cabinet that helps designers collect and organize their visual material for inspiration. The design makes interaction with digital material more physical by dragging digital images on a table as if they are real objects. It offers a fluent way to add physical material to the digital collection by digitizing and projecting any objects placed on the table. This type of study was followed by several other recent projects in the domain of computer supported cooperative work (CSCW), such as designing and testing of a mixed reality (MR) system that supports collaborative troubleshooting of office copiers and printers [O'Neill et al., 2011], designing an intelligent robot worker that transports goods and samples in a semi-public hospital context [Ljungblad et al., 2012] and designing a shape-changing communication device that facilitates expressive 'knocking'

communications between two office workers [Rasmussen et al., 2012]. Another example is an intelligent reading lamp which aims to design ethics and aesthetics in products and systems [Ross, 2008]. By moving the hand over the lamp, a ‘living light’ can be directed onto an object such as a book. This interaction design can fit into both the home and work context. Figure 2.3 gives an impression of the research projects mentioned above.

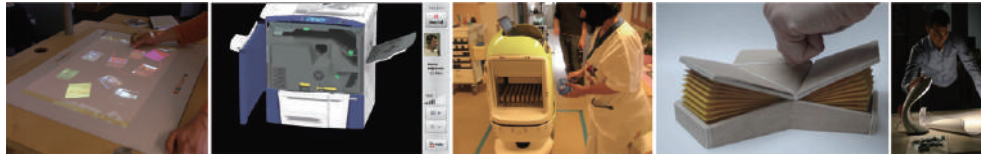


Figure 2.3. The research projects related to interaction qualities in the work context. From left to right: cabinet, troubleshooting system, robot worker, ‘knocking’ device and aesthetics lamp

The above examples seek, as an outcome, to explore how thinking of qualities can be used to enhance user product interactions. However, the designs do not enable users to clearly articulate the full intent of the specific users and interaction qualities. For example, it is not entirely sure whether the camera’s variable tangible interfaces are designed for novice, experienced, teenager or senior users, because different user groups have different behaviors and styles of interaction. The interaction qualities for each variation are not specified, and the criteria for assessing the designed interaction are missing. Rasmussen’s shape-changing communication device does evoke expressive quality, but it is not entirely convincing whether this creative interaction style can be accepted and adopted by all types of office workers. Office workers who use highly interactive devices often may find this device very expressive, yet other office workers may not experience this in the same way, they may even argue not to design such a device for them because they require a more formal communication style in an emergent situation. We envisages the potential to associate a specific group of office workers and interaction qualities with new ways of interacting, could enable future office tools and applications to develop. With this in mind, interaction qualities were explored that are currently experienced in the home and work context.

2.3.2 Method

A series of contextual interviews was conducted, aiming to identify the main interaction qualities that people currently experience while interacting with IT in both home and work context. Four interviews with ten office workers have taken place at four companies, which are SMEs, with the number of office workers varying from 10 to 100 employees. The interviews are ‘face-to-face encounters between a researcher and two or three informants at a time, directed towards understanding the informants’ perspectives on their lives, experience or situations as expressed in their own words’ [Taylor & Bogdan, 1998]. This definition underlines two essential characteristics: 1) it involves face-to-face interactions, 2) it seeks to understand the informants’ perspectives. Because we intended to obtain the data of user interactions, concerns and wishes in both the home and work context, the interviews consisted of ‘a joint inspection of the context, followed by a structured field interview’ [Paton, 2002].

2.3.3 Procedure

Each interview started with a 15-minute guided tour by the participants in their workplaces. Then the actual interview took place, which lasted about 45 minutes. The participants were asked to describe their daily activities in interacting with IT tools in both their home and work context. Each interview included six steps as described below:

1. Participants receive a set of pictures, which illustrate user product interactions. These pictures help evoke memories and trigger responses [Sleeswijk Visser et al., 2005], e.g., turning a car key to start the engine (see Figure 2.4).
2. The researcher asks the participants to select a number of pictures, which express their behaviors and interactions in life and work the best.
3. Participants use the words and the selected pictures to make collages in order to illustrate their personal experiences (see Figure 2.5).
4. The researcher collects stories and triggers discussion. Participants reflect on their experiences.
5. Participants cluster the collages in order to find categories of interactions.
6. Round up discussion and reflection.

Audio recordings were made of the interviews, which then later were transcribed. Photographs were also taken during the interviews. In addition, during the interviews, field notes were taken by the researcher to capture informal conversations and contextual observations.

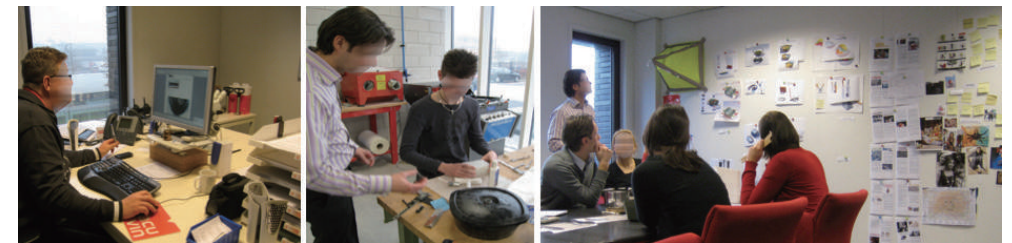


Figure 2.4. The interviews at the four companies with ten Generation Y office workers, including observations and inquiries



Figure 2.5. Making collages and clustering by the interviewed Generation Y office workers. Two of them even use a number of abstract tinkering objects and prototyped office tools, which enable them to scan and to upload receipts for reimbursement

2.3.4 Results and Analysis

Qualitative analysis started with all the data (transcripts, collages, field notes and visual materials) gathered in the interviews, followed by communicating the selected and distilled insights with two other researchers. First, each researcher individually read the transcript, marking possibly relevant quotes. For example, a quote reads like ‘for me, working in a software company means that you can basically work from any place that have Internet connection’. Secondly, the researchers consolidated the selection by turning about 150 quotes into explicit interpretations in the format of a statement card (Sanders & Stappers, 2012). Key part of the format was the interpretation (paraphrase), in which the researchers made explicit in their own words what the quote is saying. For example, an interpretation of the previous quote could be ‘Internet enables flexible working for me’. Finally, the researchers clustered these statement cards into manageable groups, which were labeled and described. The words and pictures from the collages were also clustered together with the statement cards to help describe the interpretations and convey insights.

2.3.5 Discussion

Based on the clustering of the statement cards and the findings above, we identified six key interaction qualities that together embody a style of interaction that we have labeled as ‘Generation Y’, referring loosely to the first generation of people (roughly born between 1980 and 2000) that have grown up as digital natives and who are currently starting to dominate the work place. These interaction qualities are as follows: Instant, Expressive, Playful, Collaborative, Responsive and Flexible. Table 2.1 describes the interaction qualities with specific examples (provided by the participants).

The six interaction qualities were sufficient to categorize the set of activities we found in the home and work context, and all six had value in giving direction to designers. They are a key set for this research, but not a complete set (e.g., the playful quality may extend to cheerful, engaging and passionate qualities) for reaching out every detailed aspect describing user-product interactions.

Qualities	Definition	Example
Instant	The interaction is experienced as immediate, spontaneous and on the spot	Dragging files into Dropbox to store and share timely
Playful	The interaction is experienced as engaging, enjoyable and challenging	Pulling down a list to update Tweets on a smart phone
Collaborative	The interaction is experienced as supportive, unifying and shared	Writing and commenting a paper in Google Docs online
Expressive	The interaction is experienced as open, free and animated	Shaking an iPhone to shuffle songs
Responsive	The interaction is experienced as alert, quick and reactive	Taping to wake up a device alertly
Flexible	The interaction is experienced as adaptable, accommodating and adjustable	Swing a Wii controller to play electronic games

Table 2.1. Generation Y interaction qualities, definitions and examples

In general, the participants described their working relations as very friendly, supportive and open. The main office tools were personal computers and mobile (smart) phones. Besides these digital tools, whiteboards, papers, notebooks and flip charts were also still considered important in their daily work. They put very high demands on the applications, services, devices and networks that enable and support life and work and clearly expressed that some (online) tools that assist them instantly and playfully in their private life were not available or did not meet their expectation in their work settings. For example, one participant said that ‘pulling down a list to updated Tweets on an iPhone is experienced very playful in my private life, but such interaction is not experienced in my work’. They stated that expressive communication channels were lacking at work, highlighting a significant friction in expectations versus reality, e.g., calling a colleague urgently without getting him/her notified about the urgency. One participant claimed that ‘shaking an iPhone to shuffle songs is very natural and animated. But I don’t feel I am in control at work yet. Now it is really only about work, nothing more. I would like to personalize it more’. Another participant said that ‘I like arranging things with a whiteboard at home. Although it’s chaotic, I exactly remember each bullet, each line, what it’s all about’. Flexible work styles, locations and patterns have changed the ways of working. This creates a better-connected, more responsive and increasingly complex work environment. Three participants related responsive to more user-product interaction aspects. For example, they found ‘tapping on the touchpad of a computer to wake it up alertly’ very responsive. Key trends are increasing the collaboration within virtual teams (geographically spread), the changing demand for flexible employment (in time and place) and the increased number of mobile workers. One participant said that ‘I use a laptop, a phone and a Google Docs application to create, store and share agenda... especially to share to do things within the company... where they grow faster than the time to think’. These office workers have much more choice in products or services that help them to do their work. They value efficient and emotional communications between people and information in their network. This gives direct and relevant insight and helps them run their business better. To them, information is the key to communicate and to deliver the best service. Considering these situations, future office tools need to take further steps to accommodate these new and evolving ways of interacting.

2.4 Demonstrating with the First Prototypes

Instead of giving a detailed description of Generation Y interaction qualities in words, a demonstration was more appropriate. From the interviews, we found that interactive communication channels are lacking in the work context, e.g., calling a colleague urgently without getting him/her instantly and expressively notified, the level of urgency is lacking. To accommodate and improve this situation, a series of preliminary prototypes were built, aiming to explore Generation Y interaction qualities and new ways of notifying people of an incoming event. This fitted in the research through design approach in this research. They were made meant for evocation and exploration. The context in this case was set in three urgency levels: 1) very urgent, 2) intermediate and 3) relax. This model was successfully

used for designing playful persuasive solutions about upcoming activities and was proved to work well for demonstrating interaction qualities (Romero et al., 2010). A number of effects were used to represent the desired interactions, such as light, sound, smell and fire, etc. Two of these prototypes are presented below. Max/MSP (2014) and Phidgets sensors (2014) were selected as development environments. These prototypes were attached to a computer using the MAX/MSP and Phidgets technology. Simple form was preferred because the intention was to explore interaction qualities, rather than aesthetics.

2.4.1 The Odor

The Odor demonstrates instant, playful and expressive interaction qualities. It is a stand-alone concept design that works with a computer interface. The device can be placed on desks in home or work context. When an incoming event occurs, it releases a colored water spray into the air. A red colored spray is smelly, it notifies a user that something urgent is happening that needs attention immediately. As an example, the spray notifies the user that he/she is asked to call his/her boss at work right away. A white colored spray has no smell, it notifies the user an event with intermediate urgency. A blue colored spray smells fragrant, it notifies the user of an unimportant event, which needs the least attention.

2.4.2 The Plate

The Plate demonstrates instant, expressive and responsive interaction qualities (see Figure 2.6). The device can be placed on desks or hung on walls in home or work context. When an incoming event occurs, it indicates lights and/or plays a sound. When red colored lights flash in high frequency companioned with a raspy sound, it notifies a user that something urgent is happening that needs attention immediately. After touching the device, the notification ceases responsively. When white colored lights flash in intermediate frequency companioned with a soft sound, it notifies the user an event with intermediate urgency. When blue colored lights flash in low frequency without any sound, it notifies the user with an unimportant event, which needs the least attention, e.g., a movie invitation. The user can ignore this notification and deal with it later.

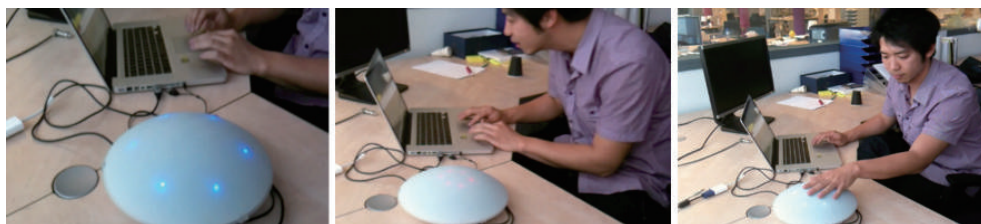


Figure 2.6. A user receives notifications in different urgency levels and ceases a notification by touching the device

2.4.3 Discussion

Two prototypes were presented to demonstrate Generation Y interaction qualities, which come to life in interaction design through the tight integration of a target user (group), information technology and a specific (work) context. These preliminary prototypes on their use, the way of interacting were tried out by ten colleagues and six students recruited from our university. During the try out, the interaction qualities (as in table 2.1) were introduced and the context of notifying people of an incoming event was verbally described. The computer triggered these interactive notifications on the Max/MSP application. The participants viewed and reacted on the notifications. Playful and expressive interaction qualities were experienced the best, e.g., 'getting an urgent notification through light and smell is emotional and natural, yet fun'. Twelve out of the sixteen participants felt the need to design user-product interactions by using interaction qualities.

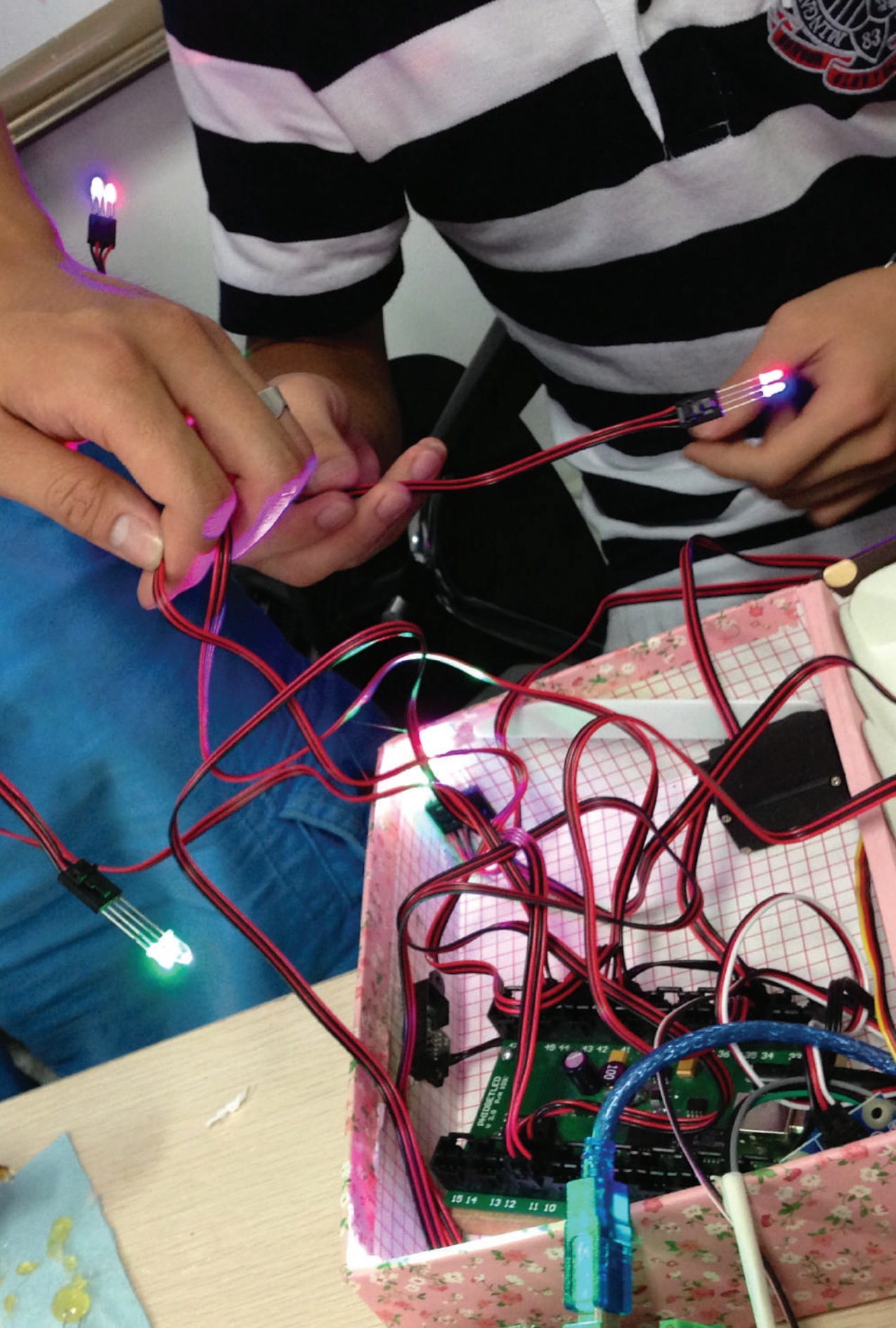
Since the research and design activities are intertwined in an iterative 'research through design' cycle (Stappers, 2012), more prototypes will be built and tested to explore interaction qualities and new styles of interaction, and more techniques will be applied such as sophisticated microchips and advanced electronic components. The next chapter presents these prototypes.

2.5 Conclusions

Six Generation Y interaction qualities (instant, expressive, playful, collaborative, responsive and flexible) have become a new component in the research framework to pull knowledge towards the center. These interaction qualities have been given concrete examples in the home and work context. Based on the quotes and the interpretations on the statement cards in the user studies, we got the impression that these interaction qualities might be experienced richer in the home context than the work context. In chapter 4, we validate this impression in a qualitative study comparing home and work situations. The interaction qualities will be used as guidance to design and assess user interactions in the home and work context in next studies.

We argue that to successfully support the generation of office workers that is currently entering the market, future office tools and services should embody rich interaction qualities. In order to make office work richer in interaction in the office context, we suggest transferring these interaction qualities from the home context to the work context. The design challenges lie in supporting Generation Y styles of interaction within the context of office work, developing office tools that support these new styles and studying how they could affect future ways of working. Future work will be carried on to determine how these challenges fit into a concrete work context in industrial practice. In the next chapter, the interaction qualities are used as guidance in design education.

► **CHAPTER 3:**
USING INTERACTION QUALITIES AS
AN APPROACH TO DEMONSTRATE
GENERATION Y STYLES OF INTERACTION



Research question 4 is central in this chapter: What are opportunities to design office tools or services that support Generation Y styles of interaction? This chapter explores how to use interaction qualities to guide the design of Generation Y styles of interaction by combining functional, experience and technology approaches. In an interactive prototyping course a number of interactive prototypes were built by students in which specific interaction qualities were explored and demonstrated. From designing, building and testing these prototypes, we learned to use interaction qualities explicitly to guide and constrain the design process. Interaction qualities were found to be able to integrate all three design approaches, and thus can be introduced as a new principle into design research and education.

This chapter is based on:

Liu, W., Stappers, P. J., Pasman, G., van der Helm, A., Aprile, W. & Keller, I. (2012). Interactive Pong: Exploring ways of user inputs through prototyping with sensors. Proceedings of the ACM 2012 conference on Ubiquitous computing [UbiComp]. New York: ACM Press.

Liu, W., Stappers, P. J., Pasman, G. & van der Helm, A. (2011). Demonstrating generation Y interactions through interactive prototyping. Proceedings of the ACM 2011 conference on Ubiquitous computing [UbiComp]. New York: ACM Press.

3.1 Introduction

In interaction design research and education, we often see that researchers, designers and students either go for: 1) a functional approach by creating product forms and running usability tests, 2) an experiential approach by applying storyboarding or role-playing techniques, or 3) a technological approach by bringing together sensors, actuators and displays and exploring what comes out. Each of these approaches has its strength and weaknesses. The functional approach has its strength in that it typically provides measurable success. It has a drawback that it takes a traditional and limited area of improvement [Chiang & Tomimatsu, 2011; Thomassen & Ozcan, 2010], e.g., improving usability of button pushing. The experiential approach has its strength in that it connects deeply to the user [Buxton, 2011; Sleeswijk Visser et al., 2005]. However, it also runs the risk of being very limited in developing concepts from ideas to real products and, as a consequence, we often see that designers and students do not get beyond concepts described in words, in associated images or in scenarios [Boess et al., 2007]. The technological approach has its strength in that it uses state-of-the-art developments in technology, but also runs the risk that the first sensor picked and the first program written are where the design ends up [Martin & Roehr, 2010], because the designers fixate on incremental tuning of the prototype and neglect looking for totally new directions.

We envisage using interaction qualities (as in 2.3.1) as design guidance and a new approach that can help researchers, designers and students to integrate functional design, experiential interactions and interactive technology. In a prototyping design course called interactive technology design in our university, ten research prototypes were built in which interaction qualities were explored. The students were asked to explore IT supported user-product interactions through learning the characteristics of different sensors and actuators, how to program them, and how to employ them in realizing engaging interactions. They had to focus on the experiential interaction qualities instead of programming details. The primary goal for the students was that it had to be a working demo and to be engaging for users. This is an interesting challenge that presents itself to educators, researchers, designers and developers. The research objective has been to explore how to use interaction qualities to guide interaction design, in order to try to pull functional, experiential and technological approaches together.

3.2 Research Setting

The interactive technology design [Aprile & van der Helm, 2011] is a course in the design for interaction master programme in our university. The course aims to equip students with design theory while gaining practical experience in the development of interactive prototypes, which utilize potentials of embedded interactive technology in products in terms of enriching user experience. Max/MSP [2014], Phidgets sensors [2014] and Arduino [2014] were selected as development environments. These tools make it possible to build experiential prototypes, even with students who have few electrical and programming skills.

In the spring semesters of 2010, 2011 and 2012, 50 students worked in teams of five on three design briefs concerning Generation Y styles of interaction in an office context. The six key interaction qualities (instant, playful, expressive, collaborative, responsive and flexible) identified in Chapter 2 were explored and used as design guidance. Table 2.1 describes the qualities with specific examples. The concept and prototype development involved a total of five phases. The first two phases focused on exploring conceptual possibilities and building initial prototypes by hacking existing products. The third phase aimed to nut-crack the hardest technological problems and further develop the concept to a mature level. The fourth phase involved users, while the last phase targeted on integrating user comments to finalize the prototypes.

3.3 Research Framework of this Study

Figure 3.1 shows the research framework of this study, which distinguishes three design approaches: functional approach, experiential approach and technological approach. On the intersections of these three approaches lie design opportunities we want to understand, explore and use. In three iterations of the interactive technology design courses, we tried to gain insights and experiences into building the coherence of keeping together of function, experience and technology by making use of interaction qualities. In the sections below, the design research activities are presented on the three approaches and their intersections.

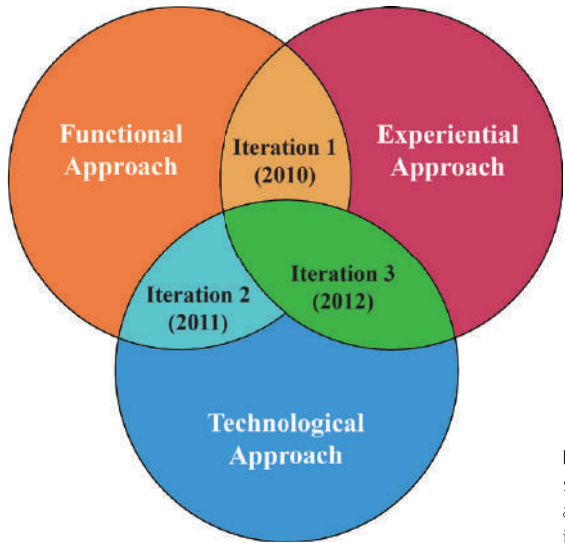


Figure 3.1. Research framework of this study. The aim is to understand, explore and use design opportunities on the intersections

3.4 Exploring the Work Context

In the first iteration in this course in 2010, the six interaction qualities (as in table 2.1) were not yet available from this research. This iteration especially focused on function

and experience. The design brief stated that each student team had to understand styles of interaction, to create a specific scenario in a work context and to design an interactive tangible product that visualizes Exact’s corporate identity and engages their employees and visitors in a collaborative activity. Exact is interested in learning about future office workers and implementing proper designs in their own services and products. Previous work (as in chapter 1 and in 2.2) was provided to the students to help them understand (office workers’) styles of interaction. Two visits to Exact were organized to give them an impression on understanding office work in a real-world setting. The student teams had to build prototypes, going through several rounds of conceptualizing and improvement. Table 3.1 shows how the work context, key technology (e.g., sensors) and key interactions were distributed over the student teams.

Prototype	Work Context	Key Technology	Key Interactions
One of Us	Hosting visitors	Adobe Director Distance sensor	Picking Switching
Spyglass	Learning departments and viewing blogs	Augmented reality Motion sensor	Swinging Clicking
Message in a Bottle	Improving social cohesion at lunch	Pressure sensor Light sensor	Sitting Speaking

Table 3.1. Distribution of the work context, key technology and key interactions over the three prototypes in the first iteration in 2010

3.4.1 One of Us

One of Us is an interactive video installation (see Figure 3.2) that aims to introduce the corporate identity in a natural, collaborative and innovative way by the people who work at Exact. Using the metaphor of the family portrait, the employees who play an important role in the installation, react according to the visitors’ actions. Three tangible objects, a telephone, a lamp and a table, are metaphors for communication, inspiration and collaboration. When a person gets close to the installation, the phone starts to ring until the visitor answers the call. From the other side of the line, a virtual employee tells about her/his own working experience at Exact. Visitors are invited to switch on the lamp to play a movie, which presents the international network of the company all over the world. A virtual employee invites visitors to take a seat. The employee starts to explain the corporate identity.

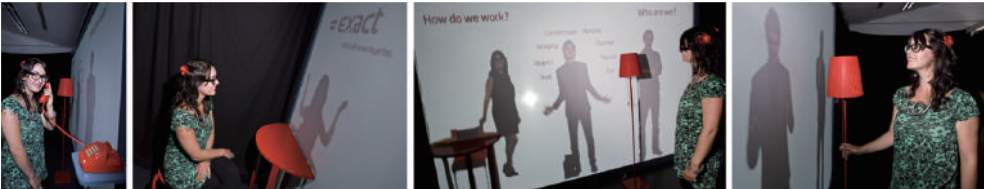


Figure 3.2. User tests of One of Us. A video scenario is available at: <http://goo.gl/qJkgzS>

3.4.2 Spyglass

Spyglass is a mediator between Exact employees and people visiting the company (see Figure 3.3). The visitors and the employees can experience the company building with augmented reality. The Spyglass breaks the reality into a second layer of information, which people can interact with. While exploring the building through the Spyglass, users can see and listen to the names of the departments with the employees, the frequently updated company blog with (voice) comments, the menu of the day in the canteen and other information.



Figure 3.3. User tests of Spyglass. A video scenario is available at: <http://goo.gl/1YJPSb>

3.4.3 Message in a Bottle

Message in a Bottle is a communication system that stands on a long table for the lunch area in the company building (see Figure 3.4). This system improves social cohesion in the company. The light from the bottles invites people to sit at linked places. In this way people will be placed randomly next to each other, without gaps in between. People can speak to each other, even if they sit far apart, by speaking through the bottles. Glowing light indicates the microphone and speakers are on. This happens on two spots randomly chosen by the system (it can recognize the spots which are occupied). So, the person on one spot is able to hear and speak to the person on the other spot without any initiative effort. If a person does not want to be part of the conversation, he or she has a chance to turn it off.



Figure 3.4. The setup, field trial and scenarios of Message in a Bottle. A video scenario is available at: <http://goo.gl/p5IQvY>

3.4.4 Design Insights

Three interactive prototypes were built, each demonstrating new ways of communicating in a work context. All prototypes tried to communicate corporate identity by engaging employees and visitors in collaborative activities with variant of user-product interactions. Technology was widely explored in this iteration. Technology was broadly explored. The students practiced prototyping skills (e.g., programming) and we gained teaching experiences. The results were more design visions made into prototypes than feasible designs. An important positive thing to say about this iteration was that it offered experience with the teaching format, of what to expect from the students, their base level performance, which helped in formulating the improved guidance and instruction in the later iterations. There was some demand from the course to feature interactivity and sensor technologies. The lack of interaction design guidance made the results difficult to be compared and summarized, e.g., in the course evaluation, the Spyglass team presented their prototype from the functional perspective more than from the interaction perspective. Studies on design guidance [as in 2.3] had to be done by the researchers before running this design course in the next iteration in 2011.

3.5 Exploring Interaction Qualities in a Work Context

In the second iteration in this course in 2011, understanding of the work context and the six Generation Y interaction qualities were available from this research. These interaction qualities were applied as leading, especially focusing on function and technology. The design brief stated that each student team had to focus on a pair of instant, playful and expressive interaction qualities, to create a specific scenario in a work context and to explore how these qualities could stimulate or facilitate new ways of working. To do so, the students had to build prototypes, going through several rounds of conceptualizing and improvement. Table 3.2 shows how the interaction qualities, the work context, key sensors (i.e., technology) and key interactions were distributed over the student teams.

