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# APPLICABILITY OF A REFLECTION MODEL FOR COMMUNICATING VALUE SENSITIVE DESIGN RESEARCH

*Research*

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## *Abstract*

*Reflective approaches in the context of Persuasive Systems Design (PSD) research are mainly concerned with reflection in the process of research and design and pay no explicit attention to the issue of how to communicate the research results of such a reflective form of research. On the other hand, Design Research (DR) literature in Information Systems provides several methodological guidelines for communicating DR knowledge, which are in principle applicable in a variety of fields, including PSD research. However, some DR methodologies explicitly value reflection in a research process, yet rarely consider DR communication, whereas others include communication as an activity without paying explicit attention to the communication of values and related design rationale. This paper provides a Reflect-and-Communicate schema for guiding DR communication and demonstrates its applicability by applying it to a published PSD research article. This paper contributes to the literature on the communication of DR knowledge in general and of value sensitive PSD research results in particular (including work in progress on design knowledge), by complementing and enriching the existing communication schemes with more specific concepts dealing with values, goals and actions. In addition, it adds a level of reflexivity in DR by allowing researchers to link reflections in a DR process with reflections in a DR communication process.*

*Keywords: Design Research Communication, Persuasive Systems, Value Sensitive Design, Reflection*

## **1 Introduction**

Reflecting during a research process and communicating research results are two activities that have gained explicit attention in the Information Systems (IS) field. Reflection is considered necessary for challenging the dogmatic nature of knowledge, problematizing taken for granted meanings, explanations, assumptions and values as well as objectivity in resolving problematic situations and undertaking change through design (Ulrich 2001; Yetim 2006, 2011b; Cecez-Kecmanovic 2011).

Research on Persuasive Systems Design (PSD) investigates and suggests a set of principles, models and methods for the analysis, design and evaluation of such systems that aim at influencing people to change their attitudes and/or behaviors (e.g., Oinas-Kukkonen & Harjuma 2009; Oinas-Kukkonen 2012). Several works argue that persuasive actions of a system imply value assumptions and have consequences for those affected and emphasize the importance of reflection and user participation in the analysis, design and evaluation of such systems in order to take into account individual as well as social goals and values (Davis 2009; Yetim 2011a, 2013; Brynjarsdóttir et al. 2012; Oinas-Kukkonen & Oinas-Kukkonen 2013; Haghighatkhah et al. 2014). Nevertheless, these reflective and value sensitive approaches are mainly concerned with reflections in the process of PSD research and practice and pay no explicit attention to the issue of how to communicate the results of such a value sensitive research.

On the other hand, Design Research (DR) literature in IS provides several methodological guidelines for conducting and communicating DR, which are described both at an abstract and general level so that they are in principle applicable in a variety of fields, including PSD research. However, as described later in detail, some DR methodologies explicitly value reflection in a research process (e.g., Sein et al. 2011, Kuechler & Vaishnavi 2012), yet rarely consider DR communication, whereas others include communication as an activity without paying explicit attention to the communication of values and related design rationale (e.g., Hevner et al. 2004; Peffers et al. 2008). Moreover, the current DR literature does not provide a schema or model, which can explicitly link the reflections in the DR process with reflections in the communication of DR results.

The purpose of this work is to provide a set of value-related issues to help and guide design researchers in communicating reflective and value sensitive design research results, in particular in the context of PSD research. More concretely: We will show how a model suggested earlier for structuring reflections in a research and design process can also be used for structuring DR communication. So far we are not aware of any reflective work that is also used for such purposes simultaneously.

Thus our work contributes to the literature on the communication of DR knowledge in general and on the publication of value sensitive PSD approaches in particular (including work in progress on design knowledge), by complementing and enriching the existing communication schemes with more specific issues dealing with values and value consequences of goals and actions. In addition, it adds a level of reflexivity in DR by allowing researchers to link reflections in a DR process with reflections in a DR communication process.

In the following, we first clarify important concepts and issues that recur throughout the paper and identify some gaps in the current literature. Then we explain the relevance of a broader reflection model for communicating research in general and suggest a specific schema (the so called Reflect-and-Communicate schema). We evaluate its applicability by applying it to a published PSD research article. Finally, we provide some discussion and conclusions.

