

How Do User Stories Inspire Design? A Study of Cultural Probes

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Introduction

User-centered design relies on methods that elicit, describe, and interpret user experiences on the one hand and that provide room for designers' subjective insights on the other.¹ The methods typically used include surveys, post facto evaluations, user laboratories, brainstorming techniques, participatory design or co-design, and ethnography.²

Among these methods, the use of ethnography has become widespread because it offers design researchers relatively less obtrusive methods of identifying users and eliciting data about how they live and what they do in their everyday lives. According to Fetterman, ethnography is "the art and science of describing a group or a culture."³ Ethnography calls on researchers to participate in people's daily lives—watching what happens, listening to what is said, and asking questions.⁴ In this sense, participant observation and semi-structured interviews require researchers to immerse themselves in people's lives by joining them in their everyday activities.⁵ As a result, they are far from being unobtrusive. However, spontaneous, informal conversations in the course of other activities are one of the less obtrusive methods that allows the distinction between interviewer and interviewee to dissolve.⁶ In joining ongoing conversations, ethnographers do not seek to establish a fixed sequence in which relevant topics are covered; they adopt a more flexible approach, allowing the discussion to flow in a way that seems natural. They do not have to restrict themselves to a single mode of questioning.⁷ Similarly, through virtual ethnography, in which data can be generated through immersion in virtual worlds and virtual communities, even participant observation becomes less obtrusive.⁸ With its anthropological and sociological origins, ethnography is an important method for any research that aims at a deeper understanding of people's lives.⁹ In user-centered design, ethnographic methods are used to observe, talk to, and understand users to incorporate their views into the evaluation and creation of design solutions.¹⁰ Ethnographies tend to bring to a design problem significant redundancy and broader contextual information by focusing on how people

1 Jane Fulton Suri, "Design Expression and Human Experience: Evolving Practice," in *Design and Emotion: The Experience of Everyday Things*, ed. Deana McDonagh, Paul Hekkert, Jeroen van Erp, and Diane Gyi (London: Taylor and Francis, 2004), 13–17.

2 For research on survey methods, see Joseph Pine and James Gilmore, "Welcome to the Experience Economy," *Harvard Business Review* 76, no. 4 (1998): 96–105; and Bruce Hanington, "Methods in the Making: A Perspective on the State of Human Research in Design," *Design Issues* 19, no. 4 (Autumn 2003): 9–18. User labs have been studied and analyzed in Per Ehn, *Work-Oriented Design of Computer Artifacts* (Falköping, Sweden: Arbetslivcentrum/Almqvist and Wiksell International, 1988); Thomas Binder and Eva Brandt, "The Design:Lab as Platform in Participatory Design Research," *CoDesign: International Journal of CoCreation in Design and the Arts* 4, no. 2 (2008): 115–29; Jacob Buur and Susanne Bodker, "From Usability Lab to Design Collaboratorium," *DIS: Processes, Practices, Methods, and Techniques* (New York: ACM Press, 2000): 297–307; JoAnn T. Hackos and Janice C. Redish, *User and Task Analysis for Interface Design* (New York: John Wiley & Sons, 1998). For work on participatory design and user co-design, see Joan Greenbaum and Morten Kyng, *Design at Work: Cooperative Design of Computer Systems* (Hillsdale, NJ: Lawrence Erlbaum, 1991); Doug Schuler and Aki Namioka, *Participatory Design: Principles and Practices* (Hillsdale, NJ: Lawrence Erlbaum, 1993); Elizabeth B.-N. Sanders, "From User-Centered to Participatory Design Approaches," in *Design and the Social Sciences: Making Connections*, ed. Jorge Frascara (New

- York: Taylor and Francis, 2002); Tuuli Mattelmäki, *Design Probes* (Helsinki: University of Art and Design Helsinki, 2006); and Kirsikka Vaajakallio and Tuuli Mattelmäki, "Design Games in Codesign: As a Tool, a Mindset and a Structure," *CoDesign: International Journal of CoCreation in Design and the Arts* 10, no. 1 (2014): 63–77. For ethnography studies, see Rob J.F.M. Van Veggel, "Where the Two Sides of Ethnography Collide," *Design Issues* 21, no. 3 (Summer 2005): 3–16; Bill Gaver, Tony Dunne, and Elena Pacenti, "Cultural Probes," *Interactions* (January/February 1999): 21–29; Anita DeLongis, Kenneth J. Hemphill, and Darrin R. Lehman, "A Structured Diary Methodology for the Study of Daily Events," in *Methodological Issues in Applied Psychology*, ed. Fred B. Bryant, John Edwards, R. Scott Tindale, Emil J. Posavac, Linda Heath, Eaaroon Henderson, Yolanda Suarez-Balcazar (New York: Plenum Press, 1992), 83–109; and Tony Salvador, Genevieve Bell, and Ken Anderson, "Design Ethnography," *Design Management Journal* (Fall 1995): 35–41.
- 3 David M. Fetterman, *Ethnography: Step by Step* (Thousand Oaks, CA: Sage, 1998).
 - 4 Alan Bryman, *Ethnography: Overview* (London: Sage, 2001); Martyn Hammersley and Paul Atkinson, *Ethnography* (London: Routledge 1995).
 - 5 Hammersley and Atkinson, *Ethnography*.
 - 6 David Silverman, *Doing Qualitative Research: A Practical Handbook* (London UK: Sage Publications, 2000); Hammersley and Atkinson, *Ethnography*.
 - 7 James A. Holstein and Jaber F. Gubrium, *The Active Interview* (Thousand Oaks, CA: Sage, 1995), 40–43.
 - 8 See, e.g., Tom Boellstorff, Bonnie Nardi, Celia Pearce, and T. L. Taylor, *Ethnography and Virtual Worlds: A Handbook of Method* (Princeton: Princeton University Press, 2012); Annette Markham, *Life Online: Researching Real Experience in Virtual Space* (Lanham, MD: AltaMira Press, 1998); and Christine Hine, *Virtual Ethnography* (London: Sage, 2000).
 - 9 Boellstorff, Nardi, Pearce and Taylor, *Ethnography and Virtual Worlds: A Handbook of Method*, 13–22

