Is this a design-worthy dilemma? Identifying relevant and inspiring concern conflicts as input for user-centred design

Deger Ozkaramanli*

Industrial Design,
Delft University of Technology,
Landbergstraat 15, 2628 CE Delft, The Netherlands
and
School of Engineering,
University of Liverpool,
Harrison-Hughes Building, L69 3GH Liverpool, UK
Email: d.ozkaramanli@tudelft.nl
Email: d.ozkaramanli@liverpool.ac.uk
*Corresponding author

Pieter Desmet and Elif Özcan

Industrial Design,
Delft University of Technology,
Landbergstraat 15, 2628 CE Delft, The Netherlands
Email: p.m.a.desmet@tudelft.nl
Email: e.ozcan@tudelft.nl

Abstract: Personal dilemmas can be valuable starting points for user-centred design. Since dilemmas prevail in everyday life, designers can identify many dilemmas relevant for a given design brief. It can therefore be a challenge to choose a target dilemma as a means to frame an appropriate problem space. To address this challenge, this paper proposes seven qualities of 'design-worthy' dilemmas. These key qualities were derived from a cross-comparison of four dilemma-driven design cases, and were clustered in three categories: 1) relevance for target users; 2) potential to inspire design ideas; 3) meaningful formulation of conflicting concerns. The qualities of design-worthy dilemmas explicate the considerations designers have when selecting a target dilemma, and thus, they can facilitate introspection and discussion in problem framing. In addition, the case studies demonstrate the main activities involved in dilemma-driven design, namely discovery, definition, and application.

Keywords: concern conflict; dilemma-driven design; user-centred design; problem framing; design process.

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Biographical notes: Deger Ozkaramanli is a PhD candidate at the Faculty of Industrial Design Engineering at Delft University of Technology. She studied Design for Interaction at the same university and received her MSc degree with a thesis focusing on designing long-term goal engagement using conflicting concerns. The goal of her PhD research is to develop tools and methods that support user-centred designers in identifying emotional dilemmas during user research and in generating design ideas that address these dilemmas. She is a member of Delft Institute of Positive Design, which aims to explore the contribution of design to human flourishing and happiness. She currently works at University of Liverpool as a Lecturer.

Pieter Desmet is a Full Professor of Design for Experience at the Faculty of Industrial Design Engineering at Delft University of Technology. He chairs a research group that focuses on the fields of design for emotion and subjective wellbeing. He is a Board member of International Design for Emotion Society and Co-Founder of Delft Institute of Positive Design, a scientific institute that stimulates and initiates the development of knowledge to support designers in their attempts to design for human flourishing. Besides his research, he contributes to community projects, such as the Rotterdam-based cultural 'House of Happiness' foundation.

Elif Özcan is an Assistant Professor at the Faculty of Industrial Design Engineering at Delft University of Technology. She has published in peer-reviewed, international journals and has been a guest editor for the *Journal of Sonic Studies*' special issue on Sound Design. With her PhD on meaningful associations of product sounds, her recent research focuses on the perceptual and cognitive processes underlying meaning attribution to product experiences. She is involved in commercial research projects (e.g., Toyota Motors Europe, European Space Agency) and European doctoral-level research programs (Cognovo, a Marie Curie program on cognition and creativity; docARTES, practice-based research in musical arts).

1 Introduction

Everyday life is replete with personal dilemmas: wanting to snooze in bed instead of getting up, choosing a chocolate bar instead of a piece of fruit as an afternoon snack, reluctance to compromise from leisure time to meet an urgent deadline, or having second thoughts about a job offer are only a few examples of personal dilemmas. Such dilemmas are often linked to personal values and high-level human motivations, such as being a responsible person, maintaining good health, or attaining professional success. Therefore, it has been suggested that they constitute a viable problem space for addressing psychological and behavioural needs through the design of products and services (Ozkaramanli et al., 2016). Designing with personal dilemmas has been implemented in a multitude of design projects (e.g., Ozkaramanli and Desmet, 2012; Ozkaramanli et al., 2013; Bins, 2014; Coehoorn, 2014; Innemee, 2014). These projects revealed that every personal dilemma represents a new design challenge, which necessitates focusing on a specific dilemma when constructing a viable problem space. At the same time, selecting a target dilemma can be a challenge, since there might be numerous dilemmas relevant for a given design brief. In this paper, we address this challenge, namely how to best select a

target dilemma when framing design problems. Ultimately, we aim to reveal the key qualities that make a dilemma worthy of design.

Design problems are characterised as ill-structured problems: they often have unclear formulations, malleable goals, and multiple possible solutions and solution paths (Simon, 1973; Jonassen, 1997). These characteristics necessitate dealing with uncertainty in design activities and making decisions based on the best possible judgment. One of the most important decisions in ill-structured problem solving is framing an appropriate problem space by exploring and restricting alternatives and refining arguments (Jonassen, 1997). Problem framing plays an important role in clarifying and justifying decisions at the initial phases of the design process (e.g., the fuzzy front end, see Buijs, 2003), as well as in bridging analysis and synthesis (see Roozenburg and Eekels, 2005). Several models can explain problem framing. Schön (1991) characterised the design process as a reflective conversation that the designer has with the situation. In this conversation, framing refers to understanding the issues to be tackled through iterative thought experiments. Simon (1969) suggested that problem solving is a rational process, in which the development of solutions furthers the understanding of the problem. This iterative handling of the problem and solution is referred to as the co-evolution model (e.g., Dorst and Cross, 2001).

Jonassen (2000, pp.80–81) stated that dilemmas are the most vexing type of ill-structured problems characterised by multiple conflicting perspectives. Because of this, addressing dilemmas requires multi-disciplinary expertise in order to best manage compromises that might otherwise remain implicit in the proposed solutions (Jonassen, 2000). Framing design problems as personal dilemmas (e.g., *I want to get a promotion at work* vs. *I want to spend more time with my family*) explicates these conflicting perspectives, and thus, captures the complexity of many individual and societal issues (Ozkaramanli et al., 2016). Due to these characteristics, dilemmas have become a topic of interest in design fields such as design for subjective wellbeing and design for behaviour change. For instance, Desmet and Pohlmeyer (2013) proposed a framework for positive design (i.e., design for subjective wellbeing) that is sensitive to conflicts between any of its three constituents, namely pleasure, personal significance, and virtue. Design for behaviour change often addresses the behavioural manifestations of personal dilemmas, particularly those related to self-control challenges (e.g., smoking, overeating, failing to recycle) (e.g., Lockton et al., 2010). Social design methodically addresses social dilemmas in which behaviours involving personal benefits conflict with those benefiting the society (e.g., over-spending, speeding, littering) (Tromp, 2013). In addition, the field of critical design raises awareness about dilemmas of socio-cultural significance to stimulate discussion around topics such as sustainability or technological advances (Dunne and Raby, 2013).