Prototype	Interaction Qualities	Work Context	Key Sensors	Key Interactions
DropBall	Playful Expressive	Sharing digital files	RFID Force	Throwing Squeezing
Hermès	Instant Playful	Scheduling meetings	Light Switch	Pushing Turning
Permission Lamp	Playful Expressive	Reacting to meeting requests	Vibration Motor	Pushing Stroking

Table 3.2. Distribution of interaction qualities, the work context, key sensors and key interactions over the three prototypes in the second iteration in 2011

3.5.1 DropBall

DropBall is an explorative concept for fun and easy file transfer (see Figure 3.5). It was designed to demonstrate the playful and expressive interaction qualities. With DropBall

users can transfer files by throwing a physical and familiar object: a stress ball. Colleagues are encouraged to share digital files and links on this ball through an easy user interface. A squeeze in the ball triggers a desktop application to pop up, and while squeezing the ball the user can drag and drop files into the digital representation of the ball. Then they can pick out a colleague with they would like to share the information with, and throw the ball towards him/her. Once received, the colleague only needs to squeeze the ball to make the files appear on his screen, clearing the data ready for a subsequent use.



Figure 3.5. The use scenario of DropBall. A video scenario is available at: <http://goo.gl/oLUuNJ>

3.5.2 Hermès

Hermès is aimed at unobtrusively asking a colleague whether he is available for a short, unscheduled meeting (see Figure 3.6). It was designed to demonstrate the instant and playful interaction qualities. The sender can select a receiver from a personalized list of favorites by turning a selection ring. The ball that is pushed into Hermès conveys the request. At the colleague's Hermès, the ball pops up. The sender is displayed in the list of favorites on the selection ring. The colleague chooses to accept or reject the message. Consequently, Hermès gives positive or negative feedback to the sender by popping up the ball in different scales. It also instantly registers absence of the recipient and gives negative feedback in that case.

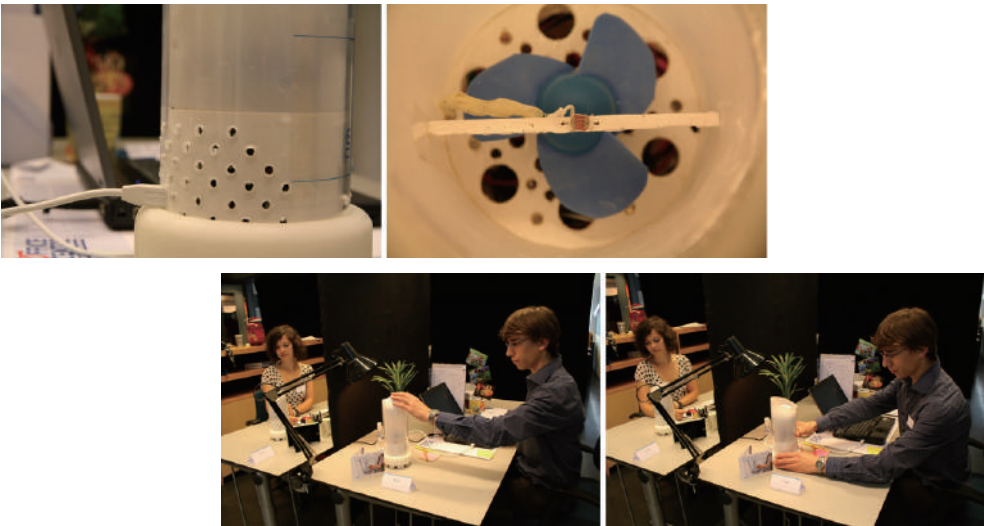


Figure 3.6. The design and field trial of Hermès. A video scenario is available at: <http://goo.gl/Zx1lkQ>

3.5.3 Permission Lamp

Permission Lamp is a desk lamp that assists colleagues to receive and respond to meeting requests (see Figure 3.7). It was designed to demonstrate the playful and expressive interaction qualities. When a request is received, a green light shines towards the user to notify him/her. The lamp provides the user with three ways to respond: 1) postponing the request by pushing the shade (head) of the lamp away, making the light dim. After a while the shade turns back towards the user, indicating that it still needs attention, 2) rejecting the request by pushing the shade of the lamp down to the desk, making the light turn red first, then turn off, it turns back to its neutral position with the green color and 3) accepting the request by stroking/petting the shade of the lamp. The light turns green and drops the shade submissively, followed by the lamp turning back to its neutral position with the green color.

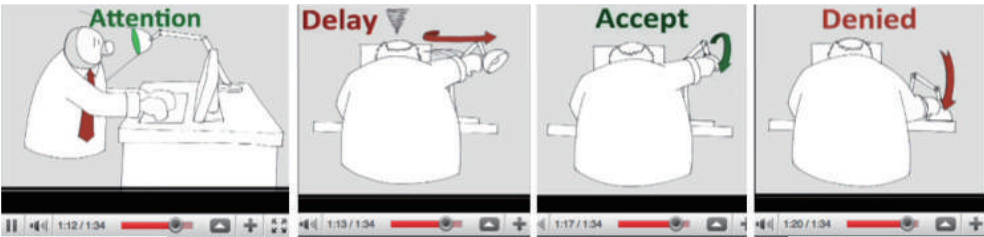


Figure 3.7. The user interactions of Permission Lamp. A video scenario is available at: <http://goo.gl/jhg8Be>

3.5.4 Design Insights

Three interactive prototypes were built and showed possible opportunities to design office tools or services that support Generation Y styles of interaction. Each demonstrating a pair of interaction qualities and novel user-product interactions, which could enable, support and affect new ways of working in office situations, e.g., physically ‘throwing’ information to colleagues. We found that the interaction qualities can be picked up, but in the learning experience of the students, the functional, experiential and technological approaches were still pulled very hard. It was difficult as the first iteration for the students to achieve all those goals together, e.g., in the early phase of development, the Hermès team cared about function more than interaction and the Permission Lamp team focused too much on applying advanced interactive technology.

User tests with office workers in a real company context were performed. Each team introduced their project background and concept, invited three to five office workers to experience their designs for about ten minutes and asked direct questions, such as ‘how do you compare the interactions and user experience of the new design with existing tools’. We found that the office workers agreed that the concepts were more engaging and tangible to interact with compared with the existing tools in office work. Further modifications were made to the prototypes, e.g., the DropBall team focused on personal files sharing instead of more generic file sharing, because the throwing action was considered as a more personal and playful way for sharing by the users. Based on the evaluation of the demonstrators,

a number of preliminary design guidelines to support Generation Y styles of interaction in the work context can be foreseen to drive the development of future office tools and applications:

- Future ways of working need to enable instant and expressive ways of user input interaction, such as squeeze, blow and stroke.
- User interactions in the work context need to express a playful interaction quality, and need to be easily recognized and performed.
- Future office applications need to support collaborative interactions and features, e.g., sharing and co-editing files simultaneously and in a collaborative way.

3.6 Exploring Interaction Qualities

In the third iteration in the course in 2012, the aim of the assignment was to focus on improving the interaction qualities for a given product or application. The classic computer game Pong was chosen as a vehicle to build interactive prototypes. It has a sufficiently simple required input, so broad explorations with technology are possible. The basic principles of Pong are easy, robust and iconic, which help in focusing on optimizing and tuning the interaction qualities rather than thinking up (and developing) a totally new principle. Moreover, the iconic game helps in attracting visitors and in explaining the setup and goal in seconds. The students were instructed to focus on designing tangible user inputs, instead of on screen interfaces. Each student team was given a pair of the six interaction qualities to create a specific scenario and to implement in their variant of Pong. A pair of qualities was assigned to each team. To do so, the students had to build prototypes, going through several rounds of conceptualizing and improvement. Table 3.3 shows how the interaction qualities, key sensors (i.e., technology) and key interactions were distributed over the student teams.

Prototype	Interaction Qualities	Key Sensors	Key Interactions
Space Ship	Instant Collaborative	Force Proximity	Blowing Thrusting
Pada	Expressive Flexible	2D Tracking Accelerometer	Intercepting Tilting
Jump & Balance	Expressive Collaborative	Distance Light	Jumping Stepping
Pirate Ship	Playful Responsive	Infrared Motion	Pumping Steering

Table 3.3. Distribution of interaction qualities, key sensors and key interactions over the four prototypes in the third iteration in 2012

3.6.1 Space Ship

Players fly two ships on a 2D map with obstacles (see Figure 3.8). The aim is to eliminate the opponent by taking the initiative to crash into him. It was designed to demonstrate the

instant and collaborative interaction qualities. A balancing board with thrust control was designed and built to fly one ship. Leaning left on the board turns the ship left and vice versa. Pulling a rope thrusts it upward. There is also an option for multiple players to join this side. These players get respectively a flame-thrower and a gravity gun to pick up and throw virtual objects. A Kinect is used to fly the other ship. The Kinect lets the player fly the ship around the map in a free style.



Figure 3.8. The use scenario and field trial of Space Ship. A video scenario is available at: <http://goo.gl/3mQtOI>

3.6.2 Pada

Pada is an audio game with bodily movement as input and music as output (see Figure 3.9). It was designed to demonstrate the expressive and flexible interaction qualities. By using headphones and spatial sound, two players hear the music moving through the environment. In order to pass the music to each other and get the game going, they need to intercept the music before it has passed. Players tilt their bodies and/or heads left and right to catch the position where music goes, in the mean time Pada measures their positions. These interactions involve whole body movements and convey guiding information.



Figure 3.9. The use scenario of Pada. A video scenario is available at: <http://goo.gl/wjNqCB>

3.6.3 Jump & Balance

The game is projected on the floor, which allows controlling the paddles to become a physical activity (see Figure 3.10). It was designed to demonstrate the expressive and collaborative interaction qualities. Four players are challenged to use special features (e.g., acceleration and vibration) in order to influence their opponents in a negative way. Controlling the paddles needs collaboration between two players as a team. One team controls the paddle by jumping on air pillows. The paddle reacts on the movements of the sensor by using air pressure. The other team controls the paddle by using a large balancing board. The paddle reacts on the height difference of the board.

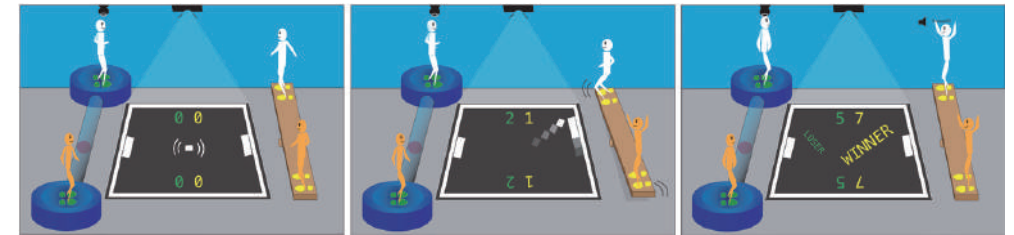


Figure 3.10. The use scenario of Jump & Balance. A video scenario is available at: <http://goo.gl/bJZFCR>

3.6.4 Pirate Ship

Two pirate ships represent the two paddles in the Pong game (see Figure 3.11). It was designed to demonstrate the playful and responsive interaction qualities. There are four set of user inputs: 1) pulling and releasing handle to attack the opponent, 2) dodging onto the platform to avoid cannonballs, 3) pumping air to repair the shortened paddle (Note: The paddle shortens when hit and also as time goes by), and 4) steering a steering wheel to move the paddle.

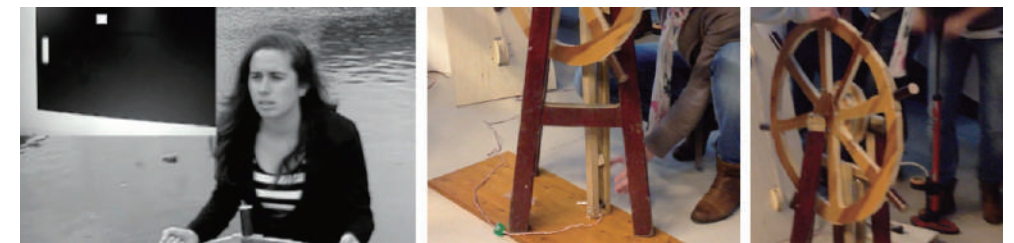


Figure 3.11. The design and use scenario of Pirate Ship. A video scenario is available at: <http://goo.gl/ig2oaP>

3.6.5 Design Insights

Four interactive prototypes on Pong were built. Each demonstrates a pair of interaction qualities and variant of styles of interaction. We focused on making the interaction qualities stand out. The students used sensor technologies to make user inputs physical and interactive, e.g., blowing and steering. We have chosen to drive design and demonstrate styles of interaction by choosing an interaction quality as aim, and then explore the use of function, experience and technology to support the chosen quality. The function, experience and technology depend on the chosen quality, rather than the other way around. The benefit is that the interaction qualities were given in the design brief and were dressed down the complexity of function, experience and technology to a very well known and basic structure, Pong. So that the students could get more freedom to focus their attention on achieving the qualities rather than chasing a gimmick or going into developing a new view of the office and then not being able to achieve a testable result. Pong was chosen because it would have simple, basic and rich game characteristics. It was proven to be so during this exercise. Within that narrow space of interactions, the center of the research framework forced to engage deeply with the interactions among function, experience and technology through exploring and using the interaction qualities. For example, the Pada team demonstrated the

expressive and flexible interaction qualities by minimizing user interface from computer screen to spatial sound, focusing on bodily interactions (e.g., running and intercepting) and implementing with adequate technology (e.g., 2D tracking sensors). The Space Ship team crossed the boundary of using the classical Pong and created their own. This design was still relevant because the students were asked to focus on exploring the instant and collaborative interaction qualities rather than keeping an identical game format. The Pirate Ship team struggled in the early phase of development. Their implementations did not bring the playful interaction quality well, because a steering wheel was literally used and it was only playful in its function. This team was then encouraged to explore its interaction to connect to the playful quality, e.g., spinning the wheel in different speed and frequency to accelerate the paddle.

3.7 Discussion

In the three iterations, we gave increasing design guidance with interaction qualities. In 2010 there were no interaction qualities mentioned because they were not available. In 2011 the interaction qualities were mentioned, but less visible in complexity of exercise (i.e., concept development). In 2012 the interaction qualities were prominently mentioned in the design brief, and were paid more attention by fixing the basic game concept to Pong. This helped us get a better view on how interaction qualities can work by having the students focus more explicit on designing interactions.

These iterations were done in an educational setting but not in a practice setting of commercial product development, because in the educational setting we can take control, pay attention to design interactions and structure the course as an exercise, which does not have to have full complexity and pressures of commercial reality. The students in the course are also treated as designers.

Functional, experiential and technological approaches are different. Each approach has its advantages and disadvantages. Designers may use the three approaches to go about in different ways in designing a product, e.g., a telephone. The functional way of designing a telephone would focus on product form and usability (i.e., a call has to be connected). The experiential way would focus on good user experience without caring about how to make the telephone work. The technological way would focus on bringing modern technology (e.g., multiple sensors) to make the telephone work well. Interaction qualities are a means to integrate the valuable contributions of the three approaches (i.e., applying appropriate technology to make the telephone work and to provide good user experience). This enables the students to use the interaction qualities in their design process and to give more explicit reflection on the value of the interaction qualities (given). The benefit allows the students to take the good parts of the three approaches and unite them. This is a way of creating an interaction vision (Pasman et al., 2011), which would help designers to design Generation Y type of things and interactions. By defining the level of interaction, interaction qualities can guide the design process.

3.8 Conclusions

From the experience in the three iterations of the design course, insights and experiences (as in 3.4.4, 3.5.4 and 3.6.5) into building the coherence of keeping together of function, experience and technology were gained by making use of interaction qualities. Interaction qualities were successfully applied to integrate functional design, experiential interactions and the use of interactive technology. Two valuable things are brought out. The first is bringing in interaction qualities explicitly to guide and constrain the design process. The advantage of using the interaction qualities approach is connecting all three design approaches (as in the intersections in Figure 3.1). The second is using this approach by applying a well-known concept (e.g., the game Pong) as a given for research projects, so that the interaction qualities of different design solutions can be compared and evaluated. Future work (as in chapter 4 and 5) is to further explore and use the interaction qualities in understanding and designing Generation Y interactions.

Acknowledgements

We would like to thank all students who participated in the interactive technology design course in the Design for Interaction master programme in 2010, 2011 and 2012.

► **CHAPTER 4:**
COMPARING INTERACTION QUALITIES
IN THE HOME AND WORK CONTEXT



Research question 3 is central in this chapter: How are interaction qualities experienced within the home and work context? This chapter adds to the design research community's notion of interaction qualities by exploring these new ways of interacting and comparing them in the home and work context. A series of contextual interviews conducted with office workers are described and analyzed to consider how they perceive, experience and compare interaction qualities. The six Generation Y interaction qualities (instant, expressive, playful, collaborative, responsive and flexible) were applied. The findings showed that playful, expressive and responsive types of interaction were mostly experienced in the more private home context, while collaborative type of interactions was mostly experienced in the more public work context. The office workers scored the interaction qualities in their home context as richer than in their work context. This study resulted in a set of design guidelines, aiming to be used to implement the Generation Y styles of interaction in future office tools and applications.

This chapter is based on:

Liu, W., Stappers, P. J., Pasman, G. & Taal-Fokker, J. [2013]. Making the office catch up: Exploring interaction qualities at home and at work. *ACM Interactions*. 20 (5), pp. 36-41. New York: ACM Press.

Liu, W., Pasman, G., Taal-Fokker, & J. Stappers, P. J. [2013]. Exploring 'generation Y' interactions at home and at work. *Journal of Cognition, technology & work*. London: Springer-Verlag.

4.1 Introduction

Information technology (IT) support of office work has increased rapidly in functionality, but new ways of interacting have evolved more slowly (see detailed description in chapter 1 and 2). An interesting challenge presents itself to researchers, designers and developers: How to bring the richness of the interactions that people currently experience in the private context of their homes and friends into the more formal context of their offices and colleagues? This research is an attempt to provide some insights and guidance to face this challenge.

We identified six key interaction qualities (instant, playful, collaborative, expressive, responsive and flexible) that make up for the newly defined Generation Y style of interaction. In a second series of contextual interviews presented in this chapter, the six interaction qualities are subsequently used to compare home and work context, and to identify opportunities for porting advantages from one to the other. The findings of this study are translated into a set of guidelines for designing future office tools and applications. The research objective has been to explore the differences between the home and work context for the six interaction qualities, and to find out the possible opportunities for enriching the interactions in the work context.

4.2 Method

To focus the interviews on the six interaction qualities, a generative interview toolkit (see Figure 4.1) was developed (Sleeswijk Visser et al., 2005). The interview toolkit was to serve two purposes: 1) prompting the participants to recall concrete experiences and to think about how they experience certain interactions and, related to that, 2) evoking the participants to make comparisons between the home and work context. Awareness and focus on ways of interacting was thus created which subsequently helped conducting the interviews and analyzing the user data afterwards.

A pilot version of the interview toolkit (see Figure 4.1) was first created, which consisted of a set of forty icon cards representing common IT supported tools, a board for each interaction quality, a legend to express the degree of interaction qualities and a clear comparison of the home and work context. With a number of office workers recruited from our university we tried out this toolkit on its use, the way of rating and the design of the boards. They received one board and two sets of the cards. They were asked to fill in each row with the same two IT tool cards. During the pilot, they made a selection of twenty-four IT tools, which they frequently experienced in the home and work context and felt the need to improve the current user interactions. After the pilot, we changed the cards from describing IT supported tools to IT supported activities. We decided to rate the same activity cards on the boards in the home and work context to see comparisons. We also made several improvements to the structure and graphic design of the boards, e.g., unifying scale for each interaction quality and adding text explanation on the scale. The results would be easier to interpret.



Figure 4.1. The boards and IT tool cards in the draft interview toolkit

The final interview toolkit, shown in Figure 4.2, consisted of 6 boards, each with sets of activity cards, a set of blank cards and a number of colored pens and post-its. Each set of activity cards contained two copies of each card. One for 'home' and one for 'work', depicting 24 IT-related activities most commonly performed in the home and work context. At the start of each interview, the participant was asked to arrange the activity cards according to the degree in which they felt that the interaction quality was experienced in that activity. One copy of the card was to be placed in the 'work' range above the 0-7 Likert scale [Likert, 1932] and the other copy in the 'home' range under the scale. The scale helped the participants compare the interaction qualities and discuss their experiences easily.

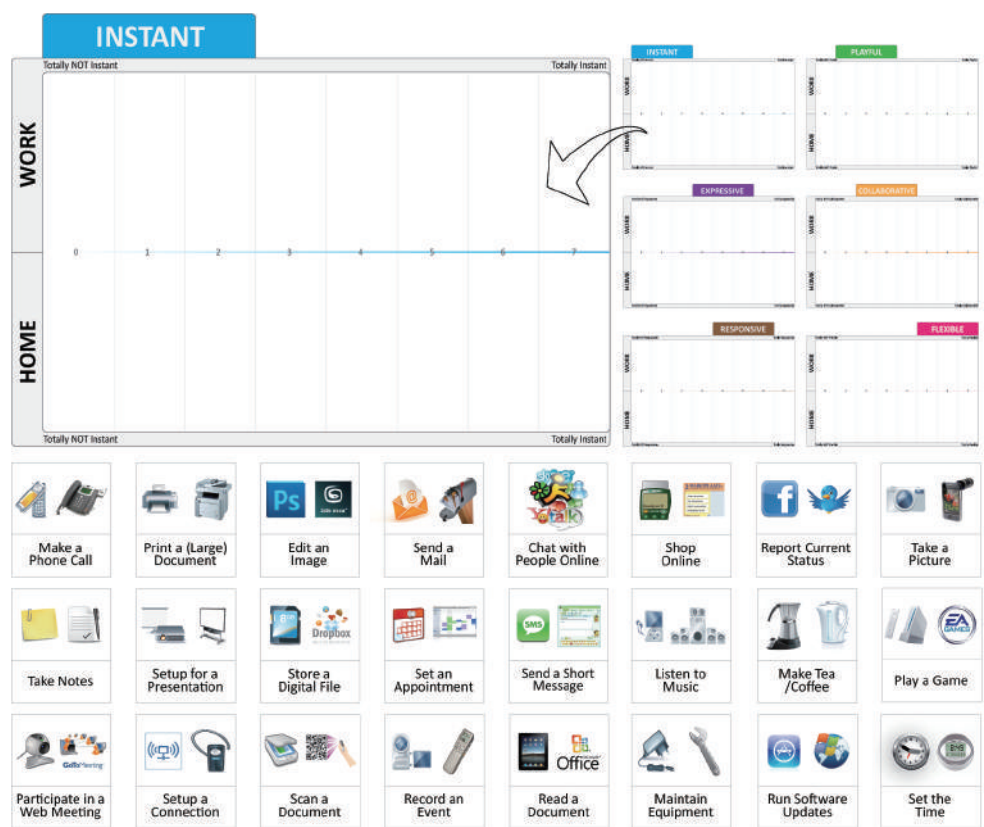


Figure 4.2. The boards and activity cards in the final interview toolkit. Figure 4.4 gives an impression on how a completed board would look like

4.3 Participants

The character of the study was explorative and qualitative, aimed at laying bare prominent relations, not a quantitative study aimed at proving a necessary hypothesis, a large number of participants was not required. For this, a small number of participants sufficed. Six participants were selected. They were young entrepreneurs, wholesalers, designers and

other office workers. They worked in companies of different sizes, varying from a two-man consultancy to companies over 100,000 employees, in order to sample a variety of the work context (Table 4.1).

Participant	Gender	Job Title	Company Type	Company Size
DC	Male	General Manager	Innovation Consultancy	1-10
JF	Female	Research Consultant	Design Consultancy	50-100
JD	Female	Research Associate	Medical Research Company	500-1000
MG	Female	Project Manager	Web Technology Company	10-20
DM	Male	Research Assistant	Well-Being Company	100-200
VR	Male	Software Developer	Software Company	1000-2000

Table 4.1. Participants and their work context

4.4 Procedure

Each interview was preceded by a 15-minute guided tour by the participant in his/her workplace. Then the interview took place, including the activity rating exercise and a reflective discussion, which lasted about one hour. The participants were asked to describe their daily activities and recall their experiences in interacting with IT tools (see Figure 4.3). During this they were encouraged to refer to their experiences in terms of the six interaction qualities. The actual interview included seven steps as described below:

1. Start with the first interaction quality (randomized per participant).
2. The researcher briefly introduces the definition of the quality (as in table 2.1).
3. The participant selects at least five activities from the card set, in which he/she feel this interaction quality is best represented in either home and/or work context.
4. If the participant finds activities are not in the presented card set, he/she is invited to create these on blank cards.
5. The participant arranges the activities on the board for both the home and work context. The position of the 0-7 scale rounded to a half number is taken as a score for that activity on that quality.
6. The participant discusses the rationales, reasons behind, expectations and suggestions, etc. He/she is asked to focus specifically on significant differences between the home and work context, and if he/she sees opportunities for porting qualities from one to the other.
7. Repeat with the other five interaction qualities.
8. Round up discussion and reflection.

All participants were asked to describe in words how they perceived the six interaction qualities (instant, expressive, playful, collaborative, responsive and flexible), and to indicate where and how they experienced these in the home and work context. Demands and wishes

for new ways of working were put on the boards as notes and sometimes drawings. Audio recordings were taken for the interviews, which then later were turned into transcripts. Photographs of the toolkit, the participants and their activities were also taken during the interviews. In addition, during the interviews, field notes were taken by the researcher to capture informal conversations and contextual observations.

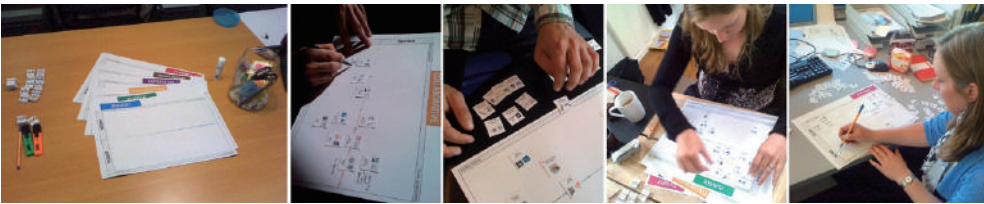


Figure 4.3. The participants arrange activity cards, rate interaction qualities and take notes with the interview toolkit

4.5 Results and Analysis

All participants completed the activity rating exercise. They were open and cooperative in showing their workplace, describing their daily activities and tools involved and explaining their ways of interacting in the home and work context.

In the guided tours, we found that the observations always supported the opinions that the participants expressed. All workplaces contained a diversity of tools requiring different ways of interacting. The computer, mouse, keyboard, printer, camera and mobile phone were the most frequently (i.e., everyday use) found IT tools in all workplaces. These tools varied in physical product design, thus the ways of interacting with them varied. For example, scrolling the wheel on a mouse was considered ‘the proper interaction’ (participant JF) to view a webpage, while sliding in papers and pressing on buttons on a printer led to get documents printed. We also found that the participants relied on ‘(laptop) computers to do daily work’ (participant JD). The computer was the central tool to interact with and was wired to other office tools, such as printer, scanner and other computers. Furthermore, software applications were also regarded as office tools. Online communicators (e.g., Skype) and social network websites (e.g., Twitter) helped the participants work besides the traditional applications, e.g., Microsoft Office. They functioned as communication tools in the work context. One out of the six participants, participant VR, used Exact Online and Synergy, software solutions from Exact, which are mostly used for administrative tasks such as placing travel requests and making reimbursements. He used Exact Online for one to two hours per day.

Six sets of completed interview boards (see Appendix A) served as a data pool for analysis as well as triggers for discussions between the researcher and the participants. The activity cards were rated and placed on the boards (see Appendix B), accompanied by notes and

drawings during the interview. About a dozen of new activities were created on the blank cards, e.g., setting a reminder and turning on a machine. An illustrative example is shown in Figure 4.4. Participant JD placed the activity icons in the home context far to the right, those in the work context to the left. This expresses that she rated the interaction quality ‘responsive’ in her home context higher than in her work context. For example, ‘editing an image’ scored 5 in the home context and scored 2 in the work context, ‘reporting current status’ scored 5.5 in the home context and scored 1.5 in the work context.

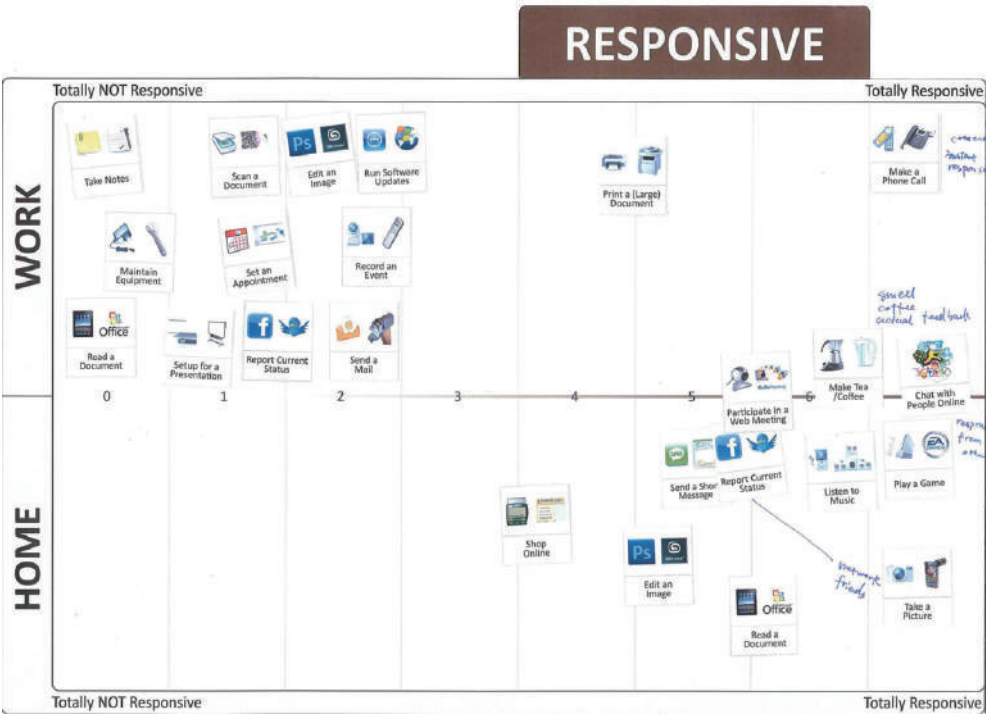


Figure 4.4. The completed board by participant JD, showing a comparison between the home and work context for the interaction quality ‘responsive’

The main function of the toolkit was to serve as triggers during the interview and in discussions among researchers in the qualitative analysis. In an interpretation session with three researchers, the transcripts were reformulated to nail down specific user interactions and to build a shared understanding among the researchers (see Figure 4.5). Transcripts, field notes, and the notes taken on the interview toolkit by the participants were used in the analysis. A team of three researchers selected interesting portions of the quotes. Each researcher first gave his own interpretation of a quote of a participant. Then, the team reviewed the interpretations, discussed possible conflicts and differences in perspectives and then agreed on a final interpretation. Interpreted quotes were gathered from all the interviews and clustered (Stappers, 2012).

