

Designing for Self-Reflection on Values for Improved Life Decision

ALINA HULDTGREN^{1,*}, PASCAL WIGGERS² AND CATHOLIJN M. JONKER¹

¹*Interactive Intelligence Group, Delft University of Technology, Mekelweg 4, 2628CD Delft, The Netherlands*

²*Digital Life Centre, CREATE-IT Applied Research, Amsterdam University of Applied Sciences,
Duivendrechtsekade 36, 1096AH Amsterdam, The Netherlands*

**Corresponding author: alina@hexgroup.nl*

Taking important life decisions is a complex task leading to long-lasting consequences. It requires balancing one's own needs and those of other stakeholders. Current digital decision support focuses little on the human decision-making capabilities. Systems are designed as analytic tools to find optimal outcomes assuming stable and known preferences. However, insights from psychology and behavioral decision research show that people construct preferences during an adaptive decision-making process and are less rational than assumed by current tools. It has been suggested that a stronger focus on personal values could lead to improved decision making, but reflection on values is difficult for people. This paper presents a first exploration of how to aid people in reflecting on their values. It serves as a starting point to develop digital value-focused decision support tools. We describe the design of a probe for value reflection and several studies with experts and end-users that led to a first set of considerations for such tools.

RESEARCH HIGHLIGHTS

- Reflection on personal values is beneficial in life decision making.
- We present user-centered exploration on creating tools for value reflection.
- Several studies with experts and users were conducted to gain insights into value reflection.
- We developed a probe of a value-reflection website for job choices.
- We present five design considerations for digital value-reflection tools.

Keywords: user studies; user centered design; participatory design; interface design prototyping

Editorial Board Member: Jonathan Earchy

Received 20 November 2012; Revised 12 March 2013; Accepted 16 March 2013

1. INTRODUCTION

Taking major life decisions in today's globalized society is a complex task. People cannot simply consider their local environment when deciding where to live, and occupational choices are vast (unlike for earlier generations who often followed the footsteps of their parents). Take, e.g. a young family in which both mother and father have a job and take care of their children. The decision of one parent to apply for a new job depends, among other things, on the number of alternatives in the current job market, the person's needs and wishes in terms of career opportunities, tasks, involvement with other people, salary, etc. In addition, the decision requires consideration of the family, e.g. the time left for taking care of the children; whether the family needs to move, which will in turn affect

the spouse's work and life situation; and maybe the distance to other relatives. This type of decision making requires balancing one's own needs and those of the other stakeholders, i.e. family members, and dealing with long-term consequences.

As a process, decision making requires assessing an often vast set of alternatives according to one's preferences in order to find a suited outcome. Economic theories, e.g. Coleman and Fararo (1992), assume this to be a matter of rationally calculating each option's utility based on given, stable preferences. However, this view does not represent real-life decision making. Especially untrained decision makers (i.e. people who are not familiar with decision theories, the domain or decision making as a major part in their daily work) often follow an adaptive model (Payne *et al.*, 1993).

According to this adaptive model individuals simplify decision making through applying choice heuristics as a response to their own limited cognitive processing abilities in complex decision tasks (Payne *et al.*, 1993). As partially reflected in the example above, three major types of factors influence the choice of a decision strategy or heuristic: the problem characteristics (e.g. the task variables), the decision maker's characteristics (cognitive ability and prior knowledge) and the social context (e.g. accountability). This behavior can lead to bad choices, because people 'zoom in' quickly on a small set of alternatives, find the best among these and then try to justify their choice to others, e.g. by adapting their original preferences. Keeney (1992) has entitled this behavior alternative-focused thinking. He argued that a value-focused thinking approach which first identifies and analyzes one's values and then creates or regards alternatives that would fit the values would improve decision outcomes. Research has shown that people using this approach were more comfortable with their decisions, more knowledgeable about relevant issues to make an informed decision and considered a wider array of relevant issues (Arvai *et al.*, 2001).

Value-focused thinking is promising, but requires time and effort to assess one's values, which are often hard for people to understand and articulate (Keeney, 1992; LeDantec *et al.*, 2009). We believe technology can be designed to support people in self-reflection on personal values. A mobile tool, e.g. in form of a website or mobile application, would provide a resource for people to reflect whenever they feel like it, not just in dialog with a coach, as suggested by Keeney. Furthermore, mobile tools enable reflection on values within the relevant decision context, e.g. thinking about work values at work.

As part of a large research project on digital decision and negotiation support, we focus on the design of tools to improve decision making. As opposed to current technology-focused decision support system (DSS) (Carenini and Poole, 2002), we use a human-centered approach that takes into account the cognitive and emotional characteristics of human decision making in the design process. Our overall research question is 'how can we design digital tools to support people in reflecting on their values?' Our first step to answer this question is presented in this paper. We explored the design space by (1) talking to experts on value reflection to learn about their approaches and tools and (2) engaging end-users to create possible designs for digital value-reflection tools. Based on this exploration we present a first set of design considerations for value-reflection tools and propose directions for future work.

2. BACKGROUND

2.1. Decision making

Research on decision making is vast and done in several disciplines, e.g. economics, psychology and organizational science. We concentrate in the following on theories that are

most prominent in DSS research and relevant to our focus on values. One prevailing decision-making theory in economics is rational choice theory (Coleman and Fararo, 1992). This theory describes rationality as an act to maximize personal benefits while minimizing costs. Models belonging to this theory assume people's choice of the best action according to consistent and stable preferences which reside in the decision maker's head. Other preference assumptions are completeness (alternatives can be ranked in order of preference) and transitivity (whenever A is preferred over B and B is preferred over C, then also A is preferred over C). These assumptions make it possible to express preferences in utility functions.

Rational choice theory has been subject to criticism from behavioral decision-making researchers as it neglects psychological aspects. In reality, decision problems are often ill-defined, i.e. the desired goal state is only clarified throughout the decision process and people are not always rational. According to the adaptive decision-making model by Payne *et al.* (1993), people adopt strategies or heuristics to simplify the decision-making process in complex situations with many alternatives. Such heuristics are often much more selective in the use of information from the decision context than economic models suggest. Based on cognitive ability and prior knowledge decision makers have several decision strategies at their disposal that they use in an adaptive manner to solve a decision problem with reduced cognitive effort. When choosing a strategy, decision makers try to maximize decision accuracy, reduce cognitive effort, minimize negative and maximize positive emotions and maximize the ease of justifying their decisions.

Which strategy is used depends on the characteristics of the person, the decision problem (e.g. task variables, such as the number of alternatives or time pressure) and the social context (e.g. accountability to family members). Even small changes in the task environment may lead people to adapt their strategy. While this adaptive behavior can be seen as an intelligent way to deal with decision complexity, it often leads to an elimination of a potentially good alternative early in the decision process. Furthermore, it has been shown that adaptive behavior can lead to preference reversals or changes depending on how a task is stated, e.g. either as a choice or a matching response (Tversky *et al.*, 1988), or in which order elements of a choice set are considered (Tversky and Sattah, 1979).

2.2. Preferences

Preferences are statements about a desired condition on an attribute. Preferences are crucial to DSS to assess options. However, current systems using rational choice theory create preference models based on assumptions of stable and known preferences, thereby not reflecting the users' psychological processes (Fischhoff *et al.*, 1980). Behavioral research has shown that preferences are constructive, i.e. attention to information and methods used to combine the information vary with different tasks. Therefore, they are hard to capture and

may change (Payne *et al.*, 1993). With respect to designing digital decision support, it is important to take into consideration that preferences may change and be subject to effects related to information display. Values are stable over long periods of time and, therefore, provide a good basis for preference definition for a given decision context.

2.3. Values

In the diverse literature on values the concept has been introduced as referring among others to interests, likes or preferences, duties or moral obligations, goals, needs or wants (Williams *et al.*, 1979). This variety of terminology led to confusions about the nature of values, but nevertheless agreement on their influence on decision making has been established lately (Cheng and Fleischmann, 2010). According to Keeney (1996) 'values are fundamental to all we do; and thus, values should be the driving force for our decision making.' (p. 537)

A general distinction in ethics literature is made between intrinsic and instrumental value. While an intrinsic value is the value an object carries in itself and is an end in itself, an instrumental value is a means to an end. For example, consider someone who values happiness (intrinsic value) and for whom the love (instrumental value) to his wife is a path to happiness. Another term used for intrinsic is terminal coined by social psychologist Rokeach (1973). He classified 18 terminal values (e.g. happiness, equality, freedom, social recognition) and 18 instrumental values (e.g. ambition, love, courage, honesty, independence). Schwartz and Bilsky (1990) specified 56 basic human values grouped into 10 value types (achievement, benevolence, conformity, hedonism, power, security, self-direction, stimulation, tradition, universalism). Others have classified values differently, e.g. regarding the type of benefits at issue, according to which values can be classified into material and physical, economic, moral, social, political, aesthetic, religious (spiritual), intellectual, professional, and sentimental (Rescher, 1969). For an in-depth discussion of value definitions, classifications and inventories see Cheng and Fleischmann (2010).

In our work, we borrow Cheng and Fleischmann's (2010) definition, which conceptualizes values 'as guiding principles of what people consider important in life.' (p. 2) Values should not be seen in isolation. People have value systems consisting of a complicated web of values that are often implicated simultaneously, which leads to value trade-offs (Schwartz, 1996). In particular, complex decisions may promote some values while violating others cherished by the decision maker.

Besides general classifications of values, specific value inventories exist for concrete domains. One of these is the list of career anchors including functional competence, managerial competence, service, security/stability, entrepreneurial creativity, challenge, autonomy/independence and lifestyle (Schein, 1990). As we work in the domain of supporting career decisions we use this specific list of values in the following.

2.4. Value-focused thinking

As a basis for our focus on explicating values relevant to a decision-making context, we take the framework of value-focused thinking (Keeney and Raiffa, 1993). A major characteristic of this framework is its proactive stance. By considering decision making as a creation of new opportunities rather than problem solving it puts the decision maker in control over the situation she has to face. To be more specific, it posits that the typical approach to decision making, i.e. first concentrating on a given set of alternatives and then evaluating them according to one's values, leaves the decision maker in a position which is merely reactive to a given situation. By actively approaching decision situations through (1) focusing on one's values and (2) choosing or creating alternatives that suit these values, the decision maker can channel thinking efforts to achieve better decisions.