live, while surveys—the epistemological opposite of ethnography—elicit answers to questions posed from the perspectives of producers or designers, leaving respondents no space to respond on their own terms.

In this study, we tested a method intended to strike a balance between the impositions of structured surveys and the broader outcomes of ethnographies, eliciting design-relevant information while preserving the conceptions of users. One such method is cultural probes, conceived by Gaver, Dunne, and Pacenti.¹¹ Cultural probes rely on participants' self-documentation through photographs and narratives. This method is particularly helpful in environments where an observer's presence can distract from the everyday behavior of participants, such as in hospitals or domestic spaces. We investigated how data generated through cultural probes were interpreted by individual designers when they were expected to relate them to design ideas. To do so, we prepared cultural probes packages consisting of daily tasks and sent them to users, who voluntarily participated. After we received these packages with participants' records of completed tasks, we turned them over to designers and asked them to make sense of these data in terms of certain design tasks. The limited number of our participants prevented us from making broader generalizations; nevertheless, with the depth of the information we received from users and designers, we have sought to open up new perspectives and opportunities for further studies based on a user-centered design approach. Through follow-up interviews and a content analysis of designers' interpretations and idea generation, we identified concepts that would be helpful in generating user narratives and in embedding the narratives into design considerations.

Cultural Probes and Design Processes in User-Centered Approaches

Broadbent describes four generations in design methodology: craft methods, in which product information is transmitted through apprenticeship; design-by-drawing methods, in which design is separate from production; hard systems methods, directed to defining and solving problems in systematic order; and soft systems methods, based on the approach that designers should be aware of the social aspects of the everyday life of users.¹² In addition, Bredies, Chow, and Joost present constructivist approaches, such as human-centered, participatory, non-intentional, and critical design.¹³ Among these approaches, human-centered design aims at understanding all stakeholders and creating artifacts that make sense to them by seeking to understand the everyday life of users.

- 10 Sanders, "An Evolving Map of Design Practices and Design Research," *Interactions – Experiences, People, Technology ACM* 15, no. 6 (November–December, 2008), 13–17; Sanders, "From User-Centered to Participatory Design Approaches," 1–8; Patricia Seybold, *Outside Innovation: How Your Customers Will Co-Design Your Company's Future* (New York: Collins 2006); Schuler and Namioka, *Participatory Design: Principles and Practices*; Clay Spinuzzi, "The Methodology of Participatory Design," *Technical Communication* 52 no. 2 (2005): 163–74.
- 11 Gaver, Dunne, and Pacenti, "Cultural Probes," 21–29.
- 12 John Broadbent, "Generations in Design Methodology," *The Design Journal* 6, no. 1 (2003): 2–13.
- 13 Katharina Bredies, Rosan Chow, and Gesche Joost, "Addressing Use as Design: A Comparison of Constructivist Design Approaches," *The Design Journal* 13, no. 2 (2010): 156–79.
- 14 Bruce Hanington, "Methods in the Making: A Perspective on the State of Human Research in Design," *Design Issues* 19, no. 4 (Autumn 2003): 9–18.
- 15 Pine and Gilmore, "Welcome to the Experience Economy," 96–105.
- 16 Nancy E. Adler, Mardi Horowitz, Anne Garcia, and Anne Moyer, "Additional Validation of a Scale to Assess Positive States of Mind," *Psychosomatic Medicine* 60, no. 1 (1998): 26–32; Henriette Van Vugt, and Panos Markopoulos, "Evaluating Technologies in Domestic Contexts: Extending Diary Techniques with Field-Testing of Prototypes," in *Proceedings of HCI International* (Hillsdale, NJ: Lawrence Erlbaum, 2003), 1039–44.
- 17 Sanders, "From User-Centered to Participatory Design Approaches," 1–8.
- 18 For participant observation, see Harry F. Wolcott, *Ethnography: A Way of Seeing* (Lanham, MD: AltaMira Press, 1999). For fieldwork documentation, see Russel H. Bernard, *Research Methods in Anthropology: Qualitative and Quantitative Approaches* (Lanham, MD: AltaMira Press, 1995); Robert M. Emerson, Rachel I. Fretz, and Linda L. Shaw, *Writing Ethnographic Fieldnotes* (Chicago: University of Chicago Press, 1995); and James Clifford and George E.