Selecting a dilemma to design with can be a challenge not only because dilemmas have multi-faceted structures as exemplified above, but also because people experience many dilemmas relevant for any design context. Imagine, for instance, having dinner at your favourite restaurant. In this context, the conflict between *I want to have an indulgent dessert* (concern for enjoyment) and *I want to maintain my healthy diet* (concern for health) is only one of the many dilemmas you might experience. Researching such a context will reveal multiple other concerns and concern conflicts, such as *I want to order a dish I did not taste before, but I also want make sure that I will enjoy my dinner* (i.e., novelty vs. security); *I want to taste a bit of everything, but I do not want to waste food* (i.e., exploration vs. responsibility); or *I want to have an appetizer, but I do not want*

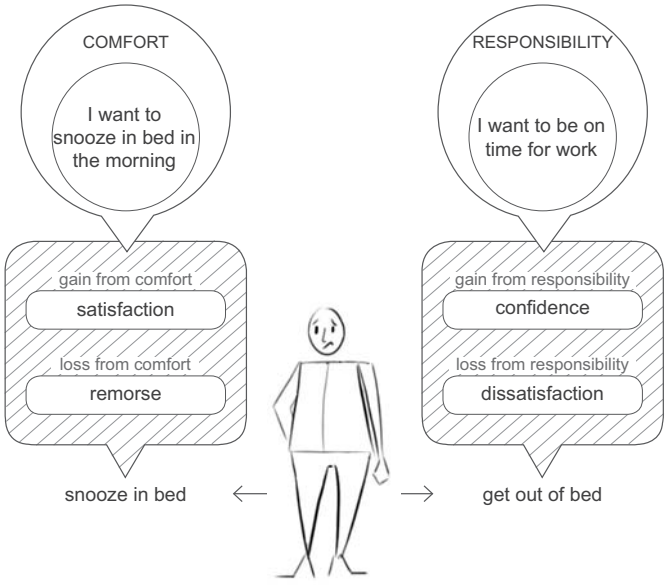
to keep my friend, who will not have an appetizer, waiting for his dinner (i.e., enjoyment vs. belonging). These dilemmas are experienced either simultaneously or sequentially; some are experienced repetitively, while others seem incidental; and some are ideological in nature, while others are relatively more practical. In summary, the decision on what dilemma to focus on can be a challenge due to the diversity and abundance of dilemmas relevant for a given design context.

In this paper, we examine the main activities designers engage in across four dilemma-driven case studies, with a specific focus on the considerations mentioned when selecting a target dilemma. In each case, a number of dilemmas were identified, and a promising dilemma was selected as input for further design activities. In the next section, the four cases are presented, including aims, outcomes, and relevant design considerations. Next, we present seven key qualities of design-worthy dilemmas, which were identified by cross-examining the design cases. Finally, we discuss the relationship between using these qualities and framing an appropriate problem space.

2 Designing with dilemmas: four case studies

In the context of dilemma-driven design, we define a dilemma as the experience of having to make a choice between two mutually exclusive alternatives, both of which touch upon personal concerns, and the simultaneous fulfilment of which is challenging, if not impossible (Ozkaramanli et al., 2016). Because of this challenge, people experience both positive and negative emotions towards each choice (Ozkaramanli et al., 2016). Figure 1 illustrates the three main ingredients of a dilemma, namely conflicting concerns, mixed emotions, and mutually exclusive choices, using the example of wanting to relax in bed instead of waking up at a planned time.

Figure 1 Framework of dilemmas, illustrating the conflict between the concern for comfort and the concern for responsibility in the context of waking up



The theoretical insights into dilemma experiences are very useful for examining user dilemmas, but they do not offer clues for selecting those that are most fruitful in design initiatives. Therefore, we used a bottom-up approach to address the challenge of selecting a target dilemma. We collected qualitative data on designers' considerations when selecting a target dilemma across four exploratory design cases that were conducted sequentially (see Thomas, 2011). Case studies allow for researching a phenomenon in its context using multiple sources for data collection (Yin, 1984). Characterised by questioning, noticing, and expert interpretation, case study approach offers exemplary (vs. generalisable) knowledge based on the unique and complex context of the case (Thomas, 2010). By reflecting on designers' considerations when selecting a target dilemma across four dilemma-driven case studies, we gathered insights into the qualities of design-worthy dilemmas.

2.1 Description of the case studies

Designers engage in three main activities when designing with dilemmas. These are *discovery*, *definition*, and *application* (Ozkaramanli et al., 2014). *Discovery* involves identifying dilemmas using various research methods, such as experience sampling and in-depth interviewing, as well as methods that do not necessitate the direct involvement of users (e.g., interviews with domain experts). *Definition* involves analysing dilemmas to reveal their main ingredients (see Figure 1). This facilitates an in-depth understanding of identified dilemmas and supports the selection of a target dilemma. *Application* involves generating ideas that can address the selected dilemma.

Table 1 Summary of the case studies

Case study	*Design brief*	*Method used to identify dilemmas*	*Format and timing*
1	Design a play activity to improve the social interaction between children with and without a physical disability by changing the mind-set about disabled children[1].	Emotion capture card (ECC) procedure (see Section 2.1.1)	Graduation project (06/2013–01/2014)
2	Design an intervention to support people in dealing with conflicting life-goals by triggering them to question their (limiting) convictions, such as the fear of missing out[2].	Experience booklets followed by in-depth interviewing (see Section 2.1.2)	Graduation project (10/2013–06/2014)
3	Design an intervention to encourage doubtful citizens to support renewable energy production by triggering them to consider the gains and losses of having a wind-farm in their neighbourhood[3].	Experience booklets followed by in-depth interviewing (see Section 2.1.3)	Graduation project (03/2014–2/2014)
4	Design an intervention to nurture the experience of visiting a cemetery or attending a funeral by using dilemmas as a starting point[4].	Co-exploration procedure (see Section 2.1.4)	Design workshop (05/2015)

All case studies followed the three activities of dilemma-driven design. Three of the cases were in the format of a graduation project conducted at Delft University of Technology. A graduation project is the final project completed by master-level students at the Faculty of Industrial Design Engineering. During these projects, students work individually and are free to choose their own topic and supervisory team (i.e., two academic supervisors

and a company mentor if the project is in collaboration with a third-party). Graduation projects are finalised within six to eight months.

The fourth case study was conducted in the format of a design workshop during a course on emotion-driven design taught to master-level students at Delft University of Technology. This format was specifically selected to accommodate the nature of the co-exploration procedure, which was used to identify dilemmas. Twelve designers worked in teams of four people assigned by the course teachers (first and second author). The goal of the workshop was to design an intervention that could nurture the experience of visiting a cemetery or attending a funeral using dilemmas as a starting point. Table 1 summarises the design brief, method used to identify dilemmas, and the format of each case study.

2.1.1 The Uniekies game: improving the social interaction between children with and without a physical disability

2.1.1.1 Problem statement

Children with a physical disability often have difficulties connecting with other children during play activities. This is due to their limited physical abilities and rejection by able-bodied children. Nowadays, a lot of attention is paid to accessibility in play (i.e., the removal of physical barriers), while little attention is paid to inclusion (i.e., the removal of social barriers). This leads to peer isolation. Therefore, enabling social inclusion can improve the quality of life and happiness of disabled children.

2.1.1.2 Design brief

Design a play activity to change the mind-set about disabled children by improving the social interaction between children with and without a physical disability.

Figure 2 The Uniekies game and the instructions for creating super-hero suits (see online version for colours)

2.1.1.3 Design concept

The Uniekies game (Figure 2) introduces disabled children as heroes with special powers who are to be admired. Able-bodied children can also become heroes by dressing up in special suits and training their powers. For example, Bumper symbolises a child in a wheelchair who cannot run, but has the unique power of quickly clearing off the play-path for his followers. When playing the game, an able-bodied child can wear a balloon-suit to experience the challenges of being in a wheelchair in a fun way. The Uniekies game consists of six super-heroes, whose playsuits can be prepared with everyday materials, such as balloons, kitchen foil, and umbrellas.