Value-focused thinking proposes to make values explicit in the first stage of decision making. Simply listing values or objectives—statements of what one wants to achieve in a decision context—however, is not sufficient. Often people confuse ends with means. It is, therefore, important to identify which are the means objectives that ultimately lead to fundamental objectives, i.e. the ends one wants to achieve in a decision context. Means and ends are context-dependent. If your decision context, e.g. concerns investing your available funds for retirement, the amount of money you receive at the start of your pension may be a fundamental objective. If you are, however, deciding how to achieve a good life during retirement, the amount of money may serve as a means objective. Overall, value-focused thinking is structured into the following steps: (1) identifying objectives through hard thinking and creativity, (2) structuring objectives into means and fundamental ones, (3) creating alternatives beyond merely obvious ones by e.g. thinking about how to better achieve one's objectives and (4) evaluating in how far alternatives promote or trade-off fundamental objectives. When applying these steps to decisions over time, people gain experience and coherent value patterns emerge that can be instantiated to many decision situations.

Other research has shown that people using value-focused thinking felt more comfortable with their decisions and more satisfied that choices reflected their values than people using traditional approaches. Furthermore, they considered a wider array of decision-relevant issues and felt more knowledgeable with regard to being able to make an informed decision (Arvai *et al.*, 2001). In line with Keeney's (1992) observation that articulating and revising values is difficult and needs hard thinking, this research reported that participants using value-focused thinking considered the decision task more mentally difficult than participants using alternative-focused thinking.

To reduce mental effort people should be supported in the process of assessing their values as well as articulating them and relating them to a given decision context. Value-focused thinking suggests a dialog-based approach assessing one's

(fundamental and means) objectives, i.e. one's values in a given context. In a career choice context this could be compared with a career coach who asks many open questions to probe a client's values and supports the client to understand her values. While we are not planning to make such coaches obsolete by introducing a tool that can take over these tasks, we believe that a digital tool can provide additional help in people's self-reflection on values.

2.5. HCI research on self-reflection

Assessment of one's values can be achieved through self-reflection, which is the 'examination of one's own thoughts and feelings' (Merriam-Webster). Within HCI researchers have described the nature of reflection as a process of making unconscious aspects more aware to users, using awareness to notice behavioral patterns and underlying values and consequently using this knowledge to make (better) conscious choices (Sas and Dix, 2009; Sengers *et al.*, 2005).

Most prominent research within HCI on self-reflection has been done in the area of affective systems building on the interactional model of emotion (Boehner *et al.*, 2005). An example in this area is the Affective Diary (Lindström *et al.*, 2006), which augments traditional diary keeping with sensor technologies. While such systems lead the user to gain awareness of their emotional states, self-reflection can also focus on behaviors and their underlying values and beliefs (Sas and Dix, 2009).

Recent trends in HCI on monitoring and improving people's behavior, which are related to decision making in life, are moving towards persuasive systems (Törning and Oinas-Kukkonen, 2009) and Personal Informatics (Li and Forlizzi, 2010). The latter has a strong focus on supporting self-knowledge through collecting personal data and analyzing it, which is similar to our goal. However, they do rely heavily on quantitative data collected automatically from sensors and they have no specific link to decision making. Take e.g. the quantified self-movement (<http://quantifiedself.com/>) with many participants who are simply curious about their own data but do not use it explicitly for given decision situations.

The focus of persuasive systems lies less on self-knowledge and more on motivating people to change their behavior. Many of these systems focus on health or environmental choices. While the focus on (behavioral) choices relates to our work, we do not agree with the approach taken in persuasive systems. It seems that these systems mainly embed the designer's values and notions of what good and bad behavior is. Often it is even unclear whether these values are made explicit to the users and whether the user can critique or adapt them. In our view, this approach does not lead to knowledge about how decisions may affect the user's values and what consequences the decisions have. Little emphasis is placed on self-reflection of one's values. Similar critique has come from other researchers questioning these system's ethical limits. 'When designers make decisions

about the "one right way" that should drive suggestions to influence the 'flawed' user, it removes agency from the individual' (Purpura *et al.*, 2011, p. 431). Researchers question whether such an approach to design technology respects the users' values.

Another related HCI research agenda is that of Slow Technology, coined by Hallnäs and Redström (2001). This area has recently gained more attention (see e.g. www.willodom.com/slowtechnology/) as an opposition to our fast-paced way of living augmented through ubiquitous computing leaving people with an omnipresent need to be constantly efficient and connected to others through technology. Slow technology aims to balance these aspects of people's lives with moments for reflection, mental rest and solitude. One could view our efforts as part of this agenda in respect to slowing down the decision-making process, taking time to reflect on one's values and considering alternatives in depth.

These HCI trends support the importance of investigating the design of tools for reflection. In summary, our work takes inspiration from Personal Informatics and Slow Technology, using the capture of data for *in situ* reflection and the notion of slowing down, respectively. It contrasts Persuasive Technology approaches as we aim for informed decision making instead of using smart algorithms that push people towards a certain choice that is considered right by the designer of the system. That said, we do not deny that future systems can provide intelligent support in form of analyses of user input, but the analysis should be transparent and not be used to force choices but to offer insights that users can scrutinize and use to form a decision.

3. METHODOLOGY

Given the presented background we aim at designing support tools that help people to assess their values and (later on) take informed decisions. Because of the abstract nature of values and the difficulty in expressing them (LeDantec *et al.*, 2009), we decided that a first exploration of value reflection is needed before we can develop concrete value-focused DSS. This exploration aims to give insights into how people reflect on values and can be triggered to do so and how a digital tool can support the process.

In this exploration, described in the remainder of the paper, we engaged experts and end-users in order to get an in-depth understanding of self-reflection and support thereof. Our methodology (see Fig. 1 for an overview of the steps) combines qualitative and quantitative research drawing on user-centered design (UCD) (Norman and Draper, 1986) and participatory design (PD) (Schuler and Namioka, 1993) methods. In line with the proactive stance of value-focused thinking and the empowerment of decision makers through a reflective approach, we decided to already involve end-users in the making of this technology through the means of PD methods. We chose for

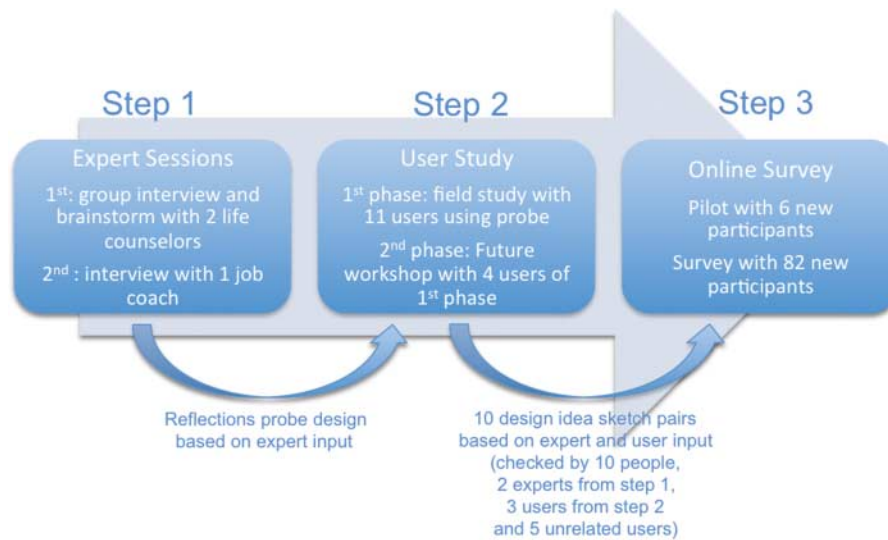


Figure 1. Overview of the studies and design activities.

a mixed methods approach that allowed us to triangulate data from different sources: on the one hand, expert and user data and, on the other hand, in-depth qualitative data and quantitative data from a larger sample.

In the early steps of the work we used qualitative methods from UCD such as semi-structured interviews and brainstorming with experts, and methods from PD such as a probe (Hutchinson *et al.*, 2003) and a Future Workshop (Kensing and Halskov-Madsen, 1991). Close contact between the researchers and participants was important in these steps. We decided to conduct semi-structured interviews with experts, as we were mainly interested in their professional knowledge, which can be elicited best through interviews. After concrete questions targeting their work practice we brainstormed ideas together of how their knowledge and methods could be utilized in a digital tool.

To elicit deliberate and critical feedback from end-users we designed a probe based on expert knowledge. ‘A probe is an instrument that is deployed to find out about the unknown. . . . Technology probes are a particular type of probe that combine the social science goal of collecting information about the use and the users of the technology in a real-world setting, the engineering goal of field-testing the technology, and the design goal of inspiring users and designers to think of new kinds of technology to support their needs and desires.’ (Hutchinson *et al.*, 2003, p. 18) After participants experienced the probe we collaborated with a subset of them in a participatory method called Future Workshop, in which the first author and the participants envisioned new ways to reflect on values supported by a digital tool. We chose for participatory methods with end-users as we wanted to empower people in their reflection on values, and let them be part of the design process, which may increase the later acceptance of the tools.

In the next step ideas coming from the experts and users were transformed by the researchers into design sketches and used in an online survey to gain insights from a broader sample group. The different activities within our study built closely on each other and are outlined in the following.

3.1. Materials

3.1.1. Probe: ReflectionsWebsite

As our work constitutes a first exploration into digital value-reflection support we considered a technology probe to be a good way of triggering user feedback and entering a creative dialog with the users. We created a website including a mobile version to be used as a probe. The idea for a mobile tool is based on the situational nature of values, i.e. that they play out differently in different context and should be discovered in relation to this particular context (LeDantec *et al.*, 2009).

The concept of the website is inspired by Personal Informatics systems in the sense that users continuously collect data about themselves in their daily lives, which they can use to analyze their behavior, or in this case, their values. This type of value reflection over time slows down the decision-making process and asks for moments of reflection similar to the idea of Slow Technology.