Hanington divides user-centered research methods into three categories: traditional, applied, and innovative methods.¹⁴ Traditional methods include market analysis, group discussions, and interviews, which typically produce knowledge of large masses of people and result in figures, statistics, and tables. However, the generalizable data extracted from a study of the satisfaction in particular market segments are not sufficient for designing mass-customized solutions because they do not disclose the needs of an individual customer.¹⁵ Applied methods include observation and ethnography, as well as human–computer interaction (HCI) studies, using methods such as thinking aloud and heuristic evaluation. Research methods such as self-documentation, used in ethnography, sociology, and medicine, help to determine user expectations and to understand the use of technology.¹⁶ Innovative methods are creative and projective and are used for collecting qualitative data from users regarding their values, dreams, and needs for further development of design.¹⁷

At the intersection of applied and innovative methods, ethnography is widely used in user research. Ethnographic methods include participant observation, fieldwork documentation, and multi-levelled analysis of the data.¹⁸ Because anthropological methods usually aim at describing what "is," and design is about creating something new, these methods need to be adapted to the aims and implications of design processes.¹⁹

Supplementing ethnography-inspired methods (e.g., observations and interviews) is often done by applying empathic, experimental, and/or generative approaches in user studies.²⁰ Among these methods, we investigated cultural probes. Traditional ethnographic methods require researchers to spend long periods living in a culture to study it, whereas cultural probes offer a less obtrusive way of gathering information by asking participants to generate their own visual and narrative data.²¹

The cultural probes method was developed in the late 1990s in a research project titled Presence; it was financed by the EU, and participants included researchers and designers in many European countries.²² Gaver et al. developed the method, which provides users with opportunities to self-document certain predefined tasks linked to design research questions, to create dialogue between designers and users so that designers might gain an empathetic understanding of the details of people's lives in different places.²³ The probes inspiring the self-documentation were regarded as useful in situations where observations in people's private accommodation would have been disruptive.²⁴ The data obtained via cultural probes were then introduced into the dialogue and the design process to inspire designers' innovations through a deeper understanding of potential uses.

Marcus, *Writing Culture: The Poetics and Politics of Ethnography* (Berkeley CA: University of California Press, 1986). For multi-level data analysis, see Norman K. Denzin and Yvonna S. Lincoln, *Collecting and Interpreting Qualitative Materials* (Thousand Oaks, CA: Sage Publications, 2003).

- 19 Klaus Krippendorff, *The Semantic Turn: A New Foundation for Design* (New York: Taylor and Francis, 2006); Krippendorff, "Three Models of Design," (Keynote Speech at Design for a Billion Conference, Gandhinagar, India, November 7–8, 2014); Knut Holt, *Need Assessment: A Key to User-Oriented Product Innovation* (Chichester, UK: John Wiley & Sons, 1984); and Antonio J. Ballelli and Paul F. Litva, "Integrating Customer Requirements into Product Designs," *Journal of Product Innovation Management* 12, no. 1 (1995): 3–15.
- 20 For empathic methods, see Ilpo Koskinen, Katja Battarbee, and Tuuli Mattelmäki, *Empathic Design: User Experience in Product Design* (Finland: IT Press, 2003); Tuuli Mattelmäki, Kirsikka Vaajakallio, and Ilpo Koskinen, "What Happened to Empathic Design?" *Design Issues* 30, no. 1 (Winter 2014): 67–77; and Kirsikka Vaajakallio, *Design Games as a Tool, a Mindset and a Structure* (doctoral diss., Aalto University School of Arts, Design and Architecture, Finland, 2012). For experimental methods, see Gaver, Dunne, and Pacenti, "Cultural Probes," 21–29. For generative methods, see Sanders, "From User-Centered to Participatory Design Approaches," 1–8; Elizabeth B.-N. Sanders and Pieter Jan Stappers, "Co-Creation and the New Landscapes of Design," *CoDesign: International Journal of CoCreation in Design and the Arts* 4, no. 1 (2008): 5–18. See also Tuuli Mattelmäki, "Probing for Co-Exploring," *CoDesign: International Journal of CoCreation in Design and the Arts* 4, no. 1 (2008): 65–78; Mattelmäki, "Applying Probes—From Inspirational Notes to Collaborative Insights," *CoDesign: International Journal of CoCreation in Design and the Arts* 1, no. 2 (2005): 83–102; John M. Carroll, *Scenario-Based Design: Envisioning Work and Technology in System Development* (New York: John Wiley & Sons, 1995); and Schuler and Namioka, *Participatory Design: Principles and Practices*.

A remarkable quality of cultural probes is their subjectivity and openness, as well as their ability to provoke discussion and encourage commitment to design processes. Mattelmäki introduced the term "design probes," based on Gaver's cultural probes, within the scope of user-centered design to describe a means of understanding human phenomena and exploring design opportunities.²⁵ Building on these approaches, Vaajakallio developed "design games," which connect co-design and game-like activities and use play, games, and performance to explore ways to reshape personal and collective experiences that open up novel opportunities for design and enhance empathic understanding of the research subject.²⁶

As Sleeswijk Visser et al. state, applying the cultural probes method to a large target group does not make sense because the objective of cultural probes is not statistical generalizations.²⁷ Rather, the participants must be motivated and experienced in the subject so that they can contribute productively. To that end, probes packages should offer participant volunteers both encouragement and the tools they need to report rich and useful data.