1	TOI	INSTANT	Researcher 1	Researcher 2	Researcher 3	not etc.
1	1003	JF well, instant stands for fast, quick in common sense. I guess it should mean the same when you talk about interaction. The product behaves or reacts quickly after you touch it, right?	JF believes that instant stands for quick actions and reactions	JF seems to relate "instant" to the response time of a product, and, more specifically, to operating it by touch	She relates INSTANT to FAST, QUICK, not IMMEDIATE (or uses these terms interchangeably)	3
2	1010	JF the first thing I would like to do is to pick a blank card, ha. ... the least instant thing in my work is [getting contract signed], this takes weeks, I don't like it.	JF finds getting contract signed is time consuming	JF spends time on waiting	SIGNING A CONTRACT is the extreme waiting-for experience (anti-instant)	3
3	1013	JF ok. This is a lot easier. I start with ... taking photo. Taking photo [8] at work is not fun. For most of the time, I document my works, such as notes on a whiteboard, sketches to be sent as an email attachment. So the photos are formal. The activity itself is quite instant, because I always have a camera with me, ha. I put it in the middle.	JF is prepared for taking documentary photos at work	JF states her experience of taking pictures at work ++ ++ ++ ++ JF relates this experiences to the content of the photos. ++ JF does not address the interaction with the product, but its availability	Not fun: waiting/non-instant is annoying; ++ ++ TAKING A PHOTO is INSTANT, meaning the camera is always ready at hand	3
4	1015	JF oh, taking photos is a quick thing. But finding the camera and do the image settings take some time.	JF spends time on finding the camera and doing settings before taking photos	JF addresses the interaction with the camera	1: (cmp 1013) now GETTING THE CAMERA is non-instant; and settings; ++ ++ 2: she doesn't regard editing/sending as part of taking the photo	3
5						

Figure 4.5. Example of the transcript and interpretations by three researchers for the interaction quality 'instant'

The number of activity cards placed was noted down and the average scores were compared for each participant and each board. As indicated in the method section (as in 4.2), the main purpose of the cards was not to measure scores, but to evoke reflection on the interaction qualities and the differences between the home and work context, and to provide starting points for discussing the interaction qualities. Therefore, the average scores were explored for trends that led to discussion on these interaction qualities. The scores are rough measures for a small number of respondents, but illustrate a few differences.

4.6 Discussion

In general, activities in the home context required different ways of interacting, but involved more playful, expressive and responsive types of interactions (as in the observation results, the completed interview boards and the interpretations in 4.5), such as pulling down a list to update an app on an iPhone or punching fiercely with a Wii controller to play a boxing game. Instant communication was popular through use of the Internet and mobile technology, e.g., Skype and Twitter. The participants preferred this immediate way of communication with their family, friends and colleagues. Communication in a wider social network created opportunities for them to interact with a larger and more diverse group of virtual friends than they would meet face-to-face in the real home and work context.

The work context contained a larger diversity of activities, requiring different ways of interacting. Collaborative type of interactions was mostly experienced while interacting with the frequently found IT tools in the work context (as in the observation results, the

completed interview boards and the interpretations in 4.5), such as co-updating work schedules. The participants behaved more formal in the work context. They did not feel comfortable to perform large-scale body actions (e.g., jumping) in the work context. The computer, mouse, keyboard, printer, camera and mobile phone were the frequently found IT tools. These tools varied in physical product design, thus the ways of interacting with them varied as well. Also, conventional user actions were still frequently found. For example, scrolling a mouse wheel was considered 'the right interaction' (participant JF) to scroll up/down a webpage, while pressing buttons on a printer led to get documents printed. They relied on '(laptop) computers to do daily work' (participant JD). The computer was still the central tool to interact with and was wired to other office tools, e.g., printers, scanners and other computers. Online tools supported them at work beyond the traditional tools, e.g., the office telephone. They functioned as communication tools in office work.

Overall the participants scored the interaction qualities in their home context as higher than the interaction qualities they experienced in their work context. As mentioned above, the aim of this study was to discover possible patterns, not to prove general claims (which would require quantitative analysis and a substantially larger group of participants). The participants experienced the interactions in the home context as much more playful, expressive and responsive than in the work context. The wish of experiencing the same interaction qualities in the work context was also expressed. The participants desired switching modes between home and work tasks. They did switch these tasks at work, but they did not experience it as being a fluent way of switching tasks.

The most relevant interpretations of each interaction quality are described below. These interpretations come from the user data (e.g., transcripts) on the corresponding interview boards.

4.6.1 Instant

The participants related instant to 'time saving, immediacy, quick reactions and less response time'. Based on the locations on the boards and the interpretations from explanations in the transcripts, they experienced the interactions in the home context as almost equally 'instant' as in the work context. In the home context, mobile applications for online chatting (e.g., Skype) were used frequently. The interactions of dragging to send a photo in Skype and pressing on a remote controller to turn on the TV were experienced as instant, especially pressing and holding an icon on an iPod to arrange icons as very spontaneous. In the work context, they used Dropbox to store and share files, dragging files into Dropbox within a few mouse clicks so colleagues can reach these files immediately, which they felt as instant. Dropping files in Dropbox was evaluated as equivalent to physically dropping an object. They believed that their devices detect Wi-Fi environment and connect to the Internet automatically instant. Doing a lot of settings (e.g., logging in and switching accounts) before the actual web meeting was experienced not instant.

4.6.2 Playful

The participants related playful to ‘fun content, non-routine, non-boredom, freedom and surprise’. Based on the locations on the boards and the interpretations from explanations in the transcripts, they experienced the interactions in the home context as much more ‘playful’ than in the work context. In the home context, bodily and embodied ways of interaction were regarded as typical for enabling playfulness. They enjoyed sliding to unlock an iPhone and swinging a Wii controller to play a game. Participant JF found dancing while vacuum cleaning enjoyable and very physical. In the work context, transferring files from a memory stick to a computer made them feel bored and unchallenged. The button-pressing actions can eliminate playfulness at work, regarding work activities as functional and lacking of engaging interactions (e.g., multi-touch) compared with home activities. A case was participant VR, who found bodily interactions at work totally not playful, e.g., sending files and waiting for them to be printed.

4.6.3 Collaborative

The participants related collaborative to ‘team work, control and automation and degree of self-control’. Based on the locations on the boards and the interpretations from explanations in the transcripts, they experienced the interactions in the home context as less ‘collaborative’ than in the work context. In the home context, some of them did cooking, cleaning and online shopping together with their family members. Corresponding supportive interactions included passing plates in the kitchen, putting clothes into a washer and selecting a second hand car on a website, e.g., marktplaats.nl. Participant VR always teamed up with his girlfriend to play online games against other virtual players. They tiled wireless joysticks to accelerate to avoid hitting each other in a car racing game. In contrary, some activities require commitment so it cannot be shared, e.g., typing a pin code on a banking website to make a payment. In the work context, the functional qualities and interaction qualities may be confused by the participants. They experienced making Outlook appointments as unifying. They clicked time slots on screen-based interfaces to send and confirm appointments with colleagues from different time zones. Google Docs were used for co-creating documents and social networks were used for updating their work progress with colleagues. For example, participant MG created an online document, wrote the first section of her document, asked her colleagues to add review comments, and then she revised and continued writing the next section.

4.6.4 Expressive

The participants related expressive to ‘freedom of [input] choice, fluent and rapid response’. Based on the locations on the boards and the interpretations from explanations in the transcripts, they experienced the interactions in the home context as much more ‘expressive’ than in the work context. In the home context, they enjoyed making photograph albums by using their preferred camera settings. Sliding an espresso capsule gently into a coffee machine and tapping on its touch screen were experienced as animated, one form

of expressive. Tapping the multi-touch screens of mobile phone was preferred over mouse clicking on traditional computer monitors. Shaking an iPod to shuffle songs was experienced as very expressive. In the work context, open and free ways to do tasks were limited because the tools used were too ordinary and outdated. Work interactions were experience generally not inviting, because everyone did the same actions. They wanted to be expressive and unique when editing images. When using Adobe Photoshop, participant DM combined thumb and index fingers on his left hand to make shortcut commands while navigating the mouse by using his right hand.

4.6.5 Responsive

The participants related responsive to ‘directness of interaction, ability of access and not being blocked’. Based on the locations on the boards and the interpretations from explanations in the transcripts, they experienced the interactions in the home context as much more ‘responsive’ than in the work context. In the home context, dragging was experienced as a quick input action for attaching files to an email. They refreshed webpages by clicking on the ‘reload’ icon directly when the Internet connection was lost. Participant JD swiped her mobile phone screen to browse contacts fluently without being delayed. In the work context, a lot of interactions were experienced as not alert and reactive because they do not provide immediate feedback to give them confidence. For example, there was no confirmation or notification for successfully sending emails. They wished to have a positive sound feedback after successfully sending an email or storing a file. They also wished to have an interface that indicates waiting status when printing.

4.6.6 Flexible

The participants related flexible to ‘rules and limitations, availability and physical location’. Based on the locations on the boards and the interpretations from explanations in the transcripts, they experienced the interactions in the home context as more ‘flexible’ than in the work context. In the home context, digital reading and reading texts from their mobile phones were preferred. Participant MG tapped gently on an icon on her mobile phone to launch her reading application, swiped horizontally on the screen to flip pages, shook her phone vertically to change digital books and double-clicked on the ‘home’ button quickly to switch applications. Physical interfaces (e.g., mouse and joystick) for playing games were considered more adaptable and accommodating than the interfaces for office work. For example, the interaction with a Wii controller requires meaningful bodily engagement, but the interaction with a mouse only requires gentle clicking actions. They also had multiple means for sending emails (e.g., through webpages and mobile phones), which makes accessing and managing information flexible. In the work context, they experienced online chatting with colleagues limited because it was not adjustable. For example, sending a (voice) message from an office phone to an online chatting application was not possible. There was often only one way to do work activities. Participant JF even argued that running software updates gave her no choices but doing so.

4.7 Design Guidelines

The results from comparing the interaction qualities offered a rich source of experiences, anecdotes and routines on the ways of interacting in the home and work context. To make these results more instrumental, they were translated into a set of design guidelines based on the most relevant interpretations of each interaction quality described above. These guidelines can be subsequently used to implement the Generation Y style of interaction in future office tools and applications. Each design guideline contains information of one interaction quality in a specific work context, in order to make each interaction quality workable and meaningful for design.

In the interaction design literature, findings are often presented in the form of guidelines for designers. There are several lists of general guidelines [Borchers, 2001; Koskinen et al., 2011; Kumar, 2005; Pasman, 2003; Preece et al., 2007; Temkin, 2007]. Compared with these general design guidelines, the guidelines below specifically focus on supporting office workers to experience rich interaction qualities in the work context.

- **Use instant interactions to convey meaning** – designing instantness in an office context not only aims at increasing efficiency or effectiveness, but also at generating a sense of professionalism or importance. Interactions are not only experienced as quick and prompt, but also as constructive and solid as well. File transfer, for example, might be enhanced by providing feedback that also communicates the status, confidentiality or state of completion of the file or document.
- **Integrate playful interactions in low-attention office tasks** – playful interactions, such as the full-body movements people perform while operating the Wii, are highly valued within the home context, since they evoke fun, pleasantness and engagement. Within the office context, however, playfulness needs to be designed to fit the context of use [Kumar et al., 2013] rather than being the dominant interaction quality. By adding small playful interactions to low-attention office tasks, such as entering numerical data or browsing emails, the monotony and repetition of such tasks could be influenced in subtle, yet meaningful ways.
- **Integrate collaborative interactions into office teamwork to strengthen the connectedness of the team** – doing things together is a very important element in establishing and strengthening a bond between people. Especially in games many strategies have been implemented that require people to collaborate to achieve certain goals [Kumar et al., 2013]. The recent introduction of multi-touch tablets and tabletops, with their interactive surfaces and simultaneous multiple user inputs, has provided designers with a new pallet of interactions that require group processing, social skills and physical coordination. Office work, however, even when done in teams, is still designed around the single-user, single-computer paradigm. Designing interactions that would require the simultaneous input and collaboration of more than one person at the same time could therefore contribute to a team's cohesion.

- **Integrate expressive interactions into regular office tasks** – many office tasks involve small, rigid and subconscious interactions, such as button pressing or mouse scrolling, that leave little to no room for expressiveness. Providing opportunities to make these interactions more animated could give office workers the possibility to communicate certain emotions or intentions, such as affection, urgency or frustration, in subtle and implicit ways, thus adding meaning to otherwise identical and repetitive tasks.
- **Make office tools and systems more (emotionally) responsive** – responsiveness characterizes a tool's or system's behavior during an interaction with a user. The tool or system is responsive if its behavior adapts itself to the behavior of the user. More specifically, it is emotionally responsive when it is able to adapt to his or her emotional expressions. Emotional expressions are the non-verbal behaviors that signal emotions, e.g., smiling, laughing, sighing and soft voice tone. Using sensing technology expressions could be measured and translated subsequently into responsive interactions. For example, the expressiveness of typing an email (see previous guideline) might be an indication of importance, anger or affection, to which the system might react by changing the responsiveness of the keys on the keyboard.
- **Allow for flexibility while interacting to overcome physical limitations of the workspace** – Services need to offer the office worker many possibilities to easily access, store and display work content of various kinds. The interaction therefore possesses a highly flexible character, enabling the office worker to fully concentrate on the information flow from colleagues, which makes up the work content. Besides, customization of services is highly appreciated in office work. The customized interaction need to allow the office worker to set personal preferences in a high degree, e.g., customizing settings and reorganizing the interface.

4.8 Visions of Future Ways of Working

Several short scenarios were created to illustrate how the design guidelines could have implications for designing future office services. First, situations occurring in office work were described in current scenarios. Then, new ways of interacting were described in visionary scenarios, in which the relevant design guidelines were applied. In addition, the interactions and workflow were further explored in visual storyboards. Below are the scenarios and storyboards:

4.8.1 Making a Phone Call

- **Current Scenario** – Y1 experiences a limitation related to use his desk phone in office. Without knowing the availability of his colleagues, he dials numbers instead of persons on the phone. During the calling process, his ear is stuck to the phone all the time and he cannot see the body language from the person he is talking to. He feels at a distance and unable to express himself.

- **Visionary Scenario** - Y1 is about to call his colleague from a desk phone in the office (see Figure 4.6). In the dialing process, he is presented an availability overview. During the calling process, he receives visual feedback on his colleague's mood. The call is able to roam between devices, from desk phone to mobile phone or online communicators (e.g., Skype), which enables him to continue the conversation flexibly without interrupting the phone call. When roaming the call to online communicators, he frees up his hands and works with his colleagues collaboratively to transfer digital files. He is also presented an option for switching styles of interaction between informal (personal) and formal (serious) calls, e.g., squeezing the horn hard to indicate his boss that this call is important.



Figure 4.6. The visionary scenario of making a phone call

4.8.2 Setting Up a Connection

- **Current Scenario** - Y2 encounters a limitation with a Wi-Fi connection that could not recognize her device as expected. A pop-up dialogue indicates her to enter username and password, which is too complex to remember. So she fails to connect to the Internet. She encounters this problem every time she starts her computer. She feels restricted to the technical and non-playful rules. She would like the machine to provide human conversations, e.g., Apple Siri (Apple, 2014).
- **Visionary Scenario** - Y2 enters a new Wi-Fi environment (see Figure 4.7). During the setup process, she is presented options for performing expressive gestures or register her fingerprint to get recognized in the Wi-Fi environment, instead of entering a complex password. She finds this interaction playful. She gets a responsive and positive feedback after successfully setting up the connection. Her device connects to the same Wi-Fi environment automatically the next time.

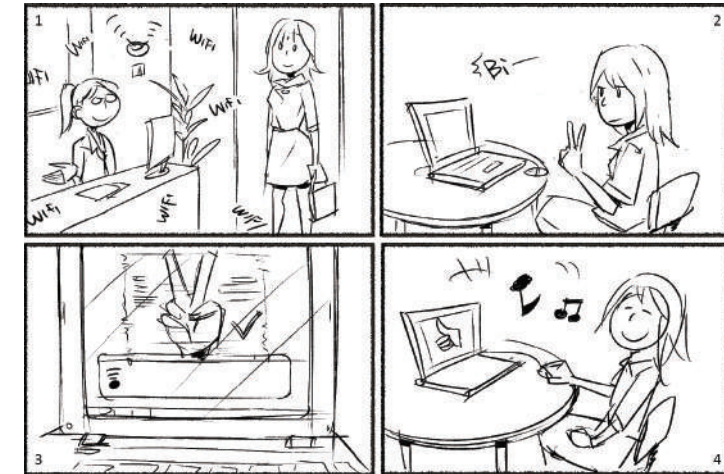


Figure 4.7. The visionary scenario of setting up a connection

4.8.3 Printing a Document

- **Current Scenario** - Y3 sends her file to the printer from her computer. The printer starts working. During the printing process, she has nothing to do except waiting. In addition, she doesn't receive any feedback and indication of the printing (waiting) status. She spends 10 minutes standing besides the printer, she feels bored. She would like the system to be instant and responsive.
- **Visionary Scenario** - Y3 is about to print a file (see Figure 4.8). After successfully sending the file, she is indicated about the printing status without going to the printer. The indication shows the time spent and left, the current file being printed, etc. During the printing process, she can also adjust the printing speed, quality and order. She is indicated timely when her printings are completed.

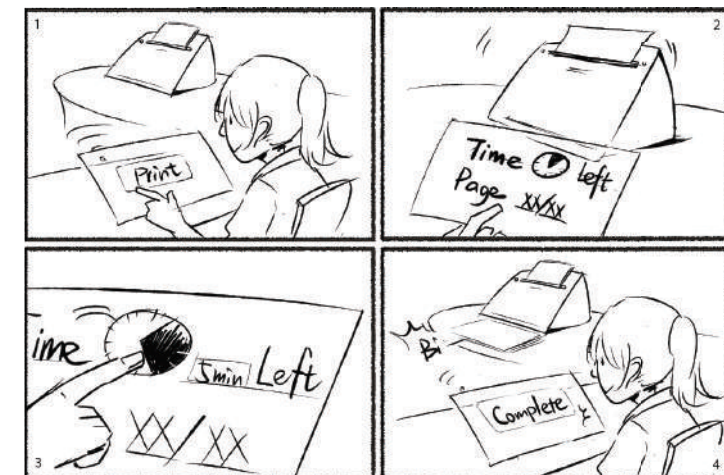


Figure 4.8. The visionary scenario for printing a document

4.8.4 Running Software Update

- **Current Scenario** - Y4 concentrates on her work while she receives a notification on an interface that a piece of software needs to be updated. She decides to stay concentrated on her work and postpones the update. The notification pops up again every five minutes. She feels bothered.
- **Visionary Scenario** - Y4 concentrates on her work while she receives a notification on an interface that a piece of software needs to be updated (see Figure 4.9). She launches the notification interface. At the same time, her agenda interface launches automatically. She selects a convenient time on her agenda to run the update. An audio and visual feedback confirms her selection. Then the notification interface turns into an inactive mode. When it comes to the selected time, the system runs the update itself.

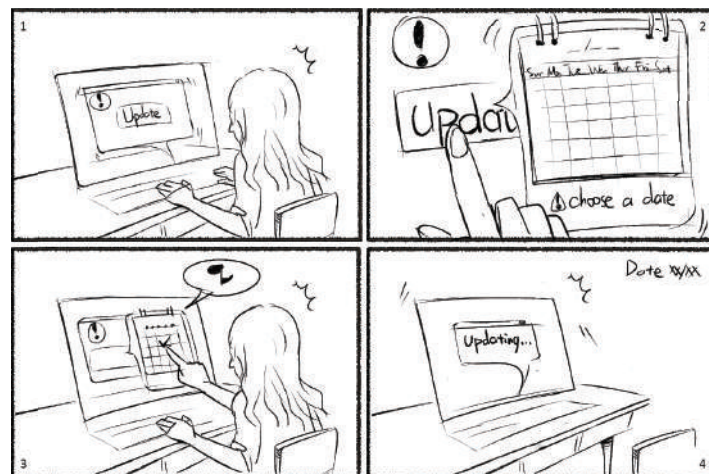


Figure 4.9. The visionary scenario for running software update

4.8.5 Taking Notes

- **Current Scenario** - Y5 writes down several notes on paper. When reviewing the notes, he re-writes them again to prioritize and categorize them. He also leaves one note to his colleagues, but they couldn't read his handwriting.
- **Visionary Scenario** - Y5 is about to note down tasks to do for the next week (see Figure 4.10). He speaks to a device to get his notes taken, while he performs expressive gestures to prioritize them and categorize them into home and work context. By performing the gestures, he can also set the notes private or public, and share them with family and/or colleagues instantly.



Figure 4.10. The visionary scenario for taking notes

4.8.6 Sending an Email

- **Current Scenario** - Y6 creates an email. First, he enters recipients and a subject. Secondly, he enters text and adds attachments. Finally, he clicks on the 'send' button to send the email.
- **Visionary Scenario** - Y6 creates an email (see Figure 4.11). According to the recipients' account information, the system separates private and work emails automatically. During the process of composing the email body, a meaningful subject is automatically given, and profile pictures of the recipients are shown. When he is about to send the email, he is presented options for sharing his context, e.g., location and availability.

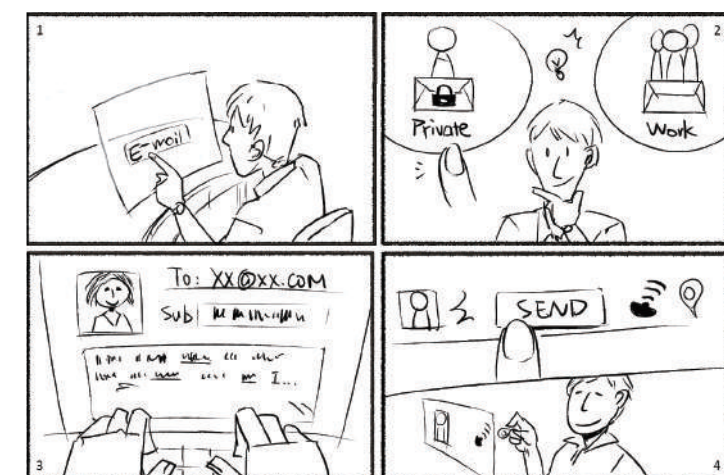


Figure 4.11. The visionary scenario for sending a mail

4.9 Conclusions

We have conducted interview studies on the ways of interacting with IT tools in the home and work context. The goals were to find out differences between the home and work context for the qualities and to classify possible opportunities for enriching the interactions in the work context. The design challenges lie in supporting Generation Y styles of interaction within the context of office work.

The contribution to the existing body of knowledge is to draw attention to IT supported new ways of interacting (e.g., dragging digital files to Dropbox folders to share online) that are currently emerging from organizing, mixing and separating private life and public work. Six interaction qualities (instant, expressive, playful, collaborative, responsive and flexible), together defining Generation Y styles of interaction, were used as criteria to assess and compare the experience of user interactions in the home and work context, which resulted in a set of design guidelines for supporting Generation Y interactions. These design guidelines could be appropriate in designing other products in other contexts, e.g., interactive applications, tools and services at the airport, in the hospital or in the amusement park. Six guidelines were sufficient to categorize the set of workable and meaningful interactions in designing future office tools and applications, and all six had some value in giving direction to designers. They are helpful to guide designers to transfer the rich interactions from the home context to the work context, but not a complete set for reaching out every detailed aspect defining and describing interactions. Based on the locations on the boards and the interpretations from explanations in the transcripts from the interview results, the four qualities playful, expressive, responsive and flexible seem to give the best opportunity for improvement for the work context. These interaction qualities will thus be more worthwhile to investigate in the future research.

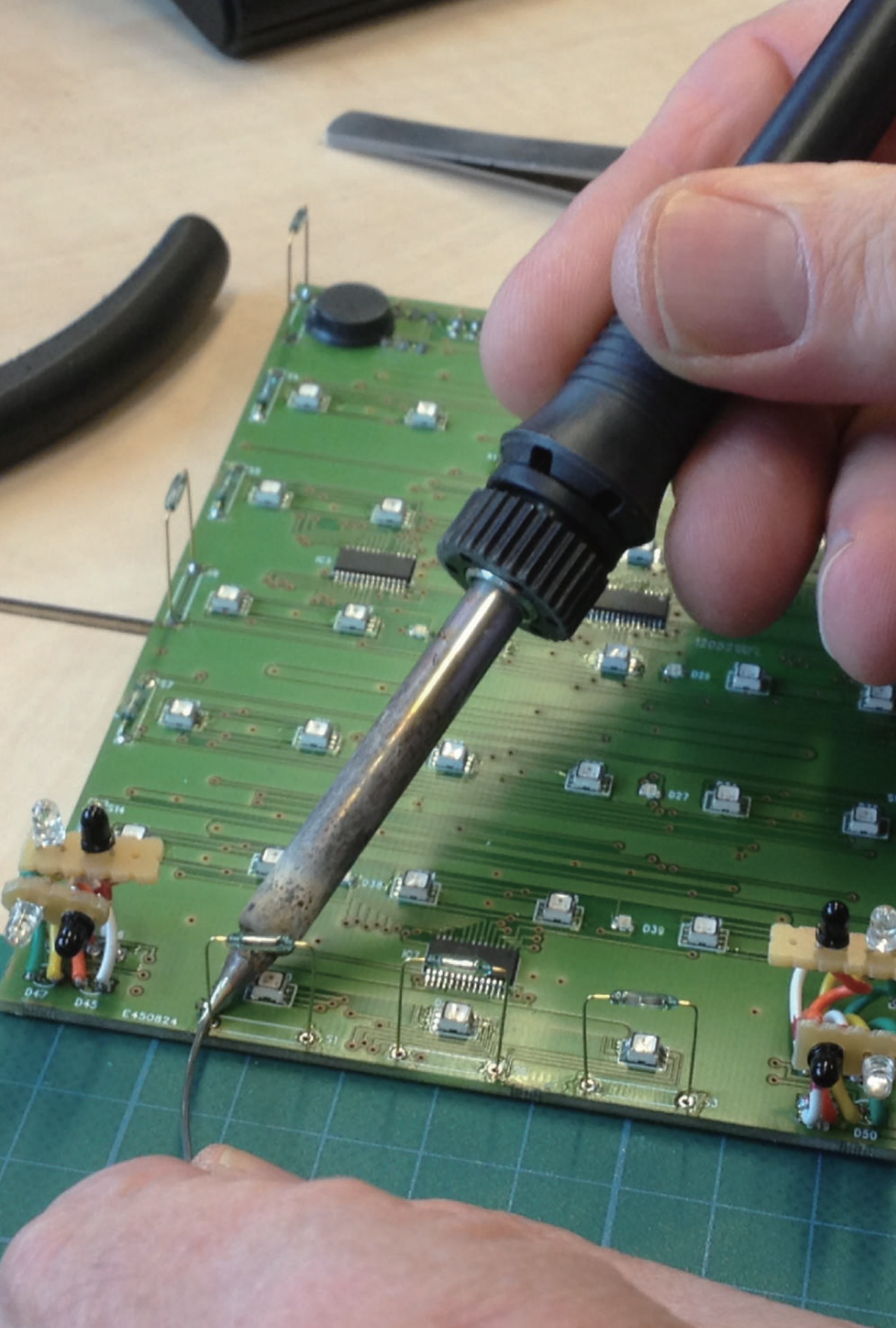
This research follows that of Frens (2006), Locher (2010) and Ross and Wensveen (2010) in discussing the idea that rich interaction (i.e., a concept that comes to life in interactive products through the tight integration of form, function and interaction) and aesthetics of behaviors in interaction (i.e., the use of aesthetic experience as a design mechanism) are two key criteria for designing intelligent products and systems. The use of interaction qualities could be an addition to these two ways for designing new ways of interacting. However, the perspective in this research on doing interaction design differs from just integrating factors of form, function and aesthetics. This research has a strong focus on studying the target users and meeting their wishes in the early phase of design. Because its findings have implications on the development of the future office services, it is recommended to utilize the power and advantages of the interaction qualities approach. The six interaction qualities together, with their corresponding guidelines, hopefully will offer designers a new perspective for designing new user interactions in the work context. Implementing them successfully, however, does require a better understanding of the meaning of the identified interaction qualities within the office context. What exactly is

playful or expressive in a business setting, and how does this translate into the experiential qualities of an interaction, such as feedback, fluentness, or resistance? Future work (as in chapter 5 and 6) will therefore involve applying the design guidelines to the development of a new office tool and subsequently evaluating this tool in an actual office context. This tool will demonstrate how the design guidelines can be used and also serve to assess how well the design guidelines can contribute to the future of office work.