2.1.1.4 Method used to identify dilemmas

The ECC procedure was used in three play sessions to identify dilemmas of able-bodied children, disabled children, and their caretakers. Frijda (1988) formulated the 'law of concern', which states that every emotion hides a concern. In line with this law, an individual's emotions can be considered as reliable entry points to their concerns. The ECC procedure is based on this law of concern, and it follows three main stages (see Ozkaramanli et al., 2013):

1 capturing emotions

2 distilling concerns

3 formulating dilemmas.

In the first stage, the researcher captures emotions (both positive and negative) through immersing in the context of design (in this case, the play context) in a relatively unobtrusive way. Participants (in this case, the children and caretakers) can either report emotions as they arise, or researchers can prompt for an emotion when they observe an emotional event. Next, the researcher interviews the participant using a laddering-type technique to deepen the understanding of concerns underlying captured emotions (see Reynolds and Gutman, 1988). In the second stage, researchers distil concerns from each ECC, and cluster similar concerns to form an overview of the participants' concerns. In the third stage, researchers explore the relationships among the concern clusters, which leads to the identification of (potential) dilemmas [for details of the ECC procedure (see Ozkaramanli et al., 2013)].

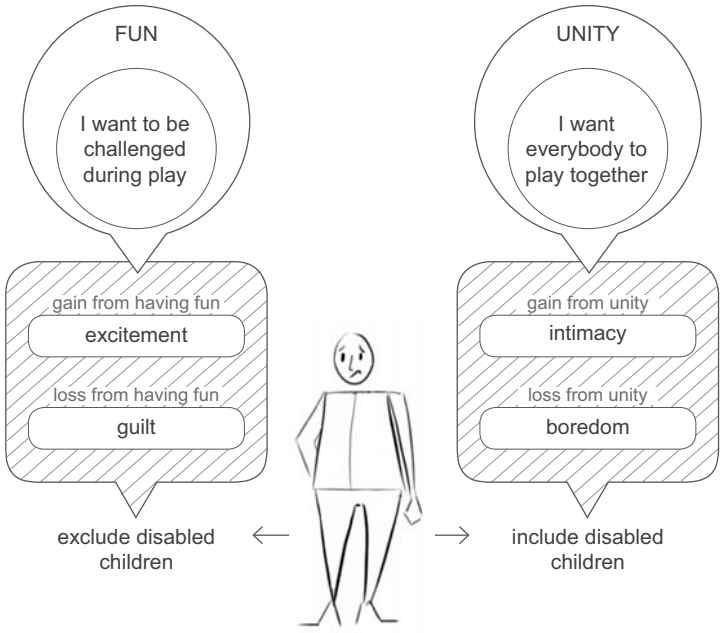
2.1.1.5 Identified dilemmas

Researching the concerns of able-bodied children, disabled children, and their caretakers generated 102 ECCs, which yielded 102 concerns relevant for social play. After analysing the conflicting relationships among these concerns, the designer identified twelve dilemmas. Table 2 outlines three of these dilemmas, supported by participant quotes. Among these, the designer selected the dilemma of the able-bodied children as input for ideation, which is formatted in *italic* in Table 2 and illustrated in Figure 3 using the framework of dilemmas.

Table 2 Identified dilemmas and the selected dilemma for the Uniekies game

Dilemma	*Quote*
Able-bodied children's dilemma: I want to be challenged during play activities (concern for fun)[5], but I also feel the need to include everyone in the play, even if they are less competent (concern for unity).	*"I am willing to let everyone play along, but when other children cannot run or jump like I do, it slows down the game and I get bored."*
Disabled children's dilemma: I want to be treated equally (concern for equality), but I also want others to help me when I need it (concern for receiving support).	"I want to be seen as a play-mate who can be as fun as other children, but when I need help, I expect others to help me."
Parents' dilemma: I want my child to feel as competent as other children (concern for competence); however, he should also be aware of and accept the limitations of his disability to be happy (concern for self-awareness).	"I have the urge to help my child in performing certain tasks or to encourage him too much, but this can make him feel like he is not good enough."

Figure 3 Dilemma framework illustrating the conflict between the concern for fun and the concern for unity in the context of social play



2.1.2 Attention seeker: a design intervention to balance conflicting life-goals

2.1.2.1 Problem statement

This project focused on people who have difficulty balancing the competing demands of living in a modern society. When people have multiple strivings that conflict with one another, i.e., when they have conflicting life-goals such as meeting a deadline vs. spending time with friends, they can experience fear of failure as well as fear of missing

out. Such conflicts among life-goals fixate people on the lack of resources (e.g., time and money), and thus, they can threaten mental wellbeing. In contrast, focusing on developing personal strategies to balance conflicting life-goals can enhance mental wellbeing.

2.1.2.2 Design brief

Design an intervention to support people in dealing with conflicting life-goals by triggering them to question their (limiting) convictions such as the fear of missing out.

2.1.2.3 Design concept

The attention seeker (Figure 4) intends to confront people with their urge to constantly engage with their smartphones, which can be interpreted as a behavioural manifestation of the fear of missing out. It is an interactive coaster that responds to mobile-phone usage within its surroundings by randomly moving around when it senses smartphone usage. When placed on the table in social venues (e.g., cafés or meeting rooms), a radio-frequency detector recognises smartphone usage, and a motorised mechanism allows the device to move randomly until it grabs attention. Over time, people associate these movements with smartphone usage, which might trigger thinking about the need to continually check their phone.

Figure 4 Attention seeker intends to trigger reflection about smartphone usage in social settings (see online version for colours)

2.1.2.4 Method used to identify dilemmas

Experience booklets followed by in-depth interviewing were used to research the concerns and dilemmas of ten participants who voiced complaints about struggling with limited resources such as time and energy. Experience booklets provide a medium for participants to record their dilemmas by answering a number of questions designed to probe these experiences (see Ozkaramanli et al., 2014). In this particular project, the designer prepared a booklet with three to six open-ended questions that were phrased in an easy-to-understand way. In addition, the design of the booklet (e.g., size, format, colours, illustrations) aimed to invite and engage the participants with reporting their experiences. Following the completion of the booklet, an in-depth interview was conducted with each participant to detail the dilemmas reported in the booklet.

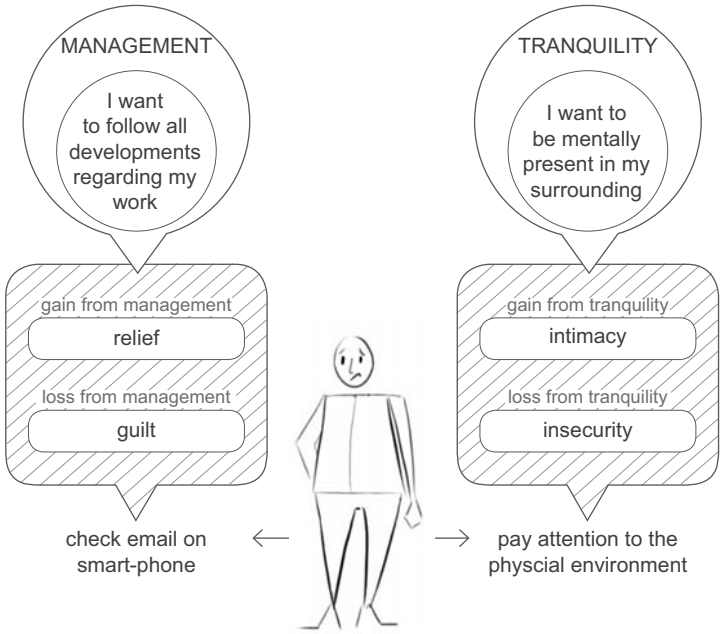
2.1.2.5 Identified dilemmas

Individual interviews yielded four to six dilemmas per participant. The designer identified seven dilemma clusters through grouping together similar dilemmas and the factors that influence these dilemmas (e.g., loss aversion, high personal expectations, and so on). Table 3 outlines three of these dilemmas, supported by quotes from research participants.