The website was developed for the career domain, in particular to prepare for a job negotiation. The website’s structure was based on a tab layout that guides decision making from reflecting on values, identifying the salient ones and constructing preferences. In a subtle way this structured layout was chosen to evoke value-focused thinking and allow for thoughtful construction of preferences (which we do not focus on in this paper). However, users could go forth and back between tabs as they wished. An



Figure 2. (a) Tool selection and (b) tool entry.

introduction tab contained explanations and outlined the basic interaction with the probe. The tools tab (Fig. 2a) offered several tools for reflection (based on the expert sessions described below: association cards, storytelling, reflection questions, symbolic thinking and uploading personal pictures).

The interaction steps for each tool were the same: When a user clicked on a tool icon, a pop-up (Fig. 2b) opened allowing the user to fill in a form describing his reflection. Once the means to reflect had been chosen (e.g. a photograph) or entered (e.g. a story), the user was asked to describe its content, what important things it reminded her of, an emotion, and a value related to the reflection. This strict design was chosen for two reasons: (1) due to practicality, as it simplified saving to the database and processing the data in a later stage and (2) because of experts' advice on supporting users to get from the concrete experience, e.g. what happened in a story or what do you see in a picture, to the abstract reflection on values related to the experience. Similar to value tables that the experts use to label written reflections of their clients with concrete values, we defined and offered a list of work-related values (Schein, 1990).

Once a user saved an entry, it was entered into a database. All entries could be reviewed on the reflections tab. Here, the user could share any entry with other users connected to him via a friends function (friends tab). On a values tab the frequency of occurring values was captured and displayed as a tag cloud, in which a bigger font strength and size indicated a higher frequency. The user could also get a quick overview over all entries belonging to a certain value by clicking this value in the tag cloud (Fig. 3).

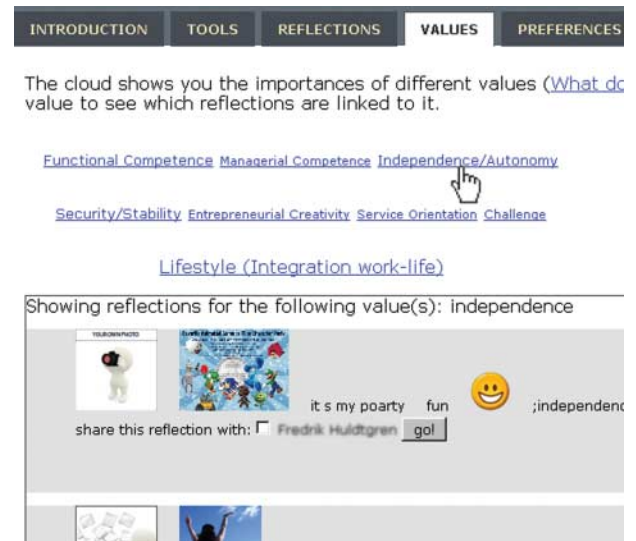


Figure 3. Value tag cloud.

3.1.2. Design sketches

In the online survey we used hand-drawn design sketches that were based on user feedback from the first steps of the work. In order to create the sketches we used, on the one hand, the concrete design ideas that the users sketched in the Future Workshop (sketches 3, 7 and 8) and, on the other hand, analyzed the user feedback and discussions from the workshop to identify other design ideas (sketches 1, 2, 4, 5, 6, 9 and 10). For each idea we created two extreme versions of how the interface could look like, e.g. a free-form entry of reflections

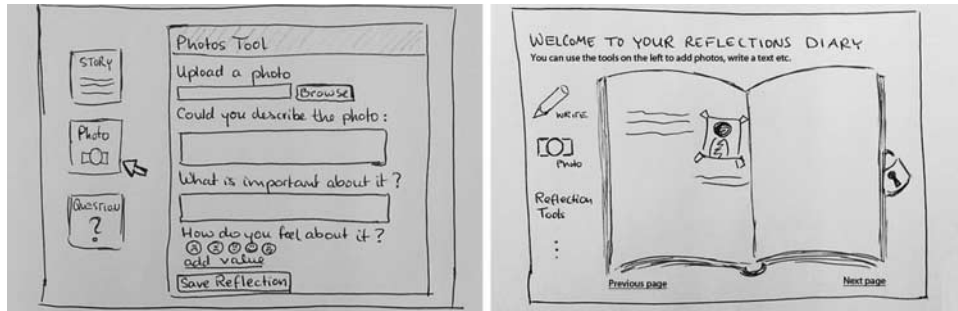


Figure 4. Example of a design sketch pair.

Table 1. Overview of design ideas: for each idea that was derived from the user study we created two opposing versions (i.e. sketches as in Fig. 4) in order to receive feedback on which version was preferred by users

Design pair number	Design A	Design B
1	Same look and feel for all users	Personal look and feel (customizable)
2	Only given values	Possibility to add new values
3	Structured form-style	Free-form (scrapbook/diary-style)
4	No explanation for a tool	Explanation for each tool
5	General reflection questions	Personal reflection questions
6	System shows inputs (user can adjust them if(s)he thinks something is inconsistent)	System points out possible inconsistencies of inputs
7	Value chart on separate tab after entering reflections	Value chart adjusts while entering reflections
8	Definitions for values given in the system	Find out the meaning of a given value and whether it fits you through questions
9	Link a reflection directly to pre-defined work values (for job choices)	Link a reflection first to personal values and then to predefined work values (for job choices)
10	Overview of reflections without explanation	Overview of reflections with explanation

versus a very structured form-like interface (see Fig. 4). This way people were asked to make a clear choice of what they preferred. In total, we created 10 sketch pairs with the ideas presented in Table 1 (detailed explanations are in Sections 4.1 and 4.2).

3.2. Participants

Three counselors were involved as experts throughout the study, most prominently in the first step to provide insights into their practice to support people in value reflection. We recruited experts on value reflection who finished a master's program at the University of Humanistic Studies in Utrecht where they gained extensive experience in supporting people in reflection on their lives and how to make life worthwhile. Four experts were initially interested in an interview and brainstorm session, but because of time limitation only two were able to take part. In addition, we contacted the job coach in our department for an interview in order to receive more insights into reflection support in the domain that we developed the probe for (i.e. career domain).

We also worked closely with 11 end-users (three females, eight males) aged between 21 and 50 ($M = 30.4$, $SD = 8.9$), who took part in the first part of the user study (see Fig. 1). These participants were recruited through the universities network. We targeted mainly master students, who were close to finishing their studies and looking for jobs, with the exception of a 50-year-old colleague. We did not explicitly account for different cultural backgrounds, thus, students from different countries took part. Except for one participant they were not familiar with the research. Three participants dropped out due to a self-stated lack of time, eight people remained to finish the study. We invited these users and the experts to participate in the follow-up workshop, of which only four users (all males) had time to participate.

Ten people checked the design sketches that we used for the online survey, five of whom were engaged in our earlier studies (two experts, three users), and five who did not know the research and had different backgrounds in terms of education level and expertise. By this we ensured that respondents of the study would understand the design ideas represented by the sketches. For the survey itself we recruited participants through

our personal networks and further snowball sampling. To get insights from people who were not yet involved in the design none of the participants of steps 1 and 2 took part in the survey. Of the 119 people, who approached the study, 82 completed the study (35 females, 45 males and two with unknown gender). We targeted young people who were about to or had recently finished their education, as this reflected our target group of untrained decision makers for career choices. Respondents were aged between 22 and 64 ($M = 31.71$, $STD = 7.095$), which shows the majority to be what we call young professionals (ca. 25–35 years old). The majority of respondents, ca. 75%, held a university degree. Participants came from 13 different countries, the majority from the Netherlands (30), the United States of America (15), Germany (11), China (7) and Sweden (6). All 82 participants were included in the analysis.

3.3. Detailed set-up

In the following we discuss our activities in chronological order.

3.3.1. Expert interviews

We conducted two semi-structured interviews, one with the career counselor and one with the two life counselors. In the beginning the experts were briefed with the overall aim of our project (decision support) and the details of our current work (support for value reflection). The remainder of the sessions were structured into three parts, (1) focus on typical work practice and sharing of experiences of the experts, (2) focus on methods used to support people's value reflection and (3) brainstorm of ideas for computer-supported value reflection.

Both interviews were audio-recorded and transcribed. The data were then annotated separately using the following predefined codes: cases (work example), question (expert questions used in coaching), method (specific methods and tools the experts use), aim (purpose of various aspects of the experts' work), assumption (underlying the experts' work) and application (anything related to what a digital tool could or should do or be like). After separate coding the researchers discussed the data, in particular any conflicts in the annotations, to reach a shared understanding of the themes discussed during the sessions. For the design of our probe we used the methods named by experts that we could easily utilize in a digital tool (i.e. association cards, storytelling, reflection questions, symbolic thinking and uploading personal pictures). Furthermore, the discussed themes inspired the probe design, e.g. supporting the unique ways in which people reflect and guiding people from the concrete (e.g. a picture) to the abstract values.

We sent summaries of our findings back to the experts to validate that we understood them correctly. The experts agreed with this summary so that we did not have to adapt it.

3.3.2. User study

Based on the expert sessions we created Reflections—the technology probe described in Section 3.1.1, which provided

Table 2. Post-use questions

- | | |
|---|---|
| 1 | List the three most negative aspect(s) |
| 2 | List the three most positive aspect(s) |
| 3 | Would you like to suggest other values that you were missing in the tool that are important in a job context? |

participants with different tools to enter reflections on values and an overview of their values. The probe was used in a two-phase study with end-users. In the first phase we gave the probe to 11 participants to use it between one and four weeks in their daily lives. We asked people to try both the website and the mobile version and enter data with the different tools provided every day. This first phase aimed at giving the participants time to explore the probe and deliberate on value reflection, a new activity for most people. To create a relationship between the researcher and the users we asked people to stay in contact with us either through the system's built-in message function or via email. This allowed users to give *in situ* feedback. To facilitate an easy start for a dialog we did not limit the type of feedback to value reflection alone, but asked for other types of feedback, e.g. on bugs or aesthetic issues, which are easier to express. After using the prototype for the given time period participants were asked to answer the questions shown in Table 2.