Acknowledgements

We would like to thank all the participants who have taken their time to provide us with an insight in their ways of interacting in their home and work activities.

► **CHAPTER 5:**
DESIGNING INTERACTION QUALITIES



Research question 4 is central in this chapter: What are opportunities to design office tools or services that support Generation Y styles of interaction? This chapter presents the design process and resulting prototypes of a novel office phone, based on Generation Y interaction qualities and design guidelines formulated in the previous chapters. Taking the knowledge and experience from the previous study on interaction qualities in the home and work contexts, the goal is to bring Generation Y behavior, information technology (IT) and the work context together in a series of working prototypes. The perspective of the designer and builder of product services and interactions were taken. People were put in a work situation, user interactions were learned and a working prototype called YPhone was created. Section 5.1 of this chapter recapitulates the main findings in the interview study from a design perspective. Section 5.2 explains the research objectives. Section 5.3 describes the research approach. Section 5.4 describes the design process, which is highly iterative, involving user studies, play-acting, prototyping, evaluating and creating new prototypes. Section 5.5 specifies the design of YPhone.

This chapter is based on:

Liu, W., Stappers, P. J., Pasman, G. & Taal-Fokker, J. (2013). Designing generation Y interaction by eliciting interaction qualities. Proceedings of the ACM SIGCHI conference on Ubiquitous computing (UbiComp). New York: ACM Press.

Liu, W., Stappers, P. J., Pasman, G. & Taal-Fokker, J. (2013). YPhone: Applying generation Y interactions into an office context. Proceedings of the ACM SIGCHI conference on Computer supported cooperative work (CSCW). New York: ACM Press.

5.1 Introduction

The six interaction qualities (as in table 2.1) that were identified for Generation Y in the previous work were used as guidance to design and assess the user interactions of new office phones. Generation Y office workers experienced the interaction qualities in their home context as generally richer than the interactions in their work context. These findings have implications on the development of the future office tools is recommended to utilize the power and advantages of the interaction qualities, yet integrate the rich interaction qualities from the home context to the work context. A set of design guidelines (as in 4.7) was found based on comparing the interaction qualities in the home and work context. They will be used to design and assess the user interactions of new office tools.

This study aims to support Generation Y styles of interaction into the work context, making the office catch up with the richness of interaction that is experienced in the home context. An office phone was chosen as a vehicle to apply the design guidelines. Phones are widely and frequently used in office work and often have a complex user interface, so broad explorations on user interactions are possible. Improving the efficiency of communication, however, not an explicit aim. The prototypes of the office phone design aim to elicit specific interaction qualities and to demonstrate how Generation Y styles of interaction can support future office work. They also aim to support Generation Y office managers in experiencing rich interaction qualities over time (e.g., a week), enabling them to gain insights and inspiration in new ways of working. These prototypes need to function at an experiential level. They need to be technically robust, easy to use, stable, self-explanatory and pleasurable enough to be exposed to the real work context for assessment purposes. Technology does not have to be fully embedded, as long as it does not interfere with the designed interactions. The physical shape, material, detailing and finishing of the prototypes need to suggest a finished product, insuring users believe they are interacting with a real office phone. A research through design approach (as in 1.3) was applied in this study for designing experiential office phone prototypes, which are used as research means to demonstrate and explore these theories.

In this study the target users were referred to as Generation Y office workers, and more specifically Generation Y office managers. This helped narrow down design tasks to a focused set of user needs and helped have less variability in the evaluation of the prototype in the next chapter. These office managers are multi-taskers who handle a variety of administrative activities in the work context. They often experience a high frequency of interacting with office tools, e.g., the office phone. They grew up with the Generation Y styles of interaction at home, and would more easily recognize and be able to give feedback on the potential of the interaction qualities for the office phone, whereas Generation X managers would be less open to the new styles of interaction. Note: If a new design becomes standard office equipment, they will be users too and would adapt to new user-product interactions.

5.2 Design Process

The research through design process for consists of the following steps, involving user studies, conceptualizing, prototyping, evaluating and creating new prototypes (Kumar, 2005; Koskinen et al., 2011). This section treats these steps for the YPhone design. First of all, it begins this section with how the target users were involved in the design process. In the second place, it expands on the explorations of interaction qualities that influence the design of YPhone. Finally, it ends with the different conceptual prototypes that lead up to the final prototype called YPhone.

5.2.1 User Observation

The purpose of these observations was to learn more about user needs regarding a specific product (i.e., the office phone) in the office context in order to make the design guidelines more specific (as in table 5.2). It is important to empathize with and take the perspective of the target user (Laurel, 2003). Two so-called 'non-participant observations' were conducted (see Figure 5.1). This is a specific type of observation in which the researchers do not get involved in the activities but remain passive observers, watching and listening to the target users' activities and drawing conclusions from this (Kumar, 2005). One observation was conducted with three office managers at a HR office at the Delft University of Technology. The other observation was conducted at Exact with two office managers and the customer support team with about twelve people. The reason why we decided to observe the customer support team at Exact was that they experience a high frequency of using office phones. Each observation took about six hours in two working days. The participants were asked to keep their styles of interaction with office tools and people the same as in their daily activities. Field notes were taken, focusing on describing experiences in interacting with office phones and referring to the interaction qualities whenever appropriate. Table 5.1 shows typical field notes as the observation results. These field notes were assigned to the interaction qualities according to their description and by the researcher.

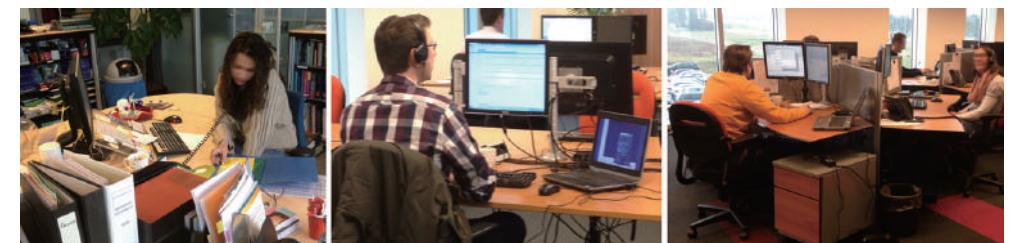


Figure 5.1. The participants and their interactions with their office phones. From left to right: taking notes on a paper while holding the earphone by shoulder, calling from a screen-based simulator interface and working in a group of three people in a triangular setup

Qualities	Field Notes
Instant	<ul style="list-style-type: none"> Stretch to put the horn back after ending a call Press a button to activate the hands-free function Wear an earphone all the time, even when not making phone calls Compared with the office managers, the support team always pick up phone calls within 3 ringtones and have a long conversation period, e.g., longer than 10 minutes
Playful	Note: Based on observation, playfulness with office phones in the work context was not found.
Collaborative	<ul style="list-style-type: none"> Talk to colleagues very often in the same office Talk to the phone while talking to other office managers to inquire information Borrow the usb earphone from colleagues Experience a neither quiet nor noisy work environment Sit in a group of 4 people in a square setup (the support team) Influence each other when speaking loudly
Expressive	<ul style="list-style-type: none"> Tap gently on the dial pad when dialing an ordinary call Tap rashly on the dial pad when dial a urgent call Dedicate the laptop screen to display the phone simulator, while connect the laptop to a monitor to display work stuff Perform limited user actions with office phones and other office tools, e.g., pushing buttons
Responsive	<ul style="list-style-type: none"> Activate the hands-free function, dial a number, pick the earphone up until the call get's connected Do not know the caller and the context when the phone display shows a number Talk to the phone while people wait in front of them Ignore an incoming SMS on private phones until the current task is completed, e.g., typing a sentence in the MS Word application Only pay attention to office phones when interacting with them Are always busy when people stand in front of their desks
Flexible	<ul style="list-style-type: none"> Type keyboards while talking to the phone Take phone calls while checking notes on paper and calendar on computer monitor(s) Tap on a button on the phone to answer a call from another desk Place the phone next to computer monitor and keyboard Hold the horn and walk within a limited distance to find support, e.g., a pen Use laptop computer as a medium to call, e.g., using a phone simulator interface Use mouse to dial on the simulator interface Feel (the size of) the phone is too big to be relocated on other spots on the work desk Free hands by using earphone or the phone simulator on computer monitor(s) Are used to sit with a table full of cables, e.g., phone and computer cables Treat office phones as a separate communication tool from other office tools, e.g., online messenger

Table 5.1. The typical field notes categorized by the interaction qualities. Many notes describe situations that interaction qualities are not experienced

Collages

To understand what cause the styles of interaction noted in table 5.1, the office managers were asked to make collages (see Figure 5.2 for one example). Six collages were made. Collage making is a design technique typically used in the early phase of design. A collage combines images to create a provoking experience, which can hardly be described in words only and are rarely based on words only [Tufte, 1997; Muller, 2001]. They depict what interactions this type of office managers are experiencing when using their office phones, what interactions they are trying to replace or improve, and what the dreamed solutions are to achieve and explore possible design directions. These office managers treated office

phones as a regular office tool, which is designed with insufficient technologies developed today in their opinions. They evaluated sharing, awareness and communication important when interacting with their office phones. We found that their wish of having the rich interactions experienced in the home context, e.g., swiping to scroll phonebook on an iPhone.

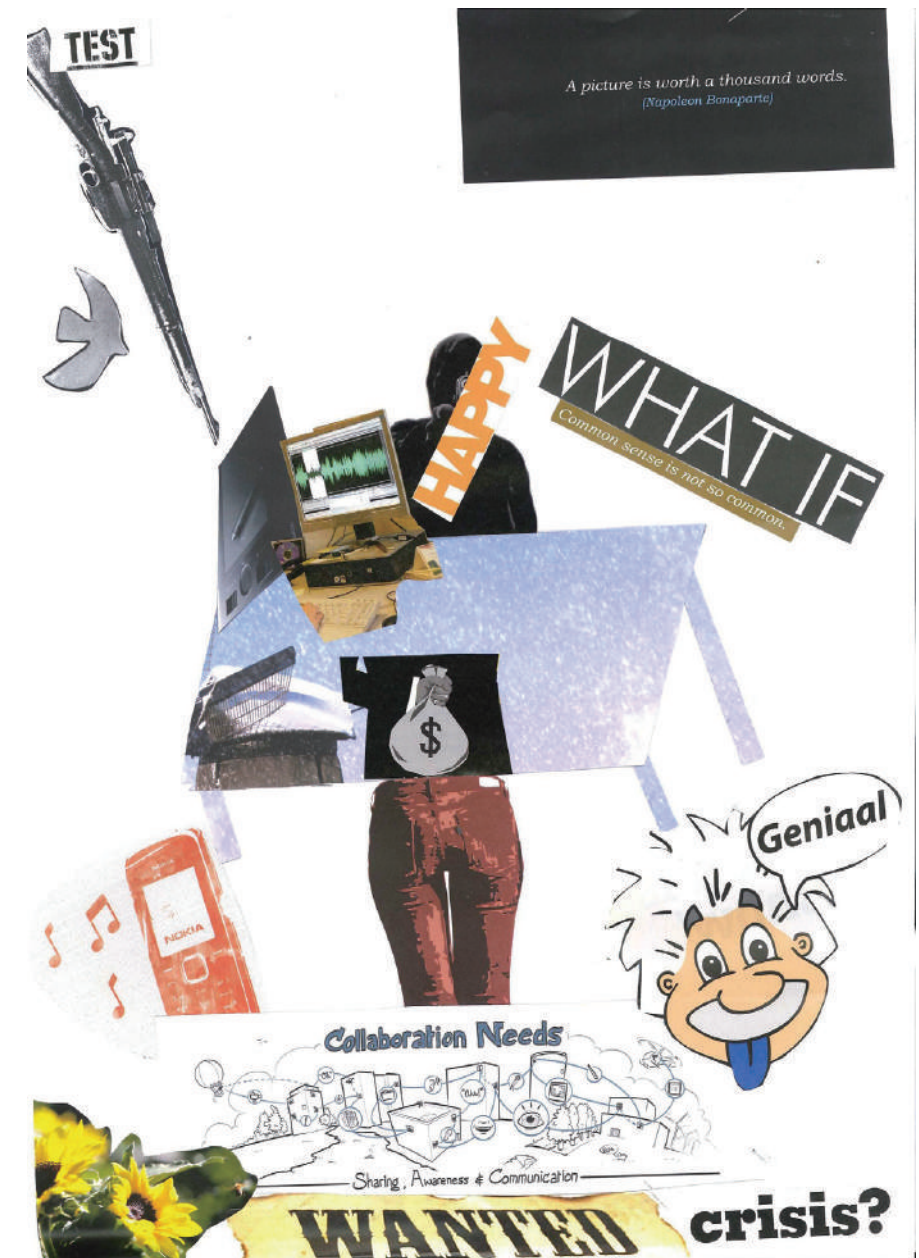


Figure 5.2. A collage made by one of the office managers. This female office manager works under high pressure. She evaluates collaboration as important in her work. She experiences outdated technologies and would like to experience rich interactions in her work

Specified Design Guidelines

From doing observations, categorizing notes and making collages, we found that interacting with an office phone often requires limited actions in space and in variation, e.g., picking up the horn and dialing numbers. All six interaction qualities are important to support Generation Y styles of interaction, but they have different focuses and levels of importance. Table 5.2 shows the specified design guidelines for designing an office phone with Generation Y styles of interaction.

Qualities	An office phone that supports Generation Y interactions has to...
Instant	... use immediate and spontaneous reactions with making and receiving phone calls
Playful	... integrate enjoyable and meaningful indications, in which user attention is organized and presented in an engaging and enjoyable way
Collaborative	... allow office managers to collaboratively communicate with their colleagues to strengthen connectedness
Expressive	... animate the urgency of phone calls with expressive input gestures from the office managers and reactions from the phone
Responsive	... indicate (and broadcast) availability status of the colleague being called at the moment
Flexible	... enable office managers to overcome physical limitation of workspace when calling

Table 5.2. The design guidelines for designing an office phone with Generation Y styles of interaction

5.2.2 Scenarios with Action Storyboards

Visionary scenarios and their corresponding action storyboards were created to describe how the specified design guidelines could have implications for designing future office phones. New ways of interacting were described in these scenarios, embedded with the relevant design guidelines. To visualize the design in more detailed actions and to indicate which interaction qualities are leading, a set of rough storyboards was created to illustrate the interaction and workflow between users and the new office phone in everyday typical office situations.

Background and Context

Y1 is a 25-year old female office manager with two years of office work experience. She works in an open-space office, together with 15 employees. She is responsible for running daily communications both inside and outside of her office. In her home life, she enjoys using an iPad to listen to music and surf on the Internet (see Figure 5.3).

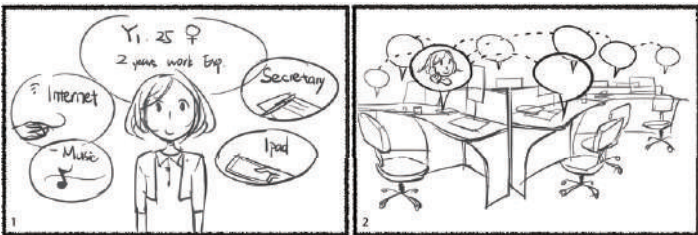


Figure 5.3. Illustration of Y1's life style and her work context

Indicating Availability

In the dialing process, Y1 is presented an availability overview (see Figure 5.4). Note: If Y2 is at his desk, Y1 will get a responsive indication that Y2 is available to respond to her call at the moment. If Y2 is not at his desk, Y1 will get a responsive indication that Y2 is not available at the moment. If Y2 is at his desk and physically co-working with other people, e.g., talking to a colleague, Y1 will get a responsive indication that Y2 is busy at the moment.

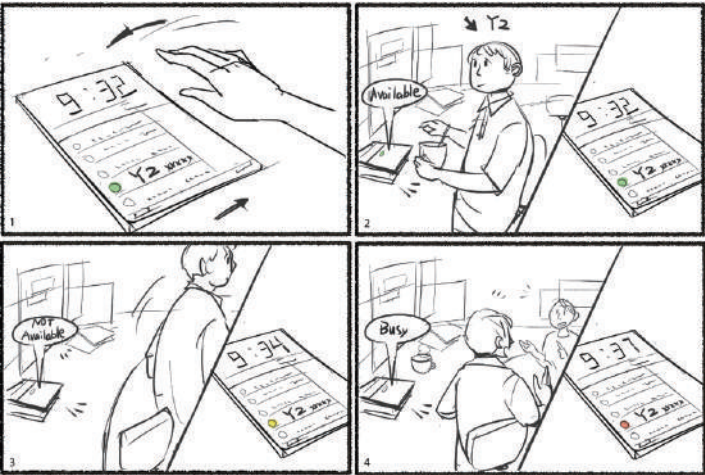


Figure 5.4. Manager Y1 gets indicated of Y2's availability through lighting up the contact's name in different colors, i.e., green, yellow or red

Browsing Phonebook

Y1 is about to use her office phone to make a call to her colleague Y2. Y1 activates the phone instantly by flexibly wearing the earphone. She performs playful and expressive hand gestures to browse her phonebook to find Y2. When browsing to the end of the phonebook, she gets a playful indication (see Figure 5.5).

Sending an Urgent Mood

Y1 finds Y2 available at the moment. She initiates the call. She expressively sends her urgent mood during the ringtone. Y2 receives an urgent visual indication and an urgent ringtone. He understands Y1's mood and picks up the call quickly (see Figure 5.5).



Figure 5.5. Storyboard of the actions Y1 goes through with the new office phone to make an urgent phone call to her colleague Y2

Enabling a Group Call

A call can be forwarded and shared, from one office phone to another office phone, or even to online communicators, e.g., Skype. During a connected phone call, Y1 browses her phonebook and invites Y2 to the call. Y1 collaboratively enables a group conversation without interrupting the original phone call (see Figure 5.6).



Figure 5.6. Storyboard of the actions Y1 enables a call with Y2 and the original caller, Y2 then initiates a group conversation by inviting other persons.

5.2.3 Concept Design

To support the interactions described on the action storyboards, a number of concept designs are presented below. These designs are visualized by drawing design sketches.

Slide

This concept looks like a slide or a sliding board (see Figure 5.7). It has a soft phone body, which can be bent (i.e., deform) slightly. A sliding knob is embedded in a slot in front of the phone. An earphone is attached to the back of the phone. When receiving an urgent mood (call), the phone shows caller’s name, glows and plays ringtone intensely. Table 5.3 shows user interactions, phone behaviors and corresponding interaction qualities.

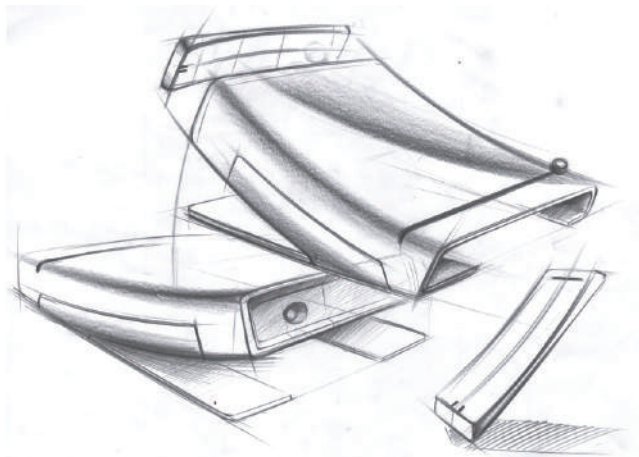


Figure 5.7. Concept design of Slide

Qualities	User Actions	Phone Reactions
Instant	Pick up the wireless earphone that is attached to the back of the phone body	Activate the dial pad interface
Playful	Hold and bend the phone body	Bounce the phonebook interface back when reaching the end
Collaborative	Put the earphone on a contact in the phonebook when a call is connected	Invite the selected contact to a group call
Expressive	Hold and bend the phone body; Select a contact and shake the phone body hard to send an urgent mood	Scroll phonebook vertically; Detect the degree of vibration and send an urgent mood to the contact
Responsive	Slide the knob; Sit at desk, leave desk or work with another colleague	Switch between dial pad interface and phonebook interfaces; Detect the user’s motion and send availability status to the caller
Flexible	Wear the wireless earphone and free hands; When wearing the earphone, scroll on its backside vertically	Enable the call to stay connected; Scroll phonebook vertically

Table 5.3. User actions, phone reactions and corresponding interaction qualities in the concept design of Slide

Clip

This concept looks like a paperclip (see Figure 5.8). It has a flexible surface (user interface), which can vibrate slightly. A rolling ball is embedded in a slot in front of the phone. An earphone is magnetic attached to the top of the phone. When receiving an urgent mood (call), the phone shows caller’s name, vibrates and plays ringtone intensely. Table 5.4 shows user interactions, phone behaviors and corresponding interaction qualities.

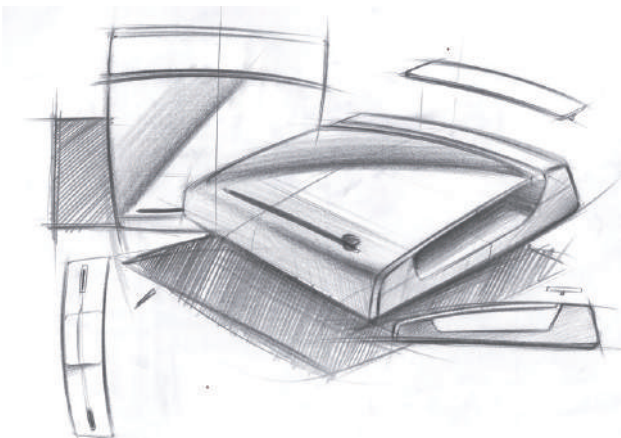


Figure 5.8. Concept design of Clip

Qualities	User Actions	Phone Reactions
Instant	Pick up the wireless earphone that is attached with a magnet to the top of the phone body	Activate the dial pad interface
Playful	Swipe in the air above the phone	Bounce the phonebook interface back when reaching the end
Collaborative	Knock on a contact in the phonebook when a call is connected	Invite the selected contact to a group call
Expressive	Swipe in the air above the phone; Push down hard on a contact to send an urgent mood	Flip phonebook horizontally; Detect the degree of pressure and send an urgent mood to the contact
Responsive	Tilt the phone body to move the rolling ball; Sit at desk, leave desk or work with another colleague	Switch between dial pad interface and phonebook interfaces; Detect the user’s motion and send availability status to the caller
Flexible	Wear the wireless earphone and free hands; When wearing the earphone, swipe on its backside horizontally	Enable the call to stay connected; Flip phonebook horizontally

Table 5.4. User actions, phone reactions and corresponding interaction qualities in the concept design of Clip

Mat

This concept looks like an inflated mat (see Figure 5.9). It has an inflatable phone body (user interface), which can be squeezed. A magnetic sliding ball is embedded in a slot in front of the phone. An earphone is suspended on the back of the phone. When receiving an urgent mood (call), the phone shows caller’s name, inflates and plays ringtone intensely. Table 5.5 shows user interactions, phone behaviors and corresponding interaction qualities.

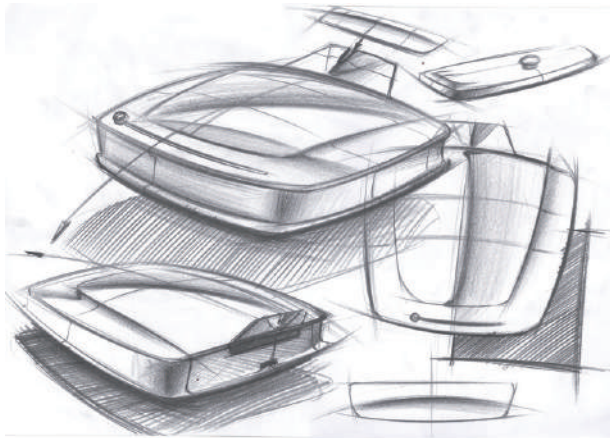


Figure 5.9. Concept design of Mat

Qualities	User Actions	Phone Reactions
Instant	Put a palm on the phone body	Inflate slightly and activate the dial pad interface
Playful	Tilt the phone body	Bounce the phonebook interface back when reaching the end
Collaborative	Select a contact and squeeze the phone body when a call is connected	Invite the selected contact to a group call
Expressive	Tilt the phone body; Select a contact and squeeze the phone body hard to send an urgent mood	Flip phonebook horizontally; Detect the degree of extrusion and send an urgent mood to the contact
Responsive	Slide the magnetic ball; Sit at desk, leave desk or work with another colleague	Switch between dial pad interface and phonebook interfaces. Magnet the ball into position; Detect the user's motion and send availability status to the caller
Flexible	Wear the wireless earphone and free hands; When wearing the earphone, tilt head left or right	Enable the call to stay connected; Flip phonebook horizontally

Table 5.5. User actions, phone reactions and corresponding interaction qualities in the concept design of Mat

A number of design variants (see Appendix C) on the Slide, Clip and Mat concepts are varied in the design of phone body, earphone and method of switching dial pad and phonebook interfaces.

To make the concept designs experiential for a user trial session (as in 5.2.4), a sketchy prototype (see Figure 5.10) was built to explore interaction qualities and to think about how to act out the scenarios. Sketchy prototyping (e.g., paper prototyping) is a widely used technique that helps designers to quickly create and test user screen interfaces (Snyder, 2003). A stack of phone interfaces from the scenario were designed and then printed on cardboard and made into 95 by 110 mm cards. These cards can easily be exchanged and manipulated on a flat surface to wizard-of-oz the user interactions. Furthermore, the use of stacks or 'piles' (Mander et al., 1992) offered a good way to represent a logic workflow.

A phone body was designed and built by using Lego. A flat surface was designed to hold the printed cards. Although the interfaces on the printed cards look alike the interfaces on popular smart phones, the focus is the user interactions and logic of the workflow.

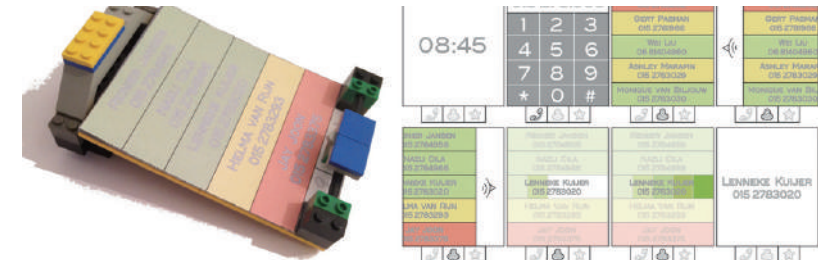


Figure 5.10. The sketchy prototype designed and built by using printed cards and Lego bricks

5.2.4 Play-Acting

By physically acting out different situations described in the scenarios and the concept designs, interactions and contexts can be explored. A play-acting video was produced to demonstrate the user-phone interactions. Figure 5.11 shows a sequence of snapshots from the video.

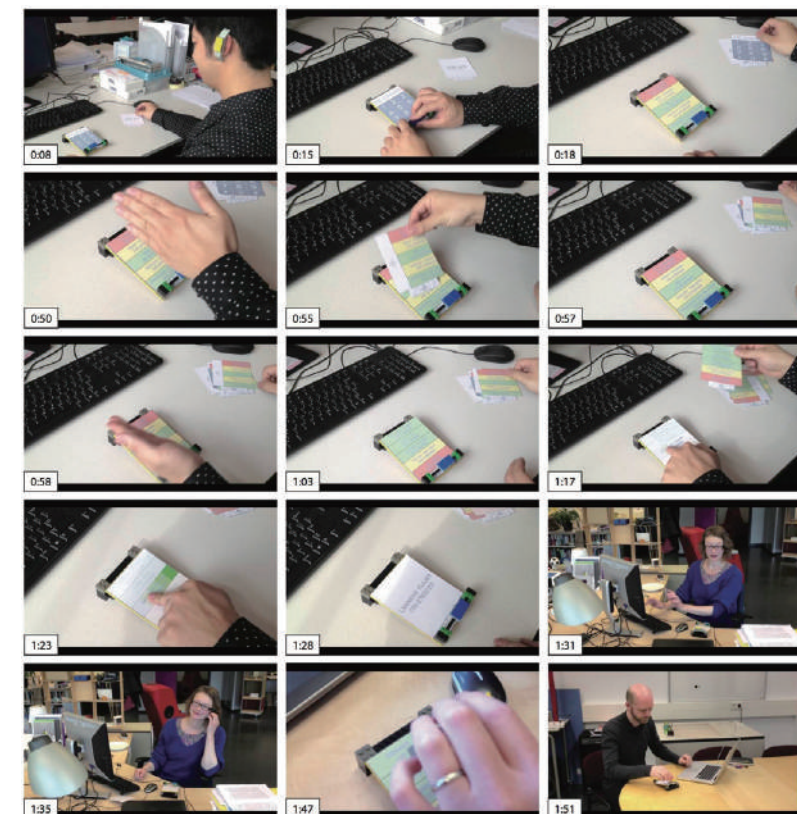


Figure 5.11. Snapshots of the user-phone interactions of checking contacts' availability, browsing phonebook, making an urgent call and enabling a group call. The video is available at: <http://goo.gl/j8Moqi>

In order to find directions for the final design, the participants from the observation sessions and office managers in our university were asked to try out the sketchy prototype and a number of foam mockups contextually in their work environments (see Figure 5.12 and 5.13). The foam mockups were 3D printed by a CNC milling machine in our university. They were made to demonstrate the concept designs. First, the participants were asked to play-act the interactions with the sketchy prototype and the foam mockups. Each participant tried out different user actions (as in table 5.3, 5.4 and 5.5) and gave preference based on user experience. Secondly, the interaction qualities and their examples were introduced and explained, the concept design sketches were shown and the play-acting video was played. Thirdly and finally, the opportunities to improve the user-phone interactions were discussed and reflected on. New ideas kept emerging on detailed interactions while acting out, such as shaking the earphone to shuffle contact list and covering the phone by both hands to hang up a call. Important decisions made in these play-acting sessions were a selection of the most experiential user interactions (as in table 5.6) described in the concept design section. For example, swiping in the air to flip phonebook was preferred because it was experienced as very expressive by the participants. The user does not have to touch the phone, but ‘the phone behavior can follow the user’s wish magically’, said by one participant. In contrary, for the concept design of Slide, the user needs to stretch body to reach the phone, and then bend to scroll phonebook. Another example is the use of magnetic sliding ball, which is experienced very responsive. The user can feel the magnetic force to confirm that the ball fits into position successfully and reactively.