Table 3 Identified dilemmas for attention seeker

Dilemma	*Quote*
I want to utilise every opportunity to do a new project (concern for professional success), but also, I want to have enough time to take good care of myself (concern for self-care).	"I had an article published in a magazine which led to many offers for freelance projects. I accepted most of them, and I also kept my full-time job. This led to a burnout. Now, I realise that self-worth does not solely rely on career performance."
I want to be outspoken about my thoughts and feelings at work (concern for self-expression), but I am afraid of hurting others or damaging my position (concern for belonging).	"Something was bothering me at work, but I was afraid to discuss it with my boss; I wanted to stand up for myself, but I did not want to hurt others."
I want to have a good relationship with my daughter (concern for belonging), but I find it difficult to reset my plans every time she wants something from me (concern for individuality).	"My daughter can demand a lot of attention, and I am afraid to say 'no' to her. My relationship with her is very important for me, but I don't know whether I can keep delaying my own plans."

Figure 5 Dilemma framework illustrating the conflict between the concern for management and the concern for tranquillity in the context of dealing with stress



The designer concluded that the main conflict that could explain the majority of the identified dilemmas was the conflict between managing tasks efficiently vs. wanting to have ease of mind. She formulated this dilemma as follows: *I want to be up to date with all developments regarding my work (concern for management), but this prevents me from being fully present in my physical environment, especially in a social setting (concern for tranquillity).* This dilemma is illustrated in Figure 5.

2.1.3 Look-out point: creating support for the implementation of residential wind-farms

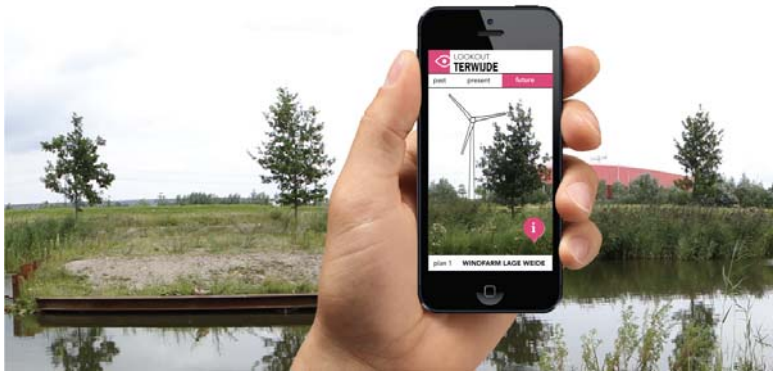
2.1.3.1 Problem statement

Although the majority of citizens support the idea of renewable energy, local communities resist the implementation of windmills in their neighbourhood. Any future benefit, such as being independent of large energy companies or contributing to a sustainable future, fails to evoke positive emotions when people fear the negative consequences of a having a wind-farm in their neighbourhood, such as the sight and sound of windmills. These negative consequences become even more threatening when opposing parties communicate them using an emotionally provocative language. As a result, the majority of citizens receive the positive messages of wind-farm supporters with suspicion and choose to remain undecided about the implementation of a wind-farm. Under these circumstances, local governments often postpone or cancel implementation plans.

2.1.3.2 Design brief

Design an intervention to encourage the doubtful citizens to support renewable energy production by triggering them to consider the potential gains and losses of having a wind-farm in their neighbourhood.

Figure 6 Look-out point provides information on the past, present and future of a specific neighbourhood and visualises different future scenarios that citizens can vote for (see online version for colours)



2.1.3.3 Design concept

Look-out point (Figure 6) intends to raise awareness about the 'certainty of change' in local surroundings. This observation-point invites residents to visit a website that can update them about the potential spatial developments in their neighbourhood. On the website, residents can explore images of their neighbourhood at three points in time (past, present, and future) from the perspective of a specific observation-point (i.e., the look-out point). The *past* option shows photos retrieved from the archives of the local municipality; the *present* option shows the current images of the neighbourhood; and the *future* option illustrates several future scenarios such as having a future wind-farm, a crematorium, or wider roads in one's neighbourhood.

2.1.3.4 Method used to identify dilemmas

In this project, the same procedure used in the second case study was used (i.e., experience booklets followed by in-depth interviewing) to identify concerns and dilemmas of seven people who were doubtful about the implementation of residential wind-farms.

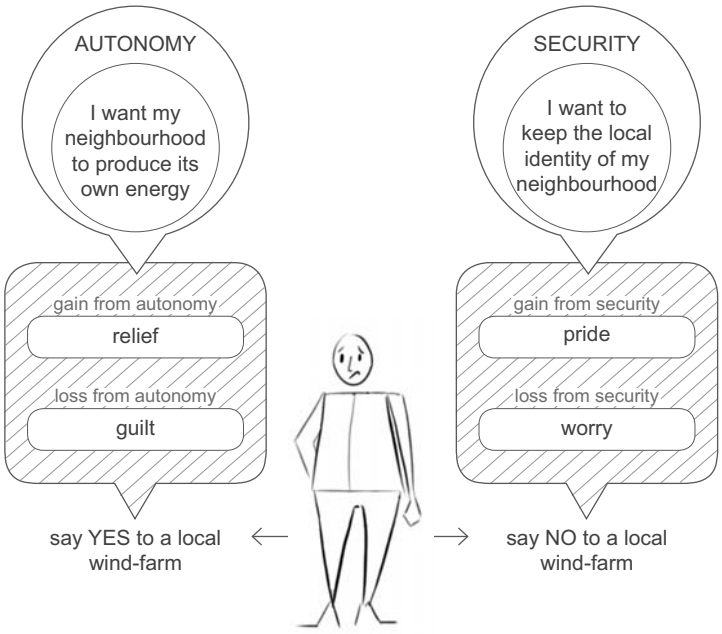
2.1.3.5 Identified dilemmas

Six dilemmas were identified, three of which were related to people's perception of windmills, and three were related to the political aspects of wind-farm implementation. Table 4 outlines three main dilemmas identified in this project, supported by quotes from research participants. Among these, the designer selected the dilemma that is formatted in *italic* in Table 4 and illustrated in Figure 7.

Table 4 Identified dilemmas and the selected dilemma for look-out point

Dilemma	*Quote*
I want to be informed about the spatial changes in my neighbourhood (concern for understanding), but I do not always feel like reading the complex newsletters, even if they are socially relevant (concern for comfort).	"We receive letters from the municipality about potential changes in our town, but they are written in such a complex and lengthy way that I never feel like reading them."
I want to enable my community to produce and consume its own renewable energy (concern for autonomy), but I am afraid that implementing wind-farms will destroy the local identity of my neighbourhood (concern for security).	*"This neighbourhood has looked and felt this way for years. By having those huge machines nearby, it will never look and feel the same."*
I want to welcome changes in my neighbourhood that can benefit a sustainable society (concern for social responsibility); however, I do not want my neighbourhood to be the only one that is willing to do so (concern for equality).	"It is difficult to know where and why the government decides to implement these wind-farms; and what if our community says yes to wind-farms and many others say no?"