In the second phase we invited the same participants to a workshop based on the Future Workshop (Kensing and Halskov-Madsen, 1991) method. Future Workshops stem from Scandinavian PD and were developed to support designer–user communication in order to generate alternative ideas of computer use and create concrete system goals that account for unique individuals (instead of the average end-user). This focus on individuals was deemed well suited for the design of our tool as value reflection is closely linked to an individual's needs and goals and such individuality needs to be handled by the tool. Future Workshops are commonly divided into a critique phase that draws out issues with current practice, a fantasy phase that allows participants to create what if scenarios of the future and an implementation phase that focuses on realistic changes. Besides these common steps Kensing and Halskov-Madsen (1991) suggested the use of metaphors to support the creative process of envisioning alternative futures.

While we invited all 11 participants from the first phase and the 3 experts, time restrictions allowed only four of the users to participate. Our aim of the workshop was to invent new design ideas for value-reflection tools. The workshop lasted 1.5 h and had three main parts in accordance with the method: (1) a critique phase, (2) a fantasy phase and (3) an implementation phase. We structured the phases so that the largest time portion was reserved for the generation of ideas. In a short briefing, the method's steps and rules were introduced and written down to be visible during the session.

Critique phase (25 min): This phase was meant to offer the participants an easy entry to becoming engaged in discussions

without having to be creative from the start. Participants were instructed to critique the Reflections website, which they had used in the previous phase. Each participant was restricted to 30 s talking time per critique statement to allow every participant to voice himself and not be interrupted by a dominant person. The statements were written on post-its and put up on a wall labeled 'problems' to be grouped into categories by the participants afterwards.

Fantasy phase (40 min): To further overcome difficulties of non-designers to be creative we started with the generation of metaphors. Metaphors helped one to think outside the box and see artifacts from new perspectives. For instance, besides being a website, the prototype could also be seen as a diary. Next, participants were given time to create new ideas. We provided materials, such as colored pens, post-its and paper, for noting critiques and ideas as well as sketching new design proposals. To open up for creativity participants were instructed to come up with utopian ideas without thinking about technical constraints. After about 15 min of sketching, we started an open brainstorm similar to the first phase. People stated ideas in 30 seconds and noted them on post-its that were stuck on the wall labeled 'ideas'. Three of four participants created sketches of designs, while one participant wrote down his ideas in words. After collecting ideas each participant had three votes (green stickers) for their three most preferred ideas.

Implementation phase (15 min): We ended the session with a discussion of practicability and implementation of different ideas.

The qualitative data (comments and group discussions) collected in the two phases of the user study as well as the concrete design ideas were used to create the design sketches described in Section 3.1. For that we, first, selected all drawn design ideas that were realizable and voted by most participants. We identified the theme they represented, e.g. guidance (form entry) and created a second sketch showing the opposite extreme, e.g. no guidance (free-form text entry). In a second step we identified the themes discussed mainly in the user workshop, e.g. personal feel, and created sketch pairs representing the two extremes, e.g. no personalization. We used all themes regardless of the frequency of being mentioned by participants, because in group discussions people tend to repeat themes others have mentioned, which makes it difficult to judge their importance by counting frequencies.

3.3.3. Online survey

Goal of the online survey was to test the expert themes and design ideas from the user study (step 2 in Fig. 1) with a large sample and relate the respondents' preferences to personal characteristics of self-reflection as well as their attitudes towards awareness of values and value-reflection tools. For this survey, we used the sketched design pairs as presented in Section 3.1. To ensure that each pair represented the theme we wanted to test, we asked 10 people to rate the extent to which this was the case (on a 7-point Likert scale). Based on the feedback we

adjusted some sketches until everyone agreed that they match the theme/idea we wanted to express. We ran a pilot test of the final survey with six participants, who had not been involved earlier, to ensure everything was working and comprehensible. No changes were administered after the pilot.

The survey was divided into four parts: (1) demographic information including age, gender, level of education, occupation and frequency of writing a diary, (2) reflection-rumination questionnaire (RRQ) (Trapnell and Campbell, 1999), (3) design ideas for value reflection (separated into binary choice of sketches (3a) and a set of questions probing links to social networks, emotional triggers and trust (3b)), and (4) a set of statements probing respondent's attitudes towards self-reflection, awareness and decision making.

We hypothesized that there maybe differences in what type of interfaces people prefer depending on their current level of self-reflection, e.g. that more reflective people may want less guidance. Therefore, we used the RRQ in part 2 to retrieve a score for people's level of reflection and rumination (a less healthy and often insecure way to think about oneself over and over.).

In the third part, we presented the sketch pairs together with their titles (see Table 1). We explained to the participants that the sketches were a means to elicit information on different themes and ideas, not to choose an interface that would be implemented in a final version. The sketches were shown from first to last in the same order for all participants, however, the position of sketches A and B was randomized between left and right. Respondents could select the preferred sketch by clicking on it. They could change their selection until they proceeded to the following sketch by clicking a next button. For each sketch pair as well as after part three respondents had the possibility to enter a comment. Based on the expert sessions we added extra questions (see Table 3) regarding the integration with Facebook (item 3.0), individual truth (item 3.1–item 3.3), emotional triggers (item 3.4–item 3.7) and the role of trust (item 3.8–item 3.10).

Part four consisted of items (see Table 3) aimed at measuring the understanding of the value concept (item 4.1 and item 4.2), self-knowledge of values and their relation to decision making (item 4.3–item 4.6), perception of benefits of value awareness (item 4.7 and item 4.8), attitude towards a digital value-reflection tool (item 4.9 and item 4.10) and perceived effect of a tool (item 4.11).

4. RESULTS

In this section we elaborate on the results of the data analysis of the different parts of our exploration depicted in Fig. 1. The structure of the following subsections is based on the three main steps in our work: the expert interviews, the user study and the online survey. As depicted by the arrows in Fig. 1 the results of a step informed the creation of materials used in the consecutive step, e.g. the themes and methods from the expert interviews were used by us when we designed the Reflections probe.

Table 3. Questionnaire Parts 3b and 4

Item	Statement/Question
item 3.0	My Facebook (or similar network) account should. . . a. be used to create a profile of me on the Reflections website b. be used to create reflections based on status updates in Facebook c. be used to connect me to my Facebook friends on the Reflections website d. never be used on the Reflections website e. the above does not apply, as I don't have a Facebook (or similar network) account
item 3.1.	I expect the system to help me create links between personal reflections and values
item 3.2.	I know better than the system how my personal experiences relate to abstract values
item 3.3.	I want the system to teach me something I did not know about myself
item 3.4.	Looking at (old) photographs often makes me reflect on my past experiences
item 3.5.	I often play songs that remind me of a certain situation or experience
item 3.6.	Artworks inspire me to think beyond what I see
item 3.7.	My old diary entries make me think of who I was or who I am
item 3.8.	I only share reflections on myself with people I trust. The same is true for a digital system
item 3.9.	I need to know that my data will be held private; otherwise I would not enter reflections on myself
item 3.10.	A breach of privacy would make me stop using the system immediately
item 4.1.	I know exactly what a value is
item 4.2.	The concept of values is still hard to grasp
item 4.3.	I know what my values are
item 4.4.	I know how my values relate to my decision making
item 4.5.	I have a clear idea of my life goals
item 4.6.	I know exactly how my life goals relate to my values
item 4.7.	More awareness about my values will be beneficial to choose a job/career
item 4.8.	More awareness about my values will be beneficial in a job negotiation
item 4.9.	I would use a digital tool (designed similar to the interfaces presented before) to self-reflect
item 4.10.	I think, using a digital tool to self-reflect would help many people in making better decisions
item 4.11.	Imagine an upcoming job negotiation. After using a digital tool for self-reflection I would probably feel . . .self-confident; . . .well-prepared; . . .know exactly what I want; . . .know what I already know; . . .nothing of the above

4.1. Expert Interviews

In the following we present results from the two expert interviews that are relevant to the design of digital tools to support value reflection, i.e. the dominant themes from the interviews and an inventory of reflection methods used in practice.

4.1.1. Themes

We will briefly discuss the themes from the interviews here. Further elaboration on how the themes can guide design and how they relate to the theoretical framework are given in Section 5.

The main theme that arose in both interviews was the *uniqueness* of the client. The experts described in depth how different every client and, thus, every session is. Therefore, the counselor needs to adapt to each client by trying and using different methods to help the client reflect on his (work-)life. As the career counselor stated: ‘Sometimes I introduce a method that would perfectly suit the situation, but then it is not working for you, because you feel it is too much blocking you. It is too vague. You have to be careful’. The aspect of uniqueness

was also the result of our previous work on methods for value elicitation (Pommeranz *et al.*, 2011).

The job coach also pointed out that the exact methods to be used with the clients may be less important, but the fact that they enter the reflection process on an emotional level is important. Thus, emotional triggers, such as art or poetry, are useful in making people reflect. ‘[T]he method . . . is not interfering with rationality but because you ask them to make pictures it is more symbolic. And you actually dive in deeper at the level of the subconscious.’

Overall, however, the experts agreed that despite their uniqueness, most people need *guidance* to get from concrete reflection on experiences to more abstract values. According to the experts it is hard for many people to think of abstract values. ‘People find it difficult to answer directly to “what are your values?” That is a difficult question.’ (life counselor) Therefore, the reflection process needs to be divided into several small steps. Specific questions of the form ‘Why is this important to you or what does this mean to you?’ can be used to support reflection. The life counselors called these slow questions, ‘that you cannot answer immediately, but you keep on thinking about

it. There is not per se an outcome. There can be but doesn't have to be. You have to formulate a question for yourself. . . . E.g. what does friendship mean to me?"