Based on user preference and quotes, we got the impression that four interaction qualities, playful, expressive, responsive and flexible, were considered the most relevant to the Generation Y styles of interaction and the work context for designing future office phones. The playful quality was considered less relevant to perform formal interactions in the work context. The collaborative quality was considered only relevant when enabling group calls. In other situations, focusing on the interactions of the user’s own office phone was preferred. Switching modes



Figure 5.12. Using the sketchy prototype to play-act with the participants from the observation sessions and office manager in our university. From left to right: sliding to view phonebook, pushing down on a contact hard to send an urgent mood, viewing contacts’ availability status, putting the earphone on a contact to enable a group call

between home and work calls was considered important, but they rarely occurred, because home calls were always received from personal mobile phones. The participants agreed that the concept phone designs fitted into the work context. One of the reasons was that there was no need for indicating availability status in the home context, because the user would not sit at a fixed desk for a long time as in the work context. Based on these decisions, the user interaction, size, scale and shape of the physical prototype were able to be defined in its context.



Figure 5.13. Using the foam mockups to play-act with the participants from the observation sessions and office manager in our university. From left to right: picking up the earphone, swiping on the backside of the earphone to flip phonebook, bending to scroll phonebook, swiping in the air to flip phonebook

5.2.5 The Final Prototype - YPhone

This concept employs a clean, neutral and inviting style of industrial design (see Figure 5.14 and 5.15), in order to lead to a prototype that works the best for designing and evaluating the interaction qualities, not for marketing a new product. It has a smooth phone body (user interface). A magnetic sliding ball is embedded in a slot in front of the phone. A magnetic earphone stands on the top of the phone. When receiving an urgent mood (call), the phone shows caller’s name, glows and plays ringtone intensely. Table 5.6 shows user interactions, phone behaviors and corresponding interaction qualities.

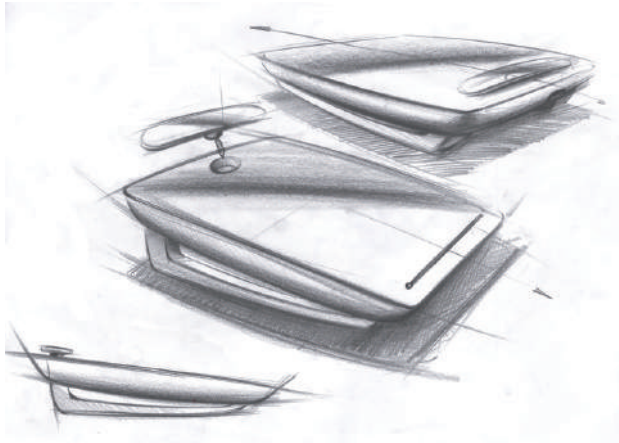


Figure 5.14. The final design of YPhone

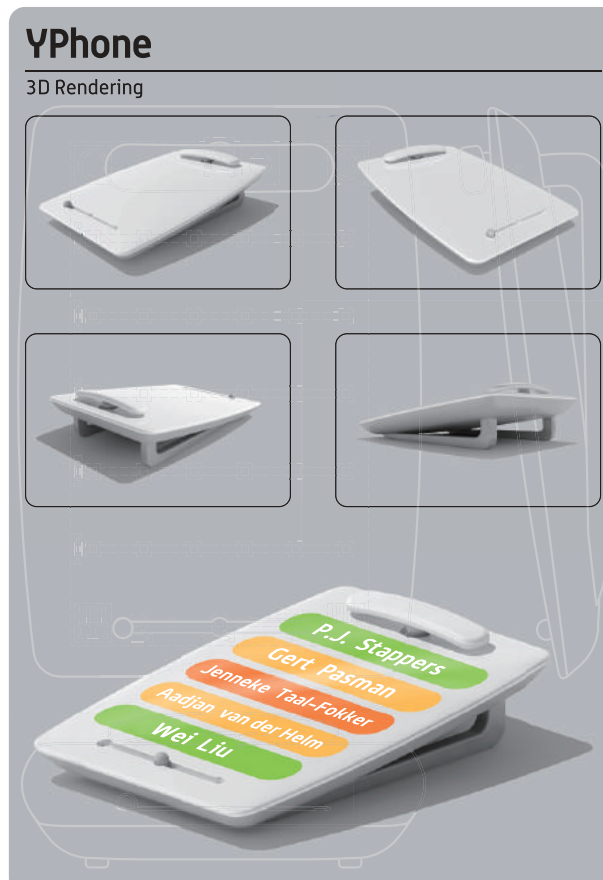


Figure 5.15. The final design of YPhone. The bottom picture shows that the phone is in phonebook mode with indication of contacts' availability status, e.g., Wei Liu is available at the moment

Qualities	User Actions	Phone Reactions
Instant	Pick up the wireless, magnetic earphone that stands on the top of the phone body	Activate the dial pad interface
Playful	Swipe in the air above the phone	Bounce the phonebook interface back when reaching the end
Collaborative	Put the earphone on a contact in the phonebook when a call is connected	Invite the selected contact to a group call
Expressive	Swipe in the air above the phone; Push down hard on a contact to send an urgent mood	Flip phonebook horizontally; Detect the degree of pressure and send an urgent mood to the contact
Responsive	Slide the magnetic ball; Sit at desk, leave desk or work with another colleague	Switch between dial pad interface and phonebook interfaces. The magnet brings the ball into position; Detect the user's motion and send availability status to the caller
Flexible	Wear the wireless earphone and free hands; When wearing the earphone, swipe on its backside horizontally	Enable the call to stay connected; Flip phonebook horizontally

Table 5.6. User actions, phone reactions and corresponding interaction qualities in the concept design of YPhone

5.3 YPhone Specification

YPhone is a tool for office workers to experience Generation Y interaction qualities in their work contexts. This section shows its workflow, technical components, physical dimension, software and the physical design.

5.3.1 Workflow

To specify how the new design works, a visionary workflow (see Figure 5.16) and an actual workflow (see Figure 5.17) were made. The visionary workflow shows the ideal and complete workflow, which we aimed to achieve in the implementation. The thick line type means the user actions. For example, a user picks up the earphone to activate the phone (i.e., the dial pad is shown) from the standby mode, he/she then slides the magnet to the middle position to activate the phonebook mode. Due to technical and time constraints, the prototype was not be able to reach a full degree of robustness. The actual workflow shows the key user-phone interactions (as in table 5.6), which were prioritized to get implemented. These implemented interactions sufficed because they were sufficient to demonstrate the interaction qualities.

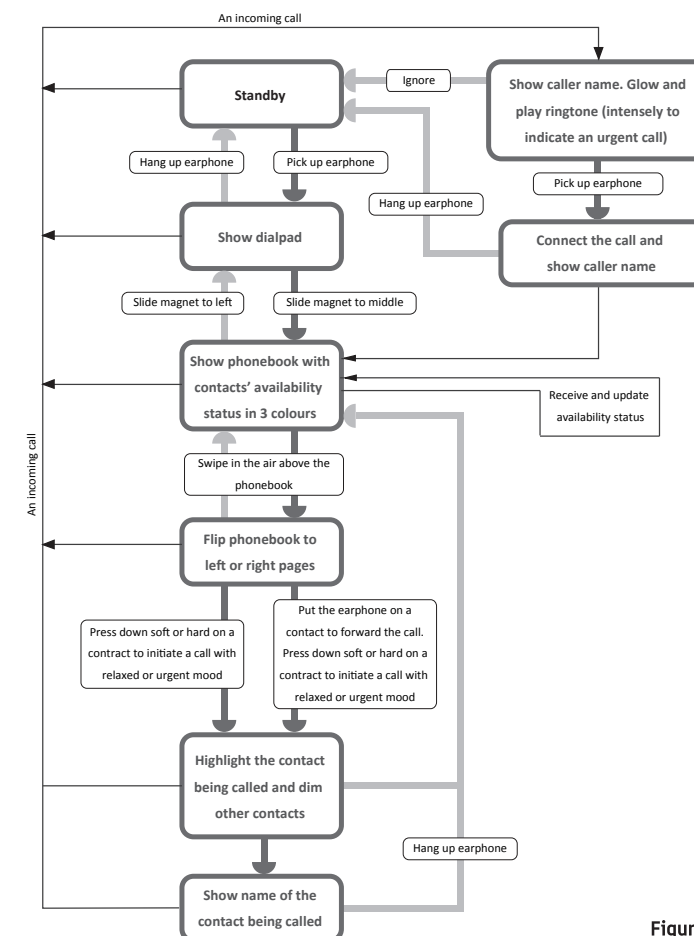


Figure 5.16. The visionary workflow

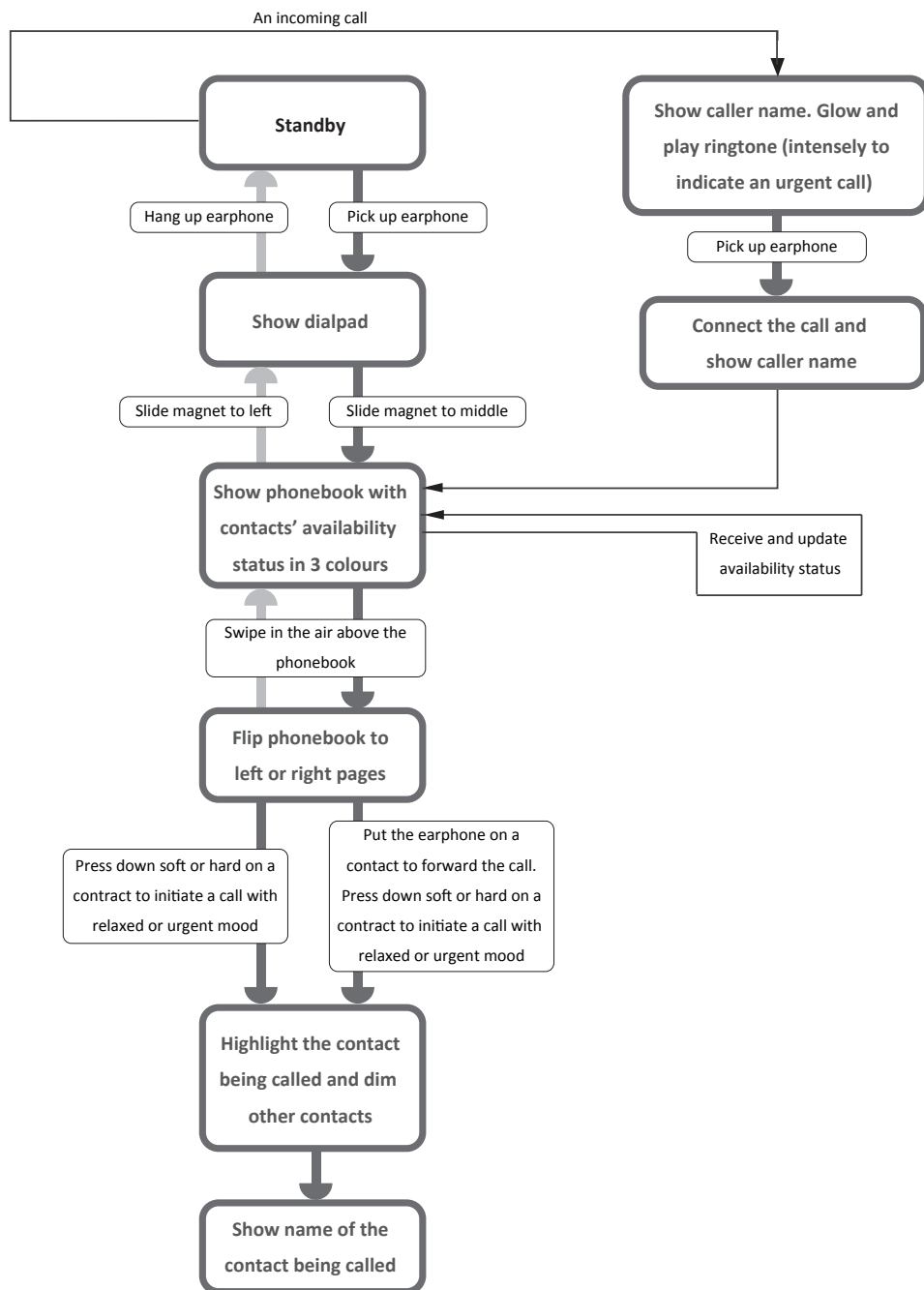


Figure 5.17. The actual workflow

YPhone

Components and Exploded View



- | | |
|-----------------------------|--------------------------|
| A - Earphone | F - Holder |
| B - Magnet | G - Accelerometer |
| C - Magnet Ball | H - Socket |
| D - Proximity Sensor | I - Reed Switch |
| E - Pressure Sensor | J - Color LED |

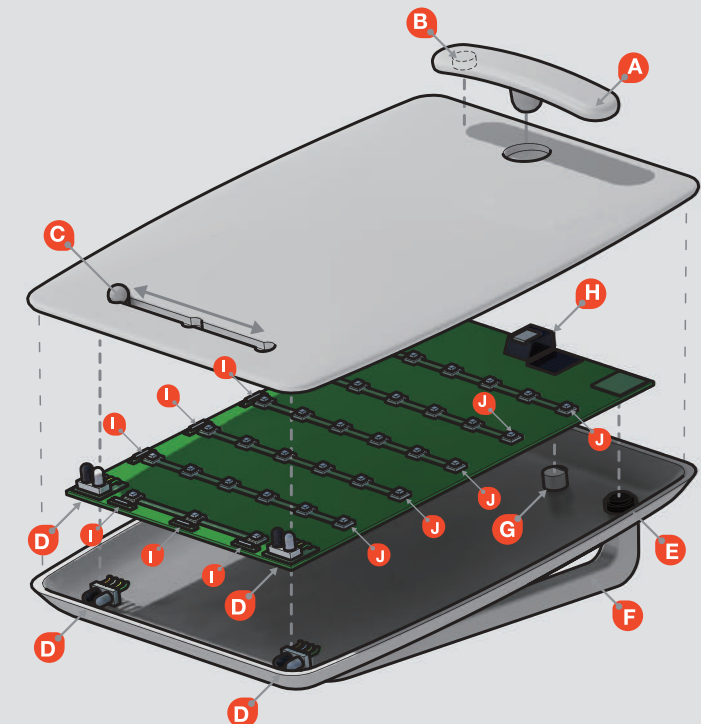


Figure 5.18. YPhone's components and exploded view

5.3.2 Technical Components

In making this technical prototype, the experiences with technology were used. These experiences were gained from building and using prototypes, such as the ITD prototypes (as in chapter 3) and others described in this chapter. YPhone relies for the most part on proven technological components. The components and exploded view are visualized in Figure 5.18. YPhone is controlled by a (laptop) computer, which connects all the components and runs software for the user-phone interactions. YPhone's main circuit boards were custom-made by Rob Luxen in the ID-StudioLab. Another custom-made component is a data transmitter. It consists of a circuit board, four Internet cable sockets, one power socket and one USB port that measure power and send a signals to the main circuit boards. Cables used in YPhone are standard commercial solutions and standard Internet and USB cables without adaptations.

5.3.3 Physical Dimension

YPhone is a device that can be placed on a work desk. It is built up from three structural components: 1) an earphone and a surface on which the user interacts directly, 2) a technical unit in the phone containing all the technical components and 3) a construction holding the interface and the components. For transportation and maintenance YPhone can be separated in these structural elements. The footprint of YPhone is 150 mm long by 110 mm wide. The front height of YPhone is 12 mm and the back height is 32 mm (see Figure 5.19). It was a conscious choice to design the prototype as smaller than typical office phones according to user research (as in the flexible quality section in table 5.1).

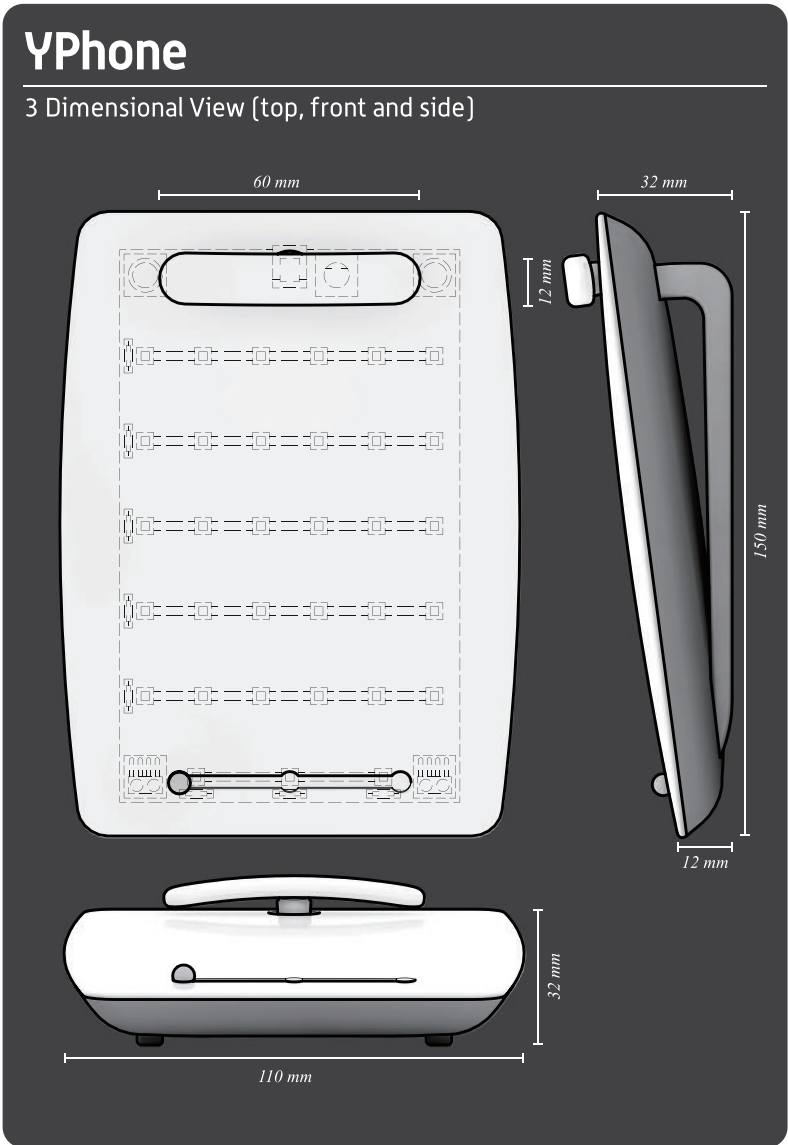


Figure 5.19. YPhone’s dimension

5.3.4 Software

All the software for YPhone was written in Max/MSP (2014), with help from Aadjan van der Helm in the ID-StudioLab. The software controls a pair of YPhones using the standard set of objects available with Max/MSP, e.g., `bytestuff` and `metro`. The software on YPhone has eight different transition states in which different features of YPhone are supported. They are standby, dial pad, user presence, phonebook, page turn left, page turn right, normal call and urgent call. These states are not communicated as such in the interface and most users will not even notice them. Figure 5.20 shows YPhone’s Max/MSP patch.

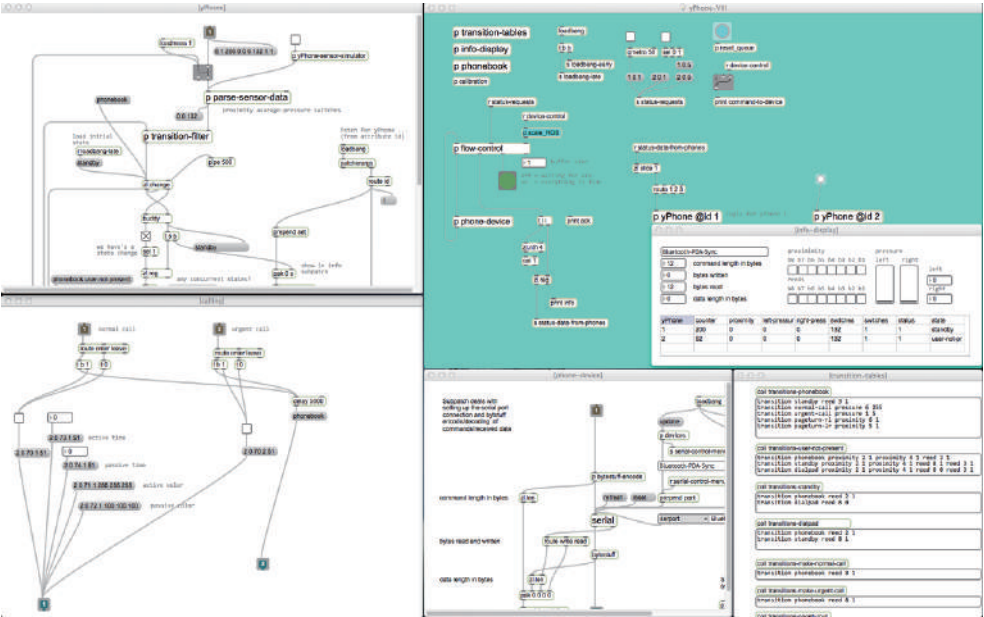


Figure 5.20. Screenshot of YPhone’s Max/MSP patch

5.3.5 The Physical Design

The physical design (see Figure 5.21) was preferred to be built as clean and neutral as possible, aiming to provide users with a physical support to explore the interaction qualities. To avoid focusing too much on the physical form and to make more room for hardware maintenance, the form and dimension (see Figure 5.15 and 5.19) were not followed exactly in this actual physical design.

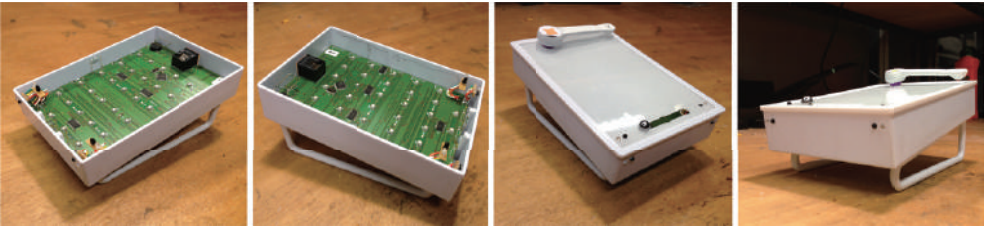


Figure 5.21. The physical prototype of YPhone

5.4 Conclusions

The goal of YPhone was to develop an office tool for supporting Generation Y styles of interaction in the work context, making the office (phones) catch up with the richness of interaction that is experienced in the home context. Developing such an office tool might make it tempting to only add gadget-like features that may be appealing, but have no relevance to the office context. The previous research in both theory and practice helped us focus on the six Generation Y interaction qualities, without losing its relevance to designers. To keep this focus we used techniques (e.g., action storyboards) that allowed keeping the target users in mind and keeping ourselves out of the design process as users. We (the researchers) are (Generation Y) office workers ourselves, yet we are not the office workers for whom this office tool is designed for.

YPhone was developed as a means for technology to support the findings from theory and practice. By developing the sketchy and foam prototypes quickly, we could try out and experience the results and decide how to further develop them. Each of these prototypes was built with the intent to develop them into the final prototype. Considering all the techniques used in the design process, ranging from sketching, storyboarding to sketchy prototyping and play-acting, the most important technique is demonstrating a new design with a working prototype. Bringing a working prototype to the table is the best way to convince yourself and others of its value. A product can only be valued if it has been used in a realistic setting by real users. Therefore in the next chapter, YPhone is set out both in the lab and in practice, to get an insight on the new design itself and to find out how the interaction qualities of the new design are experienced (in the work context).

ACKNOWLEDEMENTS

We would like to thank Aadjan van der Helm and Rob Luxen for their help with the hardware and software of the YPhone prototype.

► CHAPTER 6: EVALUATING INTERACTION QUALITIES



Research question 5 is central in this chapter: How are the interaction qualities of the new design experienced? This chapter presents evaluations conducted with a working prototype in the lab and in practice. The goal of these evaluations was to both evaluate the prototype and to find out what effect a new tool can have on the office workers' interaction behavior. By evaluating the interaction qualities we also evaluate what was found before in theory and practice. In study 1, the interaction qualities of YPhone were evaluated in a controlled in-lab situation. In study 2, YPhone is set out in practice in a series of contextual evaluations. The working prototype supports office workers in experiencing Generation Y type of interactions in the work context. The overall evaluation of YPhone was positive with some valuable suggestions to its user interactions and features.

This chapter is based on:

Liu, W., Stappers, P. J., Pasman, G. & Taal-Fokker, J. (2014). Evaluating generation Y interaction qualities in an office work context. Extended abstracts of the ACM SIGCHI conference on Human factors in computing systems (CHI). New York: ACM Press.

6.1 Introduction

This study was set up to evaluate the interaction qualities of the Generation Y YPhone prototype. The objective of the study was twofold. On the one hand, the study aimed to find out which interaction qualities of YPhone are experienced the most, which less, and if implementing desired interaction qualities was succeeded. On the other hand, the study aimed to explore the contributions of such interaction qualities on new ways of working. The main research question is: Are the interaction qualities of the new design experienced (in the work context)?

YPhone was expected to make Generation Y interaction qualities more explicit, and to bring the richness of the interactions experienced in the home context into the work context. The six interaction qualities and their corresponding design guidelines were identified and formulated through contextual interviews in chapter 2 and 4, but the participants in those studies referred only to existing products, for which Generation Y interaction qualities had not been a design driver. In this study, both the actual use of YPhone and the office workers' expressed opinions would make new ways of working explicit and experiential. This study was expected to provide insight into the concept of interaction qualities and to offer insight in the computer supported cooperative work (CSCW) products.

6.2 Reflection on Applying the Design Guidelines

In this section, the application of the design guidelines is evaluated by reflecting on the design and development process of YPhone. We had built on knowledge and experience gained from identifying Generation Y interaction qualities and design guidelines in general (as in 4.7) to develop YPhone specifically (as in table 5.2). The design challenge lay in designing a Generation Y style of interaction within the context of office work. The design of future office tools should utilize the six Generation Y interaction qualities to bring the richness usually experienced at home to the office as well (as in 2.3.5 and 2.5).

6.2.1 Using the Design Guidelines

YPhone embodies new ways of interacting within the work context through implementing the six Generation Y interaction qualities and design guidelines (as in 4.7 and as in table 5.2). Instant, playful, collaborative, expressive, responsive and flexible were put into specific user-phone interactions. Note: Some designed interactions represent multiple interaction qualities, e.g., the swiping gesture to scroll is an actuation of playful, expressive and flexible.

1. 'Using instant interactions to convey meaning' is supported by picking up the wireless earphone to activate the dial pad interface immediately and spontaneously. One magnet is mounted in the earphone, which stands on the top of the phone body. One reed switch is mounted on the PCB board in the phone body and beneath the earphone. The magnet and the reed switch are coupled to activate the dial pad

interface. Note: Here instant is used for describing user-phone interactions, not for describing product functions, i.e., every phone should be functionally instant and collaborative. The same principle applies to the other five interaction qualities.

2. 'Integrating playful interactions in low-attention office tasks' is supported by bouncing the phonebook name list back when reaching the end. Four proximity sensors are embedded on the top front of the phone body to detect the hand swiping gesture. Five rows of color LEDs are programmed to animate the bouncing effect of the phonebook interface.
3. 'Integrating collaborative interactions into office teamwork to strengthen the connectedness of the team' is supported by putting the earphone on a contact in the phonebook to invite the selected contact to a group call. Five reed switches are mounted on the PCB board and besides the five rows of color LEDs. The magnet in the earphone and the five reed switches are coupled to forward a call.
4. 'Integrating expressive interactions into regular office tasks' is supported by swiping in the air above the phone to flip phonebook and pushing down hard on a contact to send an urgent mood (call). Four proximity sensors are embedded on the top front of the phone body to detect the hand swiping gesture. Two pressure sensors are mounted on the back of the PCB board to detect the degree of pressure when sending an urgent mood.
5. 'Making office tools and systems more (emotionally) responsive' is supported by sliding a magnetic ball to switch between interfaces and indicating contacts' availability status. One magnet ball is placed on a sliding slot on the top front of the phone body. Three reed switches are mounted on the PCB board in the phone body and beneath the sliding slot. The magnet ball and the three reed switches are coupled to switch between interfaces. Four proximity sensors are embedded on the front of the phone body to detect the contacts' availability status.
6. 'Allowing for flexibility while interacting to overcome physical limitation of workspace' is supported by wearing the wireless earphone to free hands and swiping on its backside to flip phonebook. A wireless earphone can be worn to free hands. Eighteen groups of color LEDs are programmed to animate information (e.g., phonebook) flexibly.

We have reflected on how well the interaction qualities could be used by designers. Design guidelines 1, 4 and 5 were used a lot for developing the YPhone prototype because they addressed most user-phone interactions. Design guideline 2 worked in a different way than others because it not only guided the user-phone interaction design, but also guided the visual interface design. Design guideline 3 was mostly used for the early thinking of the concept design but it did not play a solid rule for developing the prototype. Design guideline

6.3 In-Lab Evaluation

A controlled in-lab evaluation was conducted to evaluate if the six interaction qualities can be experienced by the users when interacting with YPhone. The focus of this study was to see if we succeeded in bringing Generation Y interaction qualities in the YPhone design, and to see which interaction qualities added most value to the participants, and which ones did not.