A probes package, prepared by designers or researchers, or by both in partnership, usually includes task books containing daily assigned tasks, as well as any equipment needed to facilitate these tasks. These tasks call on users to document their experiences, including actions, thoughts, attitudes, hopes, and moods in physical, social, and cultural contexts.²⁸ Keeping diaries, users document several events, so that a more credible and solid description of the person can be realized than a single designer can gain by observing from a single position.²⁹ In addition, photographs give users an opportunity to document what cannot be described easily. Maps and drawings provide designers with a sense of the living spaces and contexts in which the activities of interest take place.³⁰

The tools used in cultural probes studies can always be improved, modified, or reinvented. One such example is Vaajakallio's design of "design games."³¹ Similar to cultural probes, open-ended and ambiguous tasks in design games help the participants to propose new interpretations and alternative solutions in an empathic and playful way. In this context, the visual and tangible components of the design game materials are generative tools because design game materials aim at creating a platform for a shared focus of attention to establish and maintain dialogues and idea generation. As with generative tools, design games' outcomes represent participants' experiences, points of view, and dreams, and they also provide a documentation and reminder throughout the design process.³²

- 21 Gaver, Dunne, and Pacenti, "Cultural Probes," 21–29.
- 22 Mattelmäki, *Design Probes*, 39–45.
- 23 Gaver, Dunne, and Pacenti, "Cultural Probes," 24–29.
- 24 DeLongis, Hemphill, and Lehman, "A Structured Diary Methodology for the Study of Daily Events," 83–109; Scott Carter and Jennifer Mankoff, "When Participants Do the Capturing," Proceedings of the ACM Conference on Human Factors in Computing Systems (Portland, OR: April 2–7, 2005): 438–45; Mihaly Csikszentmihalyi and Reed Larson, "Validity and Reliability of the Experience-Sampling Method," *The Journal of the Nervous and Mental Disease* 175, no. 9 (1987): 526–35.
- 25 Mattelmäki, *Design Probes*.
- 26 Vaajakallio, *Design Games as a Tool, a Mindset and a Structure*, (doctoral diss.).
- 27 Sleeswijk Visser, Stappers, Van der Lugt and Sanders, "Contextmapping: Experiences from Practice," 125.
- 28 Mattelmäki, *Design Probes*, 71–85.
- 29 DeLongis, Hemphill, and Lehman, "A Structured Diary Methodology for the Study of Daily Events," 83–109.
- 30 Mattelmäki, *Design Probes* (Helsinki: University of Art and Design Helsinki, 2006).
- 31 Vaajakallio, "Design Games as a Tool, a Mindset and a Structure."
- 32 Vaajakallio and Mattelmäki, "Design Games in Codesign: As a Tool, a Mindset and a Structure," 63–77.
- 33 Sami Hulkko, Tuuli Mattelmäki, Katja Virtanen, and Turkkka Keinonen, "Mobile Probes," in *Proceedings of NordiCHI0* (Tampere, Finland: October 23–27, 2004): 43–51.
- 34 Froukje Sleeswijk Visser, Pieter Jan Stappers, Remko Van der Lugt, and Elizabeth. B.-N. Sanders, "Context-mapping: Experiences from Practice," *CoDesign: International Journal of CoCreation in Design and the Arts* 1, no. 2 (2005): 119–49, 127–28.
- 35 For an overview of these variations, see Dianna Madden, Yvonne Cadet-James, Ian Atkinson, and Felecia W. Lui, "Probes and Prototypes: A Participatory Action Research Approach to Codesign," *CoDesign: International Journal of CoCreation in Design and the Arts* 10, no. 1 (2014): 31–45. For an example of domestic probes, see William W. Gaver,

The challenge in using all kinds of tools lies in motivating users and in analyzing the open and subjective entries.³³ To start the process, probes packages are prepared and given to participants, who are asked to follow the instructions in the task books and to work on the assigned tasks within the allotted times. According to Sleeswijk Visser et al., probes packages should encourage participants to do the work requested and make participants feel that they are taken seriously as experts of their own experiences.³⁴ Moreover, the questions explored via probes should be broader than the subject of the research they aim to support.

In summary, cultural probes reveal aspects of people's lives that are not easily accessible to designers by stimulating and inspiring the design of provocative interactive products and systems. Variations of cultural probes have been developed, including domestic probes, empathy probes, value probes, and technology probes.³⁵ In each case, the most important characteristic of a cultural probes study is to render participants "reflective practitioners" of their experiences.³⁶

Stories of Everyday Practices: Ironing at Home

To fulfill our aim of testing the probes methodology, we decided to work in the domestic probes domain. We looked into the practices of housework, such as cooking, cleaning, doing laundry, and ironing, which represent significant tasks in everyday life. Among these different types of housework, we focused on ironing because it is a part of a chain of complex tasks to be followed in a situated order: washing, drying, and collecting the clothes in a laundry basket; ironing them; and then folding or hanging them to be stored. Also, ironing requires certain products, such as the iron, ironing board, starch spray, laundry basket, and clothes hangers, along with adequate space in the home. Thus, the practice enables us to observe how the participants deal with different products in this system.

For the selection of participants, our priority qualifications included the performance of everyday housework that included ironing, and the motivation to participate in the cultural probes process. Participant users included three women who have a middle-class background, are married, have children, and perform housework and ironing on their own (see Table 1).