Another overarching theme that was brought up in both sessions was the role of *trust* between the counselor and the client. It is often difficult for people to open up and discuss their intimate experiences. This difficulty can be reduced through the built-up of a trusting relationship between the counselor and client and a setting producing comfort for the client. 'In conversations with a personal level it is very important to have a certain connection to someone, a certain trust, so that you say "yes, with you I dare to share".' (life counselor). Part of building trust is the adaptation to the unique features of the client. In addition, the experts in the first session emphasized that one should not judge the expressions of the clients and their interpretations. Thus, one should not point out that what a client says now contradicts something mentioned by the client previously as that 'can be very confronting and that is not the goal. It is more "How do you see this? What do you mean here?"' (life counselor). The counselors labeled this aspect *individual truth* of a person. While something may seem contradictory to us, it may make sense for the client. Or as one counselor pointed out, 'It is not so much about what is the truth, but what is true for that person at that moment'.

Another less prominent theme, but still discussed, was the role of *group* therapy. In the counselors' experience group sessions where people can share their thoughts with others and make sense out of different situations and reflections together work better for some people than individual conversations.

In the design of the probe we accounted for the uniqueness of people in reflecting by offering a variety of tools, with the majority having an affective component (e.g. own photographs). We also explicitly asked the users to give affective feedback for each item (photograph, story, etc.) that they had chosen for reflection. Furthermore, we employed the theme of guidance by offering a structured interface with tabs that guided the reflection process. Besides showing a visualization of values derived from their frequency, we did not design a judgment mechanism to allow for individual truths. The group aspect was implemented in form of a friends function in the system allowing for people to share their reflections.

4.1.2. Reflection methods

Experts use several methods to support people to reflect including visual, metaphorical or storytelling ones. Visual methods provide the clients with visual stimuli, e.g. pictures or paintings. The association card method is an example of this type. The counselor lets the client choose a card with an image from a set of so-called association cards (e.g. card sets used in psychological therapies or a set of images preselected by the counselor) that appeals to her. This card is then used for reflection, starting with the concrete content, i.e. what is shown on the card to reasons for picking the card, experiences that the card triggers and their importance leading to more

abstract values. The same reflection process can be used with other triggers, e.g. paintings (e.g. in a museum) or photographs. Metaphors are often used due to their figural nature, i.e. a person does not need to talk about personal aspects directly, but can pick figures that represent these aspects. One method mentioned by the experts is asking people: 'if you had to describe yourself as an animal, which animal would you pick?' Storytelling is an aspect of many methods, but can also be used as a starting point, asking clients to tell a story of a previous experience. Storytelling can also be triggered by the use of concrete questions from the counselor, e.g. 'What does friendship mean to you?' According to the experts these questions should be formulated as starting with Why? or What? to trigger reflection instead of How-questions. For concrete links between reflection and values, one expert explained the use of value tables, i.e. lists of values given to the client to pick the ones relevant to the reflection discussed with the counselor. 'I gave them a circle with different sections and asked them to write into each section something that is important to them. Then linking it to values in the table. You start not directly with the abstract, but first think about what is important. [That's] not so difficult for people. They don't block it.' We tried to implement this into our probe by structuring the reflection process from concrete to abstract.

4.2. User Study

4.2.1. User feedback during and after probe use

Eleven participants were recruited for the first phase in the user study. However, three of these did not use the probe regularly and did not engage in evaluation of the probe (neither per direct feedback nor by filling in the questionnaire). During the phase, when participants used the probes in their daily life, we collected feedback from seven of the remaining eight participants: four messages through the system, six emails and one chat conversation reporting between one and five problems each. In total we collected 47 data entries (one to seven per participant). A major aspect that was discussed between users and the researcher was the choice of work-related values that were difficult to attach to their input, which often focused on private aspects of life. One participant suggested having a layer using more personal values that are only later related to work values. Eight (two females, six males) participants answered our questions (Table 2) after they used the website. Table 4 highlights the positive and negative aspects relevant to value reflection (other aspects not shown here related to usability issues).

Overall, from the positive comments we can see that participants liked the diversity of the reflection tools. Furthermore, they said that the website was easy to use and learn. Major problems that were identified were the abstract nature of some tools, which led to a lack of clear links between the (rather personal) input and work values. Several participants mentioned that it was difficult to link a value to their input or that they did not understand or like the predefined ones. This was

Table 4. Positive and negative aspects of reflections

Participant	Positive	Negative
P1	A way to capture daily reflections, which feels good—like you telling someone your deep thoughts and feelings which you might rarely do with actual human beings; multiple ways to capture reflections	List of values feels forced and limited and doesn't always seem to match [the reflection] i choose; I'm missing a more free form tool, where i just collect some thoughts
P2	Tools are nice; nice application for people without self-knowledge or self-reflection	
P3	The idea of making a link between your lifestyle and your work-style is a very good goal	It needs to fill the gap between the tools (like a photo of my life) and the conclusions about your way of working; questions asked in the tools could be sharpened; system could introduce me more to the different kinds of values
P4	It kept giving me consistent important values; unique experience, I never used anything like this before that showed me what i care about most	Values it listed did not include all the values i cared about
P5	Association cards: helpful, but still too abstract; good idea to make values and competences explicit	[some tools] are too abstract; not all values i am seeking there; once i add a value i cannot remove it.
P6	Many options	Definitions of some values not clear; difficult to attach a value to certain activities (everything seems to be lifestyle)
P7	More than one way to know yourself	
P8	It helps to you to think about things that you aren't used to; you can see your hard points easily; you can see all your reflections together.	You don't obtain any feedback of your own reflexions; difficult to see the relation between the work and your reflections; I don't think that a photo or an story can help you

further elaborated by P1 in a general comment: '... maybe I want to add my own values and not the predetermined ones. When an interface prescribes certain steps (tell a story, tell what's important about it, select some values) in some ways I feel that I'm not able to express myself as I see fit - it feels like I'm behaving how someone else wants me to behave.' Other general comments with regard to the guidance of the system were made by P2: 'At present, the system more or less prompts you to make up your values, ... by yourself and then input them. I believe the system needs to become one that actually helps you discover them.' and P5: 'the tools are a good start, but need better guidance.' P8 takes it even a step further by saying 'when you chose a photo or a story the platform should tell you which value ... are you talking about.'

Additional job-related values mentioned by the participants were: cooperation, participation, contribution, empathy, motivation, innovation, change, flexibility, independence, respect, appreciation, money, pleasure, teamwork, being around other people, friendliness and, generally, social aspects of work. This shows the large number of values relevant to the career context which were not represented in the preselected values.

4.2.2. *User feedback from the workshop*

In the critique phase participants discussed barriers for using the website such as a lack of motivation to use the tool, too much time needed to use the tool, the gap between work and life values, lack of guidance, lack of private feel, and no option to add own values.

The metaphor generation in the second phase resulted in: therapy, meditation, consultant, career advisor, diary, stress relief, dream, conflict resolver and dating site. These metaphors highlight the different functions a value-reflection tool could fulfill. Participants used the metaphors as inspiration for the sketches (without such an instruction). Ideas ranged from concrete design suggestions (mind-mapping as a reflection tool, scrapbook or diary with handwriting for personal feel) created during the sketching to utopian ideas, e.g. a pill dispenser (for therapy) and abstract thoughts, e.g. on adding life goals and links to values.

Besides the concrete ideas other topics included the user's motivation, personality, privacy, guidance and advice. Personality was mentioned as an important aspect of a value-reflection tool. The participants discussed how important it is that the tool provides a personal and secure feeling similar to a diary that you use to note intimate feelings or experiences. One participant suggested a diary-like interface. Further, participants liked that the website provided several ways to reflect allowing to pick the one that suits the user's personality best.

A discussion arose regarding the free-form diary style and guidance that should be provided by the system. Participants mentioned that guidance is needed to get from the concrete (images, stories) to the abstract (values). One participant thought it would be a motivational factor, as with less guidance it can be unclear for people what the benefit is of using such a website. However, other participants thought that too much of it can also impede the use as reflecting is an activity that

is more free and personal. Too much structure would feel like the system's values would be imposed on the user. Overall, all participants agreed that reflections should first be tagged with personal values that a user could add to the system, but these then had to be matched to the work values predefined in the system. The latter were, however, hard for participants to grasp and definitions would be needed. One participant suggested a system-led dialog with the user to give the user a deeper understanding about a certain value and find out whether this work value relates to the user.

Participants also discussed in how far the system should provide new insights to the user, to surprise the user and make her learn something new about herself. A designer needs to consider to what extent the system would make assumptions about a user's input. In any case participants preferred the system to have a certain level of transparency, i.e. that they would easily understand how the reflection tools work and how the system analyses the data. This could be done e.g. through explanations of the benefits of each reflection tool (e.g. why should I write a story?). Especially for the rather general reflection questions participants were unsure how reflecting on those would give them insights into work-related values. Thus, one suggestion was to have more personal and context-sensitive questions. In addition, one participant suggested giving immediate feedback from the system on the importance of the different values while entering data. Another participant elaborated on the idea and sketched a pie chart in which each piece represented a value. He suggested that the pieces would be enlarged in real-time as soon as the respective value was added to a data entry. The user workshop participants voted this sketch as one of the best ideas during the fantasy phase indicating that this form of direct feedback was liked by the participants.

Finally, participants discussed an integration of the website with social networks like Facebook. Such group functionality is interesting considering that the experts suggested that group discussions can support the reflection of an individual. One participant suggested that besides inviting Facebook friends, profile information and even status updates could be used to create a value-reflection profile automatically. Other participants preferred to keep it a private tool. This was also seen as a matter of trust. The more private and secure the tool feels the more a user can trust it, a prerequisite to enter intimate data.