6.3.1 Method

In this evaluation participants were invited to a laboratory setting. The researchers controlled the evaluation procedure and observed the reaction [Kumar, 2005; Paton, 2002]. Kumar recommends the researchers do not get involved in performing the user interactions but remain passive observers, watching, listening to and documenting the ways of interacting, and then drawing conclusions from it. This study underlines two essential characteristics: 1) it is a purposeful, systematic and selective way of evaluating interaction, 2) it focuses more on the behavior than on the perception of the participant.

6.3.2 Participants

60 participants were involved in this study. 52 of them completed the quality evaluation questionnaire. There were 25 male and 27 female participants. Their ages were between 19 and 45. Their professions concentrated mostly in the field of designers and students: 5 participants worked in industry, 14 in academia, 31 were students and 2 were unemployed. They had different educational backgrounds: design [25], engineering [11], economics [8], management [2] and other [6]. Their educational levels varied: undergraduate [28], graduate [12] and PhD [12]. The office context was not important yet in this study, so experiences of working in an office context were not required from the participants.

6.3.3 Laboratory Settings

To reach out a variety of participants with different backgrounds and expertise, the evaluations took place in our university, the computer supported cooperative work (CSCW) 2013 conference venue, the The Hague University of Applied Sciences and the Leiden University. A similar context in the four locations was set up on a table with modern and frequently found tools from the home and work context, such as computer monitor, keyboard, lamp and moderate decorations, e.g., pens and books. A pair of YPhones was cable connected to a computer running the YPhone patch (explained in chapter 5). One YPhone was placed on the table besides the computer monitor for the participant to experience. The distance between the YPhone and the participant was between 20 to 30 centimeters, in order to accommodate the proximity sensors’ detecting range. The other YPhone was placed on the researcher’s side of the table. This YPhone was needed to help the participant complete the scenarios, such as making an urgent call (as in 5.2.2). Two chairs were placed at the table, one for the participant and one for the researcher. A portable video camera was pointed at the table and the participant to record all user interactions.

6.3.4 Quality Evaluation Questionnaire

A quality evaluation questionnaire (see Appendix D) was designed by adapting Hassenzahl model [2004], which investigates product qualities [attributes]. This model was used for evaluating the ‘rich interaction’ of a physical consumer product design and proved to work well for assessing interaction qualities [Frens, 2005]. The questionnaire consists of twenty bipolar word pairs on a seven-point scale. These word pairs address interaction qualities. Fourteen out of twenty-one word pairs were selected from the Hassenzahl model based on the relevance to the Generation Y interaction qualities. Six word pairs were added addressing the Generation Y interaction qualities (table 6.1). The participants were asked to read the qualities, to interpret what is experienced and to rate these experiences based on the scales. The questionnaire was designed according to the following criteria: 1) focusing on the interaction qualities, 2) evoking the participants to concentrate on user interactions, concerns and wishes, and 3) making the layout and the sequence of questions easy to read and to follow (making randomized order of the questions on interaction qualities for about 1/4 participants). The participants were asked to complete the questionnaire on site by using the computer.

Qualities	Word Pairs
Instant	Delayed - Instant
Playful	Serious - Playful
Collaborative	Solitary - Collaborative
Expressive	Restricting - Expressive
Responsive	Unresponsive - Responsive
Flexible	Rigid - Flexible

Table 6.1. The Generation Y interaction qualities and corresponding word pairs for the quality evaluation questionnaire

6.3.5 Procedure

Each evaluation took about 30 - 40 minutes per participant. During this time, each participant observed and experienced the YPhone prototype by means of the scenarios, and evaluated it on the twenty word pairs (interaction qualities). They were encouraged to refer to their experiences in terms of user-phone interactions. The evaluations were video recorded under permission from the participants. The actual evaluation included five steps as described below:

1. The researcher verbally introduces the project background and the definition of interaction quality (see Appendix E).
2. The participant observes and also verbally describes the YPhone prototype. The researcher explicitly points out that YPhone differs from other office phones in the sense that experience (interaction qualities) is the main concern instead of efficiency.
3. The researcher shows the interaction video (as in 5.2.4) that depicts a typical scenario of use and asks the participant to explore the user-phone interactions. The

participant discusses which interaction qualities are experienced. The computer logs these user-phone interactions on the Max/MSP application (as in 5.3.4).

4. The participant completes the quality evaluation questionnaire. Note: The order of questioning can have an effect on how users judge the interaction qualities, thus the order of the questions on interaction qualities is randomized for 15 participants.
5. Round up discussion and reflection.

6.3.6 Results

Data from the study were:

- Observations of participants interacting with the prototype, e.g., recorded in videos and notes. The videos were reviewed and selected. Remarks by participants were noted as quotes.
- Ratings by participants of how well the prototype showed each of the twenty selected bipolar word pairs in the quality evaluation questionnaire. Each interaction quality was rated on a 7-point scale.
- Interview notes from the round-up discussion.

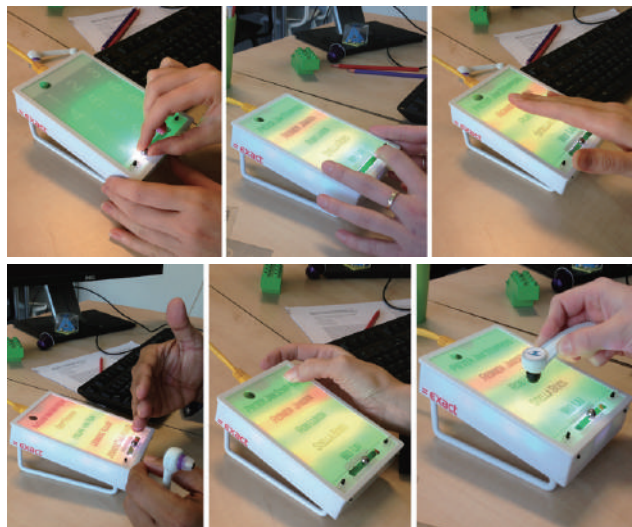


Figure 6.3. Snapshots from the recorded videos. The video is available at: <http://goo.gl/keiOcM>

General Observations

All participants were observed while actively trying out the YPhone prototype for about 20 minutes. Observation videos and notes showed that the participants had no severe difficulty in understanding or operating the various features of the prototype. They experienced the user-phone interactions generally smooth and worked pleasantly with the new design (e.g., shape, size and style). This is interesting because YPhone's style of interaction, with its minimal interface and new ways of interacting, is typical for design research prototypes, but very unlike the office phones and other tools currently used in the home and work context. Figure 6.3 shows interesting actions (e.g., trying to swipe vertically to browse phonebook) from the recorded videos.

In their descriptions of YPhone, almost all participants used the interaction qualities to describe their experiences of YPhone, e.g., 'it is expressive to see the status of people and also indicating how important your call is', 'this design reflects some intuitive needs of urgent communication factors', 'it is really playful'. Those participants who were (interaction) designers, readily adopted the terms offered to them. For example, one designer described rotating the magnetic ball 'very fun and playful'. Especially the term 'playful' was used frequently by the participants. Reason could be that they often use this term to describe interactions and experiences (e.g., gaming) in their everyday life. When the participants with a non-design background described their interactions with YPhone (e.g., sliding or rotating the magnetic ball), they did not use these terms, but rather used more generic usability terms, e.g., 'intuitive, natural and fluent'. The Generation Y interaction qualities fit the designer's vocabulary for describing interactions, but appeal less to a general audience, possibly because designers are trained to describe and analyze interactions, and therefore use a wider vocabulary.

Next to that, participants would describe the functions and purposes of using the proposed product, e.g., '... to be closer to my colleagues, knowing if they are in the office today or not ... with a few simple gestures', 'nice to know if someone is available or if you are bothering them'. Seven of the participants explicitly mentioned the context of use aspect of YPhone, e.g., '... to indicate urgency both at home and at school', 'at home, it becomes less relevant to show my availability with three distinct states', 'I may set my availability status at different levels for home and work'.

Three of the participants described the technical components of YPhone, e.g., 'availability sensor on a desk phone makes more sense for a context where one is usually sitting on a desk and is in principle available', but they did describe what they could do with it as a whole experience, e.g., 'a desktop emotional communicator', 'look and feel cognitive style'.

In their use of YPhone one exciting new pattern emerged. Most participants (ca. 45 out of 60) with and without design background spontaneously used YPhone not only to try out the designed user-phone interactions, but also to refer to similar interactions they would like to experience with their existing digital or physical tools, e.g., 'I would prefer to have such gestures with my PC monitor'. They extrapolated how the interactions can be used elsewhere in other designs. These designed interactions do not just add experiential value to calling or browsing contacts, but also triggered discussion and reflection. They picked up the idea of interaction qualities and indicated that the interaction qualities could be appropriate in other contexts. They also suggested new applications and tools (e.g., the self-service check-in machine at the airport) that can be designed by applying these interaction qualities. This result presents an exciting opportunity for applying such styles of interaction in designing other products in other contexts.

Evaluation of Interaction Qualities

Because the design of the prototype was guided by the Generation Y interaction qualities, each of these was expected to score relatively high on the quality evaluation questionnaire. All responses were compiled and mean scores were compared. Table 6.2 shows the mean scores from the evaluation questionnaire report. 52 participants completed the quality evaluation questionnaire.

Qualities	Score
Bring...closer...	5.9
Playful	5.8
Expressive	5.3
Simple	5.2
Responsive	5.1
Flexible	5.1
Innovative	5.1
Human	5.1
Original	5.0
Direct	5.0
Presentable	5.0
Instant	4.9
Creative	4.9
New	4.9
Clear	4.9
Classy	4.7
Collaborative	4.6
Practical	4.4
Predictable	4.3
Courageous	4.0

Table 6.2. Mean ratings given in the questionnaire. They are ordered on the highest score first, the lowest score last. The Generation Y interaction qualities are shown in bold. Others interaction qualities are in the Hassenzahl model

As Table 6.2 shows, four interaction qualities (instant, playful, expressive, responsive and flexible) score relatively high and two (instant and collaborative) lower. We had expected the high scores for these four qualities, but were surprised by the lower ones. One explanation is that the prototype did not have those two qualities to the intended degree. One might expect that they should have been the easiest ones to realize in the design, as they hold for any traditional telephone in its function qualities: it rings instantly when you make a call, and making a phone call is typically a collaborative activity. However, this may be the very reason why the interaction received low scores on these two qualities: because they were

so present in the function of any phone, the participants may have had higher expectations for the interaction so that it should exceed the qualities of function. Here the interaction quality of the collaborative maybe confused with the function quality of collaborative. The participants may think any telephone is collaborative from the moment of connecting a call. The collaborative quality of function (e.g., speaking to someone) might push out the focus of participants on interaction. This interpretation suggests that when people judge interaction qualities, there may be interference from the typical functions of the product. Thus the participants need to be instructed from the interaction perspective.

Factor and Principal Component Analyses

A factor analysis (Field, 2013) and principal component analysis (PCA) (Field, 2013) was performed with IBM SPSS Statistics version 21 (SPSS, 2013). These analyses show relations between interaction qualities and correlations of the ratings on the different qualities. Each quality (or ‘dimension’) is labeled by a word pair. Highly correlated dimensions are placed closely together in the ellipse in a spatial plot (see Appendix F). Most dimensions cluster in the middle, with the dimensions ‘cautious - courageous’ and ‘unpredictable - predictable’ standing apart. Apparently, the judgments on the latter two dimensions are unrelated to the dimensions in the center. Another thing that stands out in the diagram is that the dimensions ‘confusing - clear’, ‘typical - original’, ‘commonplace - new’, ‘unpresentable - presentable’ and ‘complicated - simple’ are close to each other. The correlation map shows that the Generation Y interaction qualities do not form a fully separate group. However, there is a tendency towards the left side of the horizontal dimension, which supports the grouping of the six interaction qualities into a Generation Y style of interaction.

Results of the PCA (see Appendix G) show that the first six components explain 65% of the variance in the answers, suggesting that the dimensions of the questionnaire are highly correlated. The principal component analysis was used to find groups among the dimensions (qualities). A rotation statistic analysis was made using extraction method of PCA and rotation method of Varimax with Kaiser Normalization (Field, 2013). The explained variance was then limited to 4 components, e.g., 4 groups of qualities. This means that it limits the analysis to 4 factors (components) and ignores the rest. The components are then labeled.

Table 6.3 shows a rotated component matrix. Group 1 contains the most important variance in the ratings of the YPhone prototype. The grouping revealed some interesting things about the qualities. Figure 6.4 and 6.5 show how similar product design dimensions correlated.

Group	Word Pairs	Component			
		1	2	3	4
1 EXPERIENCE	Restricting - Expressive Serious - Playful Technical - Human Rigid - Flexible Takes me apart - Brings me closer Unresponsive - Responsive Gaudy - Classy	.740 .707 .659 .657 .611 .583 .439		.403	
2 USABILITY	Confusing - Clear Complicated - Simple Cumbersome - Direct Unpresentable - Presentable Unpredictable - Predictable		.744 .700 .645 .622 .481		
3 NOVELTY	Conservative - Innovative Typical - Original Standard - Creative Commonplace - New			.766 .733 .586 .573	
4 OTHERS	Solitary - Collaborative Cautious - Courageous Delayed - Instant Impractical - Practical	.431	.421		.671 -.527 .507 -.472

Table 6.3. The rotated component matrix by using extraction method of principal component analysis (PCA) and rotation method of Varimax with Kaiser Normalization

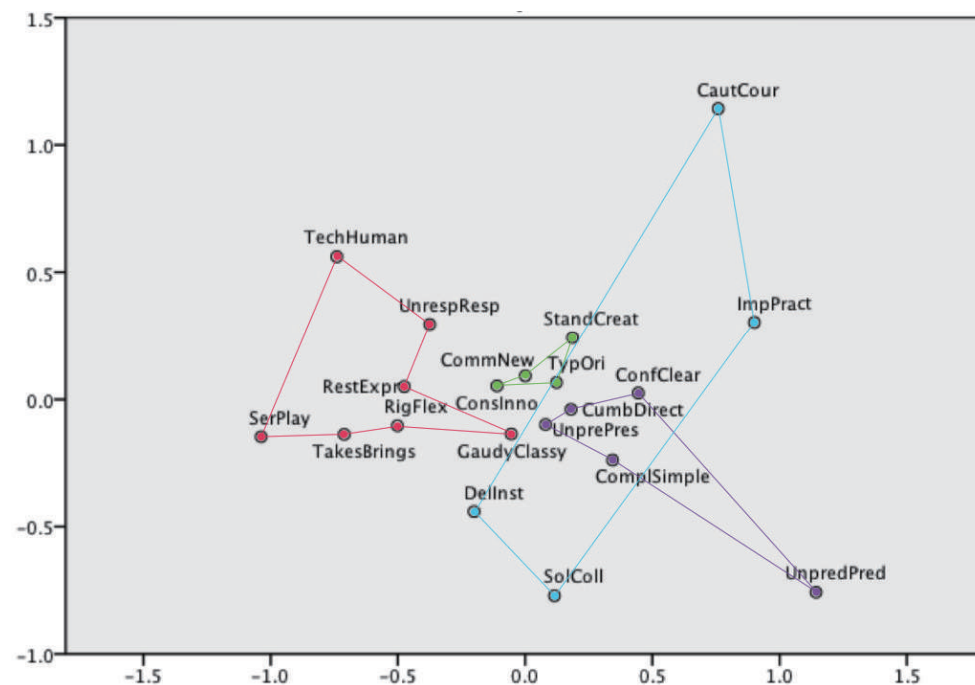


Figure 6.4. The correlation map of how similar product design dimensions correlated

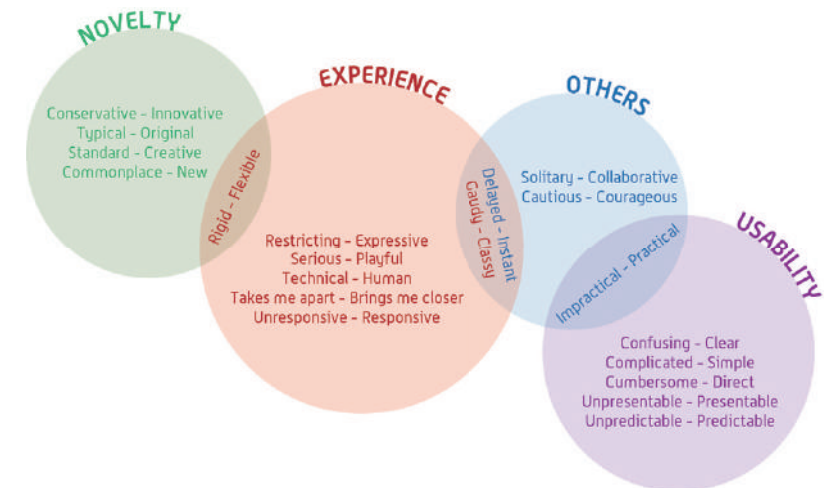


Figure 6.5. The connections between the groups

In analyzing the groupings, we tried to make sense of why dimensions were put together in the groups. Comparing the dimensions in each group suggested clear labels for the groups (those were added to table 6.3). The first group explains most of the variance in the answers and contains dimensions, which can all be regarded as qualities referring to experience. The second group contains qualities, which regularly used in discussing usability of products, whereas qualities in the third group all refer to some aspect of novelty. Finally, the fourth group is named others. These four groups are not perfectly separated. Most Generation Y interaction qualities are towards the left side of the correlation map (see Figure 6.4). They are more about user experience and feeling, compared with other Hassenzahl qualities that are more about usability and function towards the right side. Notably, the four Generation Y interaction qualities (playful, expressive, responsive and flexible) that received high scores are all together in the experience group, whereas those that received low scores are in the others group. The instant and collaborative interaction qualities suffer from being confused on the quality of function rather than on the quality of interaction.

After looking at the main groups, there are a few of values are present in more than one group. These values are dimensions, which are not only in one group but also a little bit less in a second group. They form a connection between these two groups (see Figure 6.5). The component loadings (as in table 6.3) are mostly within the groups, e.g., on the main diagonal of the table. But there are four linkages between groups, e.g., four qualities that contribute to two groups. These are 'allocated' in the group where their loading is largest, but also have a relation to the other groups. Only one of the four successful Generation Y interaction qualities in the experience group, 'rigid - flexible', contributes to another group, novelty. The other three linkages are with the others group, and because that group has no clear identity, finding a reason for that linkage is less easy. 'Delayed - Instant' links to the experience group. Differences between instant and responsive qualities seem ambiguous. 'Gaudy - classy' also links to the experience group. 'Impractical - practical' contributes to the usability group.

6.3.7 Conclusions of Study 1

This study showed that Generation Y interaction qualities can be experienced in the YPhone design. The playful, expressive, responsive and flexible interaction qualities implemented in YPhone are experienced well in a lab context. They also form a group that can be named as Experience. The results of the in-lab user evaluation can be extended towards general design guidelines that carry beyond the YPhone.

A few things were noted on the Generation Y interaction qualities and method. The playful, expressive, responsive and flexible qualities have more trust than the instant and collaborative qualities. Qualities can be grouped, although this may be different for different products that are evaluated, so researchers must be cautious about generalizing. Function qualities interfere with interaction qualities, resulting in the instant and collaborative scoring qualities low. Design audiences picked up on the Generation Y interaction qualities to describe interactions with the prototype. Laymen audiences used the terms less.

6.4 Contextual Evaluation

As a final step in the evaluation of YPhone, a contextual evaluation was conducted to assess to what extent the interaction qualities implemented in YPhone are experienced in a realistic office context. Since YPhone was an explorative research prototype and was not fully robust, a longitudinal study involving repeated observations of the actual use of YPhone over an extensive period of time, was not possible. Instead, it was decided to conduct contextual interviews with potential end-users, using scenarios as triggers for interaction to make the participants envision themselves using YPhone in future work situations and reflect on the interaction qualities with the prototype.

6.4.1 Method

In a contextual evaluation we visited participants and introduced YPhone for them to react to. Each participant experienced YPhone in his/her own work context, and the evaluation procedure was controlled and the reaction was observed (Kumar, 2005; Paton, 2002). As in an in-lab evaluation, we did not get involved in performing the user interactions but remained a passive observer, watching, listening to and documenting the ways of interacting. Compared with the in-lab evaluations, the participants were encouraged to relate more to the experience of their everyday work, e.g., tasks, environments and situations.

6.4.2 Participants

We selected 9 participants, who were young entrepreneurs (4), office managers (3) and other office workers (2) in small and big business. There were 5 male and 4 female participants. Their ages were between 23 and 31. They had different educational backgrounds: design (1), technical (4), management (3) and other (1). Their educational

levels varied: undergraduate (6) and graduate (3). Participants also presented various nationalities and various mother languages. 3 participants reported that they had more than one year of experience managing their offices, the rest of the participants reported an experience working in dynamic and fast-paced working environments.

6.4.3 Settings

To get a variety of culture, work fields and company sizes, the evaluations took place in the participants' work contexts (see Figure 6.6): EngageIT in Amsterdam, BINK36 in The Hague, Exact headquarters in Delft, Facebook headquarters in Menlo Park, Mozilla in Mountain View and goBalto in San Francisco. Young office workers were dominant at Facebook and Mozilla. The settings of YPhone, researcher's computer, the digital video camera and chairs were controlled. In this way, the camera recorded both the interaction and possible gesturing and pointing during the interview. Note: Video recording was not allowed at Facebook, Mozilla and goBalto. Only pictures were allowed.



Figure 6.6. The participants' generic work contexts. From left to right: EngageIT, BINK36, Exact, Facebook, Mozilla and goBalto

6.4.4 Instructions and Scenarios

To assist the participants to experience the prototype as much as possible (as in procedure step 2 in 6.4.5), a set of instruction pictures (see Figure 6.7) was created. The participants were asked to experience the actual use of YPhone and the detailed interactions. Key user-phone interactions (e.g., swiping in the air above the phone to browse phonebook) were demonstrated by illustrations and described by key words.

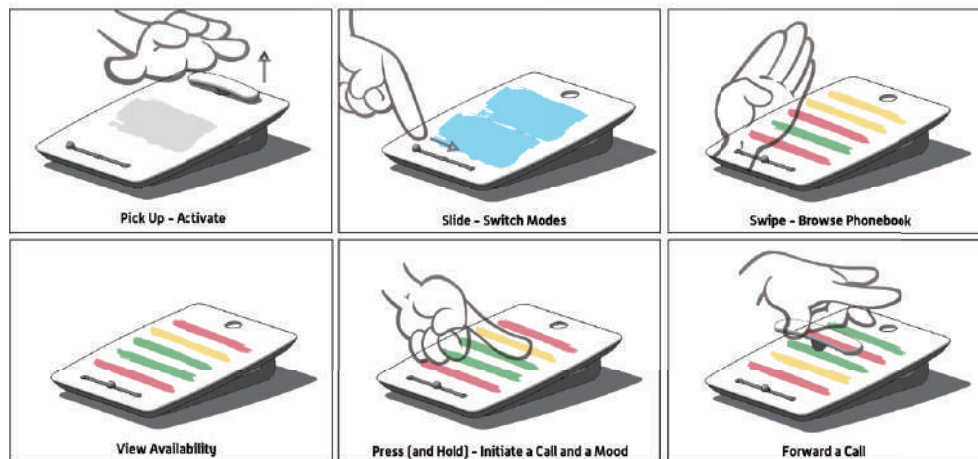


Figure 6.7. The instruction pictures that illustrate activating the phone, switching modes, browsing phonebook, viewing contacts' availability status, making a call and forwarding a call

User scenarios (as in 5.2.2) were used to have the participants enact specific use situations, while interacting with the prototype. Moreover, this was done in their specific work context, to facilitate them to relate the scenarios to their own work practice, and to make it easier for them to refer to their own situation. The scenarios determine the workflow of YPhone that the participants were asked to imagine and play out. The scenarios were described as follows:

1. Anne is a 25-year old female office manager. A client of her colleague Bill comes in, requesting to see Bill immediately because of an urgent situation. Anna tells the client to wait in meeting room B-01 and then she calls Bill. She activates her phone, switches to phonebook mode and is presented an availability overview of all her colleagues. She browses the phonebook to find Bill, who is available at the moment. She initiates the call and sends a mood complementing the ringtone. Bill receives a visual indication and a ringtone. Bill understands Anne's mood and picks up the call quickly. After the call he rushes over to meeting room B-01 to meet with his client.
2. Anne receives an incoming call from her colleague David in an overseas office. She picks up the call. David asks her to forward this call to Bill. It is urgent. Anne browses her phonebook to find Bill, who is not available at the moment. She tells David that Bill is away and she can forward his call to a colleague, who works with Bill on the same project. David agrees. She browses her phonebook to find Cindy and Edgar. Cindy is busy and Edgar is available at the moment. She forwards the call to Edgar and sends an urgent mood complementing the ringtone.

6.4.5 Procedure

Each evaluation took about 30 - 40 minutes per participant, during which they went through the following steps:

1. The researcher verbally introduces the project background in brief.
2. The participant is given the instruction pictures (see Figure 6.7) and is asked to try out each user-phone interaction with the YPhone prototype.
3. The participant reads both two specified scenarios (as in 6.4.4) for 3-5 minutes and is asked to act these through (see Figure 6.8). The acting is video recorded.
4. The participant is invited to explain in what ways the new design is related to the IT tools at home, if certain qualities are transferred from home to work, and where they succeed and where not (see Appendix H).
5. The participant views the recorded video and assesses if the Generation Y interaction qualities are in the design.
6. Round up discussion and reflection on the ways the new design would improve (or not improve) the office work.



Figure 6.8. The participants experienced YPhone on their working desks, walked through the specified scenarios and evaluated the design based on their experiences

6.4.6 Results and Analysis

Data from the study were:

- Observations of participants interacting with the prototype, e.g., recorded in videos and notes.
- Selected remarks by participants recorded noted as quotes.
- Answers by participants of the evaluation of interaction qualities, in what ways the new design is related to the IT tools that are richer at home and in what ways the new design would improve (or not improve) the office work.
- Transcripts from the evaluations.

Experiencing YPhone in a Work Context

Table 6.4 shows the participants' quotes related to interaction qualities when experiencing YPhone in their work context. In general, the participants experienced the YPhone as easy to use. Most participants immediately understood this user-phone interaction after viewing the instruction pictures. Sliding the magnet ball was experienced as fun, physical and playful. The ball was preferred to move all the way to the right position to explore further features. Swiping to flip the phonebook left or right was experienced as natural, intuitive and animated. Enabling vertical swipes to browse phonebook was requested. Some participants even tried to use multiple fingers to trigger urgent calls. Female participants with small hands tended to use their thumbs to trigger an urgent call, because they had to push down hard to meet the force sensor value. The intention was to see if they could observe and explore different mood when making phone calls. It turned out that they understood and successfully sent the urgent mood after trying out the user-phone interaction. Forwarding a call was experienced as being quite complicated.

While acting out both user scenarios (as in 6.4.4), the participants described their experience on how YPhone is operated. They believed that the interactions were appropriate within the office context, which are in line with the research findings and user expectations described in chapter 4. They thought that operating the phone was simple and experienced the user-phone interactions as tangible, natural and intuitive. Putting the earphone on a contact to forward a call was new to all participants.

The participants were asked to compare these user-phone interactions to the interactions they experience in their home context. In general, these interactions were experienced at home, but in a different form and with a different meaning. More specifically, they mentioned several interactions that were experienced and preferred to have in their home context, e.g., gesturing with a video game console. The participants expressed a wish to transfer interactions experienced at home to work. They enjoyed YPhone's physical interaction (e.g., sliding and pushing) and argued that swiping would be a good interaction to be transferred from home to work. They agreed that sending a mood would increase efficiency of communication, so this was a good interaction to be transferred. There were some interactions that the participants experienced as new and would like to experience at work, e.g., triggering an emotion.

Some participants described serendipitous experiences, which were seen as a fun way to bring out new thoughts. For example, a participant dropped the magnetic ball by accident on the table because he used too much power to slide, while another participant could not swipe to flip the phonebook smoothly until the window curtains were closed (the proximity sensors are less responsive under bright light). These experiences triggered discussion on design (e.g., taking out the magnetic ball to manually set availability status) and usability issues.