## **2 Theoretical Background and Related Work**

### **2.1 Approaches to Communicating Design Research Results**

To date IS research literature offers a few methodological ideas for conducting design research (e.g., Hevner et al. 2004; Peffers et al. 2008; Sein et al. 2008; Kuechler & Vaishnavi 2012). These methodologies exhibit a considerable plurality with respect to processes and activities, principles and outcomes, partly due to their respective differences in underlying epistemological and ontological

assumptions. For example, Hevner et al. (2004) claim that DR involves a rigorous process to design artifacts for solving observed problems, to make research contributions, to evaluate the designs, and to communicate the results. The methodology proposed by Peffers et al. (2008) includes stages such as (1) problem identification and motivation, (2) definition of objectives for a solution, (3) design and development, (4) demonstration, (5) evaluation and (6) communication. Sein et al. (2011) suggest alternative stages of action design research, including problem formulation, building, intervention, evaluation, reflection and learning as well as formalization of learning. Kuechler and Vaishnavi (2012) use a design research cycle and include awareness of the problem, suggestion, development, evaluation, and conclusion.

Reflection in the design research process is also explicitly considered by some methodologies as a principle or as a part of the methodology (e.g., Sein et al. 2011, Kuechler & Vaishnavi 2012). For example, Sein et al. (2011) include a stage for “reflection and learning” in which researchers reflect on the evaluation results and adjust the research process. In addition, the explicit representation of reasoning is also valued, based on the assumption that explicit representation can help and guide researchers’ reflections and revisions and at the end this help generate generalizations (Haynes et al. 2008).

With respect to the communication of design research results, some methodological approaches consider the communication as a guideline (Hevner et al., 2004) or as part of the methodology (Peffers et al., 2008), whereas others give little guidance on how to publish the results (Sein et al. 2011; Kuechler & Vaishnavi 2012). For the structuring of a design research article, some works follow the stages of the methodology (e.g., Peffers et al. 2008), others consider the guidelines (Hevner et al. 2004) or another publication schema (e.g., Gregor & Hevner 2013).

Hevner et al.’s (2004) communication guideline includes general statements such as: “Design science research must be presented effectively both to technology-oriented and management-oriented audiences.” “Technology-oriented audiences need sufficient detail to enable ...” “Management-oriented audiences need sufficient detail to determine ...” By reviewing the guideline from an interpretivist perspective, Niehaves (2007) argues that the research communication guideline does not pay attention to possible different interpretations, which might occur not only among different participants of a field study, but also among different addresses of a research communication process. The different interpretations by different researchers can be considered, for instance, by identifying and discussing critical key terms from the project setting and/or used in the research communication.

In a later work, Gregor and Hevner (2013) propose a general DR communication schema with similarities to conventional publications patterns, which includes the sections *introduction, background, method, artifact description, evaluation, discussion and conclusion*. They also prescribe the nature of the expected content for each section on an abstract and general level so that they can in principle be contextualized in many DR projects. Heinrich and Schwabe (2014) integrate some extensions in the communication schema for enabling the communication of practical design knowledge on different levels of maturity. They see the need to express the knowledge contribution as well as its maturity at a finer level of granularity in a publication.

We agree with Heinrich and Schwabe (2014) that the communication of design knowledge to a broader research community especially in the early stages would enable the community to participate in the “search process” for an optimal design and that guidance at different levels of granularity is needed. Yet, the extended version of the communication schema still lacks the specificity required to describe value sensitive design research projects in specific research areas such as PSD for behaviour change, in particular to integrate reflections on values, goals, actions and their (ethical) consequences in the communication of the research results. Next, we will briefly describe the rationale of considering values in DR and mention some related works.

## **2.2 Value Sensitive Design (VSD) Research**

Responsible conduct of research includes professional behaviours that are based on many of the same human values (e.g. honesty, reliability) that apply in daily life. For example, being honest implies doing

research and communicating about results without deception. A researcher's own values also (often implicitly) influence the setting of research goals, the research process, and the choice of methods and tools. Therefore, VSD researchers advocated taking an explicit value position for grounding and justifying decisions in a design research project (Friedman et al. 2006; Yetim 2011b). Myers and Klein (2011) consider taking an explicit value position as one of the critical research principles in IS.