4.3. Online Survey

4.3.1. User characteristics and attitudes

From an analysis of correlations (using Pearson's coefficient) between the different user characteristics measured, we found a weak significant correlation, $r(80) = 0.272$, $p < 0.05$, between the frequency of writing a diary and the level of self-reflection (obtained from the RRQ). Other emotional triggers play a big role in people's reflection. As shown in Fig. 5 all mean values are clearly above the neutral point of the scale (3). Especially

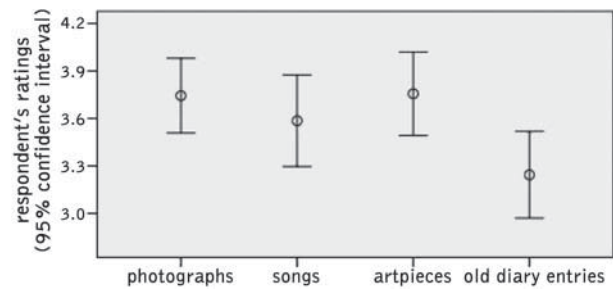


Figure 5. Average ratings of agreement of use of different emotional triggers for reflection.

photographs, songs and artworks can inspire reflection. The lower value on diary entries may be related to the fact that not every participant writes diaries on a regular basis.

Furthermore, we found a weak significant negative correlation, $r(80) = 0.223$, $p < 0.01$, between the age of the participants and their level of rumination, which suggests that young people ruminate more than older people. This could also explain the moderate significant positive correlation, $r(80) = 0.315$, $p < 0.01$, we found between age and the construct of individual truth. Whereas older people prefer the promotion of their individual truth, younger people prefer that the system teaches them something new about their values.

To measure the reliability of the multi-item constructs in part 4 of the survey (understanding of value concept, self-knowledge values-decisions, benefits of value awareness, attitude towards value-reflection tool) we used Cronbach's alpha. Acceptable alpha values were obtained for understanding of value concept (0.636), self-knowledge values-decisions (0.837), benefits of value awareness (0.672) and attitude towards value-reflection tool (0.790). We found a moderate significant correlation, $r(80) = 0.322$, $p < 0.01$, between the level of understanding of the value concept and people's understanding of the relation of values to decision making. In addition, we found a strong significant correlation, $r(80) = 0.442$, $p < 0.01$, between the perceived benefits of value awareness for career choices and a positive attitude towards using a value-reflection tool.

As shown in Fig. 6, more than 50% of the respondents would feel well-prepared for an upcoming job negotiation after using a value-reflection tool. Almost a third of the respondents would (also) be more self-confident and know exactly what they want. However, at the same time about a third of the participants think they would know what they already know. In addition, an analysis of responses to items 4.9 and 4.10 showed that about 40% would use a digital tool (with similar interfaces as the ones presented) to self-reflect and about 56% believe, it would help many people make better decisions. The data also showed that for both questions about a third of the respondents picked the neutral point on the scale. This shows that many people are indecisive or do not see the benefits of such tools. Using an actual tool could help people form a directed opinion about the benefits.

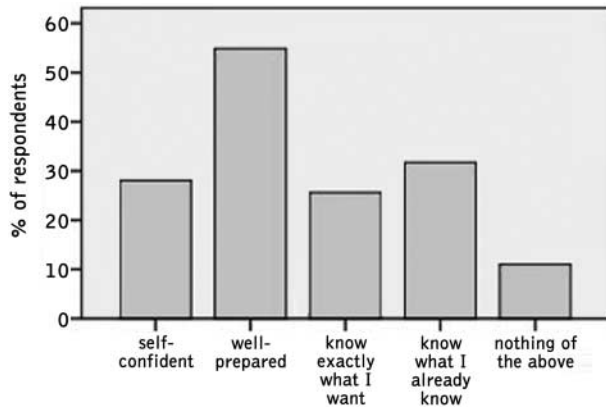


Figure 6. Percentages of respondents for each level of preparedness after using the tool.

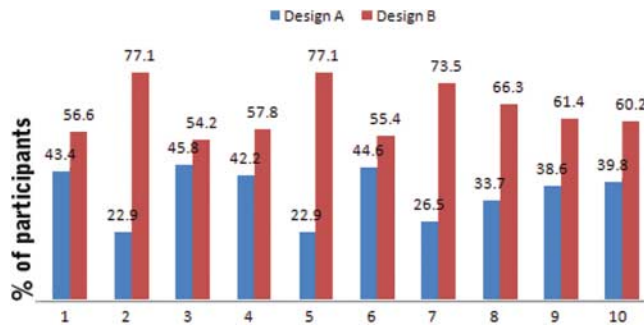


Figure 7. For each design idea (1–10, see Table 1) the percentages of people who chose design A (left column) or design B (right column) is shown.

4.3.2. User reactions to design ideas

As shown in Fig. 7, clear preferences were found for design idea 2 (given values vs. adding own values), 5 (general vs. personal reflection questions), 7 (separate or combined visualization of reflection input and value importance) and 8 (given value definition vs. dialog with system to see if a value fits). In particular, almost 80% of the respondents preferred to be able to add their own values to the system and about 80% preferred personal questions for reflection to more general ones. Over 70% of the respondents would like to receive immediate, visible feedback about their value frequencies (i.e. how often they reflect on each value) while using a reflection tool. About 66% of the respondents preferred a dialog with the system (or a coach in the system) to understand the definitions of predefined values and whether they fit to them.

We calculated (Pearson) correlations between the level of self-reflection and the different design options. A moderate significant negative correlation, $r(80) = -0.329$, $p < 0.01$, was found between self-reflection and design 7, meaning that less self-reflective people preferred immediate feedback, while for highly self-reflective people the information could be shown in separate screens. Assuming that users would

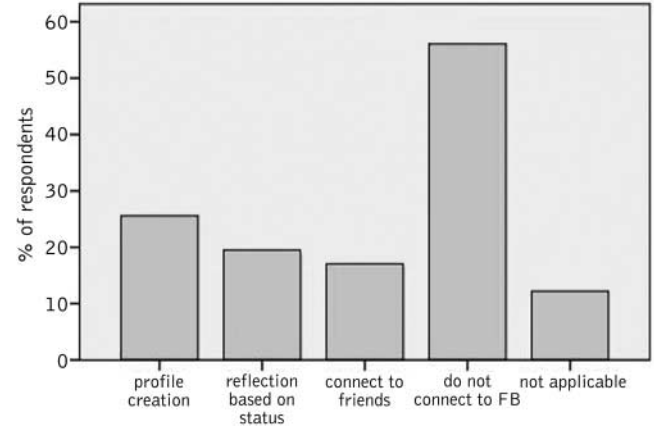


Figure 8. Percentage of people who chose each Facebook integration option.

become more reflective while using the tool over longer time, this preference should be considered in the design of the tool.

To investigate whether we can predict any of the design choices based on personal traits we used a binary logistic regression (forward stepwise) analysis to predict each design pair with age, gender, reflection, rumination, perceived self-knowledge of values, understanding of the value concept and relation between values and decision making as covariates. For design pair 5 gender and people's understanding of the relation of values to decision making were significant ($p < 0.05$) variables predicting design choice. About 95% of all females chose design B (personal reflection questions), whereas only 70% of the males chose this design. These data need to be handled with care though. Given that both percentages are rather high and given the participant sample was not representative for the whole population, it is hard to take a decision on personal vs. general based on the user's gender. In addition, the more people understood how their values related to decision making, the more they preferred general questions. For design pair 7 level of reflection (as explained above) and people's understanding of the relation of values to decision making were significant ($p < 0.05$) variables predicting design choice. In a separate correlation analysis of the latter construct and design 7 only a very weak correlation was found. Thus, this factor can be neglected. For design pair 8 the frequency of diary writing was significant ($p < 0.05$) in the prediction model. A positive correlation, $r(80) = 0.251$, $p < 0.05$, was found, meaning that people who write their diary more frequently preferred a dialog approach to finding out the meaning of a value and whether the value fits them. However, since the correlation was only a weak one this aspect needs to be retested.

User preferences for different levels of integration with Facebook are shown in Fig. 8. More than half of the users would not want to integrate the tool with Facebook (or other

social network) data. One fourth of the respondents would use it for importing their Facebook profile to Reflections and about a fifth would use it to create automatic reflections based on their status updates or to connect to their friends. From the participant's comments it becomes clear that integration possibilities should be provided, but users would like to be able to opt out.

5. DISCUSSION

In the beginning of this paper we outlined different approaches to decision support and argued that DSS should shift focus from rational decision models (e.g. Coleman and Fararo, 1992) towards more realistic models, such as the adaptive decision maker model (Payne *et al.*, 1993). In order to handle the uncertainty of human preferences, which are constructed by people in each decision context, we focused on values as stable sources underlying preferences and decision making. The value-focused thinking framework (Keeney and Raiffa, 1993) was the starting point of our design work. The focus of the work presented lay in the first step in the proposed framework, i.e. the identification of values. As there are currently no digital tools in this area and the difficulty of reflecting on and expressing values has been pointed out we chose for an exploratory approach to investigate design opportunities together with experts and users. Based on our exploratory studies we present the following five design considerations for digital tools that can support this first step.

5.1. Design Considerations

Uniqueness and Personalization The theme of uniqueness was prevailing in our exploration. It was first brought up by the experts during the interviews and emphasized that people have diverse ways to reflect and express their values. While we already stated in the background that values are difficult to identify (Keeney, 1992) and express (LeDantec *et al.*, 2009) and exist in complex networks (Schwartz, 1996), the uniqueness of people's value reflection adds to the complexity of eliciting values. While dialog approaches suggested by Keeney and Raiffa (1993) can be flexible, digital systems have to be equally flexible and offer different ways to reflect and leave it to the user to choose the way that suits her best.

We tried to account for this aspect in the probe and the first user study confirmed that users liked the diverse ways of reflecting. Further, it was found that users consider a personal feel important. Ideas that were brought up were being able to customize the tool, adding one's own values and having a more diary or scrapbook style approach where users can create a personal (art-) piece of reflection.

The survey confirmed that there is a strong preference to be able to add own values. One participant explained that 'trying to fit very personal values in predefined boxes seems very forceful,

and even condescending, dismissive of the values that might be very important, but are not on the list.' (P48)

Preferences for the other two design ideas were distributed among the two design options. Thus, customization and diary style interaction is based on a user's personal preferences and should not be enforced on the user. As P48 reasoned critically 'The question is—is this a tool solely for accomplishing its goal: reflect and learn about yourself, or is it a place for one to sit down, reflect but also enjoy the process of reflection? In the latter case customization would be more useful, as it is also an indirect way to reflect yourself. However, as reflection is something not really tied to a tool, and can be done without it, I see little incentive to spend time customizing the look and feel in cases when you would use the tool only occasionally.'