Steps	Quotes
1	<ul style="list-style-type: none">• Sometimes it is not reactive if I do it (i.e., swipe) fast, seems it does not register my swipe in this case• I would keep playing (i.e., spinning and sliding) with the ball when I get bored at work• I am so used to slide vertically to browse a phone book• ... my first thought on the color bars ... were used to highlight selected contacts, thus I ignored to observe the change of colors• It is reasonable to use enough force to ensure an emergent mood is sent• At the beginning, I don't understand sending a mood, but seeing different states from the other phone, I get it• I misunderstood that I have to flick a contact to forward a call
2	<ul style="list-style-type: none">• Within gentle, intuitive and well limited gestures, you can still call people, forward a call, get some information from a friend and you can have people join in I guess ... well limited means that you are given a designed space to operate the phone• I can use my left hand to operate it easily, so my right hand is saved for doing more complex work• It is very interesting that I have to physically move the ball to the middle, it is interesting because it is different from operating on digital screen• Swiping is natural, just like flipping book pages ... although I have to adjust the distance and angles of my hand• Sending availability signal from my side is useful, the phone reacts to my physical positions• Push and hold with a force ... I really need you now, Bill• I was not really sure where the idea of putting the earphone on the phone to forward a call came from, but once learned, I like it• These two phones really work together, the other phone is reactive timely
3	<ul style="list-style-type: none">• These interactions are similar ... to my home situations• ... you used the ideas more or less from the house• It is general human use, but it is designed for office use, I think it is interesting to see home styles (i.e., interactions) at work• I especially like the sending and checking availability interaction because it is reactive and responsive ... it is somewhat there in home situations, but it is definitely not there in work situations• I like that you borrowed the flipping (i.e., swiping) idea from Kinect
4	<ul style="list-style-type: none">• ... yeah ... swiping is commonly seen in Wii sports games, because this interaction is fun and learnable• ... swiping interaction ... from game consoles to office tools• ... you can use this interaction to design other tools, for example, an interactive calendar that notes important meeting schedules• I also see new interactions, for example, checking availability timely and sending availability automatically• Pushing is not new, but pushing with a certain force to trigger an emotion is• The operations (i.e., interactions) of activating, calling and forwarding are both innovative in my home and work situations, because I do not feel that I try out (i.e., experience) this type of interaction so often ... I am a typical Windows OS user
5	<ul style="list-style-type: none">• I would encourage you to design multiple means to make an urgent call, for example, I would tap on a contact to make a call and tap twice to make an urgent call

Table 6.4. The quotes noted in the evaluation step 2 - 6 (as in 6.4.5)

Evaluation of Interaction Qualities

Through analyzing the transcripts the following results were found regarding the experience of the six Generation Y interaction qualities:

- **Instant.** The participants experienced switching between interfaces (modes), viewing change of colors and receiving timely feedback as instant. 3 participants found instantness obvious and used similar words to describe it, e.g., quickly and timely. Their experience is instant when feedback is immediate and spontaneous, e.g., taking the earphone to activate the dial pad interface timely.
- **Playful.** Most participants experienced sliding the magnetic ball, swiping to browse phonebook, changing of colors and pushing hard to send an urgent mood as playful. All participants found playfulness obvious and used similar words to describe it, e.g., engaging, pleasing and fun. Their experience is playful when user action is new, engaging and enjoyable, e.g., swiping with different speed and gestures (e.g., with palm or with two fingers) to flip phonebook left or right.
- **Collaborative.** The participants experienced viewing contacts' availability status and putting on the earphone on a contact to forward a call as collaborative. 2 participants found collaboration obvious and used similar words to describe it, e.g., co-work and share. Their experience is collaborative when office tasks are shared and when it is in the product's function, e.g., viewing contacts' availability in three status and sending own availability information.
- **Expressive.** The participants experienced swiping to browse phonebook, push down with a force to send a mood and putting the earphone on a contact to forward a call as expressive. 8 participants found expressiveness obvious and used similar words to describe it, e.g., natural, intuitive and open. Their experience is expressive when user action is natural and playful, e.g., pushing down hard on a contact to send an urgent mood.
- **Responsive.** The participants experienced sliding the magnetic ball, switching between interfaces (modes) and sending availability status as responsive. 7 participants found responsiveness obvious and used similar words to describe it, e.g., reactive and alert. Their experience is responsive when feedback is quick and reactive, e.g., sliding the magnetic ball in to slots to switch interfaces (modes).
- **Flexible.** The participants experienced wearing the wireless earphone and putting the earphone on a contact to forward a call as flexible. 7 participants found flexibility obvious and used similar words to describe it, e.g., free and adaptable. Their experience is flexible when user choice is adaptable and adjustable, e.g., wearing the earphone to free hands.

The participants thought that the new design, YPhone, would improve their work situation. It brings new ideas into re-designing old-fashioned office equipment. '... to improve my work situation, of course, in many ways, it is more direct and natural, ... compared with my office phone ...'. The participants stated that YPhone's interactions and operations comply with office etiquette, 'decent touching and finishing, no shouting, no big arm waving', 'it

understands me and my colleagues ... availability checking ... I do not have to manually set my status as in Skype', 'to use different force to call with different mood, well fit'. One participant said that he might end up with playing with a magnet ball for a long time (when he is bored at work). In this case the design would not improve his work situation.

Further Remarks regarding YPhone and its Interactions

The participants provided several suggestions for improving the interaction with YPhone in the office context. These varied from improvements in functionality, 'enabling loudspeaker' and 'connecting to Outlook calendars to see availability status', to changes in physical appearance, 'aligning the color and shape with the office environment'. Valuable suggestions were directed at the user-phone interaction, 'allowing for tapping or rubbing the phone to send an ease mood', 'projecting contacts on a table and interact from there', 'using two fingers to swipe, it feels intuitive and cool', and 'exploring even more decent and appropriate gestures in office'.

6.4.7 Conclusions of Study 2

The results of this study indicate that YPhone and its user interactions would fit into the work context. The playful, expressive, responsive and flexible interaction qualities implemented in YPhone would be experienced well in a realistic office context. Functional qualities interfere with interaction qualities, resulting in the instant and collaborative qualities being experienced less than the other four qualities. Users can have an understanding of and can use the Generation Y interaction qualities to describe interactions with the prototype.

6.5 Discussion

YPhone was set out as an intervention to gain knowledge on Generation Y interaction qualities in the lab and in practice. The evaluations aimed to understand how the interaction qualities of the YPhone design are experienced in the work context. The overall result of the evaluation was that the prototype was able to attract users into using a new office tool and adapting it to their use. The findings from the evaluations are discussed below.

6.5.1 Supporting Generation Y Interaction Qualities

We had discussed the findings according to the six Generation Y interaction qualities, for which the research questions were set up. The biggest success was bringing the notion of interaction qualities from theory to practice and transferring rich Generation Y type of interactions from home to work. Although people know how to evaluate product functionalities by conducting usability tests, evaluating interaction design by using interaction qualities is new. Usually when researchers and designers consider interaction qualities, they would fit them into user experience. But typical user experience evaluations only address user feelings, memories and expectations from interacting with the interfaces.

These evaluations do not really address interaction qualities. In this study, we found that four out of six interaction qualities (playful, expressive, responsive and flexible) were really supported by the YPhone design. We had expected these four qualities to be experienced well, but were surprised by the instant and collaborative qualities.

The evaluation questionnaire was based on the existing Hassenzahl model. This worked because it addressed the right interaction qualities, which are the Generation Y interaction quality word pairs and the qualities in Hassenzahl model. The playful, expressive, responsive and flexible qualities are bound together tightly in a group, which forms a group in the 20 word pairs relate to the model. When the instant quality and responsive quality are both used to describe a user-product interaction, the responsive quality is easier to be understood and to be experienced. The collaborative quality is experienced the least among all six qualities based on the quality evaluation data because the participants experienced YPhone without directly interacting with other users. In their descriptions of YPhone, many participants used the interaction quality words or similar words to describe their experiences. Other researchers and designers are recommended to follow this method to evaluate interaction qualities.

6.5.2 Fitting into the Work Context

YPhone's user-phone interactions and its tangible form were highly valued by all participants. The design enabled experiential but rather subtle interactions, created a sense of virtual presence and allowed users to express emotions. Also, having a physical device on a work desk was experienced as a low threshold for interaction, which may also have had an influence on the strategies of user-phone interactions (e.g., viewing and calling) described earlier, one can reach out to the phone easily and interact with it. Most participants found the actions such as sliding, swiping and pushing down hard as intuitive and appropriate for work situations. The actions of viewing and sending availability status between colleagues, made the participants more consciously think of others' (work) situations, which supported their sense of co-working. Nevertheless, the participants did not express a desire for more accurate or detailed emotions and statuses, rather they expressed appreciation for YPhone's experiential interactions. The lack of sound in the interface was not seen as a problem. This feedback suggested that YPhone enabled rich interactions and communicated intuitively with colleagues.

6.5.3 Evaluation of the YPhone Prototype

YPhone was implemented using Max/MSP, Phidgets sensors and Arduino as development environments. A pair of prototypes was built to demonstrate and evaluate new ways of working. During the design and development process the researcher used YPhone himself and extensively demonstrated it to peers from the field of research and design. Both the positive and negative reactions gave the researcher confidence in the YPhone design.

It was worth to build interactive prototypes such as YPhone, because such prototypes enable participants to experience interaction qualities implemented within a design (in the

same way in the same evaluation settings). And the design iterations are relatively easy. And because in the making (while designing) the ideas about interaction qualities mature as we explore and experience the interaction qualities in a tangible form.

All participants actively experienced YPhone throughout the evaluations, suggesting that the prototype succeeded in maintaining user engagement. Technically the YPhone prototype was able to withstand the multiple exposures in the evaluations. The prototype was technically functional 92% of the time and the 69 participants encountered in total only four technical breakdowns while interacting with YPhone. These breakdowns did not result in total abandonment of their commitment to use YPhone. The participants reported suggestions, featuring requests and bugs, but these reflected mostly on details in interaction or appearance design and did not affect the overall experience of interaction qualities or the styles of interaction as a whole.

6.6 Conclusions

A challenge in the design and evaluation of office tools for Generation Y users motivated us to design and develop YPhone. Despite some interactive tools already available in office work, it has been difficult for researchers and designers to identify how these designs affect Generation Y ways of interacting and working. In the evaluation the YPhone prototype worked convincingly in demonstrating Generation Y interaction qualities and bringing Generation Y ways of interacting from home to work. The evaluation results indicate that the interactions transferred from home to work would fit into their work contexts and enrich their work situations. Most participants readily accepted both the physical design and the user-phone interactions.

The primary contribution of this work to the existing knowledge domain is the understanding of how interaction qualities support interaction design research on Generation Y ways of interacting and working. By carefully choosing evaluation methods and consistently controlling the evaluation procedure, we have been able to verify key interaction qualities for supporting Generation Y interactions. If researchers and designers would make designs that appeal to Generation Y type of interactions, contexts, tasks and people, the approach of following interaction qualities are recommended. Although the present study focuses on office tools only, a similar approach may be valid for other forms of [computer supported interactive] tools, applications and services.

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► **CHAPTER 7:
CONCLUSIONS AND
GENERAL DISCUSSION**

7.1 Reflection on the Research Findings

This section addresses the main research findings, including reflection on the research questions, the conceptual framework, the research framework and designing for interaction qualities. The perspective of this research underwent two big changes through understanding and designing Generation Y interactions. First, we started with demographics, which changed to styles of interaction. Secondly, we worked with interaction qualities instead of function qualities, developed a way to specify them for office situations, and used and evaluated them in design.

7.1.1 The Research Questions

The starting point of this research was formed by the research questions as listed in the introduction (as in 1.2). In the remainder of this section, the author discusses what answers were found.

‘What are Generation Y styles of interaction (in home life and office work)?’

The literature review showed that Generation Y has experienced a different state of technology and ways of (social) interaction than the generations before them, e.g., in that they grew up online, and experience mobile devices and social media as the natural condition of life. We gathered a set of examples of activities representative of what people currently do in their home and office context, and found that they could be grouped into a style of interaction, which we have labeled as ‘Generation Y’. We also noticed that this style of interaction seemed to be more prominent in the home situation than in the office context.

‘What are the interaction qualities that make up a Generation Y style of interaction?’

Six interaction qualities make up this particular style: instant, expressive, playful, collaborative, responsive and flexible. These six qualities functioned well in categorizing activities from home and work situations, and in having office workers describe how they would like qualities from home activities to be more present in their work situations. Each of the qualities could be given concrete examples in the home and work context. The interviews (as in 2.3) strengthened the impression that these qualities were better represented in home situations, such as gaming or chatting, than in office conditions, where traditional screen interfaces have seen less change over the past decade.

‘How are these interaction qualities experienced within the home and office context?’

The six interaction qualities were used as criteria to assess and compare the experience of user interactions in the home and work context. Playful, expressive, responsive and flexible seem to give good directions for improving interactions at work, while instant and

collaborative showed less opportunity. The latter, however, but may have been because of the choice of the particular office activities (as in section Interactions between Context and Product in 7.1.2).

The above might suggest a straightforward solution for improving interactions at the office: bring in the Nintendo Wii and the Microsoft Kinect controls, and social media. In practice, however, not all workers are Generation Y people, not all are digital natives, and the office equipment has to support collaborations between different people. For that reason, designing for Generation Y qualities is more subtle (and more limited) than just bringing in devices and techniques that Generation Y is familiar with.

‘What are opportunities to design office tools or services that support Generation Y styles of interaction?’

The interviews and discussions showed that the six interaction qualities made sense to users and designers alike. However, mostly designers would pick up the names of the qualities, whereas users tended to refer to examples that were given. This may be because designers are more used to talk about interactions and qualities as abstract things, whereas other people will refer to their direct experiences. The six interaction qualities together, with their corresponding guidelines, could be used by the author, and by design students with some success to design and enrich new types of user interactions in the work context. However, although they supported discussions and gave direction, this depended a lot on where in the design process they were used (as in section Interaction Qualities in the Design Process in 7.1.2).

‘How are the interaction qualities of these new designs experienced?’

In the evaluation, the YPhone prototype worked in demonstrating Generation Y interaction qualities, transferring the Generation Y style of interaction from home to work. Moreover, the evaluation results indicated that the interactions would fit into work contexts and enrich people’s work situations. And we found that the qualities could be fitted in the Hassenzahl model of qualities (as in 6.5.1). Most participants recognized the intended user-product interaction qualities, except for instant and collaborative (as in section Interactions between Context and Product in 7.1.2).

7.1.2 The Conceptual Framework

Besides finding (partial) answers along the directions of the research questions, the research helped sharpen our understanding of how interaction qualities might be instrumental in design processes. It turned out to be important where the qualities are positioned, both in the solution space of what is evaluated or designed, and in the design process.

Interactions between Context and Product

Interactions do not exist by themselves. They are situated on an activity level between the context of use level and the functional and product level. The interaction between user and

products lies between these two, and the interaction qualities at this level are connected to the other two levels (table 7.1). At the Why level, a person has an urgent reason to consult a colleague over the phone. At the What level, he does this by using the designed product, a phone. And in between is the interaction where he uses the phone toward the goal.

Why	Context and Goal (Call a colleague at work to discuss an urgent problem)			
	Interaction (Browse phonebook)	Interaction (Express urgent mood)	Interaction (Place the call)	Interaction (...)
What	Functions and Products (Use the desk phone)			

Table 7.1. The interaction between user and products lies between the context of use level and the functional and product level

Both these levels are hurdles for interaction designers. Many interaction designers see their main focus on designing ‘the concept’, i.e., that there are things like urgent consultations and who is involved in these. For many, the interaction and its qualities only come into view after the functional problems are being solved. In the student projects, this problem surfaced most visibly. Many struggled so hard with designing interactive technology that they were satisfied when ‘the button was pushable and could start the show’, showing difficulty in mustering the sensitivity to consider ‘whether the button was big, small, quick, slow, etc.’. Even when we tried to have them focus explicitly on the qualities by restricting the solution space to a pre-given context (i.e., the Pong game), the students pushed toward modifying the context (i.e., the pirate ship Pong) or a modality (i.e., the stereo audio Pong), with limited explorations along axes of interaction qualities.

In their defence, interaction qualities can easily be confused with functional qualities of a product. In the evaluation of YPhone, we found that the playful, expressive, responsive and flexible interaction qualities implemented in YPhone were experienced well in a lab context and in a work context, but the instant and collaborative qualities were experienced less. It may well have been that respondents found it difficult to assess whether YPhone’s interactions were experienced as instant and collaborative, because the activity of making a phone call is being perceived as instant and collaborative by nature, i.e., talking in real time with somebody else.

Interaction Qualities in the Design Process

The above difficulties suggest that interaction qualities are most helpful at guiding design actions during detailing rather than conceptualization. Possibly, designers should first solve the issues of context and product level before attending to interaction qualities to tweak, tune and polish them in subsequent iterations. This implies that the design should first be grounded in scenarios, storyboards and first functional prototypes, before the part of solution space is opened up where interaction qualities can help. Earlier research prototypes, e.g., those by Frens (2006) and Wensveen (2005) were also fully functional.

Qualities, Words and Experience

As noted earlier, the six interaction qualities were readily picked up by designers to discuss activities and products, and served well as labels for groups of collected activities for respondents in research. However, giving only the names and a verbal definition or description to student designers had only limited value. Often stories, memories, demonstrations and examples, were needed to give guidance. One reason for this is that the qualities are more abstract than product qualities like ‘soft’, ‘yellow’ and ‘curved’ that designers have been used to deal with: interaction qualities are essentially relations (between user and product), depending highly on dimensions like time (fast or slow), proximity (close or distant) or amplitude (small or big), that manifest themselves in bodily experiences. For each of these, the symbolic nature of language is a limited means of expression and communication.

In order to support designers in working with interaction qualities, they may need to develop not only a vocabulary, but also a ‘sense’, a repertoire along these dimensions. Designers could then pick one or more interaction qualities from such a repertoire of examples, and use these as a benchmark against which they later could compare their designs.

Tools for exploring interaction qualities are also needed. For classic product qualities, such as the color of a display, many simple and sophisticated tools exist. But the subtlety of flicking the magnet ball in YPhone requires fine-tuning resistance, friction and stability, which can currently only be done by careful craft, i.e., repeatedly cutting the running groove with appropriate tools. New developments in 3D printing may well prove important in enabling such explorations, e.g., by creating a series of variations of running grooves for testing their motion qualities.

7.1.3 The Research Framework

The developed research framework (see Figure 1.5) proved to be instrumental in guiding the research as a whole. The three main components of the framework (people, technology and context), helped explore the relation between user behaviors, technology and context. Focusing on the intersections of the three components enabled the exploration of Generation Y interactions within the contexts of home and work. Even though the project started from the people component (Generation Y), the technology and context components turned out to be instrumental in keeping an integrated overview.

The research activities (e.g., interviewing, designing and evaluating) were important, because they connected the three components, pulling knowledge towards the center of the framework. This indicates the necessity for the researchers to: 1) familiarize themselves with the existing literature before entering each research cycle (i.e., user research, design and evaluation), 2) quickly iterate with new designs and demonstrators, and 3) consciously search for moments in which the new knowledge (i.e., interaction qualities and design

guidelines) can be found. The latter emphasizes the importance of achieving guidance in designing interactions, to assist the research goal of supporting Generation Y interactions.

7.1.4 Designing for Interaction Qualities

Traditionally in design, products were designed to look beautiful and to function well. These products were created by combining technology trends, software capabilities and product functions rather than focusing on the application and experience of user interactions in a specific context. Since two decades ago, IT products have become interactive and with the maturing of interaction design as a discipline, attention is gradually shifting from designing quality of aesthetics and function to designing qualities of interaction (Löwgren, 2006; Preece et al., 2007). In the current design of product-service systems, as done in the creative industry scientific programme [CRISP] program in which this research is embedded, an even larger system is being designed (CRISP Platform, 2014). The focus there becomes managing relations, such as trust and experience, along longer stretches of time and in more complex environments.

This research contributes to the existing body of knowledge in this domain by taking the notion of interaction qualities from theory to practice and bringing Generation Y interaction qualities from home to work. Although other researchers and designers know how to start designing from a functional perspective, designing using interaction qualities is new. Previous work (Frens, 2006; Ross, 2008; Rullo, 2008) sees interaction qualities as analytical tools and inspirational instruments, and would fit them into user experience, which addresses user feelings, memories and expectations from interacting with the interfaces. In this research, interaction qualities, as a new strength in guiding design, are about what experience a user can get with a design through actively engaging with a product, system or service. They can help designers give specific emphasis when designing the interactions they want their product to evoke.

We believe that interaction qualities can serve as a tool to guide the design process, especially in tuning interactions that have been chosen. The six interaction qualities (as in table 2.1) become a set to guide designers in realizing Generation Y interactions. They are a key set for this research and are helpful to guide designers, but not a complete set (e.g., the playful quality may extend to cheerful, engaging and passionate qualities) for reaching out every detailed aspect describing user-product interactions.

Are there only six interaction qualities? In our studies, six interaction qualities were sufficient to categorize the set of activities we found in the home and work context, and all six had some value in giving direction to designers. But the ease in which these six qualities could be fitted into the Hassenzahl model (as in 6.3.4) may be a sign that there may not be a complete set. It may even be questioned if making a complete set would be useful, given the observation that none of the six qualities were identical to the ones in the Hassenzahl model. Rather, the most important lesson may be to direct the designer's attention to

interaction qualities as something that can (or should) be designed, and to point out how the solution space can be explored, possibly by showing a repertoire of solutions that instantiate each quality.

7.2 Reflection on the Approach

In this section the author reflects on research methods used in the study.

7.2.1 Literature and Interviews

In the first part of the project, literature study, contextual interviews were the main methods. Although the literature helped with identifying Generation Y demographics, lifestyles and behaviors, little was found on the specific level of interactions.

The open-ended nature of face-to-face interviewing was assisted by generative toolkits and guided tours through the users' home and work environment served to identify the interactions, and to derive a model. Previous work (IDEO, 2010; Sanders, 2008; Sleeswijk Visser et al., 2005) shows that interviewing and designing with a toolkit can engage users in a user-centered design process and support them in activities such as sharing experiences, building skills and implementing ideas. In this research, the toolkit (see Figure 4.2) served as a trigger to overcome the difficulties of getting people to talk about interactions. It helped prompt the participants to recall concrete experiences and to think about how they experience certain contexts and interactions. This evoked the participants to make comparisons on interactions between the home and work context. Because the design of the interview boards and the activities was somewhat ambiguous, the boards mainly served to help the participants talk about memories and opinions, rather than answer specific questions. This enabled us to discuss possible conflicts and differences in perspectives, and to cluster the interpretations based on the transcripts, field notes and the notes. A consequence of this openness was that the interpretation of individual cards and terms varied. Although the placement of the cards on the boards might be regarded as ratings on 7-point scales, a statistical analysis was not possible. Rather, the analysis focused on interpreting what the participants said to explain their placements.

7.2.2 The Value of Doing Design as Part of the Research

Research offers methods to conduct studies and to gain knowledge on a current state of affairs. In order to study a state of affairs that does not yet exist, we can bring that state into being, which requires an act of design. In research through design, both the resulting prototype and the act of designing itself can contribute to that new understanding. The prototype can be evaluated in the setting, with regular methods of study. In the act of designing, the designer-researcher is confronted with the difficulties of realizing the theoretical ideas into the real world. Reflecting on the design decisions also provides

understanding, which is more difficult to capture than the results that are visible in the prototype. In this research project, the author's own design iterations (3 iterations in chapter 3 and developing YPhone in chapter 5) and his involvement in student projects provided continuous occasions to reflect on and reconsider the value of the interaction qualities in guiding him or the students, and to collect examples of situations where the qualities are best represented. Although this process was not documented explicitly, it contributed implicitly to the progress of the research.

7.2.3 Prototypes and Evaluations

Each of the prototypes (as in chapter 3 and 5) was built with an iterative design process and with the intent to demonstrate Generation Y interactions. It was worthwhile to build prototypes such as YPhone, because such prototypes enabled the participants to experience interaction qualities implemented in a design (in the same way in the same evaluation settings). Considering all the techniques used in the design process, ranging from sketching, storyboarding to play-acting, demonstrating a new design with a working prototype was the most important. By designing and building prototypes, different aspects were integrated from theory and practice. By setting out and demonstrating prototypes that cover interaction qualities, feedback from users, peers and experts was gathered. Prototypes make it possible to communicate complex results through demonstration. They guide users in imagining different office situations by demonstrating interactions and user scenarios. This is valuable, as users do not only reflect on an envisioned experience, but on an embodied experience, when they are immersed in the experience by touching and operating the prototypes.

For the controlled in-lab evaluations, the evaluation questionnaire borrowed was based on the Hassenzahl (2004) model, which was proved to work well for assessing interaction qualities (Frens, 2006). This worked because it addressed the right interaction qualities, which are the Generation Y interaction quality word pairs and the qualities in the Hassenzahl model. In other research through design projects of Frens (2006), Ross (2008), Wensveen (2005) and Visser (2011), the researchers primarily focused on controlled in-lab and longitudinal studies to evaluate a main hypothesis. Compared with their approaches, the approach followed in this research has a broader range of involving user, experience and context. This was essential to capture the real-world user experiences in the work context. This helped form and improve our understanding of how to design office tools with Generation Y type of interaction.

7.2.4 Limitations and Complications

A drawback of field studies involving tangible prototypes is that they typically require a high degree of robustness, i.e., technology readiness (Koskinen et al., 2011). Although four technical breakdowns while interacting with YPhone were encountered in 69 trials, even these did not result in total abandonment of the participants' commitment to use YPhone.

In addition, the fact that the participants are required to experience a separate tool in their work contexts may distract them from routine work.

A longitudinal field study was not possible because of limitations of the Wizard-of-Oz prototype (as in 6.2.3). This means that the YPhone prototype cannot be left in the offices as a fully robust and finished product. As previous work (Keller, 2005; Visser et al., 2011) indicates, although being less controllable, a longitudinal approach may provide unique insights into user-adoption of a new design over time. A direction for further research is to make YPhone fully robust and to set out YPhone a longer period of time (e.g., a week) in the work context to further evaluate and validate the outcomes of the previous research. However, the effort required to making a fully functional prototype can come close to creating a fully working product. Future research might be conducted on modifying existing office phones, or on a product with a more limited functionality.

7.3 Recommendations

This research project was started with the aim of finding guidelines for practitioners to design 'the next generation interfaces for office use'. We aimed the work to be both useful for practitioners (in particular Exact) and design researchers. In this section the author suggests recommendations for each group.

7.3.1 For Office Tool Developers

At this moment (beginning of 2014) there still aren't too many examples of office tools being fully integrated with new interactions (e.g., Generation Y interactions) and new technologies (e.g., high-tech sensors and actuators). The few notable exceptions are mostly conceptual designs, which are not broadly experienced and adopted by office workers. To point a direction for developers, like Exact, who care about supporting office situations with new tools, applications and services, starting out projects from user-centered perspectives and from the interaction perspective are recommended. One direction that could be explored is to gamify specific ways of working, which apply elements such as training, practicing, competing and rewarding within the design of applications. The interaction qualities approach can enhance this by promoting designs that are not just game-like in a structural sense of taking turns and earning rewards, but, e.g., also more playful as an experience.

7.3.2 For Design Practitioners, Educators and Students

The six interaction qualities can help designers develop products that fit with the new interaction styles that have entered our lives in the last decade. These qualities indicate directions, present examples, and provide relevant dimensions to evaluate a design.

On the basis of the experiences in this thesis, the author recommends that the qualities are applied after a basic design direction has been chosen, i.e., both a context and a product. The qualities help in improving the how of the interactions, but provide less guidance during the earlier phases where the goals and the interactions are chosen (as the Why and What in table 7.1). Moreover, it is recommended that the designer chooses some examples of existing interactions to exemplify the design directions, so that he or she can make intuitive use of his bodily experiences, rather than going 'by the name of the quality' alone. Building a personal collection of 'inspiring examples of qualities' may serve the designers in future projects. Such a collection may also prove of value for education.

For design students, it is important gain a feeling for the difference between interaction qualities, context and product level. Such a feeling can be fostered by design exercises in which the product and context are clearly fixed, and in which the qualities are systematically varied. Such exercises can also deliver rich examples to guide others, as they have done for classic design parameters such as color and lifestyle.

7.3.3 For Design Researchers

This research studied how a specific set of qualities can be identified and put to use in designing products. The research was mainly exploratory and qualitative, and served to highlight opportunities and pitfalls. We can claim that we now understand the specifics of the new generation of devices better, and have provided means to find such qualities, evaluate their presence in existing products and prototypes of new products, and guide designers toward improving those qualities in their designs. But in none of these can we claim to have provided the final word. It is not unthinkable that an extra quality is still found. Also, the complexities of context and product level also provide some difficulties in presenting the qualities as ready-to-use tricks.

Future research may validate the qualities in more controlled conditions. But more urgently, it would be helpful if the repertoire of qualities is mapped out with examples into a collection that researchers, but also practitioners, educators and students, can use. Such a repertoire may convey the subtlety and richness of Generation Y experiences. It can be a tool to assist designers in exploring the solution spaces that underlies the qualities. Optimally, such a tool should itself be instant, expressive, playful, collaborative, responsive and flexible.

7.3.4 For CRISP

The Dutch creative industry is internationally renowned. Dutch design is one of the Netherlands' key value-adds. To support the creative industry scientific programme (CRISP) to focus on generating and disseminating knowledge for the development of complex combinations of intelligent product service systems (PSS) with a highly effective user experience (CRISP Platform, 2013), the next CRISP researchers are recommended to make a step to further: 1) collaborate with Universities with a design curriculum that educate

students and industries that employ PSS design and development, 2) develop new and advanced knowledge structures to support the development of complex and innovative PSS, 3) generate knowledge, tools and methods to allow designers to more effectively design user experiences, 4) look for optimal application of smart and enabling technology to PSS, 5) obtain fundamental knowledge as well as a means of validating the results in a near real-life and application oriented context, and 6) create a unique and extensive communication platform for the dissemination and transfer of knowledge.

► **SUMMARY**

The rapid development of information technology in the past decade has enabled the introduction of a number of new communication tools and platforms in everyday life, such as instant messaging, podcasting, blogging and social networking. These tools offer people new ways of interacting, enabling them to create, retrieve and broadcast large amounts of digital information, using a great variety of devices, techniques and media. As a result of this constant stream of information, people have become more socially active as well as become more capable and ready to integrate their virtual world with their physical world, using highly interactive devices, such as mobile phones, laptops and multi-touch tablets.

So far, however, this kind of interactive behavior has mainly manifested itself in people’s private context, while in the more public work context the rich interactions that all these new technologies are offering do not seem to be supported to a great extent yet. Whereas office applications have increased sometimes dramatically in functionality, the ways of interacting with all these functionalities have evolved much more slowly. As a consequence, most office work is thus still done through the ubiquitous, almost 40-year old, set-up of keyboard, display and mouse, which only supports limited behaviors, such as keyboard tapping and mouse clicking.