For example, by taking the value of equality into account a researcher can assess the practices in the domain being investigated and may consider the practice in some sense harmful or unfair for some subgroup and seek possibilities for change through design both in their physical and social circumstances. The research goal or intended outcome can be justified by taking an ethical position, for example, it may be good or just because it leads to a healthy society or to economic growth and prosperity. The challenge for the researchers engaged in normative issues is that they need to be aware of different levels of normativity, i.e., of different moral views, ethical theories and meta-ethical reflection and also to have knowledge of approaches and methods (Stahl 2012).

In fact, DR literature acknowledges the relevance of values and normative issues due to the world-shaping effects of DR (Iivari 2007). Goldkuhl (2004) argues for the value grounding of design theories that aim to give knowledge support to design activities, stating that "an action prescription includes an explicit (or at least implicit) reference to a goal to be attained. The legitimacy of a prescribed action rule lies in the goal and associated values that are intended to be reached and expressed through the action. In a proper grounding of a design theory it is impossible to exclude grounding in goals and values." (p. 65). Sein et al. (2011) acknowledge that IT artifacts are "shaped by the interests, values, and assumptions of a wide variety of communities of developers, investors, users" (Orlikowski & Iacono 2001, p. 131) and do justice to it in their methodology through the principles of "reciprocal shaping" and "guided emergence".

Nevertheless, current DR methodologies in IS do not provide refined concepts to guide reflections on values and the value consequences of setting goals and chosen actions or methods in a design research project. In contrast, VSD researchers investigate methods for discovering, developing, grounding, and realizing values in collaboration with stakeholders. For example, by drawing on Habermas's (1993) discourse ethics which accepts different ethical positions and values the inclusion of all those affected to reach a consensus about the ethical-moral evaluation of a situation, Yetim (2006, 2011a,b) suggested ways to integrate deliberative methods for supporting reflections in VSD research in a systematic way (an overview of current VSD methods can be found in Davis & Nathan 2015).

Moreover, the potential of deliberative methods of VSD for PSD research and practice has also been explored (e.g., Davis 2009; Yetim 2011a). In PSD research, values are implicated, among others, by persuasive intent as well as by specific persuasive strategies. Researching strategies to change behaviors to protect privacy requires an ethical grounding of privacy: is it an absolute value or a relative one? By taking a value position, PSD researchers can understand the context and design to support the value (e.g., to change or reinforce the existing behavior to support the chosen value). Relevant VSD methods include, among others, methods for reflective analysis of the context such as engaging stakeholders and identifying their values, and methods for guiding reflections and addressing value tradeoffs in design. Many VSD methods can in principle be employed at different stages of a PSD research process.

In summary, the existing DR publication guidelines lack the specificity required to describe projects in specific research areas such as PSD for behaviour change, in particular to integrate reflections on values, goals, actions and their (ethical) consequences in the communication of the research results. In addition, previous DR research (including VSD research) considered reflections in design and research process without relating them to the design of research communication.

In the following, we will show how a model proposed for supporting reflections within the research and design practice can also be used to guide the communication of research.

### 3 A Reflection Model for Design Research Communication

#### 3.1 Meta-Communication and its Relevance for DR communication

Yetim (2006) suggested a meta-communication model for communication about communication, which was implemented in a system (DISCOURSIUM) to support reflection (Yetim 2008). The model as shown in Figure 1 synthesizes several key issues for reflective practice in IS (partly based on Ulrich 2001), and a set of discourse types from Habermas’s (1984, 1996) discourse theory. A research or design team can consider these issues as a checklist and reflect on them. Different views of the participants can be discussed with arguments in related discourses. Yetim (2006) explored how the model can be used for reflecting on communicative genres. As design research articles are genres of communication, design researchers’ communication about the structure and the content of a research article can be viewed as a meta-communication of researchers about research communication.