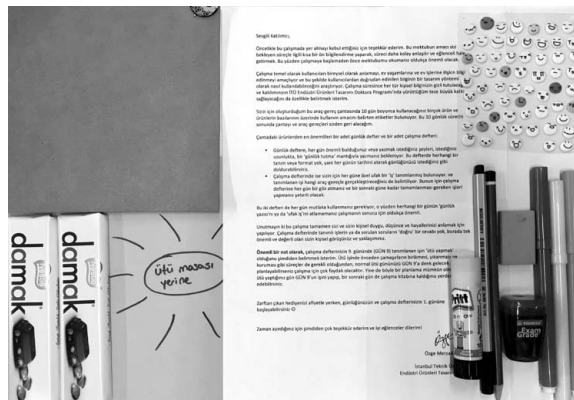
Table 1 Demographic Data of Users

User	Age	Marital Status	Education	Profession
User 1	60	Married	University	Teacher
User 2	67	Married	High school	Housewife
User 3	41	Married	University	Architect

Figure 1
Ironing probes package.



Figure 2
Projective tools of the ironing probes package.



John Bowers, Andrew Boucher, Hans Gellerson, Sarah Pennington, Albrecht Schmidt, Anthony Steed, Nicholas Villars, and Brendan Walker, "The Drift Table," *Proceedings: Extended Abstracts on Human Factors in Computing Systems CHI '04* (New York: ACM Press, 2004), 885–900, doi: 10.1145/985921.985947. For an example of empathy probes, see Tuuli Mattelmäki and Katja Battarbee, "Empathy Probes," *Proceedings of the Participatory Design Conference*, <http://ojs.ruc.dk/index.php/pdc/article/view/265> (accessed September 20, 2010). For value probes, see Amy Volda, and D. Mynatt Elizabeth, "Conveying User Values Between Families and Designers," in *Proceedings CHI '05* (New York: ACM Press, 2005); and Kirsten Boehner, Janet Vertesi, Phoebe Sengers, and Paul Dourish, "How HCI Interprets the Probes," *Proceedings of the SIGCHI Conference on Human Factors in Computing Systems CHI '07* (New York: ACM Press, 2007): 1077–86. For technology probes, see Tuuli Mattelmäki, "Applying Probes—From Inspirational Notes to

Although the number of our participant users was limited, using probes with large numbers of participants is not considered feasible.³⁷ Our main objective was to describe an approach that could enable designers to use probe data in a systematic way, rather than generating more varied data on the practice of ironing. Thus, the limited number of participants did not cause any problems within the scope of this study. We sent cultural probes packages to users who volunteered to participate. We had conversations with each user to explain the aim and context of our research, explaining that the outcomes generated by this process would be analyzed by designers as important information in generating design ideas to improve users' housework experience. The users had no previous experience in participating in this kind of research and were concerned about "doing something wrong" during the probing process. We made clear that they could communicate with us whenever they had difficulties completing the tasks and stressed that all the feedback they provided us would be valuable. Finally, we delivered our *ironing probes packages* (see Figures 1 and 2).

Our *ironing probes package* included a diary, a task book and a variety of projective tools as depicted in Figure 2.



Figure 3 (top)
Completed tasks (from left to right): Day 3, 4, 6, and 8.

Figure 4 (bottom)
Completed tasks: ironing day.

Once packages were distributed to users, the probing process spanned seven weeks. The outcomes of the process included each user’s completed tasks, daily narratives, maps, drawings, and photographs. Examples of data from completed tasks appear in Figures 3 and 4.

After all users returned their descriptive materials reporting the completed tasks, we interviewed each user to elicit insights about the probing process itself, which included the following feedback:

- Users could not complete all activities requested in the task book in 10 days; users took an average of 15 to 20 days to complete all tasks.
- Users had to ask for operational help from household members for tasks that required drawing skills.
- In multi-layered tasks, such as “take a photograph and write down a description,” users sometimes forgot or neglected one of the components of the task.
- Users experienced difficulties taking photographs but had no problems writing narratives.
- Users enjoyed writing diaries.
- Users enjoyed taking photographs in response to abstract prompts, such as “best moment of your day” but had difficulties while taking photographs to document concrete or discrete tasks, such as “preparation for ironing.” They were more motivated when instructions limited them to one or two photographs per task.

In terms of the ethnographic data collected, a structured analysis of the outcomes of the cultural probes was difficult for two reasons: (1) The sample size was too small; and (2) the subjective terms used by participants to convey thoughts, feelings, and experiences

Collaborative Insights,” *CoDesign: International Journal of CoCreation in Design and the Arts* 1, no. 2 (2005): 83–102.

36 Donald A. Schön, *The Reflective Practitioner* (New York: Basic Books, 1983).

37 Sleswijk Visser, Stappers, Van der Lugt and Sanders, “Contextmapping: Experiences from Practice,” 125.

were difficult to compare, however, such comparisons were not the aim of this research. At this point, we concluded the process of generating and analyzing ethnographic data and transferred the completed probes packages to designers for examination and interpretation.

Cultural Probes as a Tool for Designers to Understand Users

In the process of design, designers can play numerous roles, including ethnographer, survey researcher, engineer, and human factors researcher, and many practicing designers today are also design researchers. In this context, note that we separated the research activity from the design activity because our main purpose in this research was to explicitly study how designers interpret user data in relation to cultural probes. The point we mainly want to make is that at a particular stage in the design process, empirical data would help designers overcome uncertainty about how to move forward. These stumbling blocks might occur during the design process, and they might also occur in preparing for the design process. We suggest that, at this point, designers who can competently interpret probes data can obtain greater clarity.