This lack of richness in interaction is becoming more evident, now that a new generation of workers is quickly entering the market. This so-called Generation Y, born in the 1980s and early 90s, are digital natives, who have experienced digital technology their entire lives. Thus they have developed new ways and habits of interacting with their (digital) world, putting very high demands on the applications, services, devices and networks that enable and support these interactions.

An interesting challenge therefore presents itself to designers and researchers:

How to bring the qualities of the interactions that people currently experience in the private context of their homes and friends into the more public context of their offices and colleagues?

In this thesis this challenge is taken on through a number of studies, in which the following research questions were addressed:

- 1. What are Generation Y styles of interaction in home life and office work?
- 2. What are the interaction qualities that make up Generation Y styles of interaction?
- 3. How are these interaction qualities experienced within home and office context?
- 4. What are opportunities to design office tools or services that support Generation Y styles of interaction?
- 5. How are the interaction qualities of these new designs experienced?

The figure below shows the research framework of this thesis, which distinguishes three major components: 1) people (Generation Y), 2) technology and 3) context (home vs. work).

On the intersections of these three components are the interactions that are at the core of the research.



From the beginning and throughout the whole research, prototypes that are rich in aesthetic, expressive and experiential quality were built and tested in real contexts. In the first phases of the project emphasis was in the exploration of new ways of interacting, while later on in the project the focus shifted to applying these new interactions within the office context.

Chapter 2 addresses research questions 1 and 2 through literature review, as well as a qualitative study, aimed at exploring Generation Y styles of interaction, behaviors and interaction qualities. In a series of contextual interviews with office workers, we found that they put very high demands on the applications, services, devices, and networks that enable and support collaborative work. A set of examples of activities representative of what people currently do in their home and office context was gathered and grouped into a style of interaction, which we have labeled as ‘Generation Y’. This style of interaction seemed to be more prominent in the home situation than in the office context. Six interaction qualities (instant, expressive, playful, collaborative, responsive and flexible) were identified to make up the Generation Y style of interaction. The interviews strengthened the impression that these qualities were better represented in the home context, through activities such as gaming or chatting, than in the office context.

Chapter 3 focuses on interactive technology design, designing and developing a number of experiential prototypes as a first exploration. It explores how to use interaction qualities to guide the design of Generation Y styles of interaction by combining functional,

experience and technology approaches. In an educational setting a number of interactive prototypes were built by students in which specific interaction qualities were explored and demonstrated. From designing, building and testing these prototypes, we learned to use interaction qualities to explicitly guide and constrain the design process. Interaction qualities were found to be able to integrate all three design approaches, and thus can be introduced as a possible new principle into design research and education.

Chapter 4 addresses research question 3. In follow-up interviews, we explored how office workers experienced and judged the interaction qualities in their home and the office situations in order to develop interaction design guidelines. The interviews and discussions showed that the six interaction qualities made sense to users and designers alike. Designers are more used to talk about interactions and qualities as abstract things, whereas other people will refer to their direct experiences. The six interaction qualities, together with their corresponding guidelines were subsequently used by the author and by design students, to design new types of interactions in the work context.

Chapter 5 deals with research question 4 by implementing the interaction qualities into a new design, which uses the knowledge and experience gained from the previous chapters and integrates them into a working prototype. An office phone was chosen as the product to bring the Generation Y interaction qualities into an office context. The YPhone prototype was developed to demonstrate the interaction qualities with new ways of working, e.g., pushing down hard on a contact to send an urgent mood while calling. YPhone prototype is being developed using Max/MSP, Phidgets sensors and Arduino. A pair of prototypes was built to demonstrate and to evaluate the Generation Y interaction style in office work.

Chapter 6 focuses on synthesis again to answer research question 5. This chapter presents findings on the prototype's performance on the interaction qualities in a lab setup and in a real office work context. The YPhone prototype was demonstrated, evaluated and discussed at a series of venues, with respondents trying out scenarios such as placing an urgent call, or relaying an incoming message. The prototype worked in demonstrating the intended Generation Y interaction qualities. Moreover, the evaluation results indicated that the interactions would fit into work contexts and enrich people's work situations. These findings indicate that the interaction qualities can give guidance in designing Generation Y type of interactions.

Chapter 7 starts by reflecting on the answers on the five research questions. This is followed by a general discussion of the research: what has been learned and what are the possible impact of its results. The aim of this research was to contribute to the existing body of knowledge in the domains of interaction design and design research. By taking interaction qualities as a driver in the design and research process, the intention was to bring Generation Y interaction qualities from the home context to the work context. We believe and hope that interaction qualities can serve as a tool to guide the design process, and that the six interaction qualities will become a valuable instrument to guide designers in developing new office tools and applications that are rich and engaging in interaction.

► **SAMENVATTING**

De snelle ontwikkeling van de informatietechnologie in de afgelopen tien jaar heeft geleid tot de introductie van een aantal nieuwe communicatiemiddelen en platforms in het dagelijks leven, zoals instant messaging, podcasting, blogging en sociale netwerken. Deze middelen bieden mensen nieuwe manieren van interactie voor het maken, verzamelen en verspreiden van grote hoeveelheden digitale informatie, daarbij gebruik makend van een grote verscheidenheid aan apparaten, technieken en media. Als gevolg van deze constante informatiestroom zijn mensen meer sociaal actiever geworden, alsmede meer bereid om hun virtuele wereld te integreren met de fysieke wereld door middel van interactieve producten, zoals mobiele telefoons, laptops en multi-touch tablets.

Tot nu toe, echter, heeft dergelijk gedrag zich vooral gemanifesteerd in de private thuiscontext, terwijl in de meer publieke kantoorcontext de rijke interacties die al deze nieuwe technologieën bieden, voor een groot deel nog niet lijken te worden ondersteund. Hoewel kantoortoepassingen soms dramatisch in functionaliteit zijn gestegen, zijn de manieren van interactie met al deze functionaliteiten veel langzamer geëvolueerd. Als gevolg daarvan wordt het meeste kantoorwerk dus nog steeds gedaan met behulp van de alomtegenwoordige, bijna 40 jaar oude, opstelling van toetsenbord, beeldscherm en muis, welke alleen beperkt gedrag ondersteund, zoals het tikken op het toetsenbord te tikken en het klikken met de muis.

Dit gebrek aan rijkdom in interactie wordt steeds nijpender nu er een nieuwe generatie van werknemers op de markt komt. Deze zogenaamde Generatie Y, geboren tussen het jaar 1980 en begin jaren '90, zijn 'digital natives', die hun hele leven zijn omgegaan met digitale technologie. Hierdoor hebben zij nieuwe manieren en gewoonten van interactie met hun [digitale] wereld ontwikkeld, waardoor ze zeer hoge eisen stellen aan de toepassingen, diensten, apparaten en netwerken die deze interacties mogelijk maken en ondersteunen.

Hier ligt dan ook een interessante uitdaging voor ontwerpers en onderzoekers:

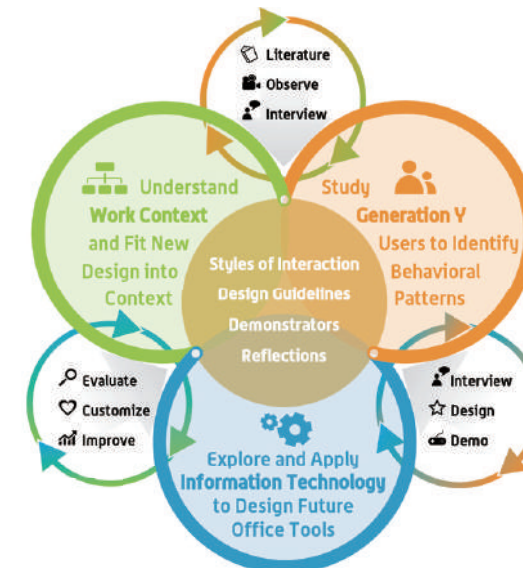
Hoe kunnen de kwaliteiten van de interacties die mensen die momenteel ervaren in de private context van hun huizen en vrienden worden toegepast in de meer publieke context van hun kantoren en collega's?

In dit proefschrift wordt deze uitdaging aangegaan in een aantal onderzoeken, waarin de volgende onderzoeksvragen aan bod komen:

1. Wat zijn Generatie Y interactiestijlen in de private thuiscontext en publieke kantoorcontext?
2. Welke kwaliteiten hebben dergelijke Generatie Y interactiestijlen?
3. Hoe worden deze interactiekwaliteiten ervaren in de private thuiscontext en publieke kantoorcontext?
4. Wat zijn de mogelijkheden om kantoortoepassingen of diensten te ontwerpen die Generatie Y interactiestijlen ondersteunen?
5. Hoe worden de interactiekwaliteiten van dergelijke nieuwe toepassingen ervaren?

Figuur toont het onderzoekskader van dit proefschrift, waarin drie belangrijke componenten worden onderscheiden: 1) mensen (Generatie Y), 2) technologie en 3) context (thuis versus

kantoor). Op de kruispunten van deze drie componenten liggen de interacties die de kern van dit onderzoek vormen.w



Vanaf het begin en gedurende het hele onderzoek zijn prototypes van hoge esthetische, expressieve en ervaringsgerichte kwaliteit gebouwd en getest in realistische contexten. In de eerste fasen van het project lag hierbij de nadruk op het verkennen van nieuwe manieren van interactie, terwijl later in het project de focus werd verlegd naar het toepassen van deze nieuwe interacties binnen de kantoorcontext.

Hoofdstuk 2 behandelt onderzoeksvragen 1 en 2 door middel van literatuurstudie, alsmede een kwalitatief onderzoek gericht op het verkennen van Generatie Y stijlen van interactie, gedrag en interactie kwaliteiten. In een reeks van interviews met kantoormedewerkers vonden we dat zij zeer hoge eisen stellen aan de toepassingen, diensten, apparaten en netwerken die hun gezamenlijk werk mogelijk maken en ondersteunen. Een aantal voorbeelden van activiteiten binnen de thuiscontext en de kantoorcontext is verzameld en gegroepeerd in een interactiestijl, welke is bestempeld als 'Generatie Y'. Deze interactiestijl leek meer prominent aanwezig te zijn in de thuiscontext dan in de kantoorcontext. Zes interactiekwaliteiten (urgentie, expressiviteit, speelsheid, gezamenlijkheid, reactiegevoeligheid en flexibiliteit) werden onderscheiden als elementen van de Generatie Y interactiestijl. De interviews versterkten de indruk dat deze kwaliteiten beter vertegenwoordigd waren in de thuiscontext, in activiteiten zoals gamen of chatten, dan in de kantoorcontext.

Hoofdstuk 3 richt zich op het ontwerpen van interactieve technologie middels het ontwerpen en ontwikkelen van een aantal ervaarbare prototypes als een eerste verkenning. Onderzocht werd hoe interactiekwaliteiten gebruikt kunnen worden om het ontwerpen voor Generatie Y interactiestijl te sturen middels het combineren van een functionele, ervaringsgerichte en technologische benadering. In een onderwijssituatie werden door studenten een aantal interactieve prototypes gebouwd, waarin specifieke

interactiekwaliteiten werden verkend en gedemonstreerd. Van het ontwerpen, bouwen en testen van deze prototypes leerden we hoe interactiekwaliteiten te gebruiken als expliciete leidraad in een ontwerpproces. Door te ontwerpen vanuit interactiekwaliteiten bleken te alle drie ontwerpbenaderingen te kunnen worden geïntegreerd, waarmee een mogelijk nieuw principe binnen het ontwerponderzoek en onderwijs zou kunnen geïntroduceerd.

Hoofdstuk 4 behandelt onderzoeksvraag 3. In vervolginterviews werd onderzocht hoe kantomedewerkers de zes interactie kwaliteiten in hun thuiscontext en kantoorcontext ervaren en beoordelen, met als doel richtlijnen voor interactie ontwerpen op te stellen. Uit de interviews en discussies bleek dat de zes interactiekwaliteiten zowel gebruikers als ontwerpers aanspraken. Ontwerpers zijn echter meer gewend om te praten over interacties en kwaliteiten als abstracte dingen, terwijl gebruikers zullen meer verwezen naar hun directe ervaringen. De zes interactie kwaliteiten zijn vervolgens, samen met de bijbehorende richtlijnen, gebruikt door de auteur en door ontwerpstudenten om nieuwe soorten interacties in de werkcontext te ontwerpen.

Hoofdstuk 5 gaat in op onderzoeksvraag 4 door het toepassen van de interactiekwaliteiten in een nieuw ontwerp, waarbij de kennis en ervaring uit de voorgaande hoofdstukken werd gebruikt en geïntegreerd in een werkend prototype. Een kantoortelefoon, genaamd YPhone, werd gekozen als product om de Generatie Y interactiekwaliteiten in een werkcontext te implementeren. Het YPhone prototype werd ontwikkeld als platform om de interactiekwaliteiten met nieuwe manieren van werken te verbinden. Bijvoorbeeld door tijdens het bellen hard naar beneden te duwen op een contact, kan de urgentie van een oproep worden geuit. Het YPhone prototype werd ontwikkeld met behulp van Max/MSP, Phidgets sensoren en Arduino. Twee prototypes werd gebouwd om de Generatie Y interactiestijl te demonstreren en te evalueren.

In hoofdstuk 6 wordt het gebruik van het YPhone prototype in een laboratoriumsituatie en in een kantoorcontext behandeld. Op diverse locaties is het prototype gedemonstreerd en geëvalueerd door samen met gebruikers verschillende scenario's te doorlopen, zoals het plaatsen van een dringende oproep of het doorgeven van een binnenkomend bericht. Het prototype bleek de beoogde Generatie Y interactiekwaliteiten te hebben. Bovendien maken de resultaten van de evaluatie aannemelijk dat de interacties zouden passen in de kantoorcontext en het werk zouden kunnen verrijken. Deze bevindingen geven aan dat interactiekwaliteiten sturend kunnen zijn in het ontwerpen van Generatie Y interactiestijlen.

Hoofdstuk 7 start met een reflectie op antwoorden op de vijf onderzoeksvragen. Dit wordt gevolgd door een algemene discussie van het onderzoek: wat er is geleerd en wat zijn mogelijke gevolgen van de resultaten. Het doel van het onderzoek was een bijdrage te leveren aan de bestaande kennis op het gebied van interactie ontwerpen en ontwerponderzoek. Door interactiekwaliteiten als leidend te nemen in het ontwerp en onderzoeksproces, is getracht om Generatie Y interactiekwaliteiten van de thuiscontext naar een kantoorcontext te brengen. Wij geloven en hopen dat interactie kwaliteiten kunnen dienen als een nieuwe ontwerpaanpak en dat de zes interactiekwaliteiten een waardevol instrument zullen worden voor ontwerpers bij het ontwikkelen van nieuwe kantoortoepassingen.

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► APPENDICES



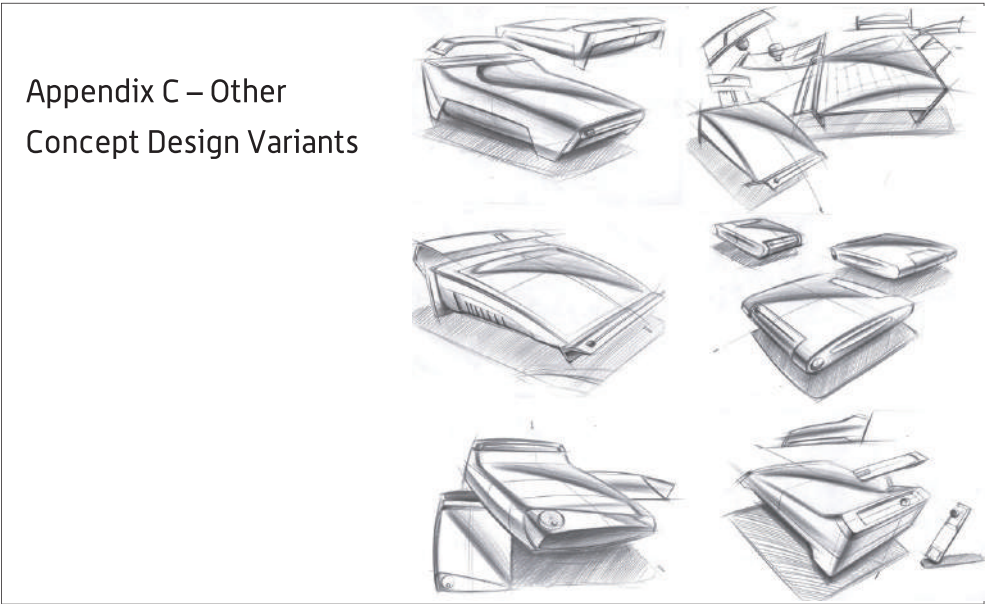
Appendix A – The Six Sets of Completed Interview Boards



Appendix B – The Rated and Placed Activity Cards

The number of activity cards placed was noted down for each participant and each board. The participants placed between 7 and 27 cards on the board. Usually the numbers in the home and work contexts were not far apart. For example, participant VR put between 7 and 13 cards on the interview boards, the number difference of the cards on each board in the home and work contexts was at most 1. In 18 cases, the number difference between the home and work contexts was smaller than 1. In 4 cases, the number difference between the home and work contexts was larger than 5. This means the participants experienced a different number of IT supported activities in the home and work contexts. The largest difference was 36%, i.e. participant MG had 8 cards for home and 17 cards for work for the playful quality. This means she experienced a lot more playful and/or non-playful activities in her work context. Because of small number of participants, no statistics were calculated.

The average scores were also compared for each participant and each board. As we indicated in the ‘research approach’ section, the main purpose of the cards was not to measure scores, but to evoke reflection on the interaction qualities and the differences between the home and work contexts, and to provide starting points for discussing the interaction qualities. Therefore, the average scores were explored for trends that led to discussion on these interaction qualities. The scores are rough measures for a small number of respondents, but illustrate a few differences. The highest score is 4.8 for the responsive quality in the home context, and the lowest score is 2.7 for the playful quality in the work context. Difference between the home and work contexts is always larger than zero, except for the instant quality. The average scores for the playful, expressive, responsive and flexible qualities are higher in the home context. The average score for the instant quality is equal for work and home. The average score for the collaborative quality is lower in the home context.



Appendix D – The Quality Evaluation Questionnaire

1. Personal information

What is your gender?
☐ Male
☐ Female

What is your age?

What is your nationality?

What is your occupation?

How often do you use desk phones?
☐ Never
☐ Rarely
☐ Sometimes
☐ Often
☐ All of the Time

How much do you like to use desk phones?
☐ Not at all
☐ Not much
☐ Neutral
☐ Much
☐ Very much

Please explain why.

Which type of phone do you prefer?
☐ Desk phone
☐ Smart phone
☐ No preference

Please explain why.

2. Please evaluate how you experienced the interaction qualities of the design.

1. Typical - Original
Typical
1 2 3 4 5 6 7
Original not Applicable
Please explain why.

2. Standard - Creative
Standard
1 2 3 4 5 6 7
Creative not Applicable
Please explain why.

3. Delayed - Instant
Delayed
1 2 3 4 5 6 7
Instant not Applicable
Please explain why.

4. Cautious - Courageous
Cautious
1 2 3 4 5 6 7
Courageous not Applicable
Please explain why.

5. Conservative - Innovative
Conservative
1 2 3 4 5 6 7
Innovative not Applicable
Please explain why.

6. Serious - Playful
Serious
1 2 3 4 5 6 7
Playful not Applicable
Please explain why.

7. Commonplace - New
Commonplace
1 2 3 4 5 6 7
New not Applicable
Please explain why.

8. Technical - Human
Technical
1 2 3 4 5 6 7
Human not Applicable
Please explain why.

9. Solitary - Collaborative
Solitary
1 2 3 4 5 6 7
Collaborative not Applicable
Please explain why.

10. Complicated - Simple
Complicated
1 2 3 4 5 6 7
Simple not Applicable
Please explain why.

11. Impractical - Practical

Impractical

Practical

Not Applicable

1

2

3

4

5

6

7

Please explain why:

12. Restricting - Expressive

Restricting

Expressive

Not Applicable

1

2

3

4

5

6

7

Please explain why:

13. Cumbersome - Direct

Cumbersome

Direct

Not Applicable

1

2

3

4

5

6

7

Please explain why:

14. Unpredictable - Predictable

Unpredictable

Predictable

Not Applicable

1

2

3

4

5

6

7

Please explain why:

15. Unresponsive - Responsive

Unresponsive

Responsive

Not Applicable

1

2

3

4

5

6

7

Please explain why:

16. Confusing - Clear

Confusing

Clear

Not Applicable

1

2

3

4

5

6

7

Please explain why:

17. Gaudy - Classy

Gaudy

Classy

Not Applicable

1

2

3

4

5

6

7

Please explain why:

18. Rigid - Flexible

Rigid

Flexible

Not Applicable

1

2

3

4

5

6

7

Please explain why:

19. Unpresentable - Presentable

Unpresentable

Presentable

Not Applicable

1

2

3

4

5

6

7

Please explain why:

20. Takes me apart from people - Brings me closer to people

Takes me apart from people

Brings me closer to people

Not Applicable

1

2

3

4

5

6

7

Please explain why:

3. Please let me know the following:

Which context do you think this design would be the most appropriate?

☐ Home
☐ Work
☐ Both home and work

Please explain why:

How would this design fit in your own organization?

Not fit in

Fit in

Not Applicable

1

2

3

4

5

6

7

Please explain why:

How much do you like to use this design?

☐ Not at all
☐ Not much
☐ Neutral
☐ Much
☐ Very much

Please indicate in what kind of contexts and/or situations you would like to use this design.

Thank you for your participation!

If you have any further suggestion, comment or question please let us know :)

Click close to finish.

Appendix E – A Poster of the Interaction Qualities

GENERATION Y INTERACTION QUALITIES

> INSTANT

The interaction is experienced as immediate, spontaneous and on the spot.

> PLAYFUL

The interaction is experienced as engaging, enjoyable and challenging.

> COLLABORATIVE

The interaction is experienced as supportive, unifying and shared.

> EXPRESSIVE

The interaction is experienced as open, free and animated.

> RESPONSIVE

The interaction is experienced as alert, quick and reactive.

> FLEXIBLE

The interaction is experienced as adaptable, accommodating and adjustable.

Wen Liu

Pharos Sen Shoppers

Gert Ploem

Jeroen Teel Rijkers

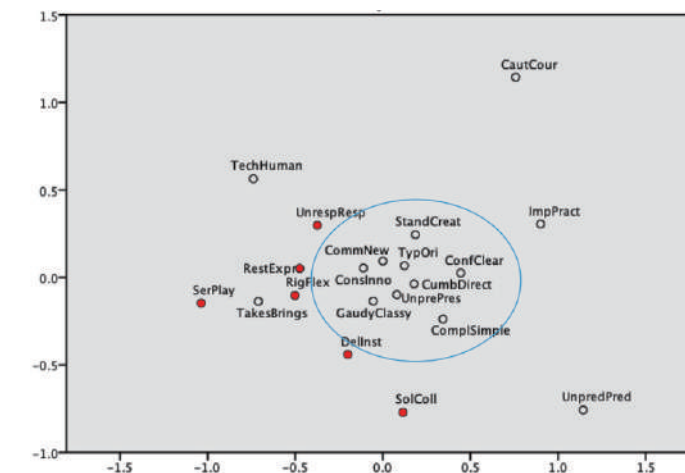
Faculty of Industrial Design Engineering

TU Delft

Delft University of Technology

Appendix F – Correlation Map of All 20 Word Pairs

Highly correlated dimensions are placed closely together in the ellipse. Generation Y interaction qualities are shown as red dots. The unfilled dots are from Hassenzahl's questionnaire.

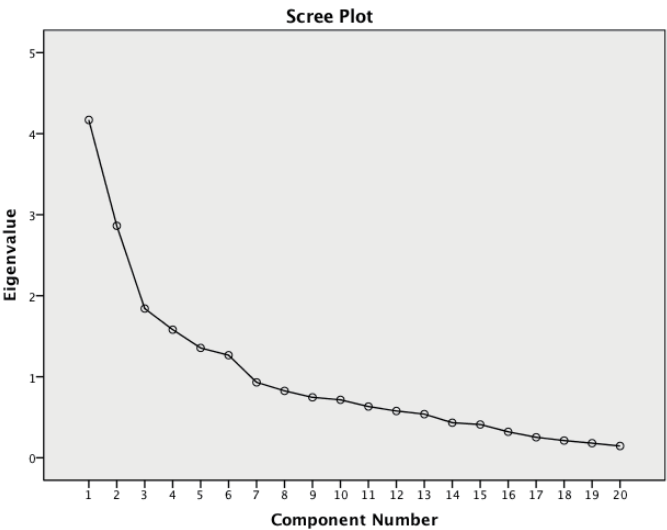


Appendix G – Results of the Principal Component Analysis

The table explains variance for each component by using extraction method of ‘Principal Component Analysis’.

Component	Initial Eigenvalues			Extraction Sums of Squared Loadings		
	Total	% of Variance	Cumulative %	Total	% of Variance	Cumulative %
1	4.170	20.848	20.848	4.170	20.848	20.848
2	2.863	14.317	35.165	2.863	14.317	35.165
3	1.841	9.206	44.371	1.841	9.206	44.371
4	1.581	7.907	52.279	1.581	7.907	52.279
5	1.355	6.776	59.055	1.355	6.776	59.055
6	1.266	6.330	65.385	1.266	6.330	65.385

Matrix based without doing rotation of the explained variance for each component in the table below.



The explained variance with a list of limited number of 4 components by using extraction method of ‘Principal Component Analysis’ and rotation method of ‘Varimax with Kaiser Normalization’.

Component	Initial Eigenvalues			Extraction Sums of Squared Loadings		
	Total	% of Variance	Cumulative %	Total	% of Variance	Cumulative %
1 experience	4.170	20.848	20.848	4.170	20.848	20.848
2 usability	2.863	14.317	35.165	2.863	14.317	35.165
3 novelty	1.841	9.206	44.371	1.841	9.206	44.371
4 others	1.581	7.907	52.279	1.581	7.907	52.279

Appendix H – Written Out Instructions

Step 1

Hi, my name is Wei. I am a Ph.D. researcher at the Faculty of Industrial Design Engineering at TUDelft. I would like to present you a prototype that demonstrates new ways of interacting and workings. The prototype is a research tool that resembles an office phone. The intention is to gather knowledge about how end users deal with the user-phone interactions. The evaluation will take about 45 minutes.

Let’s talk about the highly interactive tools, applications and technologies, such as mobile phones and wireless Internet, at home. We have grown accustomed to new, more expressive and natural interaction styles with these tools. For example, shaking an iPhone to shuffle songs. At work, these richer interaction styles do not seem to be supported yet. Therefore I designed this prototype to convey some of the rich interactions from our current home and private technologies to a work situation.

I would like to ask you to first experience the prototype and then reflect on your experience by answering a few questions. Please ‘think out loud’. For this evaluation, not every function that you would normally expect in an office phone is implemented. It is possible to move parts of the prototype. You have to make do with what the prototype offers. You are not allowed to invent new functions and interactions. Please let me know if I can have your permission to take video and voice recordings in this evaluation. The recordings will only be kept and used for research purpose.

Step 2

Here are a number of instruction pictures that tell you how to operate the prototype. Please go ahead to try out the user-phone interactions. Please ‘think out loud’.

Step 3

Thank you for trying out and for your ‘think out loud’ comments. Please read these 2 scenarios and act through them based on the user-phone interactions you just learnt.

Step 4

Thank you for acting through the 2 scenarios and for your ‘think out loud’ comments.

- What was your experience? Can you show me what exactly you mean?
- What is your experience on how it is operated? Why?
- What is your experience on the different operation of this design? Do you find your interpretation more clear? Why?
- How do you compare these interactions to your home situation? Why?
- Do you see good interactions are transferred from home to work? If yes, which and why?

Step 5

I would like to introduce the concept of Generation Y interaction qualities to you (as in table 2.1). Please now view the recorded video when you acted through the 2 scenarios.

- Do you see the Generation Y interaction qualities are in the design? If yes, which and why?
- In what ways do you see the new design would improve or not improve the work situation? Why?
- We designed the YPhone prototype to bring some of the qualities of new interactions that we experience at home in our private life, such as with a Wii, a tablet or a smartphone, to the office situations. Do you recognize this? Could you describe where this was the case, and tell us if you think we succeeded?

Step 6

Thank you for your cooperation and valuable insights!

- Do you miss ways of interacting and functionality in this design? If yes, which and why?
- Do you have further questions or remarks regarding this office phone and its interactions?

► ACKNOWLEDGEMENTS



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► CURRICULUM VITAE



Wei Liu was born on the 7th of October 1981 in Beijing, China. After obtaining his Bachelor of Engineering degree from the Department of Industrial Design at the Beijing University of Technology in 2004, he continued with his Master's studies at the Mads Clausen Institute at the University of Southern Denmark. For his graduation, Wei was involved in a design research project on the user experience of tangible interaction with electronic products, by which he received his Master of Science degree in IT Product Design in 2006.

After graduation, he started to work as an interaction designer at Motorola Mobility, where he supported user centered mobile device development from ideation to launch. In February 2008, Wei joined Autodesk as a user experience designer. He specialized in user research and user interface design in all stages of 3D application development.

Having developed an enthusiasm for design research and design education, in September 2009, Wei's academic career started with his Ph.D. research on interaction design at the ID-StudioLab within the Faculty of Industrial Design Engineering at the Delft University of Technology. His research interests are in developing methods, techniques and tools to optimize design process for user centered interaction design.

Next to work, he enjoys traveling, playing soccer and watching movie.

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