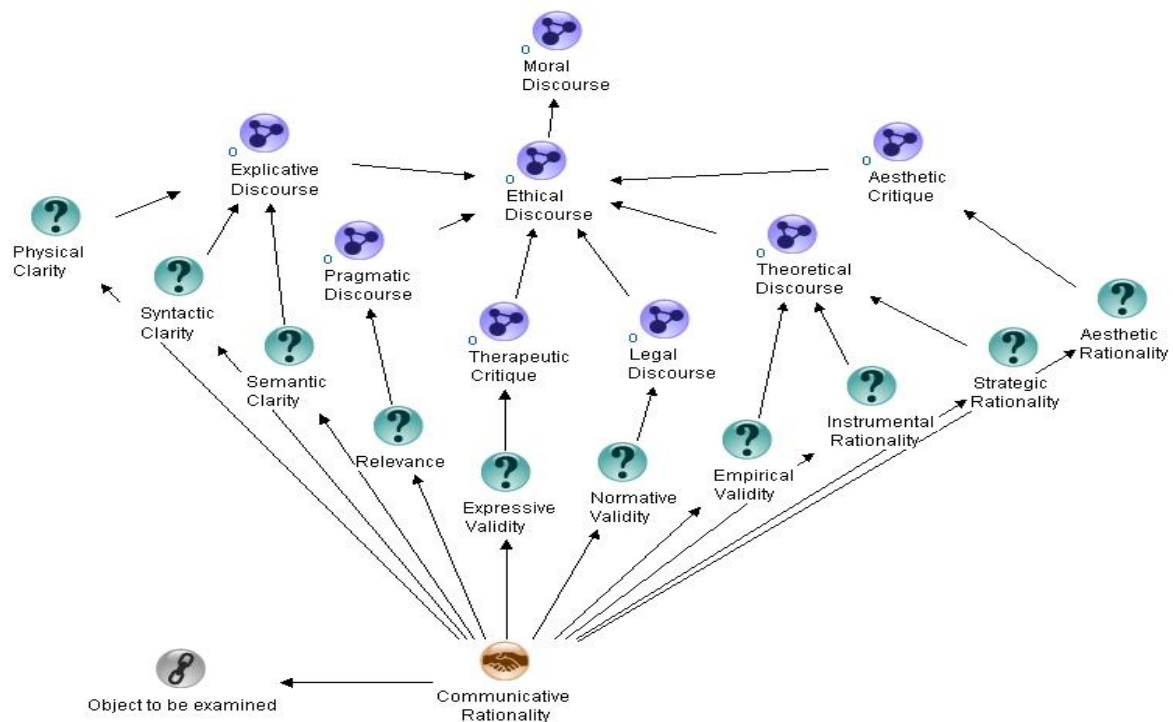


Figure 1. A Meta-Communication-Model for Reflection (Yetim 2006, 2008)

The basic issues of the model deal with the *comprehensibility* of signs at the physical, syntactic, and semantic level, the *relevance* of signs for the current purpose, the *validity* of signs (including their expressive, empirical, and normative validity), and finally, the *rationality* of signs for an effective communication (including their instrumental, strategic, and aesthetic rationality). The discourse level, include *explicative discourse* for justifying the comprehensibility of signs, *pragmatic discourse* for justifying the relevance (purposefulness) of the choices, *therapeutic critique* for critical examination of the sincerity of expressions, *legal discourse* for justifying the legitimacy of actions/expressions; *theoretical discourse* for justifying the truth of expressions and the efficacy of actions; *aesthetic critique* for critical examination of aesthetic value standards; *ethical discourse* for justifying actions from a (cultural) value perspective; and *moral discourse* for justifying the universal rightness of norms.

Although all these issues and related discourses are in principle applicable to the DR process and communication, the issue of relevance (i.e., what knowledge should be communicated?) and thus the related pragmatic discourse is of particular importance for specifying the structure and content of a research article and suggesting the related research communication guidelines. For this purpose we next need to take a closer look at the goal and nature of reasoning in such a discourse.

### 3.2 Value-Based Practical Reasoning and Practical Discourses

Practical reason is the general human capacity for resolving, through reflection, the question of what one is to do (<http://plato.stanford.edu>), for example, for resolving the question of: what should be communicated in design research? In his discourse ethics, Habermas (1993) distinguishes between the pragmatic, ethical and moral employment of practical reason and three types of practical discourses, i.e., pragmatic, ethical and moral discourses. The idea is that in practical situations the question of what one is to do can take on pragmatic, ethical, and moral meaning, requiring different kinds of answers for justifying choices among alternative available courses of action.

Reflections in *pragmatic discourse* seek reasons for a rational choice of means in the light of fixed goals, or of rational assessments of goals in the light of existing value preferences. When values underlying the goals or actions themselves become problematic, this requires value decisions in *ethical discourse*, which involves reflections on what is good for one self or for a cultural community. Finally, value conflicts between cultural communities call for a reflection in *moral discourses* to seek what is “equally good for all” and thus just.