Designers

We invited designers who were interested in user-centered design—in particular, cultural probes—to voluntarily participate in our research: The four who participated were industrial designers with an average age of 30. They were familiar with ethnography and had some information on the cultural probes method. During our conversations, the designers asked questions about the cultural probes and their different applications. They learned that our aim was ultimately to construct a systematic approach that would allow designers to use the outcomes from probes.

The Design Task

Instructions to participating designers were as follows: “Please take these ironing probes packages as a starting point, and write down how you would make sense of them for a new ironing board design. You can also make drawings if you think they are helpful.” Each of the participating designers had a product design background, and we assumed that they would generate ideas leading to the design of an industrial product. The instructions were intended to ensure that they would do so, rather than focusing on a service or system design.

The Procedure

The procedure with designers consisted of two sessions: an information and work session and a follow-up interview. The first session included a 15-minute information period and a 90-minute

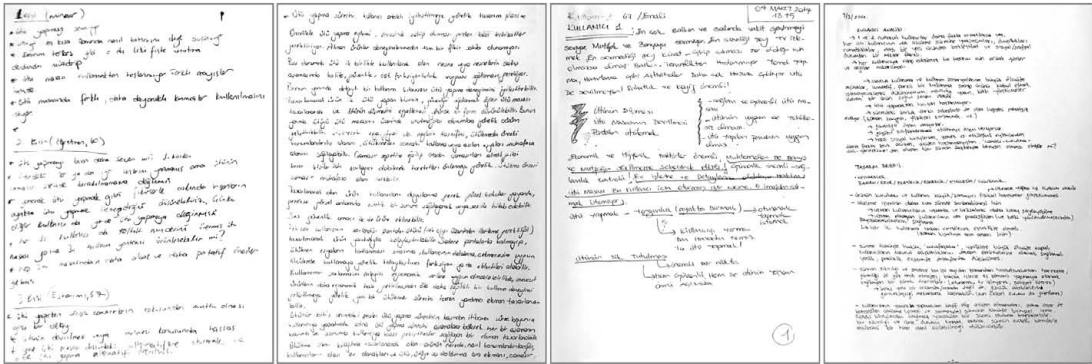


Figure 5
Samples from designers' writings during the process.

work period. First, we briefly explained our research and the cultural probes methodology, distributed the completed probes packages, and encouraged designers to ask questions or relate any concerns. We instructed designers to carefully review the completed probes packages to extract anything they considered important or useful for generating ideas and to annotate the process of arriving at preliminary design ideas. Then we left each designer alone for 90 minutes with the probes data and the design task.

The second session consisted of individual, informal 20-minute interviews with the designers. We asked how they related the information in the probes packages to their design process and asked them to help us understand their notes—their retarticulations of users' narratives and their interpretations in terms of generating ideas in response to the design task (see Figure 5).

During the interviews, designers explained in detail what they enjoyed or found useful or difficult to understand in the probes packages, and how they related the data to preliminary design ideas.

Analysis of the Relation of the Probes to Designers' Inspirations

We analyzed how each designer interpreted the probes based on their annotations and the results of our interviews. We found remarkable similarities in the processes of the four designers.

All designers proceeded through the same formative steps: eliminating, categorizing, and summarizing the probes data of each user by writing, reformulating, and transforming them into design thoughts. We encouraged designers to express themselves in any mode that was convenient for them (e.g., writing or drawing), and the outcomes of this research demonstrated that they preferred to represent their thoughts in writing. We also found that all the designers preferred to conceptualize and generate ideas for a new “system” or a new “experience” of ironing, rather than for an ironing “product” as instructed in the design task.

As expected, a content analysis of designers' writings and interpretations revealed that designers were highly selective when deciding what mattered among the data contained in users'

Table 2 Time Schedule and Tasks that Generated Interesting User Response for Designers

Days	Tasks	Designers' Reponse	Designers' Focus
Day 1	Personal information	—	—
Day 2	Environment	✓	Environment
Day 3	Happiest moment	✓	Emotional states
Day 4	Sentiment of home	✓	Emotional states
Day 5	(In)Essentials at home	✓	Environment
Day 6	House work	—	—
Day 7	Sentiment of ironing	✓	Problematic situations
Day 8	Rules for ironing	✓	Conception
Day 9	Practice of ironing	✓	Process
Day 10	Replacement of ironing board	✓	Expectations

completed probes packages. In our analysis, we identified the specific user tasks that corresponded to these design ideas, as indicated in Table 2.