In addition, regarding reflection questions, a mix of personal and general questions should be offered for the users to choose from. In any case such questions should be so-called slow questions that the user reflects upon over time and in different settings. In order to design such recurring reflection on important questions Slow Technology (Hallnäs and Redström, 2001) could provide inspiration.

Trustworthiness, privacy, and transparency Reflecting on personal experiences and values is an intimate action, and thus when shared with others a level of trust needs to be established first. The counselors emphasized the importance of trust between counselor and client and a comfortable atmosphere that is necessary for the creation of trust. In HCI and related research trust has been an important topic with regard to technology and its acceptance. Friedman *et al.* (2000) have e.g. investigated the role of trust online. They stated that 'we trust when we are vulnerable to harm from others yet believe these others would not harm us thought they could.' (p. 34). Thus it is related to the good will of others and as such to the concept of agency. Since it is questionable that technology has this agency (maybe with the exception of intelligent machines) we should speak of relying on technology rather than trusting. Often in the literature trust has been related to security, safety, reliability and correctness of systems (Schneider, 1999). These aspects are difficult to pinpoint when it comes to value-reflection systems, as it is often not clear what correct or reliable system behavior would be. Another concept related to trust is privacy (Friedman *et al.*, 2000). This is relevant to our system, as it will be collecting sensitive reflections. Especially when implementing group functionality, it is important to ensure that the user can set who is allowed to see what.

That trust and privacy can be transferred to computerized systems was confirmed by the survey's respondents (e.g. as P1 stated, 'it has to feel intimate and trustworthy'), as reflected in the answers to item 3.8. ('I only share reflections on myself with people I trust. The same is true for a digital system.'), which was agreed to by 79.3% of the participants (54.9% strongly agree). P17 commented that, 'Trust is a big issue, not just about privacy but also in the guidance the system provides. It also

changes what people enter in the system. Some systems use a humanoid avatar designed as a person the target user can relate to.' Thus, the establishment of trust is also linked to the type of interaction the tool provides. This has also been found by Pu and Chen (2007), who developed a trust model with three components: system features, trustworthiness of the agents and trusting intentions (i.e. benefits expected from users when trust has been established). System features include among others the interaction models.

In our work we learned that increasing a trustworthy feel could be achieved through transparency and user–system dialog. An example of transparency would be immediate feedback from the system when entering reflection data, as this visualizes to the user how the system's value profile is adapted in real-time. In the survey more than 70% of the respondents were in favor of this option. In addition, many respondents favored a dialog with the system to clarify a value and see whether the value suits them.

While we saw that trust plays a major role, it still needs more research, as it is a complex concept. Whether trust is directed at the system, its designers or other users of the system and what factors will increase a trustworthy feel is not completely clear at this point.

Guidance from concrete to abstract The level of guidance that the system offers to the user was a theme mentioned first in the expert interviews and later discussed in the user workshop. The experts deemed it an important aspect of helping people to get from concrete experiences to abstract value concepts. Although we tried to implement guidance as advised by the experts into the probe, users still raised the issue of getting to the abstract values. Users emphasized that it is important to understand how to get from personal reflections to related work values. This observation confirms several points in our theoretical background: that (1) values are difficult to identify (Keeney, 1992) and express (LeDantec *et al.*, 2009), (2) values are complex and should be discovered in context (Keeney and Raiffa, 1993; LeDantec *et al.*, 2009) and (3) values are hierarchical (Keeney, 1992; Rokeach, 1973).

One suggestion from the users was to have a layered approach in which first personal values (e.g. added by the user) would be identified in a reflection and then linked to work values with the help of the system. This is closely in line with a differentiation of intrinsic (in this case the personal values) and instrumental values (in this case the work values that would lead to personal values; Rokeach, 1973).

Guidance can be achieved through explanations. However, these need to be designed carefully. Several participants commented that they would like to be able to get explanations when they ask for it, but pop-ups or other forced types of explanations should be avoided. E.g. 'Explanation is good, but only if I ask for it please.' (P10) Similar comments were made on the explanation offered for the overview (design choice 10), e.g. 'I might want to see it the first time but have the option to dismiss and/or never show again.' (P47) Another related aspect

was the way the system judges the input of a user (design choice 6). Similarly to the idea of individual truth mentioned by the experts, one participant pointed out, that 'part of reflection includes also conflicting thoughts and emotions that can be perfectly valid - but it is up to user to decide what does and what does not make sense, not for the tool to divide reports into premade boxes of possible and impossible value combinations.' (P48)

While we hypothesized that the level of preferred guidance could be dependent on a user's level of reflection or rumination this could not be confirmed through the survey. However, we found that younger respondents tended to prefer that the system teaches them something new about their values, thus, guides them in their exploration of values. Furthermore, a substantial amount of respondents liked the system to point out inconsistencies (>40%) and a structured approach to entering reflections (>45%). This diversity shows that balancing guidance with the open nature of reflection is difficult and needs to be considered carefully in the design of the tool. Similarly, HCI research on supporting people's behavioral choices has come with a variety of approaches including some that are prescriptive and use persuasive mechanisms (Törning and Oinas-Kukkonen, 2009) and others that are more open, exploratory and allow for people's own interpretations (Boehner *et al.*, 2005; Li and Forlizzi, 2010). It should be considered that the success of either approach may also be linked to the characteristics of the user and her preferences of guidance.

Emotional triggers Mentioned first by the experts and confirmed by the survey, people use emotional triggers to begin a reflective process. They are more useful than asking direct questions about people's values, which are difficult to answer due to their abstract nature. Concrete examples of emotional triggers are visual stimuli such as (e.g. value-laden) images, paintings or personally owned photographs, audio stimuli such as music, written pieces, e.g. old diary entries or poems, or other art pieces. It is important to design a tool so that each user can select her personally preferred trigger. Whereas some people like writing or looking at art, others reflect through listening to a song or the lyrics of a song.

Social network functionality Experts mentioned benefits of social settings for reflection. While one respondent of the survey saw a benefit in having 'others who can access my page . . . rate my values from their perspectives. (What they think my values are)' (P23), overall the survey revealed a clear division of opinion towards the use of social networks together with a value-reflection tool. A bit more than half of the respondents clearly stated that they would not want such integration at all and about 10% of the respondents do not use social networks. The remaining people preferred different levels of integration from just importing friend connections to using status updates as reflection. P55 stated that 'linking to Facebook should be optional, with multiple privacy options (settings to share your activity with others, or ability to only share with certain people,

or linked but kept completely private-only accessing your status, etc. for your personal insight...)' P47 said, 'I'd note that Facebook integration is probably important for some of the intended users. That said, I would not want to use it. I should be able to opt out.' We propose that designers provide functionality for integration with social networks, but leave it completely up to the user whether to use it or on what level. In addition, a social function could also be implemented in the value-tool itself (as in our prototype), and, e.g. provide functionality for assessment and discussion of other user's values. Users should be able to set the privacy level of such functionality by themselves.

5.2. Critical Reflection

The work presented constitutes an exploration of digital support for value reflection and ultimately value-focused decision making. When entering a new design domain it is important to get in-depth insights into the domain, preferably from different perspectives and through collecting different types of data. This is why we chose for a mixed-method approach. Our methodology combined qualitative investigations including experts and end-users and a larger quantitative end-user survey. We believe that the qualitative data from experts provided rich insights into aspects of value reflection, such as uniqueness, trust and guidance, and concrete methods to trigger reflection, e.g. through emotional triggers.

As digital value-reflection tools did not yet exist, we worked closely with end-users through participatory methods to allow us to envision such tools. Starting out with a probe that users explored for several weeks provided a good entry point for the discussion with end-users. The direct message function during the study allowed users to give *in situ* feedback, while using the probe and gave us a first indication of the conceptual issues (such as the chosen values) and usability issues. Some in-depth discussion via email occurred. However, few people made use of this function. As we did not ask participants why they did not use it, we can only assume reasons for this behavior. It could be that the participants did not favor the possibility of receiving immediate feedback from the researchers on their comments. Perceived power differences could be at play at this point. Anonymous feedback could be a remedy for this issue and will be tested in the future.

Overall, the user study allowed us to shed light on user's perceptions on the themes mentioned by the experts. Furthermore, the quantitative data could be used to further support ideas from the small set of users in the workshop. On the other hand, triangulating data from different sources and obtained by different techniques also posed difficulties. For instance, not all the quantitative feedback on the design ideas presented by participants of the workshop provided clear guidance on interface designs.

In general, we believe that our methodology was useful in providing detailed design considerations for value-reflection

tools. However, as the methodological steps built upon the results of one another a critical reflection on the outcomes is needed. For instance, the expert interviews delivered a set of themes relevant to value reflection and support thereof, which we tried to account for in our probe. One could assume that especially with a functional probe it is hard to get participants to think outside of what they see in the probe. Indeed, in the discussions with end-users we saw that many themes were the same as the ones that the experts had brought up, e.g. differences in which means for reflection are preferred or having trouble to get from concrete reflections to abstract values.

We noticed, however, that the end-users' accounts were more nuanced and while they partially confirmed the expert themes, some new controversial aspects surfaced, e.g. the tension between guidance of the system and the freedom in expressing reflections and values, which may also affect the motivation of users. Tensions like this, how they would play out in a concrete tool (e.g. problems in translating concepts like trust to the digital) and concrete design ideas were the results of the user workshop. We believe that the group setting and steps of the workshop facilitated this.

Considering the participants of the workshop, a mix of males and females would have been better, as it can be assumed that gender would have an effect on reflection. Generally, it would have been beneficial to conduct several user workshops and include more end-users from the first phase and the experts. Limited time and scheduling problems made this impossible for us. Currently the design ideas and themes tested in the survey were based on a small set of participants. While this small number of people allowed us to consider ideas in more depth, it may have limited us in finding all relevant factors. As a result we cannot claim the list considerations to be exhaustive. Several other workshops or in-depth user interviews could reveal more factors that may be of relevance.