To provide guidance for reflections in these three types of discourses, Yetim (2011a) proposed a set of questions related to the discourses and their purposes. The questions were mainly based on the concept of value-based practical reasoning as considered in argumentation research (Atkinson et al, 2006; Walton et al. 2008). Value based reasoning is involved in any discourse to reflect on purposiveness, goodness or rightness of actions to be investigated or designed. Therefore, the approach suggested by Yetim (2011a) structures practical discourses with a set of value-related critical questions in order to support the reasoning of researchers, designers or other stakeholders and to enable them to reflect and challenge the implicit or explicit value assumptions, goals or actions involved in a DR project. However, so far these issues have only been considered for reflection in a design (research) process and provide the basis for a tool to support such reflections (Haghighatkah et al. 2014).

In the remainder of this paper we will investigate the applicability of these questions to guide the communication of research. For this purpose, we will limit our attention to pragmatic issues as communicating research is mainly pragmatic in nature.

### 3.3 The Reflect-and-Communicate Schema

The pragmatic discourse includes questions that help identify and check the interrelationships of goals, actions, and values. In this discourse participants may first reflect on whether the value is a legitimate value. Then, they may propose alternative ways to promote the desired value, check whether a chosen action or goal is in accord with the desired value, reflect on side effects of the action, the interference with other actions, etc. As shown in Table 1, we extended our previous work (Yetim 2011a) by including the statements to the concepts (Goal-Value, Action-Goal, and Action-Value) in the form of guidelines, in order to make the schema more usable for the purpose of research communication. The schema, named as Reflect-and-Communicate schema, recommends that researchers reflect on and articulate the concepts and their relationships as well as reason about the related issues.

We should also note that the questions suggested are not meant to be complete and that they act as prompts only. The questions can be reformulated in future, present, or past tense depending on the usage purpose, i.e., whether one reflects on potential future actions (ex ante meta-communication), or on ongoing actions (meta-communication-in-action), or past actions (ex post meta-communication) (Yetim 2006). This means, for the purpose of research communication, that they can be used in a different tense depending on whether researchers reflect and communicate the content of the problem formulation in the introduction section or the content of the evaluation and discussion section.

We next evaluate the schema for guiding design research communication by applying it to a published case.

Reflect-and-Communicate Schema
<p><b>Goal-Value: Reflect on and communicate the goal and its value</b></p> <ol style="list-style-type: none"> <li>1. Is the value V proposed indeed a legitimate value?</li> <li>2. Is goal G possible?</li> <li>3. Will goal G realize (or at least be consistent with) the value intended?</li> <li>4. Are there other goals considered that might conflict with goal G?</li> <li>5. Are there alternative goals to promote the same value?</li> </ol> <p><b>Action-Goal: Reflect on and communicate the preferred action (means) to achieve the goal</b></p> <ol style="list-style-type: none"> <li>6. Is it possible to do action A?</li> <li>7. Will action A bring about the desired goal G?</li> <li>8. Are there alternative ways of realizing the same goal?</li> </ol> <p><b>Action-Value: Reflect on and communicate the value consequences of the action</b></p> <ol style="list-style-type: none"> <li>9. Will doing action A promote the value intended?</li> <li>10. Will doing action A promote some other value?</li> <li>11. Will doing action A have a side effect which demotes the value intended?</li> <li>12. Will doing action A have a side effect which demotes some other value?</li> <li>13. Will doing action A preclude some other action which would promote some other value?</li> <li>14. Are there alternative ways of realizing the same value?</li> </ol>

Table 1. The Reflect-and-Communicate schema

## 4 Applicability of the Reflect-and-Communicate Schema

### 4.1 Purpose and Method

In principle, the schema can be used for different purposes dialogically or non-dialogically. It can support ideation, analysis, co-design, and critique in different stages of a project. Researchers can reflect on their beliefs and intentions while formulating the research problem, designing and evaluating an artifact, as well as articulating lessons learned from the research. When used to document decisions with respect to the preferred values, goals, and actions, the schema can promote a transparent and rational communication in the DR process.