Users' responses to tasks eliciting sentiments about the (in)essentials of home environments included thoughts and feelings, likes and dislikes:

- "The thing I like most about my home is ... *my balcony and my flowers.*" (User 3)
- "The thing I really dislike about my home is ... *the bathtub. Because it is really hard to get in and out.*" (User 2)
- "I can't live without ... *a television in my home.*" (User 1)
- "I want to get rid of ... *the old refrigerator in my home.*" (User 3)

Users' tasks for Day 8 and Day 9 focused on ironing practices and related experiences and generated the following responses:

- "Ironing Rule 3: Cool times of the days should be chosen (if it is summer). If it is winter, it should be done while watching TV." (User 3)
- "It is important to iron the clothes sequentially that need to be ironed in the same temperature." (User 1)
- "While ironing shirts, first the shoulders and then the back parts should be ironed." (User 2)

In recording their sentiments about ironing, users related likes and dislikes:

- "What I like most about ironing is ... the smell of cleanliness that comes from the laundry at the beginning of ironing." (User 2)

- “There were a few times when I forgot the iron was plugged in and continued doing other housework. I also have memories of dropping the iron to the floor and accidentally burning my arm.” (User 3)

For the task of replacing the ironing board with alternative methods, users responded with these ideas:

- “... ironing clothes on the hangers” (User 1), and
- “I would like to be able to iron on the floor. I really hate setting up the ironing board and then carrying it back to its place.” (User 3)

The designers’ notes tended to focus on narratives about users’ home environment; the things users liked or disliked; and users’ memories, experiences, and practices of ironing. Users had responded to these tasks by relating their experiences, rules, recommendations, and imagined alternatives.

The notes written by the designers included the following:

- “Considering the ideas, such as, ‘ironing on the floor,’ we can assume that people don’t like standing while ironing. (...) An environment that provides the user with different sitting facilities can be designed.” (Designer 1)
- “A new form of ironing board can be designed in a way that prevents the iron from falling.” (Designer 2)
- “Users have a traditional perception of ironing, and I don’t think they will be open for products that propose radical changes in their ironing practices. I think the new design should not be far from a traditional ironing board, but it should offer more practicality.” (Designer 4)
- “An ironing board that will motivate the user to iron by combining this chore with other kind of works: For example, the ironing board transforms the heat energy, which comes out during ironing, into another form of energy to be used and thus helps in economizing; or a system that helps with losing weight.” (Designer 3)
- “Balconies and gardens are places women mostly like. A new concept of ironing practice can be designed that is related to women’s hobbies, such as growing flowers. Because the water that is left in the iron needs to be evacuated at the end of each ironing session, we can use this waste water for flowers.” (Designer 1)
- “The design of the ironing board can respond to the user’s senses: It can give off different perfumes during ironing; look aesthetically pleasant; it can ‘speak’ to the user, especially to prevent dangerous situations.” (Designer 2)

- “Considering that the users are complaining about how boring they find the practice and the time it takes, a new process of ironing can be suggested that embeds daily activities, such as watching TV or chatting with others, into this practice. To do that, the ironing equipment to be designed should have flexible qualities so that it can be adapted to environments where the user can be in social interaction while ironing.” (Designer 4)

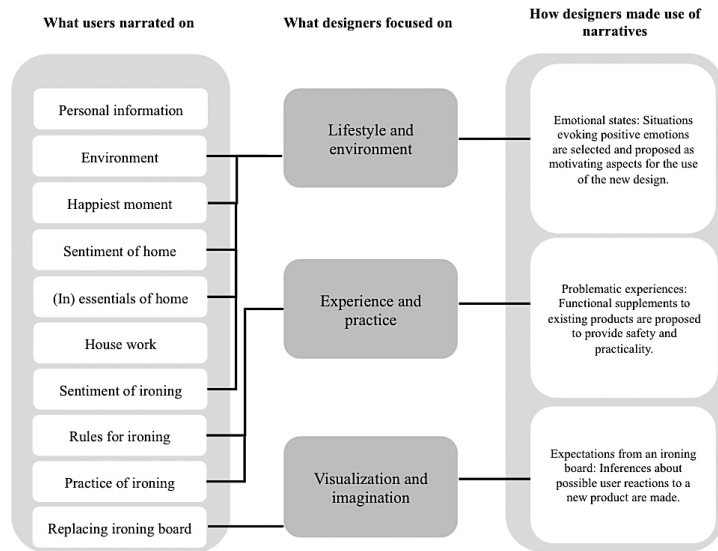
Our analysis revealed that designers tend to selectively use certain categories of ethnographic data, such as lifestyle and environment, experience and practice, and visual information and imagination.

Lifestyle- and environment-related analysis. In Figure 6, concepts such as “environment” and “likes and dislikes” refer to user narratives about the routines of everyday life, as well as to general thoughts and feelings, descriptions, and confessions about daily situations, and references to things or situations they wished to have or to avoid in their domestic environment. We categorized these responses broadly, as “lifestyle.” The transformation of the “lifestyle” concept into design was accomplished by focusing on users’ positive emotions and expressions; designers sorted from these narratives especially what users had declared “good” and “meaningful.” Designers then used these selected lifestyle stories to stimulate ideas for making ironing practices more enjoyable—for example, the “connection between watering flowers with the waste water from the iron” or “a wardrobe that irons clothes while they are on hangers.”

Experience- and practice-related analysis. Categories in Figure 6, such as “experience” and “practice,” refer to users’ descriptions of their own current ironing practices and past ironing experiences. With respect to this category, designers focused on described practices as “problematic situations” encountered by users, such as safety issues, physical stress and fatigue, difficulties with ironing board set-up and storage, and the time consumed in various phases of ironing. Accordingly, designers viewed problematic situations as opportunities to improve the functional qualities of ironing products. Conceiving of problems as opportunities led to preliminary ideas, such as, “a laundry basket that can be mounted below the ironing board” or “a foldable ironing board that looks like a piece of the furniture set of the living room when it is folded and does not need to be transported to or stored in another room.”