Figure 7 Dilemma framework illustrating the conflict between the concern for autonomy and the concern for security in the context of residential wind-farm implementation



2.1.4 Nurturing the experience of visiting a cemetery or attending a funeral

2.1.4.1 Problem statement

Visiting a cemetery or attending a funeral are psychological experiences that carry personal and cultural significance. Being in these situations can be both awkward and comforting. This is because many personal concerns are at stake, such as acting appropriately, expressing emotions, showing responsibility and so on. Although cemeteries possess an important role in personal and community life, their designs do not always support these psychological functions.

2.1.4.2 Design brief

Design an intervention that nurtures the experience of attending a funeral or visiting a cemetery by using people's dilemmas as a starting point.

2.1.4.3 Design ideas

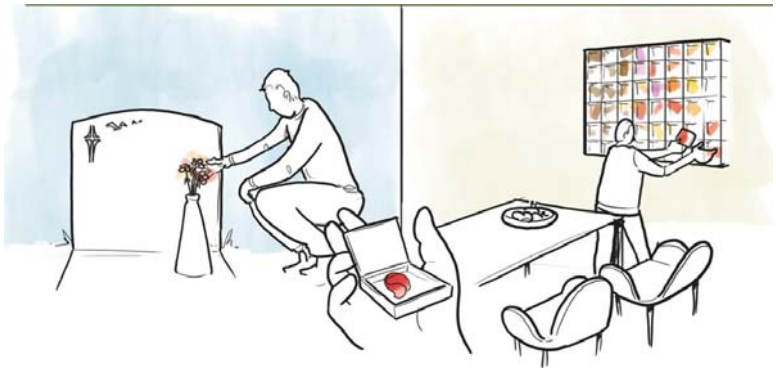
Team 1

Figure 8 The comfort swing encourages people to support each other at a funeral (see online version for colours)

Comfort swing encourages people to show that they care about other people's loss and that they are at the funeral to support them. The swing has two seats, and to balance the height of the two seats, two people need use it together. Seeing a person approaching the swing can encourage another person to sit on the other side to balance the two seats. This will raise the first seat above the ground, and metaphorically, raise the mood of the person being accompanied[6].

Team 2

Figure 9 Petal subtly reminds the person about time spent grieving (see online version for colours)



Petal is an organically changing wall piece that subtly reminds the person to visit the grave of a loved one, while also encouraging him to move on with his life. After placing a bouquet of flowers on a grave, the person can bring back one petal leaf and put it in one of the glass boxes of the wall piece. With time, the degrading petals will remind the person that it has been a long time since his last visit to the cemetery. At the same time, the increasing number of petals will symbolise the length of time he has been grieving[7].

Team 3

Figure 10 The cardboard coffin helps to gradually turn a grave into a flowerbed (see online version for colours)

The cardboard coffin is a sober coffin that transforms the grave into a flowerbed after the deceased is buried. The cardboard is a low-cost, natural material in which small flower seeds can be embedded. As the coffin deteriorates, the seeds sprout out and transform the grave into a colourful place of remembrance[8].

2.1.4.4 Method used to identify dilemmas

Using a procedure called co-exploration, twelve designers worked in teams of four to collaboratively formulate hypothetical dilemmas in the context of visiting a cemetery or attending a funeral. The teachers suggested two techniques for this procedure that were facilitated by two sets of cards: goal cards and product cards. The goal cards are inspired by the goal taxonomy of Ford (1992). These goals are abstract and general in nature, for which there can be various, situation-specific concerns associated with each goal. For example, the goal of belonging can be associated with spending time with loved ones, feeling like part of a team, or supporting a particular charity group. By pairing two random goal cards, the design teams could collaboratively explore situations in which these two goals could conflict, leading to a potential dilemma. The product cards are inspired by the Google product taxonomy, and they can facilitate brainstorming about user concerns that a specific product can fulfil or harm. By examining the relationships among these concerns, the design teams could identify potential dilemmas relevant for a specific product (e.g., a coffin, a flower bouquet).

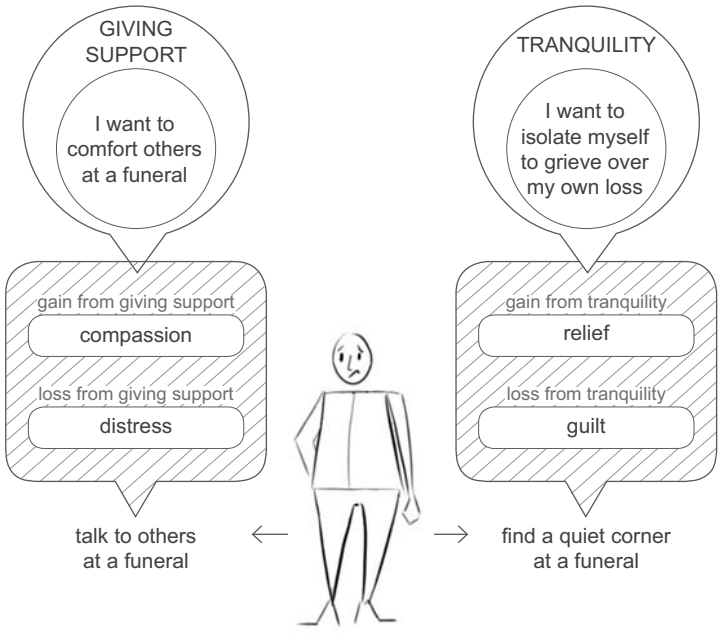
2.1.4.5 Identified dilemmas

Each design team identified three dilemmas, which led to nine dilemmas in total. Below, we describe two dilemmas per team. The selected dilemmas are formatted in *italic* in Table 5 and illustrated in Figure 11.

Table 5 Identified dilemmas and the selected dilemma for the cemetery/funeral brief

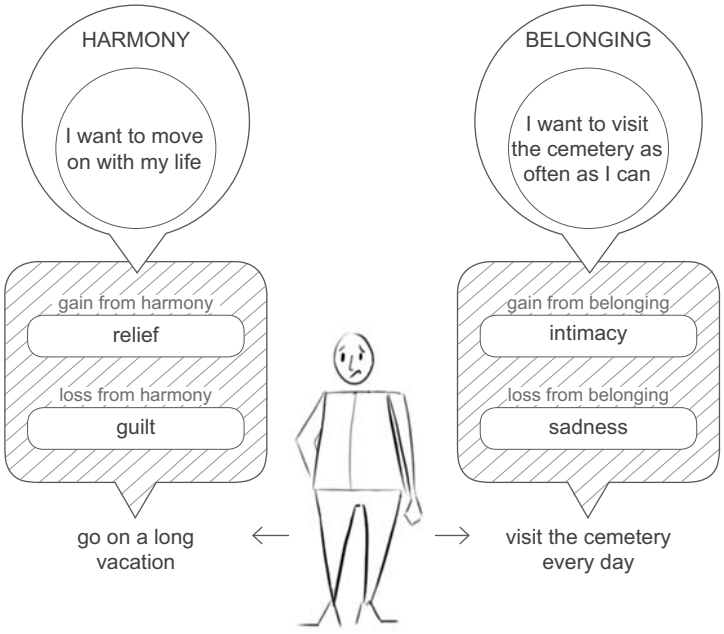
Team number	*Dilemma*
1	I do not want to attend the funeral (concern for tranquillity), but at the same time, I want to show my respect towards the people who have lost a loved one (concern for responsibility).
	I want to comfort others and give my support at a funeral (concern for giving support), but at the same time, I want to isolate myself from others to process my own loss (concern for tranquillity).
2	*I want to move on with my life (concern for harmony), but I feel the emotional need to visit the grave of my loved one every day (concern for belonging).*
	When I visit the cemetery, I want to express my feelings of happiness or sadness freely (concern for self-expression), but at the same time, I want to make sure that I act appropriately and do not disrespect others (concern for responsibility).
3	*I want to organise a special funeral to say goodbye to my loved one (concern for belonging), but I find it difficult to rationalise spending a lot of money on buying a sophisticated coffin (concern for material loss).*
	I want to keep the grave of my loved one to honour his presence (concern for personal responsibility), but I am also aware that cities lack the space to accommodate large cemeteries (concern for social responsibility).