In the following, we apply the schema to a published design research article to demonstrate its validity and applicability, as have other researchers (e.g., Hevner et al. 2004; Peffers et al. 2008; Gregor & Hevner 2013) who used secondary data in the form of published cases to evaluate their guidelines. We analyze one case to demonstrate the deliberations on pragmatic issues within different sections of a DR article.

We analyzed the published article by following interpretive research method principles (Klein & Myers 1999). We marked sentences that express concepts of the schema, i.e., goals, actions, explicit value terms (e.g., privacy, surveillance, helpful, useful), and value consequences, and interpreted them through the lens of the questions. In the presentation of our analysis, we use Q# to refer to the relevant questions of the schema, where applicable. Indeed, multiple readings and interpretations of a text can be generated. Similar to the method employed by Beath and Orlikowski (1994), the analysis draws on the text in its own right, as distinct from a strategy for challenging its authors.

### 4.2 Communicating PSD Research Results: The BinCam Case

The BinCam case (Thieme et al., 2012) presents a design research approach in HCI and explores persuasive strategies for promoting environmental sustainable waste management behavior through the design of a persuasive system. Thieme et al. structure their article as follows: Introduction; Persuading



Change in Behaviors; The Design of BinCam; Evaluation of BinCam; Discussion and Lessons Learned. For the analysis we exclude the section “Persuading Change in Behaviors” as it provides the theoretical foundation of the work. We consider the other sections which represent the main phases of a design research methodology (Peppers et al. 2008; Sein et al. 2011), including the formulation of research problem, the design and evaluation of the system, and finally reflections on lessons learned. In the following we illustrate the applicability of the schema for communicating of the research results throughout these phases of a design research project.

**1. Problem Formulation (Introduction).** The researchers identified some gaps in the literature and articulated their research goal and the value they want to promote. The goal is exploring “strategies borrowed from social psychology to facilitate reflection and behavioral change through digital design,” in particular, exploring social persuasive strategies such as informational and normative social influences (e.g., socially evoked feelings of ‘guilt’ for non-recycling or food disposal) as a source for promoting sustainable lifestyles (**Goal-Value**).

The researchers also articulated that they aim to achieve this goal through the design of a persuasive system, called BinCam, which implements social persuasive strategies (**Action-Goal**). They also reasoned about alternative approaches (Q8) and claimed that implementing social persuasive strategies may be more effective than other approaches that largely focus on motivating the lone individual and present information about an individual’s behavior to increase awareness of such behavior and promote self-reflection.

Finally, they reflected and articulated the value consequences of the action (**Action-Value**), stating that the selected approach also promotes a morality which goes beyond the ‘personal morality’ that the previous approaches foster (Q10).

**2. Design and Intervention.** This phase aims at designing the BinCam system with appropriate features to induce the intended persuasive effects. The achievement of this goal has an instrumental value for the research goal of exploring the influences of social persuasive strategies on behavior change. BinCam as a system also has a value for practice, i.e., for promoting environmentally friendly behavior in food waste and recycling habits (**Goal-Value**).

The BinCam is designed as a two-part system consisting of a *BinCam bin* and a *BinCam application on Facebook*. The *BinCam Bin* automatically captures thrown away items through digital images taken with a smart phone installed on the underside of the bin’s lid. It also uploads captured images to Facebook. The researchers reasoned about the functions of each component for achieving the overall goal (**Action-Goal**). They stated that these components provide users with the opportunity to evaluate their own, as well as other people’s, bin related behavior through information contained in the pictures taken from a household’s rubbish bin. In this way, the BinCam system invites reflections on behavior and facilitates informational and social influences (Q7).

In fact, the researcher’s communication of the rationale of each component can further be analyzed by using the concepts of our schema. Yet, for the sake of simplicity, we only consider the function of the *BinCam Application on Facebook* which aims to facilitate awareness and evaluation of a user’s own, as well as other people’s, bin related behavior for enabling informational and normative social influences (**Goal-Value**). Two functionalities, termed ‘BinPictures’ and the ‘BinLeague’, are designed for this purpose (**Action-Goal**). *BinPictures* presents pictures from the BinCam bin to the BinCam users to increase awareness of an individual’s waste management and to facilitate normative social influences. The function of *BinLeague* is to visualize the achievements of households to motivate competition between the BinCam households to facilitate social informational influence. The researchers assumed that “a comparison of own efforts [sic] with the progress of other households presents a social informational influence” (Q7).