Visual information and imagery-related analysis. One task in the probes package asked users to replace the “ironing table” with any imaginary thing and to illustrate their imagined alternative way of ironing with drawings and short captions. As expected, designers did not adopt the ideas of users directly, but they took these

Figure 6
Findings on designers' interpretations of cultural probes data.



drawings and narratives as prompts that could lead to a deeper understanding of users' perceptions of ironing practices. Designers referenced these narratives to speculate on users' initial reactions to any potential new designs, and especially on whether users might welcome radical innovations. Accordingly, designers made inferences, such as "the new ironing board design should not have a radical look—only practical solutions should be offered," or "the user is not open to innovation; she should not feel a radical change in her ironing practice, but some practical support."

The categories derived from our analysis, as outlined in Figure 6, can help designers in their initial encounters with ethnographic data. In sum, they can serve as a systematic approach that enables designers and design students to manage the variety and complexity of ethnographic data.

Conclusion

In this examination of the cultural probes method as a source of inspiration for designers, we asked how ethnographic data might be interpreted and translated into design ideas. In the process, we investigated two main issues: What types of probes data would be of interest to designers, and how might designers make use of these data? Our test demonstrates the usefulness of the cultural probes method for gathering ethnographic data relevant to design; it also reveals limitations of the method.

The most salient limitations are that users consider the probes packages "too structured" in terms of impositions on their daily lives and that interaction between the researchers and users during the probing process is lacking. Users related that they enjoyed the writing tasks; however, they had difficulties taking pictures and completing some tasks that required basic drawing skills.

Conducting cultural probes with large numbers of users is usually not feasible. This limitation makes obtaining data representative of a large population of users difficult—but collecting representative data is not the aim of the cultural probes methodology. In addition, participation is time-consuming and requires a high level of commitment from participants. In our case, the limited number of users and designers who participated in this research is a reason to refrain from making broader inferences or generalizations. Thus, we framed our research as an initial study that identifies opportunities for further studies. Finally, recording experiences, thoughts, and feelings is a task quite unlike engaging in the everyday practices, and the extent to which the probes data are artificial or genuine is far from clear. In this sense, the use of observations and conversations could provide more in-depth information if the probes had not involved a private domestic environment.

Despite these limitations, probes helped to minimize the possible effects of a researcher's presence by offering users the opportunities for and means of self-documentation. Also, users had a certain time period in which to think and write about the issues probed in daily tasks. The most important data emerging from the probes were users' narratives because designers preferred focusing on written text rather than on drawings or photographs.

We also have discussed how ethnography both resembles and differs from cultural probes in terms of the research process, the qualities of the collected user data, and their interpretation by designers. Although ethnographic methods, such as conversations, are less imposing for users, their use in certain research subjects can be problematic. Moreover, the variety and redundancy of the ethnographic data tends to make their analysis time consuming and even confusing as designers work to integrate them into their design processes.³⁸ In contrast, cultural probes are more instructive for users, and they still can be less obtrusive than some ethnographic methods, such as participant observation.³⁹ In addition, probes provide the designers with relatively more design-related data because the predefined tools and tasks are intended to create a dialogue and empathy between users and designers. They generate a common language through diaries, maps, photographs, drawings, collages, and "design games."⁴⁰ Such activities inspire reflective and generative concept searches, in which users are seen as design partners.⁴¹

One of the remarkable outcomes of our study was that designers could be encouraged to document their own process of generating design ideas in the form of written texts and to use these texts as tools in their creative process—even though designers are generally assumed to prefer visual data to written texts. In addition, we observed that designers preferred to work on broader "concepts" rather than only on discrete "products."

38 Krippendorff, "Three Models of Design"; Van Veggel, "Where the Two Sides of Ethnography Collide," 3–16.

39 Gaver, Dunne, and Pacenti, "Cultural Probes," 24–25.

40 Elizabeth B.-N. Sanders, Eva Brandt, and Thomas Binder, "A Framework for Organizing the Tools and Techniques of Participatory Design," *Participatory Design Conference* (Sydney, Australia: November 29–December 3, 2010); Mattelmäki, "Probing for Co-Exploring," 74–77; Mattelmäki and Battarbee, "Empathy Probes," 268–70.

41 Vaajakallio and Mattelmäki, "Design Games in Codesign: As a Tool, a Mindset and a Structure," 63–77.

The content analysis of designers' writings and their explanations during interviews demonstrated that among the user narratives in probes packages, designers focused on those containing expressions about *lifestyle* (expressions related to emotions in everyday life); *experience* (memories and practices of ironing); and *imagery* (wishes and expectations for a better ironing experience). In examining how designers make use of these narratives, we discovered that their interpretations rely heavily on users' expressions about (1) situations that evoke positive emotions related to lifestyle; (2) problematic experiences related to the situated practice; and, (3) expectations of and possible responses to innovation.

To conclude, the outcomes of our testing the probes methodology fulfilled the aim of this study and demonstrated that ethnographic probes data—and narratives in particular—can be handled in a systematic way in design practice. The categories we derived from analyzing designers' interpretive processes can help researchers frame the scope of ethnographic research *for design*, and thus avoid wasting time and effort. We assume that these categories can be improved and diversified in further studies using different research subjects that require an ethnographic approach. Ultimately, refining this categorical system might help designers and design students to embed user data, and thus deeper understandings of users, into their design considerations.

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