Another limitation was that the design sketches presented in the survey were static and thus the exact interaction was up for the respondent to imagine. We do not believe that this led to any major problems, as the focus lay more on testing ideas instead of concrete implementations. However, animated examples of ideas or even a new set of interactive prototypes could provide more nuanced user preferences. In addition, some of the data from part 4 of the survey was inconclusive and participants were not all convinced of the benefit of the envisioned tool. Testing several prototypes and using a final prototype over longer time could mitigate some of the users' doubts and give more conclusive data with respect to people's attitudes towards value reflection and support tools.

Finally, our work gave insights into our theoretical concepts. Especially with regard to the value concept we found that people considered it hard to understand given values and link them to experiences or thoughts. However, it seemed that it would be easier for them to add their own value expressions and then have the tool help mapping them to work-related values. This indicates that the difficulty may lie in articulating rather

than reflecting. Furthermore, it seems that the tools supported reflection on fundamental values that need to be mapped to mean values for the given decision context (i.e. career values that can lead to personal values relevant for all aspects in life). In how far the decision making will be improved by assessing values cannot be concluded yet, based on our data.

This is part of the future work.

6. CONCLUSIONS AND FUTURE RESEARCH

To the best of our knowledge there are currently no digital tools dedicated to value reflection. Furthermore, decision support systems research has not yet focused on the integrating value reflection in existing tools. However, we argue based on Keeney's model of value-focused thinking that supporting people in value reflection, in particular with mobile tools, is an important direction to enhance people's decision making on major life choices.

We have presented a first exploration of this area using a probe based on expert knowledge and design sketches to trigger end-user feedback. Our methodology was focused, on the one hand, on idea creation through close collaboration with experts and end-users and, on the other hand, on reaching out to a large population through an online survey. Based on our results, we have compiled a preliminary set of design considerations for value-reflection tools. We believe our work is the first contribution that other researchers in HCI and related fields can build upon.

We envision the following future work. First of all, more creative workshops similar to ours should be conducted in order to gather a larger range of issues and concrete ideas. It needs to be seen if the set of considerations is complete or needs to be expanded. Such workshops should be followed by the implementation of several design alternatives of a value-reflection tool to be tested by end-users. An advanced version of such a tool would also aid in structuring the identified values into fundamental and means values and support deliberation on value trade-offs.

Once a design alternative has been chosen and improved based on the user tests, a longitudinal study could provide insights into whether the tool's users reach more awareness of their values, improve their decision making or change their behavior to match their values. Especially, motivational aspects should be investigated further, as a reflection tool can only be useful if the user uses it on a regular basis. Finally, the integration into existing or new DSS needs to be accomplished.

ACKNOWLEDGEMENTS

We would like to thank the participants of all studies. This research is supported by the Dutch Technology Foundation STW, the Applied Science Division of NWO and the Technology Program of the Ministry of Economic Affairs.

FUNDING

This work is part of the Pocket Negotiator project with grant number vici-project 08075.

REFERENCES

- Arvai, J. L., Gregory, R. and McDaniels, T.L. (2001) Testing a structured decision approach: value-focused thinking for deliberative risk communication. *Risk Anal.*, 21, 1065–1076.
- Boehner, K., Depaula, R., Dourish, P. and Sengers, P. (2005) Affect: from Information to Interaction. *Proc. 4th Decennial Conf. Critical Computing: between Sense and Sensibility, CC'05*, pp. 59–68. ACM, New York, NY.
- Carenini, G. and Poole, D. (2002) Constructed Preferences and Value-Focused Thinking: Implications for AI Research on Preference Elicitation. Technical Report, American Association for Artificial Intelligence.
- Cheng, A.-S. and Fleischmann, K.R. (2010) Developing a meta-inventory of human values. *Proc. Amer. Soc. Inform. Sci. Technol.*, 47, 1–10.
- Coleman, J.S. and Fararo, T.J. (1992) *Rational Choice Theory: Advocacy and Critique, Introduction*. Sage, Newbury Park.
- Fischhoff, S.P., Slovic, P. and Lichtenstein, S. (1980) Cognitive processes in choice and decision behavior. In *Knowing What You Want: Measuring Labile Values*, pp. 117–141. Erlbaum, Hillsdale, NJ.
- Friedman, B., Kahn, P.H. and Howe, D.C. (2000) Trust online. *Commun. ACM*, 43, 34–40.
- Hallnäs, L. and Redström, J. (2001) Slow technology—designing for reflection. *Personal Ubiquitous Comput.*, 5, 201–212.
- Hutchinson, H., Mackay, W., Westerlund, B., Bederson, B.B., Druin, A., Plaisant, C., Beaudouin-Lafon, M., Conversy, S., Evans, H., Hansen, H., Roussel, N. and Eiderbäck, B. (2003) Technology Probes: Inspiring Design for and with Families. *Proc. SIGCHI Conf. on Human Factors in Computing Systems, CHI'03*, Fort Lauderdale, FL, pp. 17–24. ACM, New York.
- Keeney R (1992) *Value-Focused Thinking: A Path to Creative Decision Making*. Harvard University Press.
- Keeney, R. (1996) Value-focused thinking: Identifying decision opportunities and creating alternatives. *Eur. J. Oper. Res.*, 92, 537–549.
- Keeney, R. and Raiffa, H. (1993) *Decision with Multiple Objectives: Preference and Value Tradeoffs*. Cambridge University Press.
- Kensing, F. and Halskov-Madsen (1991) Generating Visions: Future Workshops and Metaphorical Design. In Greenbaum, J. and Kyng, M. *Design at Work: Cooperative Design of Computer Systems*, pp. 155–168. Lawrence Erlbaum, Hillsdale, NJ.
- LeDantec, C.A., Poole, E.S. and Wyche, S.P. (2009) Values as Lived Experience: Evolving Value Sensitive Design in Support of Value Discovery. *Proc. SIGCHI Conf. on Human Factors in Computing Systems, CHI'09*, Boston, MA, pp. 1141–1150. ACM, New York.

- Li, I. and Forlizzi, A.D.J. (2010) A Stage-Based Model of Personal Informatics Systems. *Proc. of the SIGCHI Conf. on Human Factors in Computing Systems, CHI'10*, Atlanta, GA, pp. 557–566. ACM, New York.
- Lindström, M., Stahl, A., Sundström, P., Höök, K., Laaksolahti, J., Combetto, M.J., Taylor, A. and Bresin, R. (2006) Affective Diary: Designing for Bodily Expressiveness and Self-Reflection. *CHI'06 Extended Abstracts on Human Factors in Computing Systems*, Quebec, Canada, pp. 1037–1042. ACM, New York.
- Norman, D.A. and Draper, S.W. (1986) *User Centered System Design: New Perspectives on Human–computer Interaction*. CRC Press.
- Payne, J., Bettman, J. and Johnson, E. (1993) *The Adaptive Decision Maker*. Cambridge University Press.
- Pommeranz, A., Detweiler, C., Wiggers, P. and Jonker, C.M. (2011) Elicitation of situated values: need for tools to help stakeholders and designers to reflect and communicate. *Ethics Inform. Technol.*, 14, 285–303.
- Pu, P. and Chen, L. (2007) Trust-inspiring explanation interfaces for recommender systems. *Knowl.-Based Syst.*, 20, 542–556.
- Purpura, S., Schwanda, V., Williams, K., Stubler, W. and Sengers, P. (2011) Fit4life: the Design of a Persuasive Technology Promoting Healthy Behavior and Ideal Weight. *Proc. 2011 Annu. Conf. on Human Factors in Computing Systems, CHI'11*, Vancouver, Canada, pp. 423–432. ACM, New York.
- Rescher, N. (1969) *Introduction to Value Theory*. Prentice-Hall, Inc., Englewood Cliffs, NJ.
- Rokeach M (1973) *The Nature of Human Values*. Free Press, New York.
- Sas, C. and Dix, A. (2009) Designing for Reflection on Experience. *Proc. 27th Int. Conf. Extended Abstracts on Human Factors in Computing Systems, CHI EA'09*, Boston, MA, pp. 4741–4744. ACM, New York.
- Schein, E.H. (1990) *Career Anchors (Discovering your Real Values)*. Jossey-Bass Pfeiffer, San Francisco.
- Schneider, F. (ed.) (1999) *Trust in Cyberspace*. National Academy Press, Washington, DC.
- Schuler, D. and Namioka, A. (1993) *Participatory Design: Principles and Practice*. Lawrence Erlbaum, Hillsdale, NJ.
- Schwartz, S. (1996) Value priorities and behavior: Applying a theory of integrated value systems. *The Psychology of Values: The Ontario Symposium*, 8. Lawrence Erlbaum, Hillsdale, NJ.
- Schwartz, S.H. and Bilsky, W. (1990) Toward a theory of the universal content and structure of values: Extensions and cross-cultural replications. *J. Personal. Social Psychol.*, 58, 878–891.
- Sengers, P., Boehner, K., David, S. and Kaye, J. (2005) Reflective Design. *Proc. 4th Decennial Conf. on Critical Computing: between Sense and Sensibility (CC'05)*, pp. 49–58. ACM, New York, NY.
- Torning, K. and Oinas-Kukkonen, H. (2009) Persuasive System Design: State of the Art and Future Directions. *Proc. 4th Int. Conf. on Persuasive Technology, PERSUASIVE'09*, Claremont, CA, pp. 30–38. ACM, New York.
- Trapnell, P. and Campbell, J. (1999) Private self-consciousness and the five-factor model of personality: distinguishing rumination from reflection. *J. Personal. Social Psychol.*, 76, 284–304.
- Tversky, A. and Sattah, S. (1979) Preference Trees. Technical Report no. 1, Stanford Univ. Calif. Dept. of Psychology.
- Tversky, A., Sattath, S. and Slovic, P. (1988) Contingent weighing in judgement and choice. *Psychol. Rev.*, 95, 371–384.
- Williams, R.M.J. (1979) *Understanding Human Values, Change and Stability in Values and Value Systems: Asociological Perspective*, pp. 15–46. The Free Press, New York.