The researchers also reflected on the value consequences of some actions (**Action-Value**), for example, that the display of personal data on a public platform like Facebook raises privacy issues and that the publication of these pictures poses a risk to the individual of being publicly humiliated (Q12).

**3. Evaluation.** In the evaluation stage, our schema can be used for at least two purposes: (a) for reflective planning and communicating the values, goals, and actions (methods) of the evaluation (b) reflecting on and communicating the results of evaluation studies, i.e., how the participants perceived the system, its features and effects. We consider the latter usage option in the analysis of the current case.

The researchers reflected on participants' reports on the effects of the BinCam system and their valuation of the system (**Goal-Value**). The researchers stated that participants reported on "social group effects as well as an increase in individuals' awareness, reflection and perceived behavioral control related to their waste behavior." (Q2). They also provided anecdotal evidence for behavior change. In addition, they reported that many participants appreciated BinCam "as a *good idea* and described it as a *useful* way to raise an individual's reflection on waste management while being experienced as *fun*; turning recycling into a more *exciting* activity than it usually is." (Q3)

Researchers also reported on actions/features that caused the persuasive effects of BinCam (**Action-Goal**). For example, with respect to raising awareness and stimulation of reflection, they stated that the "awareness was sometimes simply triggered through a quiet, yet audible, simulated camera shutter carried out each time the BinCam bin took its picture." (Q7). Concerning normative social influence, they reported that participants "felt *guilty* or *ashamed* if they disposed of recyclables incorrectly or had to throw food away", and that such feelings "were found to be evoked by (i) the visibility of one's own behavior to oneself; (ii) the potential visibility of one's own behavior to housemates; (iii) unfortunate results of one's household on the BinLeague; and (iv) the perceived presence of the BinCam bin." (Q7,Q8).

Finally, with respect to consequences of designed actions for values (**Action-Value**), the case reported that participants also expressed feelings of being observed and controlled (Q12).

**4. Discussion and Lessons Learned.** Finally, the researchers discussed the research results and articulated lessons learned. They reflected on their research goals, the effects of actions taken (or features designed) to achieve these goals, and (un)intended consequences of those actions. They also reasoned about potential actions to address identified problems and needs in future research.

With respect to the research goal and its value (**Goal-Value**), i.e., exploring the effects of persuasive strategies on behavior change through design for promoting sustainable lifestyles, the researchers summarized that BinCam achieved the goal and "led to increase in both users' awareness of, and reflection about, their waste management and their motivation to improve their waste-related skills" (Q2). In particular, they identified from participants' responses various persuasive influences and categorized them as individual self-reflection, informational and normative social influence, extrinsic and intrinsic motivation. The researchers have not measured it but only implicitly assumed that the achievement of the goal promotes the intended value of sustainable lifestyles.

The researchers also summarized and articulated what actions and/or system features these effects were triggered by (**Action-Goal**). These are: (a) individual self-reflection through feedback about one's own waste behavior; (b) informational social influence through feedback about waste behavior of others and through discussions and exchange of knowledge with flat mates; (c) normative social influence through social presence of others offline and online, and social presence of the bin; (d) extrinsic motivation through competition, social surveillance and signal trigger (BinCam camera sound), potentially: notifications and reminder; and (e) intrinsic motivation through avoidance of feelings of guilt, a fun experience, the attitude and desire to behave appropriately.

Moreover, the researchers discussed the problems and users' needs they identified in the evaluation and reasoned about potential actions in future research to improve the effects of systems for behavioral change. For example, having identified that "the normative social influence in BinCam was not as salient as expected", researchers suggested an alternative way, namely, increasing "engagement with the system," to achieve the goal of increasing normative influence (Q8). They suggested that "users could be instructed to place an object in the bin to be discovered by other households or take over the task of tagging the BinPictures as a collaborative activity."

Finally, they also reflected on the value consequences of this action (**Action-Value**), i.e., which other values the action could also promote (Q10): “This would allow for more social control and transparency as to users’ bin-related contributions, open up space for playful or competitive engagements.”

In summary, the illustrations confirm the relevance of the schema for enabling reflection on and communicating pragmatic aspects in a structured and systematic way throughout different stages of a design research project. Next we discuss and reflect on lessons learned through the application of the schema in the current case.