Figure 11 Dilemma frameworks illustrating the selected dilemmas identified by three teams, (a) team 1 (b) team 2 (c) team 3

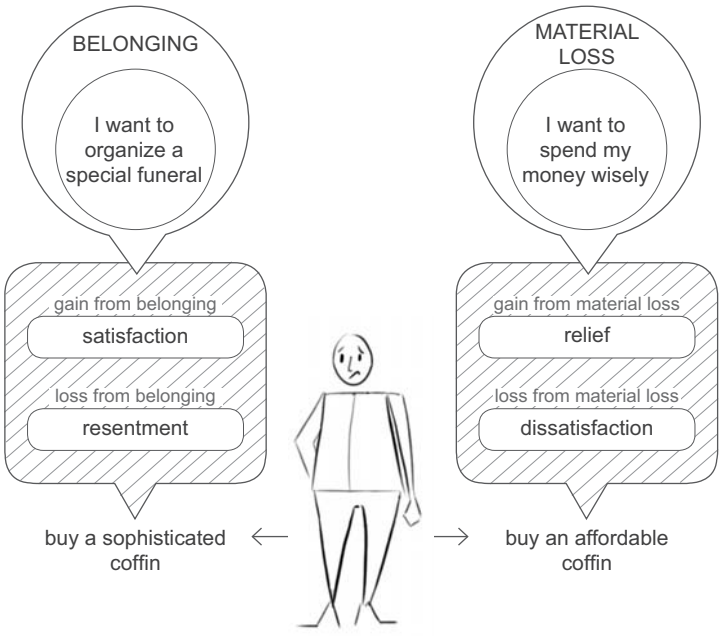


(a)

Figure 11 Dilemma frameworks illustrating the selected dilemmas identified by three teams, (a) team 1 (b) team 2 (c) team 3 (continued)



(b)



(c)

2.2 Data collection and analysis

We collected data using multiple sources such as weekly discussions, design reports, and the final outcome. The first author was involved in all case studies as an academic mentor, and recorded all design considerations that seemed relevant for selecting a target dilemma. These considerations included both the qualities explicitly mentioned and the observations of the supervisory team. In addition, we conducted a focus group with the designers of the graduation projects, in which we presented them with dilemmas identified in each project in the format of cards. To initiate the discussion, we asked each designer to order the dilemmas identified in each project from the most to the least interesting. Similarly, we asked the designers who participated in the workshops (fourth case study) to examine and indicate the most interesting dilemma identified by other teams. The considerations they had when selecting among the dilemmas were discussed in a follow-up group discussion.

Prior to data analysis, the first author fully transcribed the focus group conducted with the designers of the graduation projects. All quotes and observations gathered during the workshop were added to the transcript. Next, the first author created a long list of considerations relevant for selecting a dilemma (see Appendix). Finally, the authors systematically compared case-specific considerations across cases by asking, *How do the considerations in these two cases (e.g., case 1 and 2, case 1 and 3, and so on) differ from each other?* (see Eisenhardt, 1989). The similarities and differences between these considerations yielded cross-case patterns, which were categorised under three main themes that emerged from the data.

2.3 Results: key qualities of a design-worthy dilemma

Six to eight dilemmas were identified in each case study, with the exception of the fourth case study (design workshop), in which the designers were asked to formulate only three dilemmas. The designers could not rely on predetermined criteria for choosing among these dilemmas. As a consequence, they had to rely on a more intuitive selection process. In this process, their supervisors encouraged them to ask themselves the following question: *When imagining this dilemma, can I already envision some design ideas or directions?* The idea was that a suitable dilemma inspires the designer and opens up a design space. This intuitive approach could eliminate several dilemmas. When in doubt between the remaining two or three dilemmas, the designers tried exploring existing products or creating design ideas for each dilemma and letting the quality of their ideas guide their decision on a target dilemma. There was consensus among designers when they rated the dilemmas as the most/least interesting. For instance, the designers of the graduation projects evaluated the dilemmas identified by each other and, independently of each other's responses, chose the same dilemmas as the most interesting.

Although selecting a design-worthy dilemma seems to be specific to each design brief, common considerations could be observed across cases. We categorised these common considerations under three main themes, namely *relevance*, *inspiration*, and *meaningful formulation*. Table 6 summarises our findings.

Table 6 Three main themes covering the seven key qualities of a design-worthy dilemma

Main themes	*No.*	*Key qualities of a design-worthy dilemma*	*Corresponding design case*
Relevance	1	Addresses the key challenge given in the design brief	1, 2, 3, 4
	2	Applies to the majority of potential users	1, 2, 3, 4
	3	Has direct impact on the subjective well-being of potential users	1, 2, 3, 4
Inspiration	4	Is one in which products, or design in general, might play a role	2, 3, 4
	5	Involves surprising elements or unexpected concerns	3, 4
Meaningful formulation	6	Seldom involves strictly opposing choice alternatives	1, 2, 4
	7	Is abstract enough to be inspiring, but also concrete enough to give direction or contextual information	2, 3

Relevance of a dilemma is related to its capacity to address the key challenge in the design brief (first quality in Table 6). For instance, the first dilemma in the third case study (wanting to be informed about developments in one's neighbourhood vs. not wanting to read complex information) was considered the least relevant dilemma for the given design brief because, in the words of the designer, *this dilemma is too general, I think, you can say this [people avoid complex information] about a lot of things. It does not capture the authenticity of the topic at hand.* In addition, dilemmas that were encountered few times during context research were considered less influential than dilemmas that were mentioned frequently. For example, the second dilemma of the second case study (expressing feelings at work vs. maintaining a sense of belonging) was disregarded because it was specific to one research participant (second quality in Table 6). In contrast, in the third case study, the majority of participants expressed a conflict between maintaining the local identity of their neighbourhood and desiring independence from large energy producers. Therefore, addressing this dilemma was anticipated to have a large impact on the wellbeing of citizens. Finally, dilemmas that were directly related to future users were prioritised over dilemmas that were related to peripheral user groups (third quality in Table 6). For example, the parents' dilemma in the first case study was disregarded because addressing parents' dilemmas was considered to have only an indirect impact on the mind-set of able-bodied children.

Inspiring dilemmas are those that afford meaningful translation to design interventions. The designer in the second case study defined an inspiring dilemma as follows: *I immediately see some forms, and some design solutions for this dilemma. It does not have to be an actual design idea, but a feeling of knowing how to tackle it.* Involvement of products in a dilemma made it easier to envision design interventions that could address this dilemma (fourth quality in Table 6). For example, in the fourth case study, designers focused on redesigning gravestones, coffins, or flower bouquets, which were part of the cemetery context. In contrast, anticipating the role of design in addressing dilemmas identified in the second case study (i.e., dealing with conflicting life-goals) was a challenge since many dilemmas were related to mental wellbeing in which products played an undefined or limited role. In addition, dilemmas that involved surprising elements or unexpected concerns were considered to be more inspiring compared to dilemmas that involved obvious user concerns (fifth quality in Table 6). For example, the second team of the fourth case study was inspired by the conflict between

the concern for individuality (i.e., moving on with my life) and the concern for belonging (i.e., visiting the cemetery everyday), because they were surprised to find out that a person would strive to visit a cemetery everyday after losing a loved one.

Meaningful formulation of a dilemma can enhance the design space provided by that dilemma. For instance, dilemmas that were formulated in terms of strictly opposing choices (e.g., attend a funeral vs. do not attend a funeral) were considered to constrain the solution space compared to dilemmas that were formulated in terms of mutually exclusive choices (e.g., remain quiet at a funeral vs. comfort others at a funeral) (sixth quality in Table 6). Moreover, reformulation of concern statements at varying abstraction levels might enhance the design-worthiness of a dilemma. Concrete formulations often involve contextual details that make them immediately actionable in ideation, whereas abstract formulations lead to more original ideas due to their general, context-independent nature (Ward et al., 2004). In other words, formulating the dilemma in a concrete manner (e.g., supporting a local wind-farm vs. opposing it) offers concrete contextual information; however, it limits the solution space to a single context (e.g., voting for wind-farms). Alternatively, formulating the dilemma in an abstract manner (e.g., autonomy vs. security) offers a larger solution space; however, this formulation might be considered too general to inform design decisions in ideation. As both abstract and concrete formulations have benefits (and limitations), exploring their nuances can enable new, and possibly more design-worthy, interpretations of a dilemma (seventh quality on Table 6).

2.4 Discussion

The key qualities proposed in Table 6 are intended to facilitate introspection and discussion when framing an appropriate problem space. In ill-structured problem solving, framing involves identifying divergent perspectives, collecting evidence that support or refute alternative problem definitions, and thereby, forming an understanding of the problem situation (Jonassen, 1997). These design activities are in line with the constructivist perspective on problem framing suggested by Schön (1991). According to this perspective, problem framing is guided by a series of thought experiments triggered by the question, "What if I did *this*?" [Schön, (1984), p.132]. In dilemma-driven design, identifying dilemmas (i.e., discovery) and selecting a target dilemma (i.e., definition) can be considered as acts of problem framing. When engaging in these activities, the designers did not have any pre-defined criteria as input for selecting a dilemma. Therefore, they often chose a target dilemma through iteratively creating ideas for several dilemmas, and letting the quality of the ideas and the support of the project mentors guide them to a target dilemma. This process lasted, on average, three weeks. The proposed qualities explicate the considerations designers had when selecting target dilemmas. Therefore, when implemented, they can facilitate the reflective conversation with the problem situation as suggested by Schön (1991). For instance, dilemmas that include surprising elements were considered more inspiring (Table 6). This is in line with the idea that surprising, unexpected events encountered during the design process represent the 'backtalk' of a situation, enabling new interpretations and intentions (Schön, 1991). Moreover, the proposed qualities can create valid discussion points with involved stakeholders, such as the client or design experts. This is important because the involvement of a client with a specific product portfolio or branding strategy can greatly influence the choice of a target dilemma (Ozkaramanli et al., 2013). In short, the qualities

in Table 6 are not intended as a checklist or a conclusive measure of design-worthy dilemmas, rather as tools for introspection and discussion that can inform design decisions and possibly reduce the time required for selecting a promising dilemma.

A less apparent question is; why select *one* dilemma? The diversity of the identified dilemmas indicates that choosing one dilemma to guide further design efforts might help communicating the essence of future design ideas. Nevertheless, selecting a dilemma can still occur after generating design ideas for a small group of dilemmas. For example, in the second and the third case studies, the designers first created ideas for a group of two to three dilemmas; and they let their initial design ideas guide their choice on a target dilemma. Selecting a dilemma, generating ideas to address it, and consequently, rejecting or moving on with it are activities that align with the co-evolution of the problem and the solution space (e.g., Dorst and Cross, 2001). Each new dilemma gives clues about a different aspect of the problem, and iteratively exploring several dilemmas can help better understanding the problem and simplifying it until "the feeling of having grasped the core of the problem" is reached [Dorst and Cross, (2001), pp.13–14]. Note that the manner in which the problem space is initially framed might have an influence on the effectiveness of the iterations. For instance, the design contexts for the first and the fourth case studies were specified (play activities and cemetery/funeral, respectively), while the second and the third case study dealt with broad design domains (i.e., stress and wind-farm implementation). As a result, the latter cases required longer explorations and involved more uncertainty when framing a viable problem space compared to the other cases.

When selecting a target dilemma, designers can rely on research findings as well as their intuition. The graduation projects (the first, second, and third case studies) involved an extensive phase of context research (e.g., interviews, internet search, literature review). Having thoroughly researched the topic, selecting a design-worthy dilemma for the graduation projects was mainly driven by "what the users said". For instance, the designer of the third case study (look-out point) used vision in product design approach (ViP) of Hekkert and van Dijk (2011) to form an overview of the key factors (political, technological, psychological, economic and so on) that might play a role in wind-farm implementation. Through analysing these factors, she identified the dilemmas of specific users as well as interpreting a deeper concern for "no change in my way of living". This interpretation aligned the insights from the user-specific dilemmas with the holistic understanding she synthesised about the wind-farm problem. Similarly, the ECC procedure used in the first case study (Uniekies game) requires a certain level of interpretation when analysing the conflicting relationships among user concerns. In this way, it supports identifying design-worthy dilemmas using both user-driven insights and designer-driven interpretations. In other words, relying exclusively on users' self-reports to guide the selection of a target dilemma might constrain designers' freedom to interpret these findings in a way that helps structuring the problem. Alternatively, the participants of the design workshop (fourth case study) relied on expertise and personal experience for selecting a design-worthy dilemma, in which they had the freedom to formulate dilemmas that they considered design-worthy. However, these formulations might risk relevance for users. As a result, we suggest that selecting a design-worthy dilemma is a decision that should align the main insights from the research findings with the interpretations of the designer.

Meaningful formulation of dilemmas (Table 6) indicates that a dilemma can be reformulated at varying abstraction levels to increase its design worthiness. In other

words, design-worthiness is not an invariable characteristic that dilemmas inherit. Formulating conflicting concerns at different abstraction levels yields alternative dilemma representations, which can enhance the design value of a dilemma. Abstract formulations encourage imagining higher number of design solutions, yet they require higher mental effort as they lack contextual information to facilitate designers' imagination (Ward et al., 2004). Alternatively, concrete formulations include imaginable physical references (e.g., specific products, activities, environments), yet they often limit the design solutions to the context of these references (Ward et al., 2004). The framework of dilemmas (see Figure 1) structures a dilemma in varying abstraction levels, ranging from concrete choices to abstract motivations. In this way, it can facilitate exploring the benefits and limitations of abstract and concrete formulations, and consequently, formulating a design-worthy dilemma.

Finally, the limitations of the case studies should be mentioned. Dilemmas are mental phenomena that can be challenging to identify through self-report. Translating research goals into simple and concise questions that are understandable by users requires knowledge of abstract and complex human principles (e.g., emotions, concerns, and concern conflicts) as well as expertise in interviewing. The designers who carried out the case studies had limited expertise in interviewing, which might have influenced the quality of the identified dilemmas. In addition, the case study approach has often been criticised for not yielding generalisable results (Yin, 1984). However, the search for generalisation might overshadow the main contribution of case studies, which is the exemplary knowledge they generate based on the uniqueness of each case and the expert interpretations of those who structurally reflect on the case studies (Thomas, 2010). As a result, the proposed qualities should not be viewed as conclusive criteria on the design-worthiness of a particular dilemma; rather as an embedded narrative that might connect interpretations of the case studies in this paper with a new situation.

3 Conclusions

The purpose of this paper was to elaborate the stages of designing with dilemmas and to address a key challenge in this process, which is the selection of a target dilemma as a means to frame an appropriate problem space. By analysing cross-case patterns in designers' considerations, we identified seven key qualities of design-worthy dilemmas and categorised them under three main themes (Table 6):

1 *Relevance*, the impact of addressing a dilemma on future users.

2 *Inspiration*, the selected dilemma's potential to inspire design ideas.

3 *Meaningful formulation*, the effort to reformulate dilemmas at varying abstraction levels to form an advantageous design space.

The first quality suggests that selecting a design-worthy dilemma requires both an understanding of users' needs and interpretation of these needs based on domain-specific knowledge and design expertise. The second quality suggests that design-oriented or surprising dilemmas might be entry-points into a reflective conversation with the design task, as suggested by Schön (1991). And the third quality suggests that design-worthiness is not an inherited advantage, rather a quality that can be enhanced through reformulation of dilemmas in abstract or concrete ways. These qualities can facilitate introspection and

discussion when framing a viable problem space using dilemmas. Because of this, they have implications in fields that often implicitly address dilemmas, such as design for subjective wellbeing and design for behaviour change. In addition, the case study approach is a useful approach when researching complex and situated problems, such as dilemmas. In this paper, all case studies followed the dilemma-driven design activities (i.e., discovery, definition, and application), which also created the opportunity to compare how this approach would work for different design briefs.

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Notes

1 The Uniekies Game was the outcome of Janine Innemee's graduation project at Delft University of Technology, supervised by dr. Mathieu Gielen (chair person), Deger Ozkaramanli (academic mentor), Joris Swaak (company mentor), and Ingeborg Griffioen (company mentor). This project was conducted in collaboration with Panton, a design office focused on health care; and NSGK, a foundation that aims to support the development of children with disabilities in the Netherlands.

2 The Attention Seeker was the outcome of Marit Coehoorn's graduation project at Delft University of Technology, supervised by Prof. Dr. Paul Hekkert (chair person), Deger Ozkaramanli (academic mentor), and Linda Bolier (company mentor). This project was conducted in collaboration with Trimbos Institute, a mental-health organisation that aims to support mental wellbeing.

3 The Look-out Point was the outcome of Willemijn Bin's graduation project at Delft University of Technology, supervised by Prof. Dr. Pieter Desmet (chair person), Dr. Renee Wever (chair person), Deger Ozkaramanli (academic mentor), and Simone Maase (company mentor). This project was conducted in collaboration with Energie-U, a non-profit energy cooperative that aims to locally produce and harvest solar and wind energy.

4 Co-exploration is a procedure in which members of a design team collaboratively formulate hypothetical dilemmas in a given design domain using personal experience and domain expertise (Ozkaramanli, Özcan, & Desmet, 2014).

5 The concern titles in these statements (e.g., fun or competence) are based on the universal goal taxonomy of Ford (1992), which gives a comprehensive yet compact overview of universal motivations underlying most human concerns.

6 Design by Matthew McClumpha, Nienke van der Straten, Rochelle Simons, and Rosanne Martens, 2015. Illustration of the design concept by Freya Ruijs.

7 Design by Sofia Hnatiuk, Rozemarijn Klein Heerenbrink, Bob van Iersel, and Jaap Meijer, 2015. Illustration of the design concept by Freya Ruijs.

8 Design by Michèle Stoop, Laura Gonzalez Osorio, Otmar Balk, and Rowan Ton, 2015. Illustration of the design concept by Freya Ruijs.

Appendix

Table 7 List of considerations mentioned when selecting a target dilemma across different cases, supported by example quotes from the designers

Consideration *The selected dilemma:*	*Corresponding case study*	*Example quote*
Has a big impact on the (psychological) wellbeing of users	1, 2, 3, and 4	"I see tackling this dilemma as an opportunity to change things because this is the main problem; this is what burdens people the most."
Has potency, i.e., relevance for many users	1, 2, 3, and 4	"Preserving local identity of one's neighbourhood applies to all people, and always (case study 3). It is innate to people to protect their own territory; the place they are attached to."
Involves clearly conflicting, yet distinct concerns	1, 2, and 3	"These are two different concerns, but they are clearly opposing each other: Explore fun challenges or let everyone play along (case study 1). I can really feel the tension."
Does not involve opposing choices	4	"This dilemma is too strict: I want to do something, but actually I don't. It does not lead anywhere."
Involves opportunities for design	4	"These dilemmas already involve some products (e.g., a flower bouquet, a coffin) (case study 4), which already hint some design ideas."
Triggers ideas when I [the designer] think about it	2 and 3	"I immediately see some forms, and some design solutions with this dilemma, but not with the others. It does not have to be an actual idea, but a feeling of knowing how to tackle it."
Is a surprising (not an obvious) dilemma	3 and 4	"Design opportunities focused on concerns related to this dilemma [local identity of a neighbourhood] (case study 3) have been explored far less in this field."
Is not triggered by lack of personal resources, such as time and money	2	"Everyone wants to have more time and money. Thus, I do not like dilemmas about these factors, because their solutions seem obvious."

Table 7 List of considerations mentioned when selecting a target dilemma across different cases, supported by example quotes from the designers (continued)

Consideration / *The selected dilemma:*	*Corresponding case study*	*Example quote*
Is a recurring dilemma	2 and 4	"In the end, I chose the dilemma about the work situation (case study 2), because it is a frequent problem and it would be nice to design for."
Is a dilemma that I [the designer] can relate to	2	"I had a very difficult time here. I can relate to all of these dilemmas – they could all be interesting to design for."
Is authentic, applies specifically to the design brief at hand	1 and 3	"The dilemma about 'information on new windmill policies should be easily understandable' (case study 3) is too general. You can say that about a lot of things. It is not specific to this topic."
Involves behavioural choices, because behaviours involve different factors	2 and 3	"Behavioral dilemmas are more interesting because human behavior is rich and complex. It is influenced by many different factors that can help me come up with ideas."
Directly influences the target group, the effectiveness of the solution does not depend on other people	1 and 3	"This dilemma is dependent on other people – meaning the solution is dependent on other people, so it will be harder to design for."
Involves significant user goals	3 and 4	"A dilemma, such as whether to drink coffee or tea in the morning, sounds too small, too specific, or too personal. It would not be worth designing a product for."
Is a personal dilemma, not a dilemma between two people	1 and 3	"It is less interesting to have a dilemma between two people – it seems too black and white. I feel like designing with it would be imposing the needs of one person on the other."
Is the dilemma resolution of which goes beyond solving a problem, it can add something positive to people's lives	1 and 3	"Dilemmas that focus too much on negative aspects of a situation (e.g., noise, sight, disturbance of windmills) (case study 3) are less inspiring. I want people to see the positive side of things. That's the real challenge."
Is a flexible conflict from which new meanings can be derived	2 and 3	"I did not want to be redesigning windmills in this project (case study 3), but when users mention a product related to the dilemma, it is hard to imagine another product to address that dilemma."