## **5 Discussion and Conclusion**

In this paper we have taken a reflective perspective and argued that reflective approaches to PSD are mainly concerned with reflection in the process of PSD research and practice and paid no explicit attention to the issue of how to communicate the research results of such a reflective research. In addition, we argued that the existing DR methodological guidelines for conducting and communicating DR are described at an abstract and general level and that there is a need for more specific guidelines in particular for research areas such as PSD for behaviour change, in particular to integrate the reflections on values, goals, actions and their (ethical) consequences in the communication of the research results. Moreover, we also identified that some DR methodologies involve reflection, yet hardly consider DR communication, whereas others address communication without paying explicit attention to the communication of values and related design rationale. Finally, we identified that current DR literature has not established a schema or model for creating an explicit link between reflections in the DR process and those in the communication of DR results.

To deal with these gaps, we have first argued for the relevance of a meta-communication model for reflecting on the communication of DR research in general and that of PSD research in particular, as they have to meet several quality criteria such as comprehensibility, relevance, rationality and ethicality and that these can be addressed in a reflective way through meta-communication. The structures for reflective communication enable researchers to reflect on and communicate what is purposive, good and just, when justifying the goals (e.g., persuasive intent), means (e.g., persuasive strategies), values, and norms. We then narrowed our focus to one type of discourse, i.e., the pragmatic discourse, and revised our previous work on this discourse and added some statements for guiding the design of research communication, which we call the Reflect-and-Communicate schema. This schema includes a set of value-related issues that need to be considered not only for reflecting on but also for communicating DR knowledge, in particular in the context of PSD research. Finally, we also evaluated the schema by applying it to a published PSD research article.

The application of the schema to the case provides evidence of the validity of its concepts and for its practical relevance for communicating pragmatic issues (goals, actions and values) in a research article in a structured and systematic way throughout different sections of a design research article (e.g., Introduction, Design, Evaluation, Discussion). In the context of PSD research, reflections on pragmatic issues in different sections help to instantiate concepts such as goals and actions at different levels of abstraction and also to relate additional information and perspectives on the main concerns, including the desirability of changing a behavior to a specific direction, the effectiveness of methods chosen, and the value implications.

We should note that the use of the questions is not meant to be normative. The list of questions can create an awareness of important aspects and prompt researchers to think about them. It can also help researchers identify and reflect on alternative options for technical, strategic, social and ethical design decisions in different stages of a research project and to communicate their beliefs, intentions and reasons in the research article.

Moreover, the schema can help to link reflections in the design research process to reflections in the research communication process. In the design research process, researchers and practitioners can use the schema as a conversation template to map ideas to the issues. Such a usage option of the questions is explored in (Haghighatkah et al. 2014). The schema can thus help to manage and evolve scientific

and design knowledge as it emerges from design research and practice. As with design rationale approaches, the explicitness of a representation helps to bring to the surface and communicate the reasons why researchers and designers make the decision they do. Such a representation can also facilitate the identification and communication of (causal) relations, validate design knowledge, and develop scientific generalizations (Haynes et al. 2008). Documenting and reflecting on knowledge for grounding design research is generally valued by many researchers (Goldkuhl 2004; Sein et al. 2011). We claim that using the same schema for communication research in research projects creates a relation to the reflections of the research process. Moreover, using the schema for the analysis of the published work can facilitate a deeper understanding of researchers' reasoning throughout different stages of a design research project, as illustrated in the analysis of the BinCam case.

To conclude, the main contribution of this work is the reinterpretation of our previous work on reflection for the purpose of research communication and, as a result, the suggestion of the revised Reflect-and-Communicate schema, and a demonstration of its applicability by applying it to a published work. This paper contributes to the literature on the communication of DR knowledge in general and to the publication of value sensitive PSD research results in particular (including work in progress on design knowledge), by complementing and enriching the existing communication schemes with more specific concepts dealing with values, goals and actions. In addition, it adds a level of reflexivity in DR by allowing researchers to link reflections in a DR process with reflections in a DR communication process.

This work also offers further development potentialities for future research. The suggested questions are by no means complete. Researchers may investigate additional questions for promoting reflections and guiding research communication, for example, by considering additional questions and related discourses from the meta-communication model in Figure 